

Fire in relation to primitive agriculture and grazing in the Tropics ; annotated bibliography.

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**Fire in Relation to Primitive Agriculture
and Grazing in the Tropics: Annotated Bibliography**

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**Supplement to Background Paper No. 34, Wenner-Gren
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Changing the Face of the Earth", Princeton,
New Jersey, June 16-22, 1955**

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The books and articles reviewed or abstracted here are the same that are listed in the conference paper. Some of them are rare and not easily consulted even in the greater library centers and it therefore seemed too wasteful of time and effort merely to throw away the notes of reading done in connection with writing the paper; -- hence this Supplement.

12-4-55. AR-
It should be noted that this copiously annotated list of literature bearing on primitive agriculture and fire is by no means a complete bibliography of the subject, which would have had to be much longer to include all of the important authors and writings. In fact, certain works have had to be omitted which were available neither in the libraries of the University of Michigan nor in Washington at the Library of Congress or the Library of the U. S. Department of Agriculture. Serious gaps will therefore be noted by those who know special parts of the pertinent literature. Nevertheless it is thought that a representative part has been reviewed.

Primitive agriculture, fire, and grazing have been alluded to in an important way by many writers who did not set themselves to deal specifically with these subjects at all. Even the delimitation of the present writer's conference subject to the tropics restricted only the amount and not the range of literature which was gone through.

Conspicuous omissions have come about not merely because many titles were not accessible but because the writer's reading was at first quite desultory, restricted largely to books in his own collection, and later there was insufficient time to round it out fully in spite of a special trip to Washington for the purpose.

Adamson, Robert Stephen (1938) The Vegetation of South Africa. London: British Empire Vegetation Committee. 235 pp., 9 pl., 12 maps, 23 figs.

The Union of South Africa reaches into the tropics only slightly, to a point on the Limpopo River in latitude 22° 10' S. Much of the vegetation, however, is of subtropical character, and some allusion to it is helpful to an understanding of conditions farther north. This is especially true since there is no part of Africa where the activities of man have been more demonstrably devastating. The vegetation in its relatively recent aspects has been described by Adamson, who says (p. 9):

"The Union is a region in which the activities of man, other than on a small scale, have acted on the vegetation for rather short periods of time . . . One result is that changes brought about by human interference are usually obvious and readily recognizable; the time of their operation has not been sufficiently long to permit of the establishment of a new state of equilibrium". Adamson's book refers mainly to literature published within a few years of the time of writing. The oldest reference is to 1878 (a general work on plant geography — a secondary source so far as South Africa is concerned) so it obviously contains little in the way of comparison of the condition of the places when first visited and now. Otherwise the book is very satisfactorily informative.

He mentions the sparse population, (of Bushmen and Hottentots, now almost extinct races) at the time of the first European colonization and the relatively recent intrusion, then, of Bantu tribes.

The two original groups were essentially hunters who had a minimum of agriculture and Adamson may have underestimated the extent to which they modified natural conditions by the use of fire in hunting. Those who came next lived largely as herdsmen, and certainly set the example to the European colonists of unrestricted burning. Still, he says (p. 93) "Burning of the vegetation in the dry season has been taking place for centuries. It was carried on by the Hottentots before the arrival of the Europeans".

Of the forest and general extent of vegetational aspect he says:

"Alterations of the vegetation as a result of man's activity are probably more widespread and general in the Sclerophyll than in any other type in the country. The main agent has been fire, which has affected all but the very driest portions. The effects of fire have become so widespread that over much of the region climax communities are exceedingly rare, and the existing plant cover is composed of a series of phases of regeneration which are irregularly arranged, the separation of one from another depending on the dates of the fires and not on any features of the environment. The connections of the various resulting communities with one another or with the climax are complicated by the irregular intervals that occur between successive fires. They are generally much more frequent than the times required for complete regeneration of the vegetation. A very frequent succession of fires results in the establishment of a low bush community which is not layered. Communities dominated by Restionaceae in the mountains, and by low ericoid shrubs in the valleys, are examples."

"The practice of burning was originally employed to clear the land. It is often employed in the hope of improving or creating pasturage. . . . While this sort of advantageous result may be obtained in a few cases, most commonly the effects of burning are undoubtedly deleterious. The destruction of the vegetation leaves the soil exposed to erosion by wind or rain. Even if not removed, the soil rapidly loses water and humus. . . . The bare, or partially bare, condition of the mountains that has resulted from continued burning and erosion renders them incapable of conserving water." . . . (p. 95) "The Sclerophyll vegetation has little value either in natural products or for grazing purposes. The attempt to create pastures has been responsible for most of the wholesale burning."

Adamson (p. 118) comments on the nearly complete destruction of forest as follows:

"The forests that exist cover only a part of the area that was evidently at one time forest-clad. Felling and fire have been responsible for the greatest amount of destruction. Clearing for cultivation has also taken place. Much of the land from which forest has been removed is now occupied by grassland, by various scrub communities, or has been made use of for plantations. Evidence of the former extent of the forest is not difficult to find. The forest patches themselves often have irregular outlines that do not correspond with any natural boundaries, and small groups of trees or even isolated individuals occur between in grassland or scrub. The intervening vegetation often contains forest plants that persist, at any rate for a time. Tree ferns, for example, are often seen along streamsides in the open. . . . In addition to this complete destruction, many of the forests have been altered by the cutting out of the larger trees. . . ."

"Under the most favorable conditions forest may be regenerated by natural succession. Of the forest types two are extensions into South Africa from the tropics. The subtropical forest is a southern extension along the eastern coast and the montane forest is allied to that of Rhodesia and central Africa."

Of the various types of savannah in South Africa, one covers the whole of the northern portion, and is continuous with that which occurs in central Africa. It extends farthest down the eastern coast. Regarding the effect of fire on it, Adamson (p. 123) says:

"The pronounced dry season, during which the grass dries up and the aerial parts die, provides conditions exceedingly suitable to fire. Throughout the whole extent of this vegetation grass fires in the dry season are very common. Such burnings have certainly been occurring for a long time. . . . The fires are usually of human origin,

some intentional, others accidental, but they can start from natural causes. Whatever their origin they have become such a common occurrence that they must be reckoned as a regular part of the habitat conditions that determine the structure and development of the vegetation."

In discussion of the Acacia bush Adamson has one of his few comparisons of past with present conditions. He says (p. 159): "Under the original conditions there was a broad zone of transition between the Bush Savanna and Grassland types [of vegetation]. Much of this zone is at present grassland of an open character. The existence in it of isolated trees or bushes, stumps or occasional bush-covered areas, demonstrates the changed character. In the drier parts to the south the removal of timber has reduced the vegetation to a condition in which communities of low undershrubs or open grasslands occur with only isolated trees or bushes. The former condition may be gauged from some of the older accounts. For example, Burchell, in the description of his travels, emphasizes the difficulties experienced in getting his wagon through the dense thorn bush of the Orange River valley near Prieska, where now there is little more than a fringe. . . . The general results of interference in this vegetation are to make the communities more open and more arid in character."

In relation to continuity with and transition to plant associations north of the tropic of Capricorn, it is important to observe that the very driest parts of South Africa are occupied by what Adamson (p. 215) designates as "Bush Savanna of the Kalahari group." Nevertheless he says (p. 221) that in spite of the heart of the Kalahari region being called the "Kalahari Desert" it has a good coating of vegetation and is only a desert in the sense that there is no surface water.

The highly evolved and distinctive flora of the arid Kalahari region indicates that dry conditions have prevailed for a long time, geologically speaking, and this conclusion finds confirmation from the fact that certain ore deposits which are not found ordinarily to exist in an oxidized condition below the ground-water level are so found in the Kalahari region. This is considered as proof that the region was formerly more arid than it is now.

There is also evidence pointing toward the extension at some time of more humid conditions, and of a tendency now toward increasing aridity. Adamson considers that a careless attitude toward vegetation is bringing about a

decrease in the effectiveness of rainfall, which, without being considerably less in quantity now than a few years ago, may be doing less good if it runs off instead of being absorbed by the soil. He says (p. 224):

"The rather extensive alterations that have occurred in the natural vegetation will, if allowed to continue unchecked, certainly react unfavorably. . . . While effects of this are most apparent in the drier parts, they are by no means confined to them. The mountain regions show a definite loss in water conservation due to destruction of vegetation. The result . . . is a reduced supply . . . on the lower levels. The maintenance of complete vegetation on the mountains is a matter of very real importance for the future of the country".

As for the grasslands, which concern us especially, Adamson has concluded that in South Africa some are natural rather than man-made. Glimax grassland, he says (p. 163) has partly climatic and partly topographic boundaries.

The grasslands of which he speaks are not like the Imperata prairies of other regions. He does not mention this troublesome and fire-resistant grass but rather emphasizes the prevalence and importance of Themeda triandra, which, he says, characterizes the central and most important type of grassland. He describes two "facies" of the species, differing in many ways. What he means by "facies" is not clear, but it would seem to a non-ecologist that there are two genetically and systematically different grasses for which he prefers to use the same name. He says (p. 165):

"A detailed examination reveals the fact that the grasses . . . grow in clumps, with perennating shoots on or just above the surface of the soil, only occasionally below it."

Further on he says (p. 170): "The community dominated by Themeda is the natural climax over large portions and represents the culmination of a series of phases." Again (p. 171): "When grazing is continuous, but not excessive, a grass community dominated by Eragrostis plana, Aristida juncea, a tufted grass with narrow, hard leaves, and Sporobolus indicus in varying proportions is very commonly developed and can be seen over wide tracts of country. It is a community of much less value for stock than the true climax. . . . Under moist conditions the Themeda plants are loose and well above the soil surface and readily killed by fire unless burning is carried out when the leaves and shoots are wet from recent rain".

About grazing and burning on the South African grasslands in general, Adamson says (p. 172):

"Grazing is, however, only one of the factors concerned in bringing about changes in these grasslands. . . . In some places burning is so general that over wide stretches no vegetation exists which has not been modified to some extent. . . . The object in view in burning the grass is to produce fresh shoots suitable for fodder earlier in the year. When a fire passes rapidly across dry, dormant grassland and destroys only the dead leaves, this object may be achieved without much damage. . . . But very often destruction is more thorough and grasses, often the most valuable, are killed out." (p. 173)

"The Dry Grasslands, with their less dense cover, are not subject to burning, but are rather easily changed in character when subjected to grazing that is at all severe. . . . Small undershrubs . . . become dominant and produce an open Karoo-like vegetation . . . common around villages and settlements in drier parts. There is no doubt that along the Orange River valley and elsewhere the margin of the grassland has retreated before such arid types of vegetation. The retreat is one due to interference and not to any change in conditions. . . . The extent to which the grasslands have deteriorated owing to short-sighted interference or to attempts at over-exploitation has become a very grave problem".

Ainslie, J. R. (1926) *The Physiography of Southern Nigeria and its Effect on the Forest Flora of the Country*. [Oxford Forestry Memoirs, No. 5] Oxford: Clarendon Press. 36 pp., 13 figs.

(p. 14) "Most of the western portion of this region [the plains of Southern Nigeria] has been cleared by native agriculturists, and the original primeval forest has been succeeded by areas of oil palms and great stretches of secondary growth and low scrubby inferior jungle. This secondary growth is particularly noticeable in the Western Provinces between Lagos and Abeokuta, and in the Eastern Provinces over the greater part of the land between the Niger and the Cross Rivers. Between Lagos and the Niger the undulating plains are still to a great extent forest-clad. . . .

"In spite of the large clearings which have taken place and which are still going on rapidly, the plains contain the main forest regions of the country."

Ainslie describes certain grasslands of a very sterile upland plateau which may be natural rather than man-made, although this interpretation is the reviewer's. He says (p. 16):

"The Sonkwala Hills are a group of steep rugged hills attaining an altitude of 6,000 feet; they link up on the east with the higher Cameroon Mountains; in the south they are separated from the Oban Hills by the Upper Cross River Valley. To the southeast the hills unite to form a small undulating grass plateau 20 square miles in area. . . . Forests clothe the ravines, uniting with the Cross River 'transition forests' on the one hand and the scattered groups of 'hill forest' on the top."

These 'hill forests' are a variant of the 'tropical evergreen forest', of which the other two phases are 'freshwater swamp forest' and 'rain forest'. 'Transitional forest' is the name applied to narrow strips lying between the tall 'rain forest' and the 'fringing and deciduous forest' which is in turn bounded, on the dry side, by 'savannah'.

Elsewhere (p. 25) Ainslie says of the Sonkwala Hills subtype of rain forest:

"Much of the original forest has been destroyed, leaving savannah or grass. At points where the old forest still exists, especially at higher elevations, it possesses certain characteristic features. . . . This sub-region is a northern outpost of resistance of the lower evergreen forest species to the species of the drier regions which are gradually invading southwards."

Ibadan, the chief place and the one most frequently mentioned in the literature of land use in Nigeria, lies in the 'fringing and deciduous forest' islands which occur within the savanna belt westward and northward. . . .

Regarding the inroads made by man on rain forest, Ainslie (p. 22) writes:

"[Rain forest] is the climatic formation for the low-country wet zone or the plains. In the past it has been largely encroached upon by shifting cultivation, but it still covers very large areas. On cleared areas the original type has been replaced by a much inferior and almost mesophytic forest type more suited to the now more marked variations in soil and atmospheric humidity. Repeated clearings increase this tendency

towards a xerophytic type, and thus it happens that considerable areas well within this climatic zone are clothed with an artificially created semi-waste inferior forest. . . . This subsequent growth of more xerophytic forest after clearing is probably more marked in Nigeria than generally elsewhere in the tropics, partly because of the large areas involved in this forest destruction but mainly because of the results of what has been termed 'the desiccation of Africa'.

"Many reasons have been propounded for this, but the most probable is that these climatic forests originated here when the climate was more moist and when the coast-line was farther north than it is now, and they are now very near their dry climatic limit. The further extension of the coast-line out to sea by deltaic depositions in time causes further ecological retrogression, and this retrogression is vastly accelerated by shifting cultivation and other forest destruction. . . .

(p. 23) "Commencing from Dahomey, the rain forest occurs from just behind the littoral region to a point about 25 miles north of this. Here most of the forest has been cleared, and only isolated patches now exist, and it is not until Ijebu-Ode Province is reached that the first large areas of forest are met with. These extend eastward, gradually widening out southwards with the bend of the coastling, and northwards to Akure and Ifon, where they merge with a strip of transition forest (i. e., forest which is partly deciduous and contains species from both rain and deciduous forest). This transition forest connects the main belt of rain forest with a small outlier over the northern boundary."

(p. 24) "The Delta is still to a great extent rain forest. East of the Niger as far as the Udi Plateau this is the climatic type, but north of a line from Owerri to Calabar the country has been very largely cleared by shifting cultivation. . . . East of the Cross River the whole country is practically a vast forest spreading into the Cameroons in the east. . . . On the south coast between Calabar and Opobo the forest is almost pure 'palm belt'; this has been artificially produced by the local inhabitants. They clear the land, allowing only the palms to remain and the result is that in a very short time only palms are regenerated."

The following remarks of Ainslie regarding ecological boundaries (p. 27, 28) are particularly significant:

"As an edaphic forest type in the northern and western portions of Oyo Province, fringing forest appears along all stream beds, running many miles into savannah and grassland country. Similarly, on certain of the hills numerous remnants of previously existing deciduous forests are still to be seen."

Ainslie observes (p. 28) that at one point near Enugu the continuity of the deciduous forest zone is broken "by an artificially created southward extension of savannah. Between the Niger and the Cross River the country has been largely deforested, and a savannah type now prevails, particularly in the Udi Plateau where indeed grassland formation is common."

"It is interesting to record that where the transition into deciduous forests from rain forests occurs, it is very gradual and indefinite. On the other hand, the merging point between savannahs and deciduous forest is particularly abrupt. This leads to the conclusion that while the southern boundary of the deciduous forest is a natural climatic one, the northern boundary is the artificial result of a comparatively rapid encroachment by a more xerophytic formation encouraged by the destructive activities of man. There is little doubt that these deciduous forests at one time extended much farther north than now; this is borne out by the numbers of deciduous forest 'outliers' which extend far into Northern Nigeria and of which many cannot be otherwise accounted for."

Regarding these outliers Ainslie says, after a discussion of climate:

✓ "The climatic conditions thus lie almost on the natural limit between mesophytic formations as represented by deciduous forests, and xerophytic formations as represented by savannahs. As the influence of the desiccation of Africa is gradually making itself felt, accelerated enormously by mankind with fires, etc., savannah forests have slowly occupied a large district where the climatic formation was originally mixed deciduous forest. On such a 'boundary-line' climate, as is to be expected, the influence of edaphic or local factors is greater than elsewhere in the country. Thus, although savannah is now the climatic formation, the slightest additional moisture allows the deciduous forest to persist. This additional moisture is found along stream beds and on certain ranges of hills; in the case of the latter a further modification exists, in that, although the southwest slopes may be clothed by deciduous forest growth, the north-east slopes carry only savannah or grass, as during the dry weather the latter are for months on end exposed to the desert winds of the Harmattan."

As an example of abrupt transition showing the features described Ainslie diagrams a locality where in addition to climatic and man-made types of vegetation there would appear to be also natural grassland on a laterite pan where climatic factors for savannah are superadded to extreme drought and soil sterility.

Human utilization of this Udi Plateau is almost confined to the forested areas. Ainslie says (p. 30).

"The inhabitants of the Plateau generally live in the forest patches and cultivate the soil to a considerable extent under the shade of the large trees. Many of the trees are growing under semi-cultivated conditions and have undoubtedly been planted by the inhabitants. The forests form a protection against enemies and against fires for the primitive communities dwelling there. It is remarkable that the population in these forest areas sometimes reaches as much as 350 to the square mile. If it were not for the fact that the inhabitants do partly cultivate forest species for various purposes and otherwise protect their forests, there is no doubt that these forests would long ago have ceased to exist owing to the annual firing of the adjoining grassland."

As to the savannah vegetational zone, Ainslie (p. 32) says:

"This strip, aided by fire and clearings, is gradually extending its boundary southwards into the deciduous and rain forests. Between Ifon and the Niger appears another savannah area . . . much mixed up with deciduous outliers, . . . East of the Niger River, the grassland of the Udi Plateau may be considered savannah of a type, but eastwards of this, north of a line from Udi to Ogoja, it is all savannah, much aided by annual firing in spreading south . . . As a result of the past forest destruction, which has enabled the grassland to replace the forest of the Udi Plateau, the head-waters of the Cross River tributaries are working backwards, and are now capturing certain of the Niger tributary streams. In addition . . . three interesting outliers of savannah occur within the rain forest zones in the plains . . . The first occurs near Abeokuta . . . and . . . is an edaphic formation growing on a shallow soil which overlies partly a lateritic pan and partly crystalline rocks . . . The second is . . . 20 miles north of Benin . . . The Sobo Plains east of Benin furnish another, the third instance . . . In the last two instances the savannah has been artificially created by repeated clearing and firing."

Ames, Oakes (1939) *Economic Annuals and Human Cultures*. Cambridge, Massachusetts: Botanical Museum of Harvard University v +153 pp., figs., charts, pls.

Ames has emphasized the dependance of the great human cultures upon annual plants which produce the greater part of man's food. These are in general dominant even in primitive agriculture, and one needs only to call attention to the maize and beans of pre-Columbian American agriculture, the kaffir corn and millets of Africa and the rice of the Orient to realize that this is as true in the tropics as in the temperate regions.

There are some of Ames's conclusions regarding primitive agriculture that seem extremely doubtful. He was greatly impressed, for example, by the possibility, pointed out by Frazer (1912) that the first prehistoric sowing of seeds of annual crops may have been accidental, and to have come about by the winnowing of seeds of wild plants collected for food over land that had been turned by women with digging sticks in search of edible roots. He stated (p. 8):

"Frazer's theory emphasizes, without stating it, one point which is fundamental to the beginnings of agriculture, namely, freedom from the overpowering environment of the primeval forest. The scene he pictures calls to mind open spaces away from the forest, and it would be in just such places that man encountered the conditions best suited to agricultural practice."

The conclusion of most observers has been that tropical agriculture is ever at the expense of forest so long as any remains that is accessible. Primitive man had two choices, either to build permanent or long-maintained habitations, which would eventually require repeated use of the same soil, or to make shift with temporary habitations and move to new forest for making his agricultural clearings.

If the digging stick was the chief tool of food-hunting people, it likewise remained a tool for turning sod, as such examples as those of the Karo Batak of Sumatra (von Brenner) and the natives of New Guinea cited by Ames from Newton's "Far New Guinea". Sod was probably not turned, however, until necessity required, and so there must have been hundreds and thousands of years after agriculture began before grassland was utilized. At least this is what would be concluded from the habits of modern primitive man, from which we reconstruct a picture of how prehistoric primitive man presumably lived.

Ames distinguished the practices of agriculture from those of horticulture and concluded (p. 131) that "in primitive gardening there was a definite interest in individuals rather than in a crop". There is overwhelming evidence that this is true. He concluded at once, however, that horticulture, like agriculture, had its beginnings in natural openings. So we find:

"Where there were open glades in the forest; expanses of grass land; grassy flats near beaches; in the open places along the banks of streams or on the aluvial fans of river valleys; in other words, in situations where sun-loving herbs would thrive, small groups were cultivated and tended. In such places advanced horticulture had its origins."

Ames goes on to say (p. 132):

"To ignore the underlying principles of plant industry; to overlook the fact that even agriculture has evolved from simpler beginnings, leads to misunderstandings and misinterpretations. This becomes apparent when various theories concerning the origin of agriculture are examined. One school sees the origin through irrigation. Another finds it in forest lands, and still another attributes its origin to mountainous districts.

"Sauer [1936, 282, 296] has developed the thesis that not only in the New World but generally, the beginnings of agriculture are to be sought in forest lands. Indeed, he thinks open grasslands must have been too difficult for digging-stick cultivation and locks on agriculture as an industry which was excluded from grasslands and brush-lands. It is not clear where he places the beginning of cultivation before the forests were invaded and mastered. He does not tell us where mankind learned why trees should be girdled or cut down to allow sunlight to reach the forest floor. It is not manifest whether or not he draws a distinction between horticulture and agriculture. Nevertheless, grasslands are by no means such a hindrance to cultivation by primitive man as Sauer implies, and in open brush land the planting of a crop is not altogether impossible. Furthermore, in situations where sandy loams prevail and the covering of grass is of a non-resistant type, turning over the soil and planting are relatively simple undertakings. Even where the conditions are extremely difficult grass is by no means a deterrent of agricultural efforts. In the eastern tropics where tough grass grows to four or five feet high it is beaten down with narrow flails of palm wood and then burnt. With long digging sticks the ground is afterwards turned over and the resulting clods broken up and freed from grass roots and rubbish. Planting may be done with comparative ease. Henry Newton describes a very characteristic operation of this kind observed in New Guinea. . . . "

A great deal of reading on the eastern tropics has failed to indicate that such prodigious labor is other than very exceptional. In his thinking about agricultural beginnings Ames failed to give sufficient attention to the arguments, formidable even if not always acceptable, that grasslands owe their origin to man and fire, and that burning over of land and formation of grasslands from savannah by hunters may have long preceded agriculture.

Ames's book provokes thought even if one cannot fall in with his ideas. It seems very unlikely to the reviewer that most primitive agriculture was at the expense of grassland regardless of how the most remote beginnings were made. In his insisting on the great antiquity of man in the new world, in order to allow for the development of economic plants unrelated to those of the Old World, Ames was doubtless correct. He concluded that the cultivation of economic annuals in the New World went as far back into the Pleistocene as the origins of agriculture in the Old World. So (p. 143):

"Biological evidence indicates that man, evolving with his food plants developed horticulture and agriculture in both hemispheres at a time which may will have reached far back into the Pleistocene."

Ames likewise performed a great service in expounding the idea that agriculture and horticulture, though related, have had a somewhat distinct development during the cultural advance of mankind.

Andersson, Charles John (1856) *Lake Ngami; or, Explorations and Discoveries during Four Years' Wanderings in the Wilds of Southwestern Africa*. New York: Harper and Brothers.

There is an early description of the country northwest of Lake Ngami by C. J. Andersson, who in 1854 made a trip on the Teoge River which runs out of the lake to the northwestward. Here dwelt a people called the Bayeye, subject, however, to the Bechuana chief Lecholetebe, although linguistically allied to the Damara and Chilimanse, within a group that extended obliquely almost across the continent. Their cattle had been taken away by the Bechuana, and although they hunted and fished a great deal, Andersson said (p. 82):

"They derive their chief subsistence from the produce of the soil, which is fertile, yielding the necessaries of life in abundance, and with little labor. A month or two before the rainy season the ground for cultivation is selected, cleared, and slightly worked by a small, short

hoe, the only agricultural implement I have seen used by the Bayeye in tilling. After the first heavy rains they begin to sow the corn, of which there are two kinds indigenous to the country, namely, the common 'coffre', and another sort, very small-grained, and not unlike canary-seed -- a description which is akin, as I am informed, to the 'badjera' of India. . . . Tobacco, calabashes, watermelons, pumpkins, beans, and small peas are grown, as well as different kinds of edible earth-fruits, of which the oiengora (motu-o-hatsi of the Bechuanas, I believe) may be mentioned in particular. This is a sort of bean, having its pods under ground."

If Andersson had been an American he would have known the peanut, Arachis hypogaea, which may have been there, but he probably referred to a plant of similar habit, Voandzeia subterranea.

Andersson, Charles John (1861) *The Okavango River: a Narrative of Travel, Exploration, and Adventure*. New York: Harper and Brothers, 414 pp., 17 pl., map.

In view of the slight information available about the extent of fires in Angola, it is interesting to find in the first account of Ovamboland south of the Okavango River, which forms part of the southern boundary of Angola, that fire was frequent and devastating. The explorer Andersson (p. 60-75) between Okava and Okaoa, had the following experiences:

"The first night we bivouacked at the foot of an elevated limestone range (facing another which we had crossed in the course of the day) and on this night I observed one of the finest natural illuminations I remember to have seen in Africa. The whole of the range facing us -- i. e., the one we had traversed -- exhibited one magnificent blaze of fire, kept vividly alive by a high wind . . . assuming all sorts of brilliant and fantastical shapes. Yet, splendid as this conflagration was, it fell far short of one I beheld afterward, and which associated as it was with circumstances most peculiar and painful, will never be obliterated from my memory.

"At an early hour the next morning we were on the move . . . Almost immediately . . . we entered a defile infinitely more formidable than any we had hitherto traversed. . . . In their usual thoughtless manner, the natives had, to our horror, suddenly set fire to the grass; and as the pass . . . was narrow and the wind high, the whole mountain was soon enveloped in flames and smoke, from

which we only extricated ourselves with extreme difficulty; indeed, this was a danger to which we now found ourselves daily exposed. Wherever we went, smoke and fire were before, around, and behind us; for it is customary with the tribes of South Africa to fire the grass when it has arrived at a certain state of maturity and dryness. . . . In the afternoon of the second day nothing was seen ahead but immense grass savannas, dotted with occasional clumps of trees and low brushwood."

". . . .The people who had dwelt in the neighborhood evidently possessed cattle and goats; and as their folds were of a description resembling those constructed by the Ovambo, I concluded that the owners were Ovagandjera, the tribe we were in search of."

Almost failing to find drinking water, Andersson's party nearly died of thirst before their sufferings were relieved "and the oppressiveness of the atmosphere was greatly increased by the tremendous 'veldt' fires, which, ravaging the country far and wide, made it like a huge, fiery furnace."

Andersson's party was forced to turn back. His account goes on:

"We had proceeded but a comparatively short distance, and were just escaping out of a thorn thicket, when we were suddenly startled by a grand, but to us appalling, sight. The whole country before us was one huge lake of flames. . . . I had seen many wood and grass fires, but nothing equal to this. Immediately in front of us lay stretched out like a sea a vast pasture prairie, dotted with occasional trees, bounded in the distance by groves of huge giraffe thorns, all in a blaze! Once a huge trunk in flames from top to bottom, fell athwart our path . . . while the numerous nests of the social grossbeaks -- the Textor erythrorhynchus -- in the ignited trees looked like so many lamps suspended in designs at once natural, pleasing, and splendid. . . . But the danger connected with the grand spectacle was too great and too imminent for us thoroughly to appreciate its magnificence."

When they got back to Okoa the oxen had had no water for one hundred and fifty hours.

Andrews, F. W. (1948) The vegetation of the Sudan. In Tothill, J. D., (1948) Agriculture in the Sudan, Chapter IV, pp. 32-61, q. v.

Here we find a good vegetation map of the Sudan showing zonation from desert in the north through Acacia desert-scrub, Acacia short-grass scrub and Acacia tall-grass forest (which includes the Nuba Mountains) to the broad-leafed woodland and forest north of the eastern extremity of the Belgian Congo and west of the Lake Rudolf region of Kenya Colony. All of these zones obviously continue to the westward into French Equatorial Africa and the two grassland zones but not the tall equatorial forest to the eastward into Abyssinia.

Andrews, W. (1948) Geology of the Sudan. In Tothill, J. D. (1948) Agriculture in the Sudan, Chapter VI, pp. 84-128, p. v.

(p. 102) "There is a widespread sheet of concretionary ironstone in a thick horizontal bed capping other rocks. In the northwestern Sudan, Sandford ascribed this ironstone to a lateritic phase in the middle Pleistocene ending soon after the lower Paleolithic stage (1933, p. 222) and preceding the qōz or Kordofan sands. Edmonds rejects the identification of these northwestern ironstones with laterite.

In western Ecuatoria west of the Maridi-Yei watershed there is a concretionary ironstone sheet capping small hills at some 5-25 m. above the present-day plateau surface. In the Yei river basin a much higher remnant of a peneplain forms the Aloma plateau, south of Yei, also capped by ironstone. The present plateau is also covered by ironstone or red loam with soft red concretionary ferruginous pellets. . .

"In identifying any particular occurrence of ironstone or example of ferrification, the distinction between contemporary or recent concentrations of iron and an old 'fossil' concentration must be kept in mind (Edmonds, 1922). In the area occupied by the Nubian Series there is an additional complication in the occurrence of concretionary ironstone interbedded in the sandstone-mudstone series (e. g. at Wadi Seidna at 35 m. depth). The introduction of iron-concentrations into the Sandstone Series may have been the result of the mid-Tertiary lateritic climate. . .

(p. 103) "At some period following the lateritic ironstone, volcanicity began on the top of the Abyssinia plateau."

"This raised the watersheds and probably displaced the isohyets of the region. Volcanic period probably began in Upper Tertiary.

(p. 109) "The hypothesis of a Quaternary ironstone or lateritic climate in the northern Sudan has been based on the occurrence of a gravel of coarse pea-iron forming a thick deposit south of Omdurman. Sandford accepted this as a Pleistocene laterite and correlated the ironstone of the northwestern Sudan with the Omdurman occurrence. The Omdurman occurrence is now regarded as a gravel composed of ironstone debris, derived from concretionary ironstones in the Nubian series. Its redeposition is of middle Pleistocene age.

"The deposition of iron oxide on present-day surfaces is considered to be a normal feature of the arid climate (cf. Edmonds, 1942, p. 29) distinct from the heavy ferruginization now attributed to the mid-Tertiary.

(p. 120) "The red loams of western Equatoria form a thick cover on the low plateau in which the streams are increased in shallow or relatively narrow valleys. . . .

"These red loams . . . are derived by lateritic weathering from the subjacent rocks. On the plateau they are frequently over 3 m. thick and may reach nearly 5 m. in depth. It is considered that these lateritic loams are the product of an earlier (Pleistocene) lateritic climate, not a result of present-day conditions."

This discussion by Andrews of the occurrence of ancient laterites should serve as a warning to agriculturists, botanists, foresters, agricultural scientists and others who are too likely to ascribe the formation of superficial or almost superficial laterite deposits to recent events. One has an uneasy feeling in reading certain literature that the facile assumption of a modern date for certain lateritic soils and the implication that laterite may be formed rapidly are very unscientific, and should be guarded against. Instead of regarding a superficial laterite as recently formed an observer should at least ask himself whether it may not be a relatively old deposit exposed by erosion. There should be an effort to discover embedded charcoal in superficial laterites in sufficient amount for chronological dating by the carbon-14 method. The actual dating of the most recent laterites, if possible, would have a most important bearing on long-range climatic changes on the borders of the Sahara and elsewhere. It might even be possible to recover enough fossil resin, cuticles, pollen, etc. from strata of typical soil profiles to establish chronological dates, if they were relatively recent.

Aubreville, A. (1937) Dix années d'expériences sylvicoles en Côte d'Ivoire. *Revue des Eaux et Forêts* LXXV No. 4, 289-302 pl. 1-4, Apr. 1937; No. 5, pp. 385-400, pl. 5-8. May 1937. Paris: Société des Amis et Anciens Elèves de l'Ecole Nationale des Eaux et Forêts.

Forestry in the Ivory Coast colony is relatively young, having started in 1924 and got really established by 1930, when various experiments in silviculture were begun. In the meantime a number of reserves were established. The primitive forest of the Ivory Coast has the great disadvantage, from a commercial standpoint, of being too diversified. Aubreville says that it contains some 600 species of trees, of which 200 are large, but for very few is there any market. The French foresters tried dense interplanting of mixed forest with nursery stock of a few desirable species, in the hope that growth of the interplanted trees would be rapid enough to enable the native growth to be entirely removed in six years. That the system did not seem to give the hoped-for results is indicated by its abandonment in favor of a less intensive system of enrichment. Still, it seemed that a better method might be found and so they experimented with planting nursery stock of desirable species in the native clearings among the crop plants, arranging for the natives to let them grow and to leave them in good condition when the clearings were abandoned. From the standpoint of silviculture this system is successful, but it is socially and psychically unacceptable to the natives. It was hard to find natives who would consent to the experiments being tried. They did not want interference with their old customs and wished to avoid any French supervision, and there was no trained native supervisory personnel. So cooperation had not been general enough (by 1936) so that the system could be said to have had a fair trial. It was of course applicable only to trees that do not require shade when young but fortunately several such are available, and the results were encouraging. While the natives of the southern forested region refuse to cooperate, the virgin stands diminish rapidly. Abreville suggested introduction into the south of some people from farther north, who have had to live under different conditions (namely, in partly wooded savannah country) and who would not be so bound by tradition.

As for the regeneration of the deteriorated wooded savannah itself, Aubreville had no hope of bringing it back to a state approximating primitive forest. One autochthonous tree and, curiously enough, several introduced ones, succeeded well when planted, but, in the main, what the savannah needed was protection from fire and mixed plantings of whatever would shade out herbaceous vegetation and provide fire wood with a modicum of wood that could be used structurally.

Aubreville, A. (1949a) *Climats, Forêts et Désertification de l'Afrique Tropicale*. Paris: Soc. d'Édit. Géogr., Marit. et Colon 352 pp., ill.

Aubreville (p. 313-317) in this interesting and important contribution chided certain phytogeographers for refusing to admit the reality of the retreat of the african equatorial forest during recent times. They have been inclined to regard the entire area of more or less open savannah as climatic with the exception of a narrow peripheral band where recent destruction is evident. The question then arises whether the zone which has been denuded might not be restored to tall forest. The zonation of vegetation shows no clear distinction between the artificially produced false climax following deforestation and the climatically limited wooded savannah. Aubreville regarded most of the wooded savannah as produced by man, and as a zone into which the natural vegetation of climatic wooded savannah migrated following denudation by shifting agriculture.

In traversing the strange and deep advances of the southern savannahs into the Gabon forest by way of the valleys of the Ngounie and the Nyanga rivers Aubreville found that the brush fires actually penetrated into the forest, sometimes only scorching those at the edge but sometimes penetrating many meters. The fire fed on the accumulated duff of the forest floor and did not burn the trees and shrubs, but killed them, being followed by a rose-colored decay. The forest losses of immediately preceding years were marked out by a zone of fern surrounding the clearings.

In the Ngounie valley, between Dende and the Oano river he had a view, of course, of total deforestation. The population there cleared forest intensively and as it moved left forest remnants amid disorderly debris of stumps, unburned logs, unkempt brush and tall grass. Curiously enough, it was fire which reduced it to orderliness and beauty. The depleted forest patches became stronger within, even if eaten back a little at the edge by annual fire, and finally came into abrupt abutment on prairie, where fire gradually destroyed the evidence of former forestation. Thus there came into existence a beautiful landscape of abrupt contrasts of tall forest and grassland, which might have been planned by a fantastically imaginative architect.

In this manner Aubreville conceives the savannahs included in the Gabon forest to have been formed; made by the activities of an ancient population which today has disappeared but which has left occupational evidence

in the soil. He personally established the process for the Gabon, but other authors gave convincing evidence for other regions, Gonggryp for Surinam, Rion (cited by Robyns) for the savannahs of Itama Wetu, Congo, at 2° 20' S.

Aubreville personally observed the destruction of a swamp forest in Oubangui-Chari by fire which penetrated it from the savannah during a season of desiccation.

He personally observed in Oubangui-Chari small wooded savannahs in process of regeneration to tall forest. They were so small that they escaped burning, and were being reabsorbed into the tall forest.

Several Belgian phytogeographers are cited (p. 317) as having observed the regaining of savannah by the forest, namely Vanderyst, Robyns, and Lebrun.

Aubreville (p. 323) did not confine his attention to the tall moist forest but also considered the fate of dry-land forests in Africa. This, he is convinced, has been given relatively too little consideration because the era of great destruction of the dry-land forests preceded the period of European colonization and there are only a few places where botanists are now able to observe the passing of the remnants of a type of forest intermediate between wooded savannah and the remaining great areas of equatorial rain forest. From remote times, Aubreville believes, Africa has suffered a progressive gangrene. He admits that the hypothesis of a pre-European period of rapid and wide-spread vegetational degradation is not a matter that can be proved historically, but he does not see how the present devastation of Africa could otherwise have come about. He believes that the earlier stages of man's destructiveness were more effective because they took place in a drier part of the continent where the vegetation lacked the resistance to fire that the rain forest has.

Aubreville concluded that the progress of the desert in Africa could not be dealt with by a variety of local measures, locally applied, but that a very serious situation demanded that continent-wide planning should be done and that the plans should be put into effect by all the countries concerned in a simultaneous coordinated effort. This could only be expected to be done by colonizing powers, not by local populations or authorities. He said that to halt the extension of desert and savannah in Africa would be a gigantic labor, which could be conceived and carried out on an international scale, by a concerted effort of all the interested governments. Not only must foresters consider the

rain forest, but drier plant associations as well. The desert must not be encouraged to gain on the bush, or the bush on the grassland, or the grassland on the wooded savannah, or the latter on the dry-land forest or the rain-forest. Any local retrogression has far reaching effects from the standpoint of destruction of resources, reduction of production, displacement of population, soil deterioration, erosion, water supply and possible deterioration of climate. The ancient practices of bush and grass burning, abusive forest clearing and soil waste should everywhere be brought under control.

Aubreville, A. (1949b) Contribution à la Paleohistoire des Forêts de l'Afrique tropicale. Paris (Soc. d'Éditions Geog., Marit. et Colon.).

Aubreville gives an excellent statement of the rational view that the Sahara region has been undergoing desiccation as a result of a long continued shift of climate which has had the result of gradual extension of desert conditions toward the equator. As a result of man's disturbance of a very unstable equilibrium has resulted in extraordinarily rapid and presumably irreversible shift of vegetation away from equatorial rain forest and toward what is called the Sudanian type of vegetation. To a botanist his ideas seem much more in accordance with expectations than those of Stebbing. The latter was certainly correct in classifying some of the savannah forest as degraded mixed deciduous forest, but he extended it too far to the northward because he failed to take into consideration the existence of a special Sudanian flora, of distinct species that have not suddenly evolved.

Aubreville of course rejects the idea that the existence of gallery forests along the streams is any indication that the same sort of forest was formerly continuous across the country between streams. On the contrary, he considered the species of the gallery forests as a special biological group in the dry forest region. The four climatic regions of the Soudan-Guinea country each had its own characteristic species, and so there are four floras, namely, Guinean, Sudan-Guinean, Sudanian, and Sahelian-Saharan. Each has an evolutionary and ecological history extending back into the Tertiary, even though boundaries have moved. He cites pairs of related species in many genera, characteristic respectively of "rain forest" and "wooded savannah". On the basis of geographic distribution and relationships he

distinguishes arid-region floras of various origins, Paleopanafrican, North, also tropical, and Dry Paleoethiopian, and indicates their contributions to the modern dry woodland flora. He believes that if man had not intervened by the use of fire, there would probably have been new adaptations to the new climate. Man, however, has given no time for that. His destructive efficacy multiplied by fire, he has abruptly replaced ancient forest by man-made savannahs, -- "savanes anthropogenes." In the same way he has created the savannah region between the equatorial forest and Angola, Katanga, and the Rhodesias. This theory of the wide extension of the savannahs as a result of fires is entirely logical. The degradation continues. The unstable equilibrium resulting from climatic change is upset very easily but man has only a trigger effect. The conditioning of his vast destructiveness has been a result of a long swing in climatic change reaching back into the Tertiary. Vestiges of forest, out of range, remain, but they are doomed. Stable remnants are being relentlessly destroyed with more vigor because new economic conditions and new tools have enabled human population to grow, have made it an increasingly effective agency of destruction. Deforestation goes on apace; the African savannah extends; and Stebbing would say, after that, the desert. The process, in so far as caused by man, would not have been so rapid and so brutal if the still persisting forest of certain regions had not come to be in a state of unstable equilibrium with the increasingly dry climate.

Austen, Leo (1945-46) Cultural Changes in Kiriwina. Oceania, Vol. XVI, No. 1, pp. 15-60, 1 pl.

Native agriculture in Kiriwina Island, of the Trobriand group, belonging administratively to the southeastern division of Papua, was by 1930 profoundly influenced by the people having come into possession of steel implements. In 1840 only the most important men were able to have even stone axes, which were rare and obtained only by barter from distant sources by the dwellers on this low coral island, which provided no hard stone for making them. Stone implements and clubs were used for felling brushwood. Large trees were killed by ringing, or the branches were merely lopped off. Debris was destroyed by fire. Gardening with only a few stone axes entailed hard work.

There is no longer any virgin forest on garden lands, and the recuperative cycle is so short that there are no trees to be cut that are more than five or six years old, but they are as high as 15 feet or more.

Cutting for a yam garden (kaimata) is preceded by rules presided over by the towasi or garden magician, for which he is paid in food and also in articles of native wealth, such as old stone axes, etc., valued as heirlooms and for ritual purposes. The burning-off fire is lit with enchanted dried coconut leaflets. Unburnt stick and rubbish are then piled up for a second burning.

Yams (various kinds of kuvi; general Malayan ubi) are planted with due ceremony and a few ornamental posts are set up; then ordinary poles made from saplings, for real utility, are set for the yams to climb upon. Other root crops called taitu are planted with the kuvi, -- maybe just other types of yam. Supplementary kinds of gardens are called kaimuga; these are work-a-day affairs the making of which is not attended with the great ceremony that attends the making of the kaimata.

There are many interesting features of the ceremonially complex gardening of the Trobriands, but one is that not all of the yam garden goes into thicket fallow. A part is planted with bananas and becomes a kisi, a more permanent type of garden, marking a transition from agriculture to horticulture.

Taro gardens, made in wet places, are entirely distinct from the dry-land yam gardens.

Rice in the Trobriands was not old, but an experimental introduction by Austen himself. Rice seems not to have been a native crop there. The lands bordering swamps are known in Kiriwina speech as dumia lands. Dumia would seem to be cognate with the widespread name rumbia for the sago-palm, but Austen does not mention the cultivation or presence of this plant.

Baden-Powell, B. F. S. (1892) *In Savage Lands and Settled Lands: Malaysia, Australasia, and Polynesia. 1888-1891.* London: Richard Bentley and Son. x + 438 pp., illust., map.

This popular travel book describes the appearance of forest land in Ceylon where forest had been hastily destroyed for the planting of coffee, which in turn had been quickly almost exterminated by the coffee blight and was being superseded by tea. Of the country between Kandy and Nuwara Eliya, he wrote (p. 42):

"The plantations are a curious sight. Miles and miles of forest have been cleared and burnt; but all the larger trees are either left standing, gaunt and dead, or lie like skeletons on a battle-field over the country. But, one thinks, how grand the scenery must have been before, when these giants stood fully clothed in verdure, with creepers and undergrowth around! In amongst this scene of wreckage grow the coffee plants -- shrubs, perhaps ten feet high, with leaves at the top like a crinkly laurel, and little green and red, cherry-like berries close to the stem."

Baden-Powell joined a punitive expedition against natives who had pillaged a trading ship and murdered the crew near Chad's Bay on the north eastern peninsula of New Guinea. Here there was some open country. He wrote (p. 166):

"We got to a place which had apparently originally been one of those large swamps which exist in these parts, probably covered with rank grass and bush as high as one's head; but the drought had come, it had dried up, got on fire, and now was nothing more than a plain of ashes. These ashes were soft, so that, in treading, one's foot sank in nearly to the knee. It was like walking in deep snow, except that every time on drawing out one's foot a cloud of black dust rose up and filled the air. It seemed at times as though we must be suffocated with the dust made, and we had to halt occasionally to let it settle somewhat. After a time we got into the dry bed of a river and followed it up towards the hills, presently getting among some trees."

The foregoing account gives the impression that a surface layer of largely organic peaty soil had burned as well as the grass, for otherwise the ash would hardly have been so thick.

Near Port Moresby in New Guinea Baden-Powell was the guest of the missionary J. Chalmers, whose book "Work and Adventures in New Guinea," written

jointly with W. Wyatt Gill, was cited by O. F. Cook as telling of turning sod with digging sticks in preparing land for cultivation. Baden-Powell described no agricultural operations but did call attention (p. 201) to the native custom of hunting by aid of fire, as follows:

"Wallaby are common on the grasslands in this district. The natives often get them by setting fire to the long grass, and driving them, on the principle of a grouse drive, to a point where they await the game with their spears."

Baker, J. G. (1877) Flora of Mauritius and the Seychelles: a Description of the Flowering Plants and Ferns of those Islands. London: L. Reeve and Co. 19+L+557 pp.

The smaller islands lying between Madagascar and Africa were speedily despoiled after they became European colonial possessions. The forest which originally reached almost to the shore was cleared to make room for permanent agriculture, but there was indiscriminate clearing of land unsuited to agriculture and careless or ill-advised burning following African precedent, for the population consisted largely of African slaves. The almost complete destruction of the primary vegetation provides an example on a smaller scale of devastation that has taken place in the forested part of Madagascar.

(p. 14*-15*) "Unfortunately, so far as botany is concerned, the value of land in Mauritius for sugar cultivation has been so great that the forests, which at the time when it was named by the Dutch, in 1598, covered it to the water's edge, have been by degrees cut down till now they are almost entirely destroyed. . . . In 1761 the aboriginal forests had already been cut down to such an extent that the French East India Company sent out directions to the Governor to stop their destruction, but the value of the land had become so great that these directions were of little avail. . . . The consequence is that the indigenous flora of the island, as we have it now, is a mere wreck of what it was a hundred years ago, that the remains of the aboriginal forests now linger only in the recesses of the hills, that many of the Orchids, Ferns, Pandani, and other shade- and damp-loving plants, and the interesting endemic trees and shrubs . . . have either been entirely exterminated or become very rare, and that a crowd of introduced trees, shrubs, and weed have replaced the original vegetation to a greater extent than in any other part of the world except St. Helena."

(p. 16*) "In Praslin and Silhouette the soil is very poor. In Mahé it is rich in the ravines and forests, but has been much washed away since the principal woods were cut down, and at the present time large trees are only to be found in the more inaccessible parts of the mountains."

Baker wrote of Rodriguez:

"Here, as in Mauritius, our earliest records of the island, which go back to 1691, report it as richly wooded. Now the forests have been all cut down, and flocks of goats and herds of cattle graze over its surface and nip the young shoots of everything they can reach."

Balansa, B. (1872) Catalogue des graminées de la Nouvelle-Caledonie. Bull. soc. Bot. Fr. Vol. XIX, pp. 315-329.

In this paper Balansa called attention to the remarkable fact that the grasslands of New Caledonia contained three dominant adventive grasses. The pasturage consisted mainly of Andropogon Allionii in the more arid parts of the open country and of two additional species where the soil was rich and deep, these being Andropogon cinctus and Imperata Koenigii, but there were many other scarcer introduced species. The vast open spaces had hardly any trees except scattered individuals of Melaleuca Leucadendron and Casuarina leptoclada. The grasslands were interpreted as entirely recent, having developed only where the indigenous flora had been exterminated, and their flora consisted almost, without exception, of introduced weedy plants. There were over a hundred different grasses in all, but the indigenous ones of the native vegetation of the highlands were three bamboos of the genus Greslania with perhaps Leptaspis umbrosa, Chloris cynodontoides, Andropogon jubatus and two or three species of Panicum, which were not restricted in habitat relations to places where the associates were all ancient occupants of the land.

The remarkable fact about the vegetational aspect of New Caledonia as Balansa observed it was that the ancient endemic and indigenous flora was predominantly woody. When destroyed, its place was taken by an herbaceous flora of weedy propensities. The families that were hardly or poorly represented in the original vegetation were, aside from the grasses, Compositae, Leguminosae, Malvaceae, Cyperaceae (except those of ferruginous soils), and various others.

The installation of a complete prairie flora in a region formerly occupied almost exclusively by woody might be considered a strong argument in favor of Humbert's later interpretation of the flora of central Madagascar as consisting of late adventives.

Baldwin, William Charles (1863) African Hunting from Natal to the Zambesi, including Lake Ngami, the Kalahari Desert, etc., from 1852 to 1860. New York (Harper and Brothers). 397 pp., illust., map.

The English big-game hunter Baldwin (1863) travelled across the equator in Bechuanaland in 1859, from Lake N'gami in a generally southeastwardly direction to Mooi River Dorp in the Transvaal. The tribes encountered were herders who apparently prized their cattle only as a sign of wealth and lived chiefly by hunting. At a point about 26° E, and according to the route shown on his map not far from the tropic of Capricorn he wrote in his diary (p. 266):

"We have just had a very narrow escape of being burnt up; our road lay through thick mapani-trees, with tall white grass, thick and dry as a deal board, on each side. Some one had set the grass on fire in fifty places behind us and below the wind. A stiff breeze was bringing it to us at a tremendous pace, and we were enveloped in dense smoke. I saw at length, some distance away, the red flames breaking through, and soon heard the roaring and crashing of the fire. There was an opening in the bush 200 yards ahead, and I slipped a box of matches in my pocket and ran for my life there, setting fire to the grass in a dozen places under the wind, which instantly roared and tore away magnificently; and the wagons, whipping on through the smoke, had only just reached my friendly burn when the fierce flames came tearing up, crossed the road instantly, and burnt themselves out at the tail of the wagons for want of fuel. The ground, however, was so hot that I burnt the soles of my shoes badly, and the poor oxen in the yoke kept shifting their feet incessantly. Meanwhile we were all working like demons, throwing sand on the hot embers to enable the poor oxen to stand."

Ballet, Jules (1894) La Guadeloupe. Renseignements sur l' Histoire, la Flore, la Faune, la Geologie, la Mineralogie, l' Agriculture . . . Tome Ier. - II. 1625-1715. Basse-Terre: Imprimerie du Gouvernement.

Ballet reported (Vol. I, Sect. II, p. 357) what little was to be gleaned from Government archives regarding the agriculture of the long-extinct Caribs of Guadeloupe, as follows:

The Caribs have no idea of private property. In the imperfect state of their society, and with their needs satisfied, they thought that the land didn't belong to anybody. They chose as they pleased a piece of land suitable for growing certain food plants, kière (manioc), balàranna (banana), mabi (sweet potatoes), namouin or choucou (yam), taya (Carib cabbage) etc. They were accustomed to plant cotton. In order to clear the land, they called other people to help. The trees on a space a hundred or two paces square were felled pell-mell and then they spent the rest of the day and the whole night drinking, as payment for their work. Six months after the debris was fired on a clear day on the side from which the wind blew. The greater part burned. A new call was made for help in cleaning up the clearing, which was an occasion for another party. They called the various operations of making the garden ichali, as well as the garden itself, and this word (ichali, garden) has passed into French and is still in use down to our own days.

Baron, R. (1882) From Ambatondra to Fenoariva. Antananarivo Annual and Madagascar Magazine, No. 6 (Vol. II, Part II) pp. 164-179. Antananarivo: Press of the London Missionary Society, Christmas, 1882.

R. Baron wrote an account of a missionary tour from the chief town of Antsihanaka Province, Madagascar, to the coast, in which he described the nature of the country traversed, with ethnobotanical as well as quite detailed ecological description, and with lists of the plants and animals observed. He stated that the country of the Sihanaka with its swamp-land rice cultivation, great area of swamp, and Lake Alaotra, had been so often described as to be passed over with little comment. His party did not reach forest until, still within distant view of the lake, which lay to the westward, they came to the then mostly uninhabited district separating the Sihanaka from the Betsimisaraka tribes. It was after about an hour and a half by foot from the village of Antendrorano when they entered the forest. He described (p.169) the path as:

". . . a narrow passage cut through the dense mass of trees and shrubs and herbs, and with numerous and difficult ascents and descents. . . . The stumps of the trees that have been hewn down still stand in the way, and the gnarled and intricate roots of others are exposed above ground. . . . The road, moreover, is frequently obstructed by immense trees that have either fallen themselves or been cut down. . . . With regard to the trees . . . the species appear to be almost endless. . . . Many will perhaps imagine such a forest as this to be a perfect paradise for gorgeous flowers, whereas, strange to say, it is a perfect wilderness. . . . We had no sooner entered the forest than we heard the lemurs of various species screaming and howling on all sides; and for the next three days, -- all through the forest in fact -- we heard and saw them very frequently."

He said that he travelled much more slowly than necessary, in order to botanize, and spent nine hours on one three-hour stretch.

It is obvious that even in this dense forest there had been some cutting and clearing, but probably of such a nature that man had not yet effectively modified the nature of the flora as a whole. Near the streams there were camping places which he calls "glades" and which, from the nature of the vegetation, may be presumed to have been abandoned agricultural clearings. They entered the Betsimisaraka country at a village called Antsarasambo. He wrote (p. 174):

"The village is in an open space surrounded by dense forest. The glades hereabouts, and the country immediately east of the forest are full of capsicum plants, raspberries (*Rubus rosaefolius* Sm.); *vóatóngotra* a species of pepper; *vóampò* (*Solanum auriculatum* Ait.); *longòza*, or cardamom (*Amomum Daniellii* Hook. f. & T.); and *dingadingana* (*Psiadea dodonaeifolia* Stetz) a plant that covers many of the hillsides east of the great forest as far south as the Tanàla; and the *haronga* (*Haronga madagascariensis* Choisy)".

There had been a previous description of a patch of cardomoms so large, and traversed by such an obscure path that they got lost and took an hour and a half to find the way out. This could only have been a complex of old clearings. The plant name *haronga* suggests relationship to a Sumatran word for deserted and overgrown clearings, namely *harangan*, in which the suffix means "place of". So *harangan* means place of *harang*. Is *harang* a cognate, meaning in Betsimisaraka a characteristic plant of old clearings and elsewhere in Madagascar upland rice itself?

After leaving Antsarasambo, Baron encountered more forest but also more "glades", and eventually passed out of forest about an hour before reaching Ambavala. From

there to the eastern sea coast rolling land was finally succeeded by low-lying land with many swamps and lagoons. The path led through dense thickets and sharp-edged stiff grasses.

Such a relatively detailed account as this of Baron's is unfortunately a rarity in the literature, but some botanist really interested in the changes that have come about in three quarters of a century would do well to traverse his route again, as well as some others which give localized notes on vegetation. The information on changes during measured periods would be valuable in appraising the rate of destruction of the tropical flora of Madagascar, described by Humbert without enough historical verification of the ecological findings.

Baron, R. (1890) A Malagasy Forest. Antananarivo Annual and Madagascar Magazine. Vol. IV, Part 2 (whole no. XIV) pp. 196-211.

"A great part of the country between the interior of Madagascar and the low-lying land of the east coast is covered by a dense and continuous forest, with innumerable detached outliers of woods and thickets, great and small, which doubtless once were joined to their neighbor. This mighty primeval forest forms one of the principal features in the physical character of the island. It stretches probably for a distance of 800 miles in a northerly and southerly direction, and in an easterly and westerly averages about 30, its greatest width, which is in the north-east of the island, being not improbably 60 or 70. There is thus an area of about 24,000 square miles of forest-clad country. . . .

"In conclusion, let me express a hope that the present wholesale destruction of the forest by the natives may be soon effectually stopped by the Government, and that its valuable resources may be speedily utilized. If this does not take place, in a few more generations there will be no forest left to expatiate upon, and as the majority of its trees are found nowhere else in the world, they will have become absolutely extinct."

Barrow, John (1806) *Travels into the Interior of South Africa*. Ed. 2, 2 vols., London T. Cadell & W. Davies, xviii 427; iv + 373 pp., maps, illust.

The northern boundary of Cape Colony was far beyond the tropics, of course, but its grassland showed the same ecological alternation of grassland and forest that existed in some places to the westward of the Mississippi, a hundred or a hundred and fifty years ago. Its grasslands were continuous with those of tropical east and central Africa. Much of the once forested country had in the course of time become grassland because it was a region where there was an easily disturbed equilibrium. Barrow (1806, vol. I, p. 137) described a prairie fire near the mouth of the Great Fish River (about 33° S.) as follows:

"The country over which we passed was perfectly flat; and in those parts where the Kaffers had not yet been, there was abundance of long grass. On approaching the sea-coast we observed a long train of fires, and, supposing them to have been made by a party of Kaffers stationed there, we turned a little out of our way towards the quarter from whence the smoke proceeded; but being to leeward of it, and the wind increasing, the wagons were in the midst of the fire before we were aware of being so close upon it; and the smoke was so thick and acrid that it was impossible to see the length of the team. The oxen, being burnt in the feet, became unmanageable. . . . The smoke was suffocating; the flames blazed up on each side of the wagons. . . . The oxen, however, either by sagacity or by chance, had set their heads against the wind, and soon galloped through it. The flames ran in all directions among the long dry grass and heathy plants with incredible celerity. The face of the country for several miles was a sheet of fire, and the air was obscured with a cloud of smoke. We had yet a considerable extent of country to pass among black ashes, beyond which we presently reached the mouth of the Great Fish river. . . ."

Turning now to Barrow's description of the Lange Kloof, which he reached to the southward of the Olifant's river, he said(p.299):

"Between the foot of the Duyvil's Kop and Plettenberg's bay, the latter of which is about fifty miles to the eastward of the former, the country is beautifully wooded, and intersected with numberless rivulets, issuing out of the forests; there are also several broad deep rivers, over which it is necessary to pass in boats. Some of these terminate in large sheets of water, forming beautiful lakes, whose margins are finely fringed with wood."

Of one lake he said: "There is a tradition among the Hottentots that this lake, now six or seven miles in circumference, was, no very long time ago, a beautiful green meadow, and it is still said to be increasing in size. If the quantity of water thrown in by the rains, and its springs, should exceed in quantity that which may escape by absorption and evaporation, the Green lake will one day, by its great pressure, break down the barrier that now divides it from the sea, which has evidently been the case with its neighboring lake, the Knysna. This, in fact, is now become an arm of the sea. . . The surrounding hills are clumped with forest trees, and their sloping sides are clothed with shrubbery down to the water's edge. . . The arms of the Knysna stretch into the deep vallies at the feet of the mountains, and are there lost in impenetrable forests."

This account may indicate minor backward and forward swings during the long-range progress of increasing aridity. There are probably descriptions of the present condition of the area which the reviewer has failed to find, and which would provide material for an interesting comparison of conditions 150 years ago and today. The critical area is located with sufficient precision so that it could surely be identified today, if, indeed, it is not well known to South African botanists.

Bartlett, H. H. (1919) The manufacture of sugar from Arenga saccharifera in Asahan, on the east coast of Sumatra. Twenty-first Report, Michigan Academy of Science, pp. 157-8.

From certain accounts of Arenga in other parts of Indonesia, it must be inferred that the sugar palm is not planted, but utilized only where it is found wild. (In the Philippines, however, Merrill knew of no natural habitat for it and regarded it as having been probably introduced and certainly disseminated by man.) In Asahan, Sumatra, it has a definite place in the simple crop rotation of Batak agriculture. It is likewise planted about the villages in the more densely populated Toba region. In the heart of the Batak lands, around the southern end of Toba Lake, permanent agriculture is on a rather high plane. Irrigated terraced rice fields extend as far as the eye can see, between the beautiful, island-like groves of bamboo, palms, and other useful trees, among which the villages are concealed. Between this densely populated region and the jungles of the East coast there are great stretches of rolling grassland, covered by various coarse,

tall grasses called "lalang" or "alang-alang" in Malay. To one who has observed how these grasses occupy the land to the exclusion of other vegetation, when once they have invaded a cleared area, it seems certain that most of the desolate "lalang" region represents the final scene in a cycle of changes set up by the destructive "ladang" agriculture about to be described.

For centuries the population of the highlands has been overflowing into the low coastal belt. Here conditions have not favored the development of a dense population based upon permanent agriculture. Consequently the inhabitants show a cultural degeneration, as far as agriculture is concerned. Such high cultural characteristics as a general knowledge of reading and writing, in their peculiar character, were associated with primitive agriculture.

An Asahan plantation ("ladang" in Malay; "djuma" in the local dialect of Batak) is a clearing in the jungle, made by felling and burning. The first crop is always upland rice, which is planted in the soft, ashy ground, with no previous preparation, such as plowing. (In fact, there was (1918) no such thing as a plow in Asahan, even on the great European plantations.) The men and women walk side by side across the "ladang", punching shallow depressions in the soft surface as they go, with long, blunt planting sticks. The children follow, and drop a few grains of rice into each hole. The seeds are not covered by the planters, but are left to be covered by the first rain. In the meantime, the "ladang" must be watched from a little watch house, where someone is constantly on guard, so as to drive away birds and animals. Bamboo clackers are used, all of them often connected with the watch house by strings or rattan, so that a noise can be kept up by the watchers.

Since the land is not cultivated, it ceases to be productive for rice after a year or two. Then other plants are started, such as maize, red peppers, eggplant, onions, ginger, Caladium, tobacco, and many others. These herbaceous types are interspersed with several kinds of bananas, manihot, pineapple, etc. In former days cotton was planted, which in that climate is of course arborescent. A few remnants of it were still to be found in out-of-the-way places. But regardless of what plants were grown to prolong the utility of the "ladang", its ultimate fate was reversion to jungle, unless, through invasion by "lalang", it became irredeemable for native agriculture. The native has learned one way to turn the course of nature to its own advantage. He may plant his "ladang", before he deserts it, with sugar-palm. The "bagot" will hold its own with any of the invaders which compose second growth jungle. It grows rapidly, and in ten or fifteen years after planting it, one may have a productive sugar grove, and a source

of considerable profit. It is interesting to note that the seeds of the sugar-palm are planted by the women, in order that they may be fruitful, -- an example of sympathetic magic. Of course trees which occur spontaneously are also utilized. Blatter states that the species seems to owe its wide distribution in Java to the fact that the corrosive fruit is eaten by two mammals, Paradoxurus (the palm civet) and the wild hog, Sus verrucosus. The same is doubtless true in Sumatra. Few animals are able to eat the fruit, which is of so acrid a nature that decoctions of it are said to have been used as a weapon by the natives in their early attempts to resist European aggression. The liquid was called "hell-water" by the Dutch.

Bartlett, Harley H. (1928) The fast-disappearing Flora of Sumatra. In: Explorations and Field-Work of Smithsonian Institution in 1927, pp. 93-100, figs. 104-116. Washington.

In this article will be found a group of pictures showing forest destruction by native clearing for primitive agriculture as well as for extension of rubber plantations south of Asahan on the East Coast of Sumatra. The pertinent text follows:

"The plantation belt of the East Coast is a region of rapid development, which had its beginning at Medan, center of the famous Deli tobacco plantations. Other cultures, especially rubber and oil-palm, have extended the belt southward, and now it is growing laterally toward the highlands through plantings of tea and, locally, of irrigated rice. The great plantations of the U. S. Rubber Co. in Asahan were practically the southern end of the culture area ten years ago, but now exploitation has reached much farther and has outdistanced transportation facilities.

"It is regrettable that the resources of the jungle have not been known and utilized before its destruction. Of course the chief groups of economic trees are known, but there are doubtless many localized types of great interest and value that are doomed to extinction. The expression of such fears provokes laughter in Sumatra, where the wonderful tropical forest now seems inexhaustible. However, it will be only a few years before a patch of virgin forest will be a rarity in the culture area. As for

the flora, it is doubtful if half of it has been recorded, or can be recorded on the basis of the collections that have thus far been made. Furthermore, after potentially valuable or scientifically interesting plants have been exterminated, it is small consolation to know that a few fragments may be preserved in our herbaria. Since leprosy has come under control through treatment with chaulmoogra oil, what botanist would wish to see any one of the allies of chaulmoogra exterminated with its properties still unknown? The type locality of one of Mr. Yates' beautiful discoveries, Hydnocarpus Yatesii Merrill, may be cleared any time. The known range is not over ten miles across. It is a pity that botanical survey work cannot be pushed more rapidly the world over....."

Bartlett, H. H. (1935) The Batak Lands of North Sumatra, from the Standpoint of Recent American Botanical Collections. Univ. Philippines, Nat. & Appl. Sci. Bull. Vol. IV, No. 3, pp. 211-323, June 1935, 2 maps, Manila: University of the Philippines.

The writer's own observations on the effects of agriculture and fire in Sumatra were confined to the East Coast and adjacent parts of Tapianoeli, inhabited along the coast by Malays of various origins and by aliens, by Malay-anized Batak further inland, but, as part of the Malayan admixture, reaching to the sea, and by Batak still farther inland.

An attempt at a simple land classification of Asahan proper on an ecological basis led to only a few divisions. The region is covered by red, drained soils derived from liparitic tuff, by alluvial undrained white soils consisting mostly of the finer constituents of the same, and by sand ridges where ancient wave and stream action has sorted out the coarser and harder constituents. The drained forests are tombak, the undrained paja (paya in English spelling) and the low sand ridges in the paja are permatang. Undrained or badly drained forest in the red-soil area is rodang.

No matter how much the paja forest is depleted for timber and firewood, its species, at least, are in no danger of extinction, for part of it was too wet to permit the drying off period that is needed when the wet-rice crop of overflow land is ripening. Part was "bandjar," periodically inundated but not too deeply, and appropriate for rice, and part could be ditched and drained for rubber culture. Examples of the paja, however, were holding their own.

It was different with the upland forest between the coastal swamps and the rougher land toward the mountains. That had been largely destroyed, but two good samples were being maintained as forest reserves. Likewise the permatang flora was largely used for coconut land, and little remained with actually unculled or nearly natural flora.

The ecological classification follows (pp. 293-295):

"In conformity with the natural subdivisions of the region on a topographic basis, and with the modifications produced by human occupancy, the forests and clearings of the northern part of Asahan, mainly covered by soils derived from liparite, may be roughly classified as follows:

- (1) Mangrove forest ('bako', Malay and Batak; 'bakau', Malay; 'zeehoutboschen', Dutch).
- (2) The brackish belt of niboeng and nipa palms.
- (3) Swamp forest of the coastal plain ('paja', Malay; 'paja-boschen', 'moeras-boschen', Dutch). This forest occupies a relatively narrow northern extension of one of the greatest swamp regions of the Sunda Islands. The swamp water is acid (according to Polak the acidity is about 3) and typically non-brackish. The brackish transition from the mangrove forest to the typical paja forest is marked by a niboeng, called liboeng by the Batak, Oncosperma filamentosa Bl., a tall, slender, spinose palm that grows abundantly at the inland edge of the mangrove and extends in scattered individuals throughout the paja belt. The transition from bako to paja is often occupied by great areas of nipa, especially along the rivers.
- (4) Drained low ridges in the paja forest ('permatang', Malay).
- (5) Swamp forest in stream bottoms surrounded by upland forest ('rawang', Malay; 'rodang', Batak; 'moeras', Dutch).
- (6) Drained, more or less rolling and mountainous upland primary forest ('oetan', 'oetan besar', 'rimba', 'rimba raja', Malay; 'tombak', 'tombak na bolon', Batak).
- (7) Clearings in upland forest, made for temporary agricultural utilization ('ladang', Malay; 'djoema', Batak).

- (8) Grassland derived from forest repeatedly used for ladang, which after becoming weedy and being frequently burned over, has become more or less treeless ('lalang', Malay; 'padang', Malay and Batak; 'djalangan', Batak).
- (9) Cleared land in a weedy and thickety state of reversion to forest ('taloen', Malay and Batak).
- (10) Cleared land occupied by dense thickets and young secondary forest ('gasgas', Malay and Batak).
- (11) Older secondary forest ('baloeakar' or 'b^uloeakar', Malay; 'karangan' or 'harangan', Batak).
- (12) Mountain "mossy" forest ('tombak na limoet-limoetan', Batak).

The foregoing classification omits the 'tanah kampong' or 'tano ni hoeta', village orchard and garden ground more or less permanently occupied, and planted among the houses with coconut palms and various other cultivated plants. It represents horticulture rather than agriculture. It also neglects places belonging mostly to categories 6 (tombak) and 11 (karangan) which are sacred to gods, wild spirits, and ancestral spirits, and also permanent gardens sacred to the spirits. Such places (k^eramat; pantangan) are always botanically interesting, sometimes because of wild and sometimes because of cultivated plants. There are various artificially induced plant associations (such as the sugar-palm groves, belonging to the karangan, and the artificially replanted and extended nipa swamps, as well as various intergradations between primary and secondary forest which have their origin in a variety of ways. For instance, it is customary law in Asahan for certain trees (kajoe radja) to be left standing when primary forest is cleared, as well as certain trees left to propitiate wild spirits, or spared because of their value. These remain as a nucleus of an old flora in uncleared places not suited for ladang, but which have nevertheless been culled of valuable trees, and have thus become to varying degrees artificially impoverished primary forest. Likewise, gatherers of jungle produce enrich both primary and secondary forest with seedlings of the commercially valuable kinds of rotan palms. Some species of rotan have little or no value. It is customary, when a valuable rotan is cut that has ripe seeds, to prepare a seed bed for them. After the little plants have attained the right size, they are dug up, tied into bundles, and carried sometimes long distances to be planted here and there in places that appear suitable. In this way karangan is enriched with species of the tombak. Europeans who have not lived in close

contact with the natives have little idea how extensively they enrich wild land with useful plants. Zalacca palm (haloebi) sometimes forms almost pure stands in the small swamps (rodang) of the rolling land adjoining the coastal plain. It is native, as far as there is any evidence, but where it occurs, adjoining vegetation is chopped away to allow the haloebi, valued for thatch and for its acid fruit, to extend its area. It is likewise customary for Malays to plant seeds of durian, rambutan, mango, and the stinking mango here and there after eating these favorite fruits. (I have seen them stuck into the ground along drainage ditches in the carefully weeded rubber plantations.)

Bartlett, Harley H. (1936) A method of procedure for field work in tropical American phytogeography based upon a botanical reconnaissance in parts of British Honduras and the Petén forest of Guatemala. In: Botany of the Maya Area: Miscellaneous Papers. Washington: Carnegie Institution.

The writer gives a classification of the vegetation of the northern part of British Honduras and the adjoining part of the Petén forest in Guatemala. He felt that certain coastal savannahs and upland pine lands were natural rather than man-made. There was no evidence that they had ever been occupied for agriculture, since the sandy soil was excessively sterile, but, on the contrary, that agriculture had always been at the expense of forest which occupied the areas underlain by limestone. On the latter there were numerous Maya ruins, and evidence that there had formerly been a dense population about such Old Empire sites as Uaxactun and Tikal.

Several of the plant associations, generally taking their names from a dominant species, occurred among Maya "Old-Empire" ruins and were obviously, therefore, stages in the reestablishment of forest after clearing. It appeared likely that certain forest species may have attained dominance through having been preserved for shade or other utility in the Maya towns of a thousand years ago. This was particularly true of the ramon (Brosimum alicastrum) which dominated the neighborhood of the chief ruins. A classification of the vegetation on and near the ruins may be quoted:

"(1a) Ramonal. The dominant species is the ramon, Brosimum alicastrum Sw. This species is one of the economically very important trees of the region, since it is cut for fodder, and is essential in the "high bush" for feeding mules, which provide the only transportation of

the region. Lundell (1937) has noticed a high correlation between the abundance of ramon and the existence of Maya ruins. It is very probable that the ramon was left standing or may even have been planted by the Maya, as a resource in the event of crop failure. Its fruit may be used as a human food, as indicated by the Creole name, bread-nut. If this supposition regarding ramon should be supported by future investigations it will afford additional support for the supposition that the plant associations of the Petén forest were determined largely by human agency centuries ago. The ramon is presumed to have been given its original dominance by preservation when less useful trees were destroyed or to have been actually planted, and never to have been forced into a secondary role as the forest reclaimed land deserted by human occupants.

"(1b) Caobal. The important, even if not dominant, species is mahogany (caoba), Swietenia macrophylla King. It may be assumed to have spread quickly to abandoned lands because of its winged seeds.

"(1c) Uacutal. This phase is very rare and characterized by the gigantic tree called uacut, Bernoullia flammea Oliver. I have seen it only amid the ruins of Tikal.

"(1d) Cedral. Characterized by the dominance of Cedrela mexicana Roem.

"(1e) Manaxal. So called if "cherry," Pseudalmedia, (manax), is abundant.

"(1f) Higueral de las ruinas. The undisturbed vegetation of the ruins is similar to that of the ramonal or the caobal, but has two characteristics of its own, namely, the abundance of strangling figs, which, enveloping the stones of the masonry and eventually falling, are responsible for much of the destruction of the old buildings, and the presence of certain plants that may possibly represent vestiges of an ancient ruderal and semicultivated plant association. On the uncleared ruins of Uaxactun one finds a random assortment of the "high bush" (caobal) flora with species with the aspect of being weeds or of weedy propensity.

"(1g) Guarumal. If the "high bush" is cleared and allowed to revert to forest, a very conspicuous phase in the succession is that in which Cecropia (guarumo) springs up as a dense growth. At Uaxactun it is accompanied by a wild papaya (Carica Papaya L.) with very small, practically worthless fruit. The guarumo is a very rapid grower and with the papaya makes a dense thicket in which the soft young trees can be easily chopped with a machete as stems of herbaceous plants. The hollow stems of guarumo are inhabited by ants that bite viciously. The flora is exceedingly

weedy and is probably seeded in large part from the more scattered and less conspicuous weedy plants of the ruins. . . .

"(lh) Botanal: guanai. In the borders of the "high bush" along the bajos the flora is characterized by a predominance of palms, the species being also found on the higher ground with the plant associations already enumerated. I have called the transition flora botanal if Sabal morrisiana dominates and if the soil is moist enough so that there are filmy ferns on the bases of the botan trunks. . . . The botanal passes into the escobal, a true bajo swamp association, in which Cryosophila dominates, often accompanied by Desmoncus."

There was to have been a paper on the great upland pine and grassland of British Honduras, called the "Mountain Pine Ridge," containing observations on fire, but it has remained unpublished. The writer concluded, contrary to the views of the government forester but in agreement with L. H. Owen, Government Geologist, that there was no evidence that the savannahs would ever pass into the climax forest of the region. (See Stevenson, 1927, and Owen, n.d.).

Bartlett, Harley H. (1952) A Batak and Malay chant on rice cultivation, with introductory notes on bilingualism and acculturation in Sumatra. Proc. Amer. Philosoph. Soc., Vol. XC, No. 6, pp. 629-652, 2 figs.

In this article there are parallel Batak and Malay texts from the Pardembanan Batak of the East Coast of Sumatra, referring to the events of making a clearing for growing upland rice and to other related events. These modern texts are interesting as indication that ancient traditional gatherings for mutual help in clearing forest, planting, and harvesting were not mere toil, but convivial events in which related families and neighbors participated and which were followed by harvest feasts at which marriages were arranged, plans made for settling young people in new houses, etc.

The writer notes divergence in use of cognates of the primitive word for house and forest clearing. The Batak and old Malayan word uma is represented by Malay rumah, house, and Batak djuma, forest clearing. The primitive word uma, persisting in the Mentawai Islands in this form, is found as omo in Nias, and as guma in the chamorro of Guam, meaning house; as hauma in Toba Batak and as both uma and djuma. In Karo Batak it means clearing. He has attempted to trace the word to continental Asia where in Assam jhum is the word for forest clearings for

shifting agriculture. He may perhaps be merely credulous in recognizing an equivalent of Toba houma in Tuareg houma of the French Sudan, where it means "village". The word has reached Madagascar as well as the East Indies and islands of the Pacific, and maybe its origin is not to be sought in the Far East but in the Near East.

The recital of the events of shifting agriculture as translated from the local Pardembanan dialect of Batak used in Asahan and a parallel Malay text, indicates the brush and lower growth was first chopped out of the somewhat old but nevertheless secondary forest; then the felling of large trees was done; the large branches were chopped off of the felled trees and piled with brush and saplings for firing; all was allowed to dry and then burned the first time; there followed a clean-up and re-piling of unburned debris in preparation for a second burning; the second burning was followed by decoration of the clearing; the recital omits details of exorcism of evil spirits, of erecting an arch at the entrance, fringed by leaflets from not yet unfolded palm fronds and the making of a bamboo fence also fringed by ghost-repelling palm leaflets; then the crossed-stick barrier was placed under the arch indicating to all, including the expelled malevolent spirits that the place was pantang (under a taboo); the rice was planted with planting sticks (which are not mentioned in the recital, but see observation by Bartlett, 1919); the crop was weeded and protected from birds and wild pigs; the harvesting was done; the rice-spirit was carried out; and finally came the harvest feast, and the aftermath of building new houses.

Ethnological literature has many such references to ritual and ceremony attending the events of agriculture and the large place in primitive social life that depends upon the repetition of traditional events every year. The too rapid introduction of new types of agricultural practices may destroy ancient patterns of community life and may lead to shattering of social structure that is even worse than the evils that result from continuation of shifting agriculture in areas already largely divested of primary forest.

Basse, Éliane (1934) Les groupements végétaux du Sud-ouest de Madagascar. Ann. d. Sci. Nat., Dixième Sér., Botanique. . . . Tome XVI, Volume du Centenaire, Fasc. 2, pp. 94-229.

Charged with a scientific mission in the southwest of Madagascar, the chief goal of which was the collec-

tion of paleontological specimens and geological mapping, Eliane Basse accomplished incidentally an amount of botanical survey work that would have been creditable to a botanist with no other objective. His work is a worthy continuation of that of Perrier de la Bathie and Humbert, and in the same tradition. On account of having to collect many species when they were out of season and not in condition for ready identification, he was unable to secure precise identifications of many, but he recorded native names (in the Bara dialect of Malagassy) and the uses of many of them, data which help other botanists who may supplement his collections and observations, if anything should be left of the vanishing flora to be observed by future botanists.

An advantage of the botanical studies having been incidental to the geological mapping was that each specimen had precise data as to topography, geological formation and map location; the chief disadvantage was the collecting of incomplete specimens, such, for instance, as those of deciduous species without foliage. He did not cite descriptions of vegetation in works older than those of Poisson (1912), Perrier de la Bathie (1921) and Humbert (1923 & 1927).

The quadrangle which he studied was bounded on the south approximately by the tropic of Capricorn, and on the west by the forest of the coastal plain. The geographical chart was paralleled by one for botanical observations and the latter is published in the present paper. It shows: (1) the deciduous-leaved xerophile forest, passing variously to (2) xerophile bush and (3) the prairies ("savanes"). Then come studies of the more or less cleared-off persistent-leaved forest and of the secondary formations which replaced it (brush and nude prairie) of fringing (gallery) and stream-bank forest, of aquatic habitats, and finally of the plants of agricultural and industrial sites.

The xerophile forest has suffered greatly from the periodic fires started by the natives. It has two types, one on calcareous soils (a subtype on basalt soils) and the other on siliceous soils. Both show (with a few exceptional types such as *Pandanus*, succulents and a few rarities) the curious phenomenon of convergence of taxonomically unrelated plants to a similar general form and aspect, together with adaptation to seasonal drouth by being deciduous-leaved. Remnants are found on fire-repelling escarpments of basalt, and of other places too rocky to provide fuel for the transmission of fire, as on certain iron-stone outcrops. The flora is extremely diverse and quite lacking in ecological dominants. All of its species succumb to competition and interference with the habitat by fire.

The bush land of Adansonia (baobab) and Didiereaceae provides one of the more characteristic aspects of Madagascar vegetation. The enormous and bizarre baobabs are well known from pictures of the African Adansonia digitata with its bottle-shaped trunk. Basse considers that it was present not only in the dry deciduous forest, but also in stream bank forest traversing the latter, and by individuals dispersed on alluvial soils. In number of individuals at particular places the endemic species vary from numerous to so few that they are faced in some localities by extinction. The best known African species has been planted in various conspicuous places, but the endemics do not always hold their own against fire and the human abuse to which they seem to be subjected simply because they are such peculiar-looking things. Biologically they are of extraordinary interest. (It is said, for example, but not by Basse, that the wood remains living within the grotesquely corpulent trunk, and that if hollowed out to make a hut the living tissue of the wood will regenerate an interior bark lining within the cavity.)

As for the Didiereaceae, the family consists of three genera endemic to Madagascar. They have been monographed by Choux (1934) but their natural ecological associations cannot be held to have been thoroughly described and probably never will be because of the prevalence now of dominant alien plants. In general, the chief xerophytic bush region extends to the westward and southward of the deciduous-leaved dry forest, into which it grades insensibly. Near the mouths of the rivers it is an association of Euphorbiaceae, Didiereaceae, Adansonia, Pachypodium, etc. In addition, it occupies geologically recent coastal areas and certain especially hot and dry places within the forest.

The "Savanes" (which are far different from anything that a North American thinks of as 'savannah', but the latter word almost has to be used as a translation) are by Basse's definition composed of an herbaceous stratum and an arborescent stratum. He considers it as a secondary formation in which herbage is continuous between widely spaced isolated clumps of trees or solitary trees, and distinguishes it from the great central prairie by the latter having been subjected to repeated burning-over by violent fires, which has destroyed the trees. In other words, he regards both as degradation formations from previously existing forest. This interpretation seems irrational to the present reviewer, who cannot conceive of endemic and essentially desert vegetation having evolved in the south and west of Madagascar, and rain forest types having evolved in the east, without such transitional formations having always occupied the intermediate region, and these could only have been prairie and savannah of an indigenous composition. That the relative areas have been greatly modified by fires kindled by man it would be absurd to question, and the writer does not question that, or the state bordering on complete

destruction of the endemic flora which has followed centuries of burning-over, grazing by domestic cattle, and spread of weedy pantropic types of vegetation. It may seem unwarranted for one who has never been in Madagascar not to accept in full the conclusions of Perrier de la Bathie, Humbert, and Basse, but a distinctive desert or subdesert vegetation which required geological time for its evolution never existed without some such basic pre-human plant geography as that which exists today. Man's destructiveness in Madagascar has been inconceivably bad, without making it out to have been worse than the evidence indicates.

Basse points out, as effects of fire in the savannah, the spacing out of the clumps of grass, which, in the long run, would nullify the effect of fire in that fuel would either be too dispersed to carry fire, or the fire would not be intense enough to destroy the woody vegetation. In the main, however, the woody elements are menaced at the close of the dry season by the prevailing fires, and certain species are distinguished by morphological or physiological characteristics for survival when others are destroyed. Thus only a few fire-resistant species are left before even they finally perish, and while these last can be classed as "dominants" in the highly discontinuous arborescent "stratum" of the savannah. They characterize what Basse calls "periods of temporary stability."

Basse says (p. 144):

The existence of primary savannahs on the surface of the globe is not debatable; nevertheless, it seems little probable in Madagascar, where the climate permits everywhere, and presumably has for a long time, the existence of forest. It is this conclusion which seems to the reviewer so doubtful, in view of the data which he has himself assembled, even though he is in agreement with Perrier de la Bathie (1921).

Basse made a special point of visiting and collecting at places, mostly of high altitude, where some vestige remained of persistent-leaved forest. This type of vegetation formerly was more extended and reached farther down to lower elevations, but even after Humbert's trenchant warnings the administration for decades had viewed with indifference the destruction of some 3000 hectares of the Bara mountain forest. In the Isalo chain in spite of the perseverance of the natives in burning, ~~is an area~~ where devastation has been less rapid, because of a fortuitous arrangement of rocky blocks which stop fire by producing discontinuities in combustible vegetation. Fringing forest along streams is relatively mostly thus protected from invasion by fire.

Basse's general conclusions are: (1) that the deciduous-leaved forest, varying to deciduous-leaved bush, is a very ancient plant formation, geologically speaking, and botanically archaic. It contains species of many genera which were dominant in the subtropical Eocene. (2) This type of vegetation has extraordinary adaptation to excessive seasonal drouth. (3) Its species of diverse families have undergone convergent evolution toward a common physiognomy. (4) As a whole formation, it is in a state of rapid regression as a result of fire. (5) Its extension, under conditions of increasing aridity, is impossible, and the suggestion is made that possibly further evolution of the species cannot keep pace with rapid climatic change because the possibilities of change toward further xerophily in these ancient species has already been attained. (6) The regression in area because of impossibility of further evolutionary change of the species in one direction may have commenced in the Miocene. (7) The bush phase became more prevalent in later times, and in admitting, with Perrier de la Bathie and Humbert, that the forest phase dates from late Eocene or Oligocene, it may be admitted that the bush phase is more recent may perhaps have begun to be prevalent in the Pliocene. (8) As a living formation the bush may be a replacement of pre-existing less xerophytic forest or it may be the original vegetation to replace land reclaimed from the sea, in succession to the mangrove vegetation. (9) Bush in the long run is the natural replacement of the deciduous-leaved forest if fire does not supervene to create savannah. (10) The floristic domain of South Madagascar is genetically a direct derivative of the deciduous-leaved flora of the West Madagascar Domain, but to be held as distinct, because of its truly original characteristics, among the floras of the world.

Bastard, E. J. (1898) De la Baie du Saint-Augustin a Midongy. Colonie de Madagascar. Notes, Reconnaiss. & Explor. Vol. III, 13e Livraison, pp. 85-91.

Bastard visited Madagascar in 1896 for paleontological research for the Natural History Museum of Paris. He made observations on the distribution of vegetation during his travels. His localization of forest and treeless country is definite enough to be of use in vegetational mapping, and there is some description. Any data on distribution of vegetation in Madagascar are interesting in view of the emphasis that has been placed on the destruction by man (through fire) of much of its unique flora. (See entries under Humbert, Perrier de la Bathie, and Basse.)

Bates, Henry Walter (1864) *The Naturalist on the River Amazons*. . . . Second Ed. London: John Murray. 1864. xii + 466 pp., figs., map.

In 1848, when Bates began (with A. R. Wallace) his eleven years of travel in Brazil, it was customary for the various racially mixed people of the Amazon to follow the traditional aboriginal method in the shifting cultivation of manioc (mandioca) their subsistence crop, which custom they had acquired legitimately enough, for there were few who were not part Indian at Vista Alegre, fifteen miles above Cametá on the River Tocantins, the second affluent of the Para from the south. Here, at a typical Brazilian planter's establishment, Bates wrote (p. 70):

"The plantations of mandioca are always scattered about in the forest, some of them being on islands in the middle of the river. Land being plentiful, and plows as well as, indeed, nearly all other agricultural implements, unknown, the same ground is not planted three years together; but a new piece of forest is cleared every alternate year, and the old clearing suffered to relapse into jungle."

One wonders if Indian custom was also followed in the setting aside of a plot for permanent horticulture as distinguished from shifting agriculture. We read:

"Behind the buildings was a small piece of ground cleared from the forest, and planted with fruit trees, orange, lemon, genipapa, goyava [guava], and others; and beyond this, a broad path through a neglected plantation of coffee and cacao. . . ."

This all seems to show an agricultural pattern with three elements, the first (for local subsistence) being the unmodified aboriginal temporary clearing, the second horticultural, more permanent and doubtless partly aboriginal in character but coinciding too closely with the European orchard to be sure, and the third a plantation of the colonial European style for growing export crops.

The River Tocantins is near enough the mouth of the Amazon basin so that its headwaters from the south are in the seasonally dry to semi-arid region of north-eastern Brazil. Bates and Wallace ascended the river and at Baíaõ were in high dry country quite different from the periodically flooded forest farther down. Bates (p.75) described it as follows:

"The prospect from the village was magnificent, over the green wooded islands, far away to the grey line of forest on the opposite shore of the Tocantins. We

were now well out of the low alluvial country of the Amazons proper, and the climate was evidently much drier than it is near Pará. They had had no rain here for many weeks. . . . The woods around Baíaõ were of second growth, the ground having been formerly cultivated. . . .

"The next day . . . we glided all day through channels between islands with long, white, sandy beaches. . . . The forest was low and had a harsh, dry aspect. . . . About half-past four p.m. we brought to at the mouth of a creek or channel where there was a great extent of sandy beach. . . . Alexandro and I had a long ramble over the rolling plain, which came as an agreeable change after the monotonous forest scenery. . . ."

They were now at Pates, only 80 miles from Cameté. Ascending the river farther they came to high rocky islands of red conglomerate. They had already reached the region of campos or prairies. Bates tells (p. 80):

"Bold wooded bluffs projected into the stream and all the shores were fringed with beaches of glistening white sand. On one side of the river there was an extensive grassy plain or campo with isolated patches of trees scattered over it."

The farthest they went was to the falls and rapids of Guaribas, and then turned back. There the prospect was one of wooded hills, but it is interesting that a campo was to be found so near the Amazon. One may presume that this prairie, not much over a hundred miles from the Amazon, would have been the precursor of more frequent ones if one had gone across country to the eastward, until they became continuous with the coastal campos that stretch along the coast and are well developed in the savannah on the northern part of the island of Maranhó, in the mouth of the Amazon.

The travellers visited one more spot of native cultivation where the garden or bit of more permanent cultivation on the river was likewise a forest clearing. Here they did not observe the scattered plots of manioc in the forest, but the fact that they were there was attested by the shed where they prepared the staple food, farinha, from the poisonous roots. What the reviewer has termed "orchard" or "garden" at the house appeared too disorderly to the visiting naturalists to be worthy of such a designation but it represented primitive horticulture, as Ames has made the distinction between agriculture and horticulture. The people were mostly the mixture of Portuguese and Indian then locally called mamelucos who probably inherited much of their culture from the Indian side. Belt referred to their pilot for running the rapids, Senhor Joaquim, as a Tapuyo Indian. At his house "were planted a

number of banana and other fruit trees; amongst them were the never failing capsicum-pepper bushes, brilliant as holly trees at Christmas time with their fiery-red fruit, and lemon trees; the one supplying the pungent, the other the acid, for sauce to the perpetual meal of fish. There is never in such places any appearance of careful cultivation, no garden or orchard; the useful trees are surrounded by weeds and bushes, and close behind rises the everlasting forest."

The adoption of Indian agriculture by the Portuguese is understandable enough in view of Belt's description (p. 92) of the population of Cameté:

"The aborigines were originally very numerous on the western bank of the Tocantins, the principal tribe having been the Camútas, from which the city takes its name. They were a superior nation, settled, and attached to agriculture, and received with open arms the white immigrants who were attracted to the district by its fertility, natural beauty, and the healthfulness of the climate. The Portuguese settlers were nearly all males; the Indian women were good-looking and made excellent wives; so the natural result has been, in the course of two centuries, a complete blending of the two races. There is now, however, a considerable infusion of negro blood in the mixture. . . . It is interesting to find the mamelucos displaying talent and enterprise. . . ."

Belt spent the year 1851-52 on the Tapajos River and his description of Santarem and the region to the southward does not accord with the usual conception of the unbroken Amazonian forest. He found the population of this tributary more European and less amiable than that on the Tocantins. The original Indian tribes had been less friendly or contacts with them had been made in a less friendly spirit. They had therefore been repelled in the main rather than fused into an incompletely Europeanized culture. Bates's observations on natural prairie (campo) and primitive agriculture in the forest follow (p. 215, seq.):

"The country around Santarem is not clothed with dense and lofty forest, like the rest of the great humid river plain of the Amazons. It is a campo region; a slightly elevated and undulating tract of land, wooded only in patches, or with single scattered trees. A good deal of the country on the borders of the Tapajos, which flows from the great campo area of interior Brazil, is of this description. It is on this account that I consider the eastern side of the river, towards its mouth, to be a northern prolongation of the continental land, and not a portion of the alluvial flats of the Amazons. The soil is a coarse gritty sand; the substratum, which

is visible in some places, consisting of sandstone conglomerate. . . . The surface is carpeted with slender, hairy grasses, unfit for pasture, growing to a uniform height of about a foot. The patches of wood look like copses in the middle of green meadows; they are called by the natives 'ilhas de mato' or islands of jungle; the name being, no doubt, suggested by their compactness of outline, neatly demarcated in insular form from the smooth carpet of grass around them. . . . A narrow belt of dense wood, similar in character to these ilhas, and like them sharply limited along its borders, runs everywhere parallel and close to the river. In crossing the campo, the path from the town ascends a little for a mile or two, passing through this marginal strip of wood; the grassy land then slopes gradually to a broad valley, watered by rivulets, whose banks are clothed with lofty and luxuriant forest. Beyond this, a range of hills extends as far as the eye can reach towards the yet untrodden interior. Some of these hills are long ridges, wooded or bare. . . . A few tracks from the town across the campo lead to some small clearings four or five miles off, belonging to the poorer inhabitants of the place. . . ."

This quotation could not be omitted, though long, for it indicates that with open prairie abundantly available, the inhabitants went several miles to make a clearing. This illustrates the general rule that, in the tropics, primitive agriculture is always at the expense of forest so long as there is any forest available. Some of the country people who lived by herding a few cattle seemed to be wretchedly poor but the oxen were sleek and fat. Bates wrote (p. 224):

"The houses [of the herders] have no gardens or plantations near them. . . . In this country, grazing and planting are very rarely carried on together; for the people seem to have no notion of enclosing patches of ground for cultivation. . . . The belt of forest was intersected by numerous pathways leading from one settler's house to another."

(p. 230)"The forest in the valley is limited to a tract a few hundred yards in width on each side of the different streams. . . . My excursions to the Irura had always a picnic character. A few rude huts are scattered through the valley, but they are tenanted only for a few days in the year when their owners come to gather and roast the mandioca of their small clearings. . . . It was our custom to start soon after sunrise, when the walk over the campos was cool and pleasant. . . . A fine view is obtained of the country from the rising ground about half way across the waste. Thence to the bottom of the valley is a long, gentle, grassy slope, bare of trees. . . ."

My best hunting ground was a part of the valley sheltered on one side by a steep hill whose declivity, like the swampy valley beneath, was clothed with magnificent forest. We used to make our halt in a small cleared space We frequently fell in with an old Indian woman named Cecelia who had a small clearing in the woods."

Bates made a journey up the Tapajos and within a few miles of Altar do Chao the first little settlement beyond Santarem, had an opportunity to make the following note (p. 243):

"The people occupy themselves the greater part of the year with their small plantations of mandioca. All the heavy work, such as felling and burning the timber, planting and weeding, is done in the plantation of each family by a congregation of neighbors, which they call a pucherum: a similar custom to the 'bee' in the backwood settlements of North America. They make quite a holiday of each pucherum. When the invitation is issued, the family prepares a great quantity of fermented drink called in this part Taroba, from soaked mandioca cakes and porridge of Manicueira. This latter is a kind of sweet mandioca, very different from the Yuca of the Peruvians and Macasheira of the Brazilians (Manihot Aypi), having oblong juicy roots which become very sweet a few days after they are gathered. . . ."

Farther up the river and on the opposite side from Aveyros there proved to be fringing forest with prairie inland. Bates wrote (p. 254):

"The landing place lay a short distance within the mouth of a shady inlet, on whose banks, hidden amongst the dense woods, were the houses of a few Indian and mam-eluco settlers. The path to the cattle farm led first through a tract of swampy forest; it then ascended a slope and emerged on a fine sweep of prairie, varied with patches of timber. The wooded portion occupied the hollows where the soil was of a rich chocolate-brown colour and of a peaty nature. The higher, grassy, undulating parts of the campo had a lighter and more sandy soil."

Not far away, near Santa Cruz, Belt found (p.257):

"A narrow belt of wood runs behind the village; beyond this is an elevated barren campo with a clayey and gravelly soil. To the south, the coast country [of the broad river] is of a similar description; a succession of scantily wooded hills, bare grassy spaces, and richly timbered hollows. We traversed forest and campo in various directions. . . ."

One can hardly read these descriptions of the country through which the Tapajos flows without being convinced that here in the Amazon basin is natural edaphic grassland in locations where climatic conditions alone would determine the presence of forest. Natural tropical grassland occurs here as well as in the great central campo region of Matto Grosso, occupying areas of exceptionally sterile soil. The manioc plantations occupied clearings in tall forest, where, according to Bates, the soil was distinctly different.

Above Aneyros the distance to the last civilized settlement on the Tapajos, Itaituba (near Fordlandia of later days) beyond which the numerous falls and rapids began, was forty miles, and the country was described to Bates as being largely barren, sandy campos with ranges of naked or scantily wooded hills. He therefore chose the Cupari, an affluent, which ran through damper forest where the vegetation was more typically Amazonian. On this river, he visited a settlement of the industrious agricultural Manducuru Indians, who were just then at war with the Pararauates, a tribe of no fixed abode who had no plantations, and who had raided the plantings of maca-sheira, sweet potatoes and sugar cane of the Mundurucu. The latter received Bates hospitably. He reported that they produced surplus farinha from mandioca to the amount of 3,000 to 5,000 baskets of 60 pounds each, which was sold to traders from Santarem.

Bates and Wallace also collected around Ega near the mouth of the Rio Teffe, farther up the Amazon, in the sort of forest that we think of as typically "Amazonian". Here on one of his tramps, Bates wrote (p. 339):

"We walked about two miles along a well trodden pathway through high caäpoeira (second-growth forest). A large proportion of the trees were Melastomas, which bore a hairy yellow fruit, nearly as large and well flavoured as our gooseberry. . . . The path at length terminated at a plantation of mandioca, the largest I had yet seen since I left the neighborhood of Pará. There were probably ten acres of cleared land, and part of the ground was planted with Indian corn, water-melons, and sugar cane. . . . We crossed the forest from this place to another smaller clearing, and then walked, on our road home, through about two miles of caäpoeira of various ages, the sites of old plantations."

In this region the climatic conditions and the sparsity of population were such that clearings grew up to secondary forest instead of being transformed into artificial grassland.

Baudesson, Henry (1919) *Indo-China and its Primitive People*. Translated by E. Appleby Holt. With 48 illustrations from photographs, London: Hutchinson & Co. [1919].

Baudesson (p. 18) informs us that the principal industry of the Moi of Indo-China is the cultivation of rice by the slash-and-burn system. He says:

"The method adopted is unlike that of the Annamites of the plains. Instead of cultivating a rice-field by continuous irrigation, which produces three crops a year, the Moi wait until November, the end of the rainy season. They then clear a portion of the forest large enough to raise a crop for the entire population of the village. In April they set fire to the fallen trunks which the sun has dried. For several days these immense braziers and the crackling of the timbers can be heard for miles around. Finally the ground is covered with a layer of fine ashes, which are washed into the soil by the first rains. Then begins the sowing. Armed with a pointed stick the women hollow trenches in the soil and throw in the seed. The rains first and then the soil itself complete their work."

The photographs of graves, etc., indicate that the particular Moi of whom Baudesson writes have remarkably strong cultural affinity with the Indonesians. So, if he is right about the Moi planting in furrows instead of separate holes punched in the ground by the planting sticks, it marks a noteworthy difference in technique which might be a distinct improvement and indicate progress toward permanent land utilization, if planting in regular rows led to more weeding and cultivation.

Beard, John Stewart (1946) *The Natural Vegetation of Trinidad*. Oxford Forestry Memoirs, No. 20. Oxford (Clarendon Press) 1946. 152 pp., 46 figs., map.

Beard in this valuable monograph on the vegetation of Trinidad points out that the pre-Colombian (mostly Arawak) population was sparse and presumably confined to the coastal lands, where their settlements were few. He says (p. 21):

"It seems very doubtful whether their agriculture made much impression on the wilderness." In 1802 the lands which had been developed in accordance with the Spanish-colonial plantation system (although largely by French colonists) were only 10% of the total area. "The interior of the island was unexplored dense forest."

In spite of this early history it was a continuation of the primitive ancient type of shifting cultivation which was responsible for depletion of the forest. In 1797 Trinidad became a British Crown Colony. The negro slaves were freed in 1834, very largely took to the forest, to become squatters on Crown lands. By 1867 the land occupation situation had become so confused that the right of squatters to purchase at a nominal price lands actually occupied by them was recognized and the people became settled proprietors. To their number were added indentured Hindu laborers who elected to take land instead of a return passage to India when their contracts expired. As a result, 53% of the surface of Trinidad had gone to individual ownership by the end of 1938.

Since Crown lands had been cleared piecemeal without any regard to their suitability for permanent agriculture, much land had been cut over, planted for a brief period, and then abandoned. The aerial survey of 1938 indicated that a sixth of the area alienated to agriculture was in shifting cultivation and "semi-derelict crops," and another fifth was "non-productive". We find in Trinidad an interesting example of the partial reversion of former slaves and indentured laborers to a primitive type of land use.

As to fire Beard (p.23) says, without specifying the cause of the fires:

"Fires have occurred in the forests at intervals during years of severe drought. The most serious drought on record is that of 1869, when fires were very widespread, even in the rain forests of the Northern Range. It is difficult to assess the effect of such early fires. In 1912 there was extensive burning in the southern range, and fires were widespread in the south and centre of the island in 1926. The effects of the latter are still clearly visible."

Beard (p. 55), discussing special life-forms of plants, says of palms:

"Palms are rarely abundant in tall, dense forests where little light reaches the ground. . . . In more open forests, particularly where there has been a fire set by human agency, they may become abundant.

"Acrocomia ierensis characterizes bush on areas of shifting cultivation and is not known in natural forest except for the fringes of the Erin savanna. Burning is evidently the ruling factor in both cases. Maximiliana elegans may also become very abundant in burnt bush but occurs naturally on sandy soils and also the wetter acid clays in evergreen seasonal forest."

Beard (p. 57) says that in Trinidad:

"Natural forest is not a good indicator of soil values. . . Disturbed vegetation where there has been human interference has been shown to be much more closely related to soil type but no comprehensive study of secondary vegetation has yet been made."

Not admitting any connection between the chemical composition of the soil and the vegetation we find Beard quoting, with approval, the dictum of Hardy (1935) that "natural vegetation in the tropics is determined entirely by moisture relations and therefore the most that can be deduced for agricultural purposes is something of the physical character of the soil and general indications of habitat. A tall and luxuriant forest does not require a fertile soil to support it. Such forests, in fact, are frequently found on soils which are deficient in essential plant nutrients. Detailed studies carried out in the Southern Watershed Reserve failed to show, within one formation, any significant floristic changes as the soil changed from marl to noncalcareous clay and sand."

By way of comment, one can only wonder if the soil actually did change "from marl to noncalcareous clay and sand." After having passed the generalities, Beard himself, in discussing a particular plant association did not hesitate to say of differentiation within the Trichilia-Brosimum association: "The faciation is principally distinguished from the Bravaisia by substitution of arenophilous species for calcicole." Elsewhere (p.92) he says: "The frequently calcareous nature of the soil probably explains the abundance of Brosimum alicastrum and the former abundance of Cedrela mexicana, (now reduced by logging) these being two species which reach their optimum development on limestones."

There is a plant community which Beard (p. 70) calls the "Pentaclethra macroloba [and] Sabal faciation" in which the Sabal ("carat palm"), one of the dominants, is associated in the popular mind with agriculturally good soils. It is not impossible that renewed investigation may show that such areas may have been those anciently cultivated, burned over, and eventually occupied by savannah vegetation which has gone into the stage of palm forest, but this is a mere supposition of the reviewer. Beard says that the effect of human interference on this community is hard to assess, but in recent times there has been fire. Of ancient effects he says:

"Very little is known of the biotic factor, but there may have been some interference by the aborigines in pre-Columbian times. The only evidence is conjectural and provided by Cedrela mexicana (cedar). This tree finds

its optimum habitat on limestones, but is known to spring up as a second-growth weed in forest after fires and in yards and cultivations. Occasional very large old individuals are found in forest of this association, but it long puzzled observers that the species is nothing like so well represented among the younger age classes in natural forest, and seems, in fact, to be dying out. It was therefore thought possible that the old cedar sprang up in the second growth of abandoned aboriginal gardens. The Indians may have lived much as in Guiana today, a very thin population scattered in the forests, clearing occasional patches to cultivate cassava. One family plants on the average about 1 acre a year. No other signs of such activity have been detected in this type of forest, which belt transects have shown to be actually somewhat homogeneous. This theory is unlikely to have any foundation since the evidence is that the aborigines settled exclusively around the coasts."

About the last remark we may be certain that they did not. Inter-village warfare would have led the weaker groups to take refuge in the forest, where it is altogether unlikely that the early European visitors would have observed them. Related Indians extend all the way through South America clear through Brazil and into Paraguay.

In another type of forest (Trichilia-Brosimum association) Beard (p. 92) reports former abundance of Cedrela mexicana (now reduced by logging) with Brosimum Alicastrum much as in Central America. He says:

"The discovery of kitchen middens around the coast has led to the supposition of widespread shifting cultivation by aboriginals in pre-Columbian times, but there is no actual evidence. This theory is supported by observations in British Honduras that 'the more recent secondary growths contain Cedrela mexicana (cedar) and Brosimum alicastrum (breadnut) which is typical of secondary forest on calcareous soils' (Hardy et al., 1935) and that Brosimum alicastrum occurs on and around Maya ruins (Bartlett, 1936). . . . Of recent years, fires have frequently occurred in the forest, and there has been active logging for Cedrela and Chlorophora. . . One feels it unlikely that the aborigines chose this area for shifting cultivation since the lack of rainfall would imperil the crops; there has been experience of this of recent years with establishment of teak plantations in this area under a 'taungya' system with the aid of field crops." For discussion of the taungya system, see Brandis (1906).

One can only say that there are excellent milpas (clearings for shifting cultivation of maize) at places in the Petén district of Guatemala (near the ruins of

Uxactun and Tikal) where there was formerly a dense population, but now, in the dry season, not enough surface water for drinking. Beard (p. 135) has come to the conclusion that in Trinidad there is no such a thing as a climatic "savanna". His explanation is that the greater areas are maintained by fire but that certain ancient areas over sterile quartzite are edaphic. As he uses the term, he means "a short-grass community with or without scattered shrubs, on firm land and not in a low-lying swamp." He goes on to say (p. 135):

". . . Savanna is properly of natural origin, and the term excluded pastures and other grasslands due to man. In Trinidad, savannas which the evidence shows to be natural or partly so are found in certain quite small localized areas. There are the Aripo savannas in the marsh forest of the northern plain; the O'Meara, Mausica, and Piarco savannas farther west on the plain; the savanna on the mountain at St. Joseph, and the St. John and Erin savannas in the south."

Beard allows that grasses are rarely intermingled with Cyperaceae in the true savanna. In the very center of the Piarco savannah is the only place in Trinidad where Byrsonima verbascifolia is found, and with it the endemic Miconia savannarum and several endemic herbs, all affording evidence of very great antiquity for this plant association. He continues:

"In recent times, it is true, intensive burning has caused these savannas to expand somewhat towards the edges of the terraces on which they stand, and the probable former sharp transition to forest has disappeared. The expansion has taken place only on land marginal to savanna sites. . . .

". . . Fires do not occur on the Aripo savannas which are undeniably of natural origin and possess the richest and most endemic flora of any of the savannas. Transition to woodland is very abrupt. The savannas are bordered with palm-marsh merging into marsh forests, and there are palm-marsh 'islands' within the savannas.

"The mountain savanna at St. Joseph shows two very distinct types, the . . . Byrsonima-Curatella type . . . and the other the Myrcia-Roupala type, being sui generis, and appearing to resemble the Venezuelan hill savannas described by Pittier (1939)."

Regarding the man-made savannas Beard says (p. 138):

"There are other grasslands on the northern plain of Trinidad which differ essentially in floristic composition from the savannas described above, and are known

to have replaced forest during the last century as a result of repeated fires set by the shifting cultivator. . . . The dominant grass is always Imperata brasiliensis Trin. . . . Woody growth consists typically of an occasional fire-blackened Maximiliana elegans palm and scattered bushes or little trees -- most of which have sprouted from an old root-stock since the last fire. . . ."

"It cannot, certainly, be argued that the savannas of Trinidad are due to climatic causes. Their occurrence as small pockets in forest definitely precludes this explanation. The alternative theory that the savannas are due to fire demonstrably holds for the Imperata-Arundinella grasslands with Maximiliana palms and could possibly be applied to the St. Joseph and Piarco group of savannas: but the Aripo savannas defy a fire theory absolutely, and the Erin savannas could submit to it only with difficulty. The Aripo savannas have never been known to burn, and therefore, if fire had originally created them we should now expect them to be in a process of rapid reversion to forest, for which there is no evidence. The Erin savannas are periodically burned by fires which seldom or never penetrate the surrounding forest. Their borders are sharp, not a transitional zone of burned bush. The flora of all these savannas with its specialized and endemic elements is also against a recent origin from the burning of forest. It can be shown (Beard, 1945b) that the plains savannas occupy small fragmental remnants of an ancient land surface formerly similar to and coextensive with the llanos of Venezuela, but now almost entirely eroded away. . . ."

"In the case of the St. Joseph savanna the writer suggests that the Myrcia-Roupala type represents the primitive form, by analogy with Venezuela, and that intensive burning due to man's interference within the last two centuries has converted former areas of Myrcia-Roupala savannah and of forest into a different type of grassland. . . . The original occurrence of savanna may be attributed to the abnormally high proportion of quartzite in the parent rock. This mineral does not weather, and the result, after ages of differential weathering and erosion at this locality is a 'soil' consisting of a very shallow layer of quartz, grit and pebbles over impermeable bedrock. Soil conditions thus resemble in essential moisture relations those of the lowland savannas. The soil is without root room and is physiologically dry."

Why, in talking about quartzite, should anyone obscure his statement by such an expression as "physiologically dry". When quartzite is wet it is 100% wet, and when it is dry it is simply dry, not "physiologically" dry!

A frequent obfuscation of meaning is Beard's use of the term "deciduous seasonal forest". He means "seasonally deciduous", for a forest obviously is not seasonal. In general, however, he says what he wants to say without much jargon, and makes his point quite conclusively, that there is natural savanna in Trinidad which does not represent a "deflected climax", by which he means that it would stay savanna regardless of fire.

Begbie, P. J. (1834) The Malayan Peninsula, embracing its History, Manners and Customs of the Inhabitants, Politics, Natural History, etc. from its earliest Records. Printed for the Author at the Vepery Mission Press. 521 pp. † xix maps, charts, plates.

Begbie wrote of Ujung Salang (the Malayan name of which became corrupted to Junk Ceylon), an island off the west coast of the part of the Malay Peninsula then as now under Siamese rule, but then inhabited by Malays, that the inhabitants produced rice from flat fields (sawah) and rolling fields (ladang). The latter form of cultivation was the more laborious and less productive, but nevertheless, the more general. He said (p. 439):

"The brushwood of the spot, whereon the inhabitants purpose commencing a ladang, is first cut down, then the smaller trees, whilst those whose girth deters the laborer from the task of felling, are merely lopped of their branches. Two or three months afterwards, when the fallen forest has become dry and sapless, fire is applied to the mass which is thus consumed, with the exception of the larger stocks and stumps, which suffer only partially from the process. The ground is then cleared of the loose rubbish, and the sowing season, which always occurs in May, then commences. In this operation both sexes perform their part, the men preceding in lines with a stick in either hand, with which they make holes of two inches in depth, whilst the women follow in their footsteps with a bamboo measure containing the paddy, and drop three or four grains in each hole, closing them directly by a sharp tap of the bamboo.

"Vegetation being so luxuriant here, the field requires weeding a fortnight after the seed is sown . . . and much care is requisite in order to guard against the depredations of the numerous small birds, and the more sweeping devastation occasioned by the incursions of the wild elephants."

Bégué, Louis (1937) Contribution a l' Etude de la Végétation Forestière de la Haute-Côte d' Ivoire. Publications du Comité d'Etudes Historiques et Scientifiques d l'Afrique Occidentale Française. Ser. B, No. 4. Paris: Libraire Larose. 126 pp. + table of contents, 19 pl., map.

Bégué (1937) pointed out that although the total area of the Ivory Coast was nearly 470,000 square kilometers, only about 110,000 square kilometers at the south was forested: the entire north was covered by more or less wooded savannas. The latter, he concluded, were a replacement of primitive forest which had taken place through human agency. In spite of the publications of Professor Chevalier, there still remained skepticism about the artificial character of the Sénoufo or Mossi country. Bégué became convinced as a result of field observations from 1931 to 1935 that the savanna area in the vast majority of places seen were the result of human occupation.

As for the population of many tribes, all were Negro with the possible exception of the northernmost, the Peuhls, who might rate as white. They were few, and classified as pastoral. All of the black tribes were agricultural, and regardless of crop preference, lived by cutting and burning forest, which furnished enough ash to fertilize the soil for a more or less prolonged period. Depending upon rainfall and other circumstances there might be growth of secondary forest when the cultivated patches were abandoned, but the balance of factors favored the origin of new grassland, this tendency toward the supremacy of grass over trees increasing toward the north. Thus Bégué's map shows the remaining forest mostly to the southward of the line of 1300 mm. annual rainfall. The transition zone of least sparsely wooded savanna appeared to occupy land with as little as 1200 mm. of rain. To the northeastward toward the Niger the rainfall diminished to 800 mm. and less, and prairie became more and more treeless, but even there the evidence of vegetational remnants was generally sufficient to indicate that forest had preceded the present secondary types of vegetation.

Bégué mentions the belief that the Sahara was formerly forested and that climatic change has gradually brought about a retreat of the forest toward the south. The process in its earlier stages may have preceded the advent of man as an important modifying agent of the earth's face, but nevertheless, although inhabited by peoples who "know their annals not", the prehistory of man in Africa has been measured in scores or hundreds of millenia. Aurignacian man had already mastered the use of fire, and even if the settlement of the Ivory Coast, with its remnant of original forest, may have been achieved by some of the relatively more recent of the waves of migration, the event was nevertheless ancient as human history goes, and fire has accomplished the change

at an accelerated pace as population has increased and primitive forest has diminished.

Bégué mentions as vegetational vestiges the "sacred forests" near some of the village sites, preserved for superstitious reasons and giving evidence of what surrounding prairies were originally or previously like. He points out that fire is seldom able to penetrate old deciduous forest, although it is known to do so, with destructive effect, under certain conditions. It is man who destroys forest by felling or deadening in the first instance and who follows the initial destruction with fire, thus preventing recuperation. He concludes by quoting Lavauden (1935) to the effect that the ancients, having exploited the soil's fertility, abandoned their depleted fields to secondary vegetation, itself susceptible to fire, and that after two or three fires, nothing was left.

Behrmann, Walter (1917) Der Sepik (Kaiserin-Augusta-Fluss) und sein Stromgebiet. Geographischer Bericht der Kaiserin-Augusta-Fluss-Expedition 1912-1913 auf der Insel Neuguinea. Ergänzungsheft Nr. 12 der Mitteilungen aus den deutschen Schutzgebieten. Berlin: Ernst Siegfried Mittler und Sohn. 1917. vi + 100 pp., 9 pl., map.

Behrmann (1917) who mapped the course of Sepik R. after the visit of Schultze Jena, made a distinction between "grass swamp", of great extent for 300 kilometers as the crow flies and at its widest extent from the river perhaps 20 kilometers on one side and 15 on the other, and the alang-alang (*Imperata* grass) flats along tributary streams where his map showed no over-flow swamps. The greatest continuous stretch of alang-alang was along the "Dorfer" Fluss, (River of Villages) where it extended for some 85 kilometers, but was perhaps only up to 5 km. wide. Very great areas, however, were indicated on his map, not as forest flats, (Wald-Ebene), but as wide flats (Weite-Ebene), of unindicated vegetation. The only really inundation-free grasslands that Behrmann saw, however, were the narrow strips that he mentioned as alang-alang plains, which one infers to have been abandoned village lands.

Bertin, Andre Joseph (1920) Les Bois Coloniaux. Mise en valeur des forêts coloniales, sauvegarde de nos forêts de France. Paris: Emile Larose. 51 pp.

This is a reprint of an article which first appeared in the periodical "Colonies et Marine" for January, 1920. It dealt

with the French neglect of the forest resources of the tropical colonies, called for studies on the utilization of formerly un-commercial types of tropical trees, and demanded that such species be used, demanded that "forest exploitation" cease to be a synonym for "forest destruction", insisted that mere culling of valuable species be stopped, that definite and permanent areas be conserved as forest amounting to not less than forty percent of each colony.

He proposed a "dodecalogue" of forestry regulations for application to all colonies, following a precedent of 1912 established in the Ivory Coast, requiring such procedures as the following:

- (1) Classification of lands as free forests and forests under control.
- (2) Establishment of distinctions between first choice and inferior species.
- (3) Imposition of a tax for reforestation on the cutting of each first choice tree. Those species that had been designated in the Ivory Coast for example, had been five, acajou (Khaya ivorensis), acajou tiama (Entandrophragma), bossé (Trichillia cedrata), iroko (Chlorophora excelsa), and makoré (Dumoria Heckelii). For each tree of these the tax was ten francs, to assure replacement by the Forest Service. Such a list would be established for each area, which would require botanical surveys and identification of species.
- (4) Requirement that a certain minimum number of scattered seed trees of designated better species be left on each area cut over for timber.
- (5) Interdiction of cutting immature trees of choice species.
- (6) Regulation of shifting cultivation. This last is of greatest interest in the present connection.

The decree of 1912 for the Ivory Coast provided a precedent. It would restrict the exercise of right of usage of public forest by natives. Each village would have a right to use an area for gardens, plantations, and pasturage, equal to that actually occupied. Each time the census showed increase of a hundred persons the area would be enlarged by a hectare for each new inhabitant. Each displacement of cultivation would be allowed only after not less than four consecutive years of land utilization and after a new emplacement had been agreed to by the administrator of the "circle". Gardens and cultures would be transferable only three times to virgin land, after which a cycle of reuse of the fallow land would have to go into effect. A population which put an emplacement completely into use for permanent cultivation of palms, kola, cocoa, coffee, rubber, or other useful plants, as

attested by the circle administrator, would be entitled to a new allotment of virgin land. Natives would be forbidden to make clearings without having permits, and without special permission would not be allowed to cut first choice species or rubber-yielding trees or others reserved by order of Government.

In colonies already excessively deforested, such as Sénégal, Bertin advocated reforestation on a vast scale. If his proposed forest policy should be put into effect he predicted that France's colonies might become great producers of wood for export. Some of his suggestions were actually being given trial. Intervention of the State was absolutely essential to turn the tide from destruction of resources, with disastrous consequences, to production of a profitable surplus.

Bews, J. W. (1926) The Study of Forest Vegetation in South Africa. Chapter XVI (pp. 314-317), in: Tansley and Chipp (1926), q.v.

Bews studied instances in South Africa of the replacement of grassland by woody vegetation, sometimes by thorn-bush of the type which Bews calls tree-veld dominated by thorny species of Acacia and Gymnosporia, and sometimes by a semi-open type of savanna forest. He says (p. 316):

"The pioneers . . . are trees. Very few of the species are capable of growing up through the grassland and resisting the effects of the ever-recurring grass fires, especially during the first year or two of their growth. Some, however, . . . do succeed in establishing themselves. . . . The species which develop after the pioneer is established . . . are usually more mesophytic and are incapable by themselves of acting as pioneers. Ultimately the pioneer may be killed by the subsequent species. It is a common thing to find an old dead Acacia in the center of the clump, or the pioneer when dead may be entirely eaten out by termites, leaving the other species disposed in a characteristic ring. As more and more pioneers establish themselves and the clumps grow closer together the thorn-veld passes into a climax type of thorny and succulent scrub which is characteristic of many of the dry river valleys of eastern South Africa. In other parts the true veld succession differs considerably. Clumps are not so characteristic, but the pioneer trees, at first much scattered through the grass-veld, grow closer and closer together as their numbers increase, and the climax is a semiopen type of 'savannah forest' which covers much of the northern Transvaal, and, according to Henkel, over 64,000 square miles in Southern Rhodesia."

Bews, J. W. (1935) Human Ecology. London: Oxford University Press. xii + 312 pp.

Bews has an interesting chapter on "The Ecology of Plant Cultivators" in which he expresses the following conclusions:

(1) "There is good evidence for supposing that the cultivation of plants preceded the true domestication of animals, though the pig apparently was domesticated very early. It is worth noting in passing that the wild pig is not a grass-eating animal, but lives on roots, bulbs, tubers, corns, etc., the type of plant material most collected by the women of food-gathering peoples. While there must always be some uncertainty regarding the beginnings of plant cultivation, it is obvious that there is no great step from collecting plant roots to transplanting them and finally to cultivating them. Some of the food-gatherers, e.g., Western Australian aborigines and the Veddahs of Ceylon, after the women have dug up yams, replace the leafy portion or a portion of the root in the soil so that it may grow again."

Obviously Bews, best known as an authority on grasses, considered that cultivation of root-crops preceded that of annual grains.

(2) [Food growing] probably began under a tropical or subtropical environment. The earliest method pursued was cultivation by the hoe, and the process of cultivation was probably assisted by burning down the forest, so as to provide suitable garden sites -- the method still followed all over the equatorial regions of the globe. It has had profound results in changing the vegetation over enormous areas, and even in altering climate as well. It is specially applicable to regions where the natural climax vegetation is bush, jungle, or forest, but not to grassland regions, which, as we have seen, have only begun to be brought under cultivation in recent times. The soil, enriched by the ashes, is tilled as a garden, and crops are grown for two or three years in succession, until the soil becomes exhausted, when it is discovered that the process requires to be repeated on a new site. Brunhes (1920) has named it the 'forest devastation' method of plant cultivation."

Here there is striking contrast with Ames's exactly opposite conclusion, that agriculture originated in grassland. The reviewer accords with Bews, but believes that because the latter's experience was so largely in Africa where primitive agriculture has generally passed from the digging-stick phase to the hoe phase, that he has confused two or three distinctly different stages that must have been passed through. Bews himself emphasized the use of the digging stick by a food-gathering people, the Bushmen, and suggested that it became the first agricultural implement -- therefore that it preceded the hoe.

(3) "The next stage involves distinctly improved methods and therefore, we may suppose, came later. . . . It is confined to the great river valleys and to their tributaries, and can be

seen in operation today, in its simplest form, in the valley of the Zambesi, where advantage is taken of the natural irrigation due to seasonal floods, when the river overflows its banks and extensive areas are inundated. As soon as the river subsides, the natives plant their crops in the mud all along the river's banks. . . . This is the type of plant cultivation which was developed, along all the great rivers from the Nile to the Indus and beyond, to China, at the dawn of civilization, about which so much has been written. By the time it came fully into operation cereal crops were probably being cultivated, and grain cultivation, as we have indicated, is not so simple nor so primitive as the planting of roots in gardens."

Bews follows the sentences just quoted with considerable interesting detail about various African small grains which are often all called 'millets' by travellers.

(4) Next Bews discusses the stage of agriculture in which natural overflow irrigation is controlled by dams and ditches.

(5) Finally we have, as the culmination of 'lower' agriculture and its passage to the 'higher', terrace cultivation.

"Hocart (1933) has pointed out that this method is pursued in the cultivation of the taro, a root, and that the obvious inference would seem to be that this form of irrigation is older than grain, though he adds that it is just possible that a grain-growing people introduced irrigation into the South Seas without the grain. He also points out that for rice (with the exception of 'hill-paddy') careful irrigation is a necessity, and its cultivation could only follow, therefore, on a very long experience of irrigation."

(6) "The next great step in the cultivation of plants took place when the assistance of domestic animals was made use of, and the hoe gave way to the plough. This marked the passage from the so-called 'lower agriculture' to the 'higher', though the former would be better designated horticulture since it was the garden rather than the field which was tilled. Plough agriculture, though it developed early in Asia, Europe, and North Africa, has not until very recent times, and as a result of European colonization, been extended to other parts of the world. Among the Negro or Bantu races of Africa, except in Basutoland, it is hardly practiced even to this day."

It is tempting to make such a simple evolutionary scheme as that of Bews, but there are many difficulties. Cultural borrowings have enabled stages to be skipped. There have been independent origins of the same improvements. Doubtless tools and techniques have been passed from one people to another with almost immediate modification, or crops have been acquired without the transmission of special techniques. Nevertheless a scheme clarifies thinking.

Mention has been made of the digging stick as a more primitive tool than the hoe. It is found among the Bushmen, whose chief food supply was formerly gained by hunting, but who were also gatherers of whatever could be eaten, whether animal or vegetable. Bews says (p. 169):

"In more recent times as game has become scarcer and the white man's game laws have to be obeyed, the Bushmen have come to rely more and more upon such sources of food as tubers and roots. The plants are dug up by means of the 'Kibi' or digging stick which is also used for digging pitfalls for game. If the surface of the ground is hard the kibi is weighted by being passed through a round perforated stone or "Tikoe".

Bickmore, Albert S. (1869) *Travels in the East Indian Archipelago*. New York (D. Appleton and Company). 553 pp., 2 maps, 36 pl.

In the book of American traveller Bickmore (p. 77) there is a sentence that reminds one of the ancient narrative of Hanno, the Carthaginian. Passing the eastern end of Java by ship, he wrote: "In the evening, fires appeared on the hills near the sea. This was the last we saw of Java. . ."

Near Kayeli on the island of Buru in the Moluccas, Bickmore (p. 264) described tobacco cultivation by the natives as follows:

"Their ladangs, or gardens, are merely places of an acre or less, where the thick forest has been partially destroyed by fire, and the seed is sown in the irregular spaces between the stumps."

On the eastern side of the Bay of Kayeli, the same island he described the fire-resistant cajuput trees (Melaleuca Leucodendron), a forest relic in the grass plains, as follows:

"The fires which rage here, year after year, destroy much of the thick forest, and a tall, coarse grass takes its place. In these prairies grow many kayu-puti, or whitewood trees, so called from their bark, which makes them resemble our white birches. Their branches are very scattering, and bear long, narrow leaves, somewhat like those of our willow, which are gathered about this time of year for the sake of their "oil".

The same author (1869, p. 291) said:

"The natives [of Buru] are accustomed now, during the dry monsoon, to burn the prairie lands, partly in order that new, sweet grass may spring up, and that when the deer come out of the forests to eat it they will be fully exposed to the rifles, and partly, as

they say, to induce them to come out to lick up the ashes."

Bickmore visited the Mandeling valley of the Batak lands of Sumatra in 1866, and described the country reached from Rau in northern Padang, just across the Padang border, as follows (p. 419):

"We now turned to the northwest and began to descend into another valley, that of Mandeling. Here the mountains are quite devoid of forests, and only covered with a tall, rank, useless grass, the Andropogon caricosum. . . ."

At a Lubu settlement in the bottom of the valley, he reported:

"The many fires now raging in the tall grass that covers the lower flanks of the mountains have so filled the air with smoke, that when the sun had sunk behind the serrated crest of the Barizan [Barisan] the whole horizon for twenty degrees and to a considerable height was lighted up with one unvarying golden glow. . . . As the daylight faded, the fires in the tall grass on the hill-sides became more distinct, sometimes advancing in a broad continuous band, and sometimes breaking up into an irregular beaded line."

The region thus described is at the southern edge of the Batak lands not far from the equator. Bickmore was within a day's march from Rao, 0° 34' N., now (or at least before the war) on a good highway.

Bompas, Cecil Henry (1909) *Folklore of the Santal Parganas*. London (David Nutt) 483 pp.

Among the numerous castes of old India it was not strange that many aboriginal tribes remained unassimilated to the Hindu social system. An interesting and highly peculiar group were the Santali, occupying a district of about 4800 square miles on the eastern outskirts of the Chutia Nagpore plateau about 150 miles north of Calcutta. In 1909 they comprised only a third of the population of their area. Their folklore (p. 170) indicates that they were beef-eaters. Divided into exogamous septs and speaking an agglutinative language (in both respects like the Batak of North Sumatra) they have been grouped as one of the Munda tribes, which, like the Mundas and the Hos, are supposed to have entered India from the northeast. They are animists, worshipping ancestral and wild spirits called bonga. Bompas (p. 5) tells us that every hill, tree, or rock may have its spirit, and that a spirit dwells in the patch of primaeval forest preserved in each village. Aside from preserving sacred groves, they were great destroyers of forest and, although the

tales recorded by Bompas show that they had advanced to the use of the plough and to permanent cultivation of the land, at least one of the stories (p. 56) recalls the preparation of typical isolated forest clearings by felling and burning.

Bor, N. L. (1938a) A List of the Grasses of Assam. Indian Forest Records (New Series) Botany. Vol. I, No. 3, pp. [vi + ii +] 47-102, illust. Delhi: Government of India Press. Nov. 1938.

In the introduction to this monograph Bor indicates that the climax vegetation of the whole province is for the most part a tall forest of evergreen trees. He says:

"Even in Nowgong which possesses a microclimate of its own, characterized by a very small rainfall, a forest of deciduous trees seems to be the climax.

"From very early days, however, a large portion of the plains has been covered by a savannah of tall coarse grasses. These vast tracts of grassland are the natural home of rhinoceros and herds of wild buffalo, animals known since the earliest days, neither of which are forest dwellers. The grasslands may be assumed to have arisen partly as a result of the pastoral and agricultural pursuits of the early nomadic inhabitants, and partly owing to the vagaries of alluvial rivers. They are maintained in their present state mainly through the agency of fire. Experience all the world over has shown that grassland, which has arisen owing to the destruction of a forest, can be maintained almost indefinitely in that state by fire and grazing even in a forest climate.

Many of these savannahs are doomed to disappearance as settlement increases, and very rapidly if settlement increases at its present rate. Many will remember the vast area of grass on the southern bank of the Brahmaputra in Nowgong. At the present time this has completely vanished and its place taken by the prosperous looking fields and homesteads of the Mohammedan immigrant.

... (p.48) "As the population increases so do the cattle, and the provision of fodder for the latter is a very big problem. The degeneration of tall grass to short turf, and of the latter to noxious weeds, is a very common and easily explained phenomenon. This change is inevitable with overgrazing and cannot be avoided by the introduction of palatable, fast growing and deep-rooted exotics. The changes in a habitat subjected to overgrazing are of such a nature that only those grasses which are specially adapted to these particular conditions can survive."

By way of comment on Bor's suggestion that forest was not an appropriate habitat for the buffalo one may suggest that it depended mainly upon the existence of marsh and periodically flooded

lands along the ever fluctuating streams. He lends support to this conclusion in the following paragraph (p. 50) regarding standing water and marshes:

"Oryza sativa var. fatua, the wild rice, is often to be found in places where the water reaches a depth of two to three feet. Associated with it may be found Sacciolepis interrupta, Vassia cuspedata, and Leersia hexandra. Such an assemblage of plants provides rich feeding for cattle, buffalo, and elephant."

Speaking of xerophytic grasslands, Bor says (p. 51):

"Very large areas of such habitats are to be found in the Assam valley but their covering of tall coarse grasses is steadily going down before the settler and his domestic animals. This type of grassland may still be found in its full luxuriance in the game sanctuaries of the province.

"The typical savannah of the uplands consists almost entirely of Imperata cylindrica but associated with it are to be found other andropogoneus grasses. . . . All these grasses are coarse and . . . not very attractive to cattle. The new shoots, however, which appear after the annual fires have passed, are tender and are greedily browsed by game and domestic animals."

Regarding subtropical grasslands farther north, Bor says (p. 52):

"There are large tracts of rolling grassland in the Khasi and Jaintia Hills as well as in the Naga Hills and Manipur. There can be little doubt that these areas have arisen as the result of shifting cultivation in the past and are maintained in their present condition through the agency of fire. As far as the Khasi and Jaintia Hills are concerned, the grassland must be well over one hundred years old, as will be clear from a perusal of Griffith's journal and a glance at the plates it contains. This grassland is not, however, a climax, a fact which can readily be realized from a study of the vegetation of the hills. Fire and grazing combine to keep these areas stable and prevent any advance to the forest or climax type."

Bor has an interesting note on the probable increase in abundance of a rare grass, Hyparrhenia Griffithii, of which Griffith () collected the first specimen. Since then it may have spread 25 miles. Bor says (p. 53):

"At the present time there are square miles of this grass just north of Nartlung, and an able collector like Griffith could not have failed to notice it, had it been as common then as it is today. That its spread is due to the senseless destruction of forest accompanied by intensive grazing is scarcely open to doubt."

Bor, N. L. (1938b) A Sketch of the Vegetation of the Aka Hills, Assam. A Synecological Study. Indian Forest Records, Vol. I, No. 4, pp. [ix +] 103-221, 22 pl., map. Delhi: Government of India Press. Nov. 1938.

The Aka Hills of Assam are technically out of bounds for this review, which applies to the tropics, for they lie between 26° 45' and 28° N. The province is partly tropical, however, and Bor gives one of the clearest statements that has been encountered in the literature examined of how the type of grassland generally characteristic of human activity can originate naturally. The question is not infrequently asked: "How do tropical grasslands come to have such characteristic associations over great areas if in some of the moist tropical regions there are no natural grasslands? The answer is that there have always been some natural grasslands, even if in rather distant places. Bor discusses one important factor which would be as operative south of the Tropic as north, as follows (p. 193):

"As has been remarked above, the natural soil covering of the plains is closed forest but very large areas in the plains are found to be almost, or quite, devoid of trees and to support only a covering of grass. It is extremely probable that clearings for human habitation are responsible for part of this area but there is another way in which closed forest can be destroyed and replaced by grass.

"The rivers to the west of the Borelli, namely the Gaharu, Belsiri, Sapai and others have their origin in the foothills where very heavy precipitation takes place. Owing to the alluvial nature of the soil in the plains they are without any definite beds and the rivers continually swing backwards and forwards. It often happens that as a result of heavy rainfall in the hills, these rivers continually swing backwards and forwards. It often happens that as a result of heavy rainfall in the hills, these rivers rise rapidly and carry down enormous quantities of clay and silt. Should it happen that the spate is of exceptional duration and volume, the rivers rise above their so-called banks and flow over the adjoining country. When this happens in evergreen forest a deposit of clay and silt is laid down in the forest. . . . In the following year in an evergreen forest most of the tall trees and all of the shrubs will have died. The trees that are left soon disappear owing to the attacks of fungi and insects. This phenomenon is quite common and is responsible for the destruction of the forest over large areas in the plains close to the foothills. Grassland is the inevitable result of destruction of the forest adjoining grassland. Bare areas, however created are rapidly covered with grass."

Bor distinguished "high savannah" (with the grasses *Imperata*, *Saccharum* and *Themeda*) from "low savannah" (with *Alpinia*, a genus of the ginger family, with the coarse grasses *Phragmites* and *Saccharum*), the low type being more often flooded, and under water for longer periods. (It doubtless has a counterpart in New Guinea: see .)

Bor also discusses the primitive type of agricultural clearing known in Assam as jhum, the name of which would seem to be cognate with djuma of the Sumatran Batak, discussed elsewhere. Since his remarks would be as pertinent to the part of Assam below the Tropic as above, and because word and process may have gone into the islands from this part of Asia, his observations may be quoted as follows:

(p. 109) "Both Rupraigya and Shergya [the two chief villages of the Mönba people] have permanent fields of poor lime-stone soil, from which they take crops of Indian corn, oats, barley, murwa, chillies, and a kind of high altitude rice. Higher up the hillside, from 2,000 to 2,500 m., the slopes are jhumed and Job's Tears are grown. The trees are felled early in the year, and when dry the branches and refuse are burned. At the break of the rains seeds are dibbled in. The jhuming is not extensive but the hill sides are being gradually denuded of forests."

Turning to another branch of the Mönba people, Bor continues (p. 109):

". . . . the Sherdukpen never considers what his forests actually mean to him the annual burning of his forest leaves him quite unmoved and he cannot imagine a day when the forest may be there no longer; anyway he imagines that if such an eventuality came to pass the lamas would surely do something about it."

. . . . (p. 110) "To the east of the Sherdukpen country further down the Tenga valley are found two tribes, the Akas and the Khoas. . . . The method of cultivation is jhuming and the hill-sides around their villages have long since lost their covering of primeval forest and are covered with poor secondary growth. . . ."

"The Bhorelli [River] divides the Akas on the west from the Daflas on to the east. . . . Their method of cultivation is jhuming pure and simple."

Concluding his paper Bor says (p. 123):

"There is little that is good that can be said for Man in his relations with the forest. One frequently finds the bark of trees, on both sides of a well used forest path seamed and cicatrized from the numerous wounds inflicted by the daos [chopping knives] of the passers-by. What is the urge that impels a man wantonly to try out the edge of his dao on the bark of the trees he passes? Is it some form of self expression or does he consider trees his enemies? One would certainly think so from the results of his work, and anyone who has lived in Assam and seen the destruction wrought by Man cannot think of him as other than a ruthless and unthinking destroyer of vegetation.

"The benefits that Man confers upon natural vegetation are very meagre, but as an agent of destruction he is unparalleled. Perhaps the most noxious of all the practices initiated by Man is that of jhuming. . . . The southeast, south or southwest aspects [of the hills] are usually chosen, and all trees, even the largest, are cut down in the cold weather. During the hot period of the year the debris is set alight at the lowest part of the jhum; the rising flames cause an upward draught and the fire rushes up the hill to the accompaniment of a terrific crackling roar and immense volume of smoke. When all is over nothing is left but the charred and blackened trunks of the largest trees. As soon as the embers have cooled down, various seeds such as rice, millet, Job's tears, pumpkins, and melons are dibbled into the earth with the ashes. . . . Next year and the following year the field is cultivated and then when the accumulated fertility of the soil has become exhausted, mainly through exposure and erosion, the area is abandoned.

. . . . (p.125)"In a climate such as has been described the natural covering of the soil is high evergreen forest. Even in areas where the evergreen forest has been destroyed and replaced by grassland the tendency is, whether fire is a factor or not, for the grass to be replaced by a deciduous forest as a preliminary to farther advance.

"The effect of fire is serious in the Tenga valley which has a small rainfall and where the climax vegetation is pine and oak forest. Here annual fires are preventing the natural regeneration of the pine and assisting erosion of the steep hill slopes by removing the covering of vegetation. It may be interesting to state here that there is a tribe further to the east, the Apa Tanangs, which take the greatest pains to fire-protect their pine forest, and so insure a future supply of this timber.

"Fire and its effects are inevitably linked with the activities of Man and there can be little ground, so far as Assam is concerned, for the theory that lightning is often responsible for the annual fires. In the hot weather when storms are frequent, lightning is accompanied by such torrential downpours that it is extremely unlikely that grass jungle could be set alight."

Bor has an interesting discussion of the various concepts that have been held of "climax" vegetation, and of why he does not consider certain long-established plant associations as climax so long as disturbing factors will presumably never allow reestablishment of original climax conditions. From the standpoint of ethnology one of the points that he stresses has seemed to the present reviewer to be extremely important, namely, the preservation of vestigial natural or, seminatural areas, for religious or superstitious reasons, from which seeding of the adjacent land may take place through a series of successional phases of approach to a climax. Too often ecological writers seem to imply, very unconvincingly, that successional vegetational stages may follow one another almost by some process as remote from reality as spontaneous

generation, with only the most casual concern about where seeds are to come from. Bor (p.130) has tried to meet this illogical gap in ecological thinking, and we may quote as follows:

"With regard to the biotic climax brought about by biotic agencies such as human activity, firing, grazing, and so on (Tansley's allogenic factors) there is no doubt that they may lead to a community of vegetation which is stable for a very long time. The classic example of such a biotic climax, in so far as Assam is concerned, is to be found in the Khasi Hills. The casual visitor to Shillong for the last 20 miles of his journey, between 1000 and 1500 m., passes through rolling country covered with grassland and scattered pines. From 1500m. to 2200m. the principal tree is Pinus khasya. If he took the trouble to read Griffith's Journals he would find that there has been little or no change for 100 years. Hence he would be inclined to think that climax vegetation of the Khasi Hills is pine forest. The investigator, however, would certainly note that the undergrowth in a fire-protected Government pine forest is evergreen and that no pine seedlings are found within it, whereas that of the unprotected forest is grass with little or no shrubby undergrowth and with numerous pine seedlings. This observation would lead to the conviction that the continuance of the pine forest is the result of fire and that it is not the climax forest in the sense of Clements. It is stable over a very long period of time and is the biotic climax of other investigators.

"At this stage an intelligent student of vegetation would almost certainly say 'Where and of what is this hypothetical climax composed?'

"Fortunately for the ecologist the answer is easy. The Khasis were, in times gone by, and many of them still are, animists; that is, they believed that the phenomena of nature and also their very lives were controlled by spirits, evil and good. The abode of these spirits is supposed to be in thick gloomy forest. Hence patches of such forest have been preserved untouched for many hundreds of years; no tree is cut, no cattle grazed, no fire lit or flowers picked. These relicts are often surrounded by pine forests but they themselves contain no pine seedlings or trees and consist principally of oaks, lauraceous or magnoliaceous species, all of which regenerate themselves with ease. The undergrowth, too, is very rich and consists of many species that may be found in fire-protected pure pine forest. One can proceed to the conclusion that the relict will endure indefinitely if Man and his activities are excluded and that also the pine forest too will exist indefinitely as long as it is fired. But is Man a natural component of the biome or bio-ecological unit? Many of us believe not, but if Man and his activities be accepted then the biotic climax must be accepted too.

"The grasslands of the Khasi Hills, in addition to fire, are subjected to grazing and have remained unchanged for a long

time. Here, too, is a so-called biotic climax but of a very different status from that of the pine forest."

Bor, N. L. (1941) Common Grasses of the United Provinces. Indian Forest Records, n.s., Botany, Vol. II, No. 1, pp. vii+222, 28 Apr. 1941. New Delhi: Government of India Press.

Discussing especially the grasslands of the United Provinces but also of India in general in relation to fire and their persistence through centuries, even though not a climax association, Bor says (pp.5,6):

"The number of grasses which will stand burning and continual heavy grazing is surprisingly few. The only ones in India that come to mind are Chrysopogon aciculatus, Imperata cylindrica and perhaps Bothriochloa pertusa. Prolonged continual and heavy grazing can even annihilate these grasses.

"Broadly speaking a favourable climate for the development of grassland as a climax unit would be the following. Frequent precipitation of rain, even if the amount is small, sufficient to keep the upper layers of the soil moist during the vegetative period and sufficient warmth during the growing season.

"These demands upon the climate are very modest and something more generous is to be expected everywhere in the United Provinces. As a more generous climate ultimately leads to the development of a life form higher than that of grass it will be seen that the security of tenure of grass, as a stable vegetational unit, is placed on a very precarious basis.

"Precarious though that tenure may be, the stability of grassland over long periods is very well known in India even in the wettest of climates. Factors which aid the grass in a forest climate against the forest may be of two kinds; edaphic and biotic.

"Edaphic factors favourable to the development of grassland rather than forest in a forest climate are usually only transitory. Such soils temporarily reproduce the conditions of a grassland climate usually because of their physical characters* Trees cannot

*For example a sand bank thrown up by a retreating flood will be covered by xerophilous vegetation no matter what the climate will be. It is a micro-habitat with very dry characteristics.

colonise deep drifts of sand because the water supply in the upper layers is not sufficient for the growth and development of the

seedling. Grasses can, however, and do colonise such places but they contribute to their own undoing by adding humus to the soil and making it more retentive of moisture. When this stage is reached tree species can germinate and develop, deriving enough moisture from the upper layers of the soil until they can send down their tap roots to the permanent underground water supply. Once this stage is reached the grass colonist is ejected or weakened through shade.

"Turning now to biotic factors, it is a well-known fact that grassland is fired every year. To this factor is also added that of grazing.

"Fire alone or fire and grazing combined are very potent factors in keeping grassland stable in a forest climate. The number of trees which will stand fire is small and even they, in years of exceptional drought which makes the grass drier than usual, are burnt to the ground. Therefore, as long as fire is a factor to be contended with the transformation of the grassland into a forest is extremely problematical and uncertain.

"If grassland has been in possession of its territory for a number of years it is very difficult for the forest growth to oust it even if the fire factor be absent. Owing to the heavy growth of grass and root competition, forest can only effectively advance from the forest margin. This must necessarily be a very slow process."

Bor, N. L. (1942) The Relict Vegetation of the Shillong Plateau, Assam. Indian Forest Records, n.s., Botany, Vol. III, No. 6, pp. 152-195. New Delhi: Government of India Press. 6 Jan. 1942.

Remarkably interesting from two standpoints, (1) because it includes one of the very best accounts that we have for the preservation of bits of old vegetation in sacred groves, and (2) because it deals with the evolution in India of a form of agriculture analogous to the chitemene system of tropical Africa, is Bor's account of the shifting cultivation of the Khassi in Assam, which follows,

(p.157) "The inhabitants of the plateau are of Mongolian stock and have maintained themselves intact for many centuries. Their speech has Mon-Khmer affinities and is connected with that of such widely separated peoples as the Santhals, Annamese and Cambodians.

"The Khasis are by nature shifting cultivators. Shifting cultivation, or "jhuming" as it is known in Assam, is a practice common to all hill tribes living in the Province at the present day and is in itself a "relict" from the early days when the human race ceased to live by hunting and discovered the secret of raising grain and root crops.

(p. 158) It is the most wasteful of all forms of cultivation and while it did little harm in the dim distant ages when the number of individuals was small and areas of forest large, it is a very different tale when the cultivators live in stationary settlements and their number continue to increase.

"What one may call "saturation point" has now been reached by most of the hill tribes and one of their most urgent problems is that of the exhausted soil which must produce more at more frequent intervals. Some tribes solve this question by having permanent fields which they can irrigate, others manure their fields while the Khasis go to the trouble of growing forests which can be cut down and the area occupied by them cultivated.

"As all the wooded areas composed of evergreen species are either sacred groves or are situated in places unfit for cultivation, the areas selected for cultivation are those covered with pine forest (Pinus insularis). Roughly speaking, the procedure is to fell the pine trees, leaving a few seed-bearers here and there, and after the timber has been disposed of, the slash is burned and the area cultivated for two years. After this the field is abandoned but is fire protected. A pine forest then arises from the seed shed by the seed-bearers.

"Since the introduction of the potato in 1830, the cultivation of this tuber has made amazing strides and large areas are annually given over to its production. As the pine forest is not enough to meet the demands made upon it the Khasi farmer has evolved the following technique for adding nourishment to the impoverished soil.

"The field is laid out in beds six feet long by three feet broad separated from one another by about their own width. The beds are dug up and overlaid with boughs from the nearest pine wood. A strip of earth 2 inches thick or more is skinned from the space between the beds and laid on top of the boughs. When the boughs and twigs are really dry they are set alight and after they have burned out the earth is mixed with the ashes and the seed potatoes put in. In the following year the intervening spaces become the beds and so on.

(p. 159) "For many years past there has been considerable immigration into the Khasi Hills. Nepalis graziers are encouraged by the independant Siems for the revenue they bring and they are undoubtedly responsible for the devastation of forest over very large areas. In areas which were covered with forest a century ago, nothing but grassland remains, and on the whole it is very poor grassland. This grassland is composed of rather coarse species and it is fired by the graziers as soon as it is dry enough in order to obtain the new flush which is eaten by cattle. Under treatment of this kind grassland degenerates rapidly and loss of soil by erosion is very considerable.

THE SACRED GROVES OF THE KHASIS.

"The Imperial Gazetteer of India XV, 255 (1908) states with reference to the vegetation of the Khasi and Jaintia Hills: "At an elevation of 3,000 feet the indigenous pine (*Pinus khasya*) predominates over all other vegetation, and forms almost pure pine forests. The highest peaks are clothed with clumps of oak, chestnut, magnolia, beech and other trees, which superstition has preserved from the axe of the wood cutter".

"The above extract was written over 30 years ago and fortunately for students of plant life, superstition, or as some would have it, the grand old custom of the country, still preserves these clumps of evergreen forest. On the other hand, missionaries have been at work in these hills now for many years and the so-called superstition has begun to wane. It has always been a matter of great regret to me that the spread of Christianity in the hills tends to involve the complete destruction of all that is most interesting in the lives and customs of primitive peoples. It seems impossible to convert them to a new religion without divorcing them completely from all their customs, innocent and bad alike.

(p. 160) "The converted Khasi thinks it is a splendid thing to go into a sacred grove and cut a tree in order to defy the Gods of his fathers and to show his pagan brothers that their beliefs are all wrong. He does not realise, and his instructors do not realise, that the frequent result of such conduct is that the pagans grow up without any beliefs at all.

"The Khasi attitude of mind being what it is, it is unreasonable to expect that the sacred groves will last forever. With their disappearance goes the last remnants of the climax forests of the Khasi HILLS.

"The sacred grove on the northern aspect of the so-called Shillong peak is said to be inhabited by a spirit, Lei Shillong, who has given his name to the hill and to the town below.

(p. 161) "The sacrificial place at Law Lyngdoh, Mawphlang, is inside the grove and is marked by a number of menhirs. Pine trees have been planted round these menhirs and are of large size. They are the only pine trees in the evergreen forest and there are no seedlings beneath them.

(p. 162) "Belief in sacred groves is, or used to be, a very potent factor in the preservation of patches of evergreen forest in the Khasi Hills, and to this belief do we owe the remains of the ancient covering of vegetation which has now almost disappeared."

The mythology related by Bor in connection with the sacred groves is exceedingly interesting and should be looked up by ethnologically inclined readers.

Bornhardt, W. (1900) Zur Oberflachen-gestaltung und Geologie Deutsch-Ostafrikas. Ergebnisse der . . . in den Jahren 1895-1897 in Ostafrika unternommenen Reisen . . . , Berlin, D. Reimer, 1900. xv + 595 pp., figs., 27 pl., 11 maps + xix pp., index.

Bornhardt (1900) is quoted by Busse (1908) as indicating that in the former German East Africa burning over of light steppe-forest had little effect on the vegetation because the grass was too sparse for the fire to kill the trees. This would be true, Busse granted, in places where the grass was little developed. Elsewhere it would not be true, as Bornhardt himself said. It would appear that on the desert side of the grass prairie fire would have least effect, whereas on the forest side, where grass would be luxuriant and dried stems would provide much fuel, the effect would be very great.

Botha, C. Graham (1924) Note on early veld burning in the Cape Colony. S. African Journ. Sci., Vol. XXVII, pp. 351-352.

Botha, Chief Archivist for the Union of South Africa, contributed to the Cape Town symposium on veld burning a historical review of the subject which began with Kolbe, who said in his *Beschryving van de Kaap de Goede Hoop* (1727) that the Cape farmers took over the practice from the Hottentots. The public Archives indicate that laws against veld burning preceded 1687. In that year an uncontrolled fire destroyed a great quantity of stored grain, and a new law established scourging as the penalty for a first offence and death by hanging for the second. No attention was paid to the law, which was reenacted in 1740 and 1741. It was a dead letter, probably always, and certainly by the time the British assumed administration in 1806.

Boucabeille, Lieut. (1897) De Tananarive à Diégo-Suarez. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. 2, No. 8, pp. 93-112; No. 9, pp. 187-214; No. 10, pp. 273-299. Tananarive: Imprimerie officielle, June-Aug. 1897.

This is an excellent example of a general type of geographical reconnaissance which gives data that would have helped later botanists in vegetational mapping. Some of Boucabeille's observations follow..

(p. 94, 95) All that remains now of the lake of Alaotra is an insignificant remnant of an immense ancient lake which covered all of the high valley of the Mangoro, of the Mahajamba, and of the Maningoro. A poor vegetation covers the denuded steppes, where

not a tree obscures the view. A few rivulets, tributaries of the Mangoro and Alaota intercept the plain in beds ten or fifteen meters below the general level, disclosing a bit of verdure and the poor trees which border them. The closer one comes to the lake the larger and more extended are the marshes.

Ambatondrazaka, capital of the Silanaka country dominates the marshland which, all around the lake, has been converted into rice fields of considerable extent. To the east are hills, which, five or six kilometers away are perhaps 300 meters above the lake level. To the west great marshes attest the shrinking area of the lake.

(p. 95) North of Ivohitraivo is again a plateau, with immense views, arid and desert. In this region is the remarkable lacustrine depression of Anosimbohangy. Farther to the north the desert recommences. Here and there are poor clumps of trees, and everywhere the torrents have made deep ravines.

(p. 96) Before arriving at Ampatakamaroreny they came within the limit of the dying forest, the route traversed the last clumps of trees, surrounded by a poor brush, and only the bottoms of the ravines presented luxuriant vegetation. To the northward of the villages of this area, where the forest remnant was still being devastated by clearings, was geographic chaos, -- no trace of the mountain chain which geographers had insisted to that date on placing there. Still proceeding northward and passing the ancient lacustrine depressions, he reported arid country with some mountain crests forested, but visible to the eastward the beginning of the eastern forest which extended, at its northern end, clear to the Indian Ocean. To the north the mountain masses of Lohanimaivarano and Amboro were forested, and the forest followed the ramifications of the ridges westward, to die out, as the ridges did, toward the channel of Mozambique.

(p. 99) The chains or mountain masses forming the western boundary of the ancient lacustrine depressions were described by Boucabeille as somewhat arid, with nude rock areas, with some intact but small mountain crest forests of very dense character. These are hard to traverse but do not interpose the obstacle to travel that the deep steep ravines do. Every trace of human habitation disappeared during the traverse of the mountain massif, -- only within a day's march of the forest edge were rubber gatherers to be found. Where the rivers flow out of their gorges the land begins to be populated. The plains are there habitable and fertile, and one finds wet rice fields, cotton culture, cattle raising, etc. The country approaching Diego-Suarez is a jumble of minor physiographic details in which it is impossible to see dominant features.

One gets the impression from Boucabeille's account that much of the arid country west of Diego Suarez was not, in his

day, used for grazing. He met no inhabitants and apparently saw no cattle through a considerable distance. Moreover, the deep steep sided ravines with green vegetation and streams would interpose barriers to the passage of prairie fires, even if the vegetation were dense enough to carry them. One is confirmed in a strong suspicion, amounting almost to a conviction, that aridity and deforestation have been in process of extension not entirely since man, fire, and cattle have been effective agents of destruction, but that a long swing of climatic change requiring geological time resulted in the evolution of the characteristic flora and phytogeography of Madagascar. The vegetation, in precarious equilibrium with increasing drouth, has been easily exterminated by man, fire, over-grazing, and the introduction of weedy plants, some of which may have come in man's footsteps. The destruction brought about by man may be thought of as somewhat of a trigger effect. Such geological processes as the drying of Pleistocene lake basins can hardly be considered as man's work in Madagascar any more than in the arid American west, but the upsetting of an unstable equilibrium certainly can be, and would not be permitted in a world whose policies were determined by science and reason.

Bougainville, Louis Antoine de (1759?) *Memoire sur les découvertes et les établissemens faits le long des cotes d'Afrique par Hannon, Amiral de Carthage. Première Section. Récit historique du voyage d'Hannon. Seconde Section. Traduction du Périphe D'Hannon, accompagnée de quelques éclaircissemens. Troisième Section, Où l'on examine dans quel temps il faut placer le voyage d'Hannon. Quatrième Section. Reflexions sur le commerce de Carthage en particulier, et sur celui des Anciens en général. Memoires de Littérature, vol. xxvi, n.d. [1759?] pp. 10-45, map, vol. xxviii, pp. 260-317.*

Bougainville opposed the theory that Hanno's voyage was fabulous, but considered that the farthest point that he reached was to the westward of the Benin delta. He was therefore forced to locate the volcanic peak that Hanno called the "Chariot of the Gods" on a slightly hilly coast where there are no "mountains reaching into the sky".

Bouillenne, Ray (192) *Savanes equatoriales en Amérique du Sud. Bull. Soc. Roy. de Bot. de Belgique, Ser. 2, Vol. LVIII, pp.217-223, map. 1926.*

Bouillenne visited South America as a member of a biological mission to Brazil, under the auspices of the Belgian Government and the Belgian "Fondation Universitaire", and devoted much

attention to the matter of the distribution of the grasslands (campos) of the Amazon. He emphasized the necessity for distinguishing clearly between the plant associations of seasonally inundated land and those of terra firma. Both include grassland as well as forest. Distinguishing the flood-lands as "varzea", he omitted from consideration the campos de varzea and confined his attention to the prairies proper, occurring above the usual high-water level.

Although the notion of the unbroken Amazonian forest is almost a geographical dogma, he constructed a map showing the existence of great savannah areas beginning at the mouth of the Amazon on the island of Marajo and occurring in great areas from a hundred to five hundred kilometers across, and all in the region customarily thought of as being within the Hylaea, or great Amazonian forest. All of these he interprets as areas of seasonal dryness, and affirms that they are climatically controlled. He compares them with the African savannahs which have come about by the destruction of forest by fire, by exploitation, by wind, and by flood, and states his belief that the Amazonian savannahs have this difference, that they never have been covered by forest such as that of the surrounding Hylaea, — but that they occupy ancient land areas covered by an ancient vegetation. (In this view he accords with the earlier conclusion of Bates.)

In addition to the savannahs of the island of Marajo in the mouth of the Amazon and the extensive ones near Santarem described by Bates and the one across the river from the latter near Monte Alegre, these being the ones known to Grisebach (1878), others had been described by later explorers to the number of a dozen or fifteen by the time Bouillenne made his map. All of them are limited to the general region of the lower Amazon and its tributaries, occurring in connection with the interfluvial plateaus of rivers arising in the northern campo areas of Colombia, Venequela and the Guianas, or the corresponding rivers arising in the great central plateau of Brazil south of the Amazon. All of the campo areas have an annual dry period of from four to six months.

Bouillenne did not accept the theory of edaphic control of the campos which had been proposed by Bates and Grisebach, namely, that sand and rock areas were campos, clay areas forest. Rather, he believed that seasonal drouth was the controlling factor, and that this was demonstrated by the development of gallery (marginal) forests along the streams where the soil might be mineralogically the same as that of the campo above, but was moister through the dry season. Curiously enough, in his conclusion that the vegetational delimitation depends upon a long seasonal drouth, Bouillenne does not even mention the factor of fire. He mentioned the greater poverty in species of the isolated Amazonian campos in comparison with the northern campo of the Guianas, etc., and the southern campo of central Brazil. He regarded the Amazonian campos proper to have

84. Boulton (Venezuela); Bradley-Birt (India)

received their flora largely from the south, and the species of the gallery forests traversing them to have migrated from the north, just as he considers the forest of the Hylaea to have migrated largely from the north.

It would seem that Bouillenne was right in emphasizing the geological-historical factor, i.e., the geological antiquity of the campo flora, but that he would have explained the extremely sharp delimitation of campo and forest more satisfactorily if he had taken the factor of fire into consideration.

Boulton, Alfredo (1950) Los Llanos de Paez. Caracas: [privately published], copyright 1950.

Magnificent photographs of incidental botanical interest, illustrating scenes connected with the life of President Jose Antonio Paez of Venezuela. He came from the llanos, and the scenery of the country associated with his career is beautifully shown in this work. It supplements other works of the author showing the scenery of the mountains and of the coast. The fringing (gallery) forest along a small stream at the birthplace of President Paez is shown on p. 9. "El 13 de Junio de 1790 nací en una muy modesta casita, á orillas del riachuelo Curpa, cerca del pueblo de Acarigua, canton de Araure, provincia de Barinas, Venezuela".

Boulton has exhibited photographs at the Museum of Modern Art, New York, 1940, and was the illustrator of "Imágenes del Occidente Venezolano: Notas de Julián Padrón y texto de Arturo Uslar Pietri. Edición fuera de comercio. Tribune Printing Company, New York, 1940".

Bradley-Birt, Francis Bradley (1905) The Story of an Indian Upland. London: Smith, Elder and Company. xv + 354 pp., 21 pl., map.

Bradley-Birt says of the Santal Parganas that "In the first century of their existence this land and its original inhabitants could scarcely have been more primitive than they are today". The area, hill country, of about five and a half thousand square miles extent, it lies midway between the Vindhyan Hills and the great plain that stretches clear across northern India. It was described fifty years ago as varying from "precipitous tree-clad hills with bold irregular escarpments, huge gneiss rocks, moss-grown, piled carelessly one above another," to a "land full of gentle undulations, a rolling country of long, sweeping slopes which the cultivator has eagerly seized upon."

The people of the higher, rougher land are "the Paharias, of Davidian stock, the wildest and most backward of all the aboriginal tribes in Bengal" and, in the "Skirts of the Hills" the Santals, who have only been in this land about a century, forced there by the persecutions of the iniquitous Zemindars who had usurped by usury their old villages. The Santals undertook to emigrate, and were allowed by the British raj to occupy lands refused by the Paharias, although the latter had been promised that no Zemindar of another race would be allowed among them. Here the Santals cleared off the forest below the higher habitat of the Paharias, and by unremitting labor terraced the lower slopes of the hills for wet-rice cultivation, presumably using the upper slopes for upland crops (as in Chota Nagpur). One patch of primaeval forest was left untouched by each village, namely, the "Jaher Than" or sacred grove, scene of communal sacrifices to a varied array of gods, godlets, and spirits. It would be of great interest to make a survey of sacred groves, which, if they still exist, might be botanically interesting as preserving species otherwise gone from the localities, and valuable as seed trees.

Bradley-Birt, F. B. (1910) Chota Nagpore: a little-known Province of the Empire. London: Smith, Elder & Co. 1910. xviii + 327 pp., illust., map.

Bradley-Birt gave a graphic picture of the destruction in Chota Nagpore of what might have remained one of the finest forested regions of India. We quote (p. 7):

"Entering Chota Nagpore on three different sides, the railway has slowly crept towards the central plateau, eventually to bring the same change over the face of Old Chutia Nagpur as over the outlying districts where it has already worked its way. Vast stretches of jungle have disappeared, swept clean of the surface of the land or represented only by a puny growth of saplings that will take a century to rival the magnificent trees that were there before them. Timber gained a sudden market value with the coming of the railway and the clearings in the forest provided new lands for the more extensive cultivation that the increase in the population necessitated. . . ."

The province was the home of several remnants of interesting and ancient peoples who were suddenly pressed upon by a crowd of vicious Zemindars and other parasites. Among them were the Kols. Their peculiar superstitions saved, at least for a time, some little vestiges of the ancient vegetation. Among them (p.35):

"Every village has its own particular spirit, whose duty it is to look after the crops. . . . The home of this presiding deity is the Sarna or Sacred Grove, a little patch of primitive jungle that, when all else was cleared for cultivation, was left as a refuge for the gods where they might dwell apart."

Such primitive practices as the indiscriminate burning-over of grasslands still persisted in 1910. Bradley-Birt wrote (p. 184):

"The hills round Gobindpur form a wonderful line of light by night during the hot weather. The natives kindle jungle fires all along the slopes as soon as the undergrowth has fully dried, in order to make way for the fresh young grass that will spring up with the first breaking of the rains and provide welcome fodder for the half-starved cattle. . . . Smouldering for days, the fires creep on in zigzag lines from end to end of the hills, invisible by day, but standing out clear and distinct, a brilliant line of light, by night."

Brandis, Dietrich (1906) *Indian Trees: An Account of Trees, Shrubs, Woody Climbers, Bamboos, and Palms indigenous or commonly cultivated in the British Indian Empire.* London (Constable and Company, Ltd.) 1906. 4th impression, 1924. xxxii + 767 pp., 201 figs.

The introduction to Brandis's "Indian Trees" (pp.) indicates that his appointment in January, 1856, to take charge of forestry in Burma was his first assignment of the sort, and that it was a difficult task. He was particularly instructed to place the management of the teak forests on a safe footing, to insure maintenance and gradual improvement of the growing stock, and to keep utilization down to the amount of annual increment. He was soon assigned elsewhere and he does not mention the development of the taungya system. He did state that if his work in Burma and later work in Calcutta had not had cordial support of the Government of India, there might never have been any Forest Administration at all. He said: "The difficulties with which I had to contend were great, and the opposition against methodical forest management was powerful." Brandis returned from India in 1883, after having seen more of forestry throughout India and Burma than anyone else.

Regarding the general burning of forest, he said (p.xviii):

"Excluding the Himalayas, the forester distinguishes two great classes of forests in India: the deciduous forest, which, unless specially protected, is burnt over every year, and the ever-green forest into which as a rule fires do not enter."

He comments on characteristics of particular plants which enable them to withstand fire (p. xxli):

"After the fires of the hot season have passed through the grasslands of the Subhimalayan tract and of other parts of India, in the midst of the black desolation which is the result of these fires, we often come across a large blossom coming out of the ground, looking at a distance like a beautiful rose with numerous long delicate filaments. This is Careya herbacea, closely allied to Careya arborea, a large tree of India and Burma. Soon after the flowers a tuft of leaves appears, and during the rains the fruit ripens, looking like a large green apple. Through the action of the leaves the woody rootstock underground steadily increases in size, and, though the fires of the following season destroy all shoots above ground, the rootstock remains uninjured and annually brings forth flowers, leaves, and fruit. The undershrubs which behave in a similar fashion are very numerous, belonging to many orders. Grewia sapida with edible fruit, Cohnia pumila with large golden-yellow flowers, Brythiria resupinata with an upright raceme of scarlet flowers, may be mentioned as instances. The more prominent species of this class, besides those mentioned, are: Blax nana, Flemingia nana, Combretum nanum, Mussaenda indica, M. uniflora, Indigofera Hamiltonii, Pasitum Stallanum, Fremna nana.) They must not be confounded with temporary undershrubs, such as are formed through the action of the annual fires, by all trees that coppice readily. Seedlings of Sal, Teak, Zizyphus Jujuba, Terminalia and many other trees which spring up in grasslands or in the forest are cut back to the ground by the annual fires, and here also, through the action of the leaves, a large woody irregularly shaped rootstock is formed, which throws up coppice shoots that are destroyed by the fires of the hot season. But when the area is protected against fire these coppice shoots grow up into trees. What becomes of the permanent undershrubs here described, when the area is protected against fire, is not known; probably they are smothered by the surrounding vegetation. That some of these undershrubs were cultivated long ago in the Calcutta Botanic Garden is evident from Roxburgh's Flora Indica, but no record exists whether they had changed their habit when no longer exposed to the regime of annual fires.

"In the old Forest Flora of North-West and Central India I drew attention to a number of these remarkable undershrubs, and write regarding them on a later occasion (Ind. For. XXVI, 10). It has given me great pleasure to find that Mr. Duthie, in his excellent Flora of the Upper Gangetic Plain, has fully recognized the importance of these interesting species, and it is satisfactory that, in the Park of the Dehra Dun Forest School, Kanjilal has at my suggestion commenced to cultivate a number (particularly Grewia sapida) in order to see whether they will change their habits when no longer exposed to the annual fires. . . . I admit that no forest revenue can be made out of these undershrubs, and that they are not likely ever to play an important part in the system of forest management. But foresters who may

cultivate these remarkable species will thereby be induced more completely to study the laws which govern the habits of plants and the conditions which may under certain circumstances cause the development and mutation of species. . . . Their study may quite unexpectedly throw light upon some important forest questions. At the present day [1906] this may be pronounced fanciful by my young friends in India, and they may regret that their old friend has indulged in such fancies."

I cannot help quoting the concluding sentences of the Introduction to Brandis's book:

"I wish all my young friends [the new group of Indian foresters], whether they have learnt their profession in Europe or at the Imperial Forest School in India, an honorable and prosperous career in the Indian forests. Should anyone look down upon them because their work makes no show . . . they will console themselves with the proud consciousness that they are the guardians of the future and permanent interests of the 300 millions who inhabit the great British Indian Empire, and that they are contributing materially to insure the comfort and welfare of future generations."

Almost 50 years have passed since these words were addressed to them, and those still living are now old men. It would be interesting now to know their individual life histories. What did they accomplish? Was public sentiment for or against them? What backing did their efforts have? In the struggle for existence in overpopulated India is there to be enough of the land preserved from the despoiler to provide a decent and rewarding life to a reasonably limited population, or mere subsistence, or starvation? Something like a 50th anniversary volume of biographies of the older Indian foresters would be a most illuminating document. Why should it not be provided by some of the foundations that are concerned with sociology?

Brenner, Joachim Freiherr von (1894) *Besuch bei den Kannibalen Sumatras. Erste Durchquerung der unabhängigen Batak-Lande.* Wurzburg: Verlag von Leo Woerl. iv + 388pp., illust., map.

In North Sumatra Von Brenner had an excellent opportunity to observe Batak agriculture before it had been modified (in Karoland) especially by European influences. He does not tell us, unfortunately, just where he observed the use of digging sticks by a row of women working together for turning the soil, but this method of tillage was observed by the reviewer only in Karoland. He describes and illustrates the tools used in agriculture. Aside from the very primitive plow which he saw pulled by buffaloes, bullocks, men, and, particularly, by women he said that the especially notable tool was a wooden stick, which he saw only in the Batak lands, and exclusively used by the women. He described it as arm-thick and over two meters long. Six or more women stood in

a row, and repeatedly thrust their sticks into the ground until the holes, along a straight line, were deep enough. Then by a powerful pull backwards the soil was turned to a greater depth than was possible with the weak plow.

Von Brenner ran across the word juma (he spelled it "dschuma"), presumably in the Karodusun or lowland colonies, but he did not localize the observation. Anyway, it was in an area where, if he did not misunderstand, the word applied to the watchhouse in the cultivated clearing rather than to the clearing itself. (The variation in application of derivations of the word uma from region to region, sometimes meaning a house and sometimes a field, perhaps originally homestead, is mentioned in other reviews.) He said (p.277) that one wandering through the fields would see here and there little houses called juma on high posts or in trees, from which ropes radiated in all directions over the field. On these ropes were hung bamboo clackers and other things to make a noise that could be set in motion by a pull from the watch house in order to scare wild pigs, birds, and other animals.

Breitenstein, H. (1899) 21 Jahre in Indien. Aus dem Tagebuches eines Militärarztes. Erster Theil: Borneo. Leipzig: Th. Grieben's Verlag (L. Fernan). viii +264 pp., illust.

The interesting three-volume work of the physician Breitenstein touches upon primitive agriculture only incidentally, as observed by himself, in the volume on Borneo. (The description in the volume on Sumatra was not wholly original, but based upon Yzermann and Koorders for details of the replacement of primary forest by secondary, or eventually by grassland.) Breitenstein went to Bandjermasing in 1877 and thence to Muara Tehweh, where he lived three years. It was presumably near here that he was invited to a feast that was held by the Dyaks on the occasion of planting a new forest clearing, which he referred to by the Malay word, ladang. Weeks before, a low hill behind the village had been cleared by felling all the trees and other vegetation, and the wreckage had been burned. A row of men punched holes in the ground with pointed bamboo staves. Behind the men followed a row of girls and women wearing, in Malay style, a carrying cloth (selindang, i.e., sĕlĕndang) over the right shoulder and tied on the left side, which served for carrying a basket of seed rice. The sĕlĕndang was too hot, however, so was soon put off and the work finished in sarong only. The formality of starting in party dress shows that the Dyaks made a festival of the planting, with which invited guests helped, as is common throughout the archipelago.

90. Brockway (Madagascar); Brown (Samoa; New Britain)

Brockway, T. (1876) A visit to Ambohimanga in the Tanala Country. The Antananarivo Annual and Madagascar Magazine. Second Number, Christmas, 1876. (Reprint of 1885.)

A missionary on tour, T. Brockway made some casual but significant remarks about shifting agriculture in Madagascar (pp. 181, 182). He said:

"There is no dense forest in the immediate neighborhood of this place [Ambohimanga], as the system of cultivation pursued, viz, that of destroying the forest by fire and planting in the ashes, helps to clear the country."

"At home with her own people, there was no display of pomp and honour on the part of the Tanala princess. . . I was teaching in the chapel one afternoon when . . . she said: 'I beg permission to be absent.' I was somewhat startled, as she was not one of my pupils. But planting-time was near and she was leaving . . . to be present at the forest burning or land clearing."

Brockway's party returned by way of the districts of the Taiva tribe and then the Zafimaniry, the latter described as "great wood-cutters". Leaving their village Ivòhitràmbò, perched on a mountain, it only took two hours to reach open country, in the direction toward Ambositra. Elsewhere the editor, J. Sibree (1885, p. 198) gives the location of Ivòhitràmbò as "perched like an eagle's nest on the summit of a lofty cone of rock, on the edge of the interior plateau and overlooking a great forest region, the country of the Tanala tribes." [i.e., southeast Madagascar].

Brown, George (1910) Melanesians and Polynesians: their Life-Histories described and compared. London: Macmillan and Co. xv + 451 pp., plates

The missionary George Brown lived in Samoa for fourteen years, 1860 to 1874, and in New Britain (Bismark Archipelago) from 1875 to 1880, at which time he was the only white man in the group. Of the Melanesians of New Britain, he said (p. 324):

"The people cultivate the soil, and, as a rule, only gather the wild yams in times of scarcity. . . . The ground was dug by sharp-pointed sticks. . . . The areca palms were always preserved when found in the forest. . . . The people well understood the necessity of allowing land to remain fallow after one or two crops had been taken from it, and the garden sites were regularly changed. No manure was used by them, so far as I know."

Brown gave no account of clearing and burning for agriculture on New Britain, but did allude to grasslands that must

have resulted from shifting agriculture, and also described (p.321) hunting in the grasslands with the aid of fire:

"Large hunting parties were often formed to hunt cassowaries, wallabies, and wild pigs. The two former were generally captured by setting fire to the thick dense grass to leeward of a spot where a large number of the hunting party were stationed."

By way of contrast with Melanesia, he gave (p.338) an account of a Polynesian area:

"In Samoa the soil is cultivated by all the people. The men burn off the bush and plant the taro tops, whilst the women generally weed the plantation. The only implements which were used formerly were fire and sheets of bark, with which to shovel the live ashes from the foot of the large trees which were burnt, and to carry them to the smaller trees. Knives and axes are now used when clearing the ground. A pointed stick of hard wood was used to make the hole in which the plant was placed. The principal plants cultivated were taro, yams, bananas, 'ava [*Piper methysticum*] and the aute or Chinese rose [*Hibiscus*] for adornment. Taro was planted all the year round, as also bananas, but there was a regular season for yams. . . . The bush lands far away in the interior were owned by the families, as a body, in certain villages or districts. A second crop of taro was gathered from land on which it had been grown, but the quality was very inferior, and as a rule the land was allowed to remain fallow until the trees growing on it were as thick as a man's arm, when it was used again."

Brown, William H. (1919) *Vegetation of Philippine Mountains*. Manila: Bureau of Printing. 434 pp., 41 pl.

The deforestation of Philippine mountains is likely to bring about the development of successional stages of secondary vegetation known as parang. As described by Brown (p. 18) for the area around the foot of Mount Makiling (Province of Laguna, Luzon) it consisted of cogon grass (*Imperata*) and talahib (*Saccharum spontaneum*) invaded by shrubs and trees, but in other areas it is largely made up of bamboo thickets. Brown concluded that with the exception of very limited dry areas the whole of the Philippines must have been originally forested. He quotes Whitford's estimate that, in 1911, 40% of the land area of the Philippines was grassland (the cogonales) 17% was second-growth forest and only 10% was cultivated.

Brown stated:

(p. 18) "When land is cleared of forest and cultivated by primitive methods, grasses and other weeds make their appearance. . . . Both cultivated areas and grasslands quickly return to

forest if not disturbed by man and fires are excluded. . . . Dead leaves accumulate quickly in stands of Imperata or Saccharum, so that these grasses become very inflammable during the dry season. At such times a grass area is usually burned over completely, sometimes by accident, but as a rule, intentionally. Burning is resorted to for various purposes; as for example, to make hunting less difficult, to obtain young growth for forage, or to clear the land so that it can be readily traversed or so that a part of it can be cultivated. When an area is burned over regularly, the grasses form almost pure stands. . . . If the grass is not burned, it is quickly invaded by second growth trees but an area is rarely kept free from fire for a period sufficiently long to allow trees to cover it. . . . The fires may kill the trees at the edge of the forest, or the occasional absence of fires may cause the trees to encroach upon the grass. Thus the parang persists for years, the trees at times gaining and at other times losing ground. When they form a continuous forest the land is frequently cleared again and cultivated. . . ."

Brown had excellent opportunity to observe the reestablishment of trees in the grassland at the foot of Mt. Makiling for before the establishment of the College of Agriculture of the University of the Philippines at Los Baños, the land between the town and the mountain was burned over regularly. This was partly stopped in 1909, but there were extensive fires in 1911. After then, until 1919, there were none. Brown found that in grassland long stabilized by fire, Imperata, seldom over 1.5 meters high, occupied the drier places, whereas the lower and moister soils were taken over by Saccharum spontaneum, frequently over 3 meters tall. After these two species became sorted apart into somewhat different habitats, the distribution remained permanent so long as fires continued. Brown said (p.21):

"In old grass areas these two grasses do not form mixtures, but each in its special habitat forms a practically pure stand.

In the grass areas there are usually individuals of a few species other than grasses that, owing to large underground structures, can withstand fire. In the region under consideration the orchid Eulophia exaltata is one of the most widespread, while Blumea Balsamifera (sambong), a shrub, occurs in scattered patches. The fire-resisting trees Antidesma ghaesembilla (binayuyu), Bauhinia malabarica (alibangbang) and Acacia farnesiana (aroma) occur as scattered individuals. When these trees are young their shoots may be killed by fire, but new ones readily spring up from the roots. As each succeeding shoot is usually taller than the one preceding it, the trees finally grow taller than the grass and kill the latter by shading it. In this way the tree may become the center from which a small clump is formed. . . . When fires are excluded from a grass area, it is invaded by a large number of shrubs, vines, and small trees. The grasses can stand but little shading, and soon succumb, and in a few years they are replaced by a second-growth forest of small, rapidly growing trees."

Brown found that agricultural clearings which became re-forested without becoming serotales as a result of fire had a much less complicated successional history than those which had become grassed over. In northern Negros, for instance, Trema orientalis formed practically pure stands that could be measured in square kilometers and were only limited in size by the amount of cleared land open to invasion. In other places, as for example on Mt. Marivales in Bataan Province, Luzon, there were almost pure stands of Homalanthus populneus (balanti, in the Euphorbiaceae).

Brown, William H., and Mathews, Donald M. (1914) Philippine Dipterocarp Forests. Reprinted from Philipp. Journ. Sci., Sect. A, Vol. IX, Nos. 5 and 6, pp. 413-568. Manila, Bur. Printing, Sept. and Nov., 1914.

This work of Brown and Mathews remains one of the most important that has been written on Philippine forests. The present writer cited it in a former article as the best detailed support of Gleason's statement that two adjacent acres of tropical forest might differ in composition by a hundred species in one that were not in the other. This would not be true, of course, of old forest, but only when a line was drawn between old, highly diversified forest on one side and new secondary forest on the other. The latter, occupying an abandoned clearing, depending upon the accident of seeding, may be a stand of one or more quickly disseminated species. The statement of Brown and Mathews (1914, pp. 451-453) follows:

"Land which has been cleared of forest usually passes over either to second-growth forest or to grassland.

"If the land is cleared of forest and not cultivated, it is very quickly covered by second-growth trees. The most prominent are Trema amboinensis (anabion), Homalanthus populneus (balanti), Macaranga bicolor (hamindang), Macaranga tanarius (binunga), Mallotus ricinoides (hinlaumo), and Mallotus moluccanus (alim.) One of these, particularly one of the first four, may in certain localities form almost pure stands. Thus, a small cleared plot at an elevation of 450 meters on Mount Maquiling was very quickly covered by a growth consisting almost entirely of Trema amboinensis, while cleared areas on Mount Mariveles at a similar elevation frequently show practically nothing but Homalanthus populneus. Along with the trees mentioned there may be a number of others, but they usually occur in much less abundance. All of these trees are small, soft-wooded, rapidly growing species. They reach maturity early, are subject to decay and insect attack, and thus are very short lived. . . .

"So far we have considered only land which has been cleared and not cultivated. In the past, however, almost all clearing has been for the purpose of cultivation. The succession of vegetation naturally varies greatly with the subsequent treatment, and results in the production of either grassland or second-growth forest.

"The most primitive method of cultivation, and one which is practiced even now by some of the wild tribes, is to make a small clearing, or 'caingin' in the midst of the forest, plant it to rice or yams for a year or two, and then, as weeds grow, to abandon it. These small patches are quickly covered by second-growth trees which kill out the weeds.

"A more destructive system and one which has been very generally practiced is the making of clearings on the edge of the forest. These clearings are cultivated by very primitive methods. Cogon grass (Imperata exaltata) or talahib (Saccharum spontaneum) comes along with various herbaceous annual weeds, conspicuous among which are species of composites. The area is burned over regularly, which results in the death of practically all tree species and the spread of the grass, as the large underground rhizomes of the latter are not injured by fire. In a few years the grass takes possession of the area and cultivation is abandoned, as it is easier to clear a new patch of forest than to eradicate the grass by the primitive methods of cultivation generally in use.

"It is at this point that the differences in climate probably play their most important role in determining whether the land shall remain permanently in grass or return to forest. In regions with a pronounced dry season the dead leaves of the grass become, in dry weather, very inflammable. These grass areas are burned over regularly. Tree seedlings are thus killed, and the area remains permanently in grass. This shifting system of cultivation has resulted in producing and extending grasslands until at the present time their extent is, according to Whitford, four times as great as that of cultivated lands.

"In regions without a pronounced dry season the grass does not become so readily inflammable and the trees have a chance to become established. This point has been discussed in connection with the distribution of forests in the Philippines.

"Imperata exaltata is rarely more than 1.5 meters in height, while Saccharum spontaneum is frequently more than 3 meters. The latter grass grows in more moist situations than does Imperata exaltata and forms denser stands. Growing along with the grasses and particularly with Imperata are a few other plants. Their total bulk is small, and they are usually characterized by having large underground structures which are not injured by fire.

"There are a few trees which are able to grow up through the grass, even when this is burned over regularly, provided the burnings do not occur at too frequent intervals. Notable examples

are Bauhinia malabarica (alibangbang), Antidesma ghaesembilla (binayuyu), and Acacia farnesiana (aroma). These trees have well developed roots, and sprout readily from the base of the stem after the upper portion has been killed. After each succeeding fire a larger stem is produced, until finally the tree is able to shade out the grass around it to some extent and may form the center of a small clump. These trees, however, occur in grass regions, which are regularly burned, only as scattered individuals or small clumps, as they can make but little headway against the grass when subjected to fire.

"Second-growth trees grow up and kill the grasses by shading when the latter are not burned. This process generally requires only a few years, as the trees to furnish seed are usually scattered throughout the grass areas, especially in ravines and along the banks of streams. The seeds are usually small and are readily dispersed by birds or by the wind, and nearly all of the second-growth species grow very rapidly. The first stages in the invasion by tree species differ greatly from those on cleared land. The first species present are naturally those fire-resisting ones which are usually present in grass areas. However, many other species come in quickly, among which there are usually individuals of the same species that invade cleared areas. The chief difference between the first stages of second-growth forest in grass areas and on cleared land is that on grasslands there is usually a greater diversity of tree species than on cleared lands."

Brown, William H., Merrill, E. D., and Yates, Harry S. (1917). The revegetation of Volcano Island, Luzon, Philippine Islands, since the eruption of Taal Volcano in 1911. Philipp. Journ. Sci. C. Botany. Vol. XII, No. 4, pp. 177-248, pl. IV-XIV. July 1917.

Although man was not a factor in the revegetation of a Philippine area denuded by the eruption of Taal Volcano in 1911 this paper is of great interest in connection with tropical grasslands as affording an example of a natural grassland near sea level in the tropics. That it represents a temporary phase of vegetation, geologically considered, is quite beside the point, for it represents a type of grassland that must have occurred at intervals in all tropical volcanic areas. Like Krakatoa in the Sunda Straits, Taal Volcano rises from very few meters above sea level and is entirely surrounded by water. The physiography is peculiar. It occupies the center of Volcano Island, (14° N., 121° E.) which has an area of about 25 square kilometers in the center of Lake Bombon. The latter has an area of about 320 square kilometers. The island was not fertile enough to be extensively cultivated before the eruption of 1911 but provided for village gardens and grazing for much

livestock. After the eruption the topography was hardly changed except by the replacement of two lakes in the crater of Taal Volcano by a single one, which rose from about 70m. below sea level when first observed to about sea level in 1917. Nevertheless the vegetation was destroyed except for a few bamboos, bananas and trees in one part, with possibly some grass.

Prior to the eruption the vegetation was of the type called parang, consisting of small second-growth trees, bamboos, and grass. "Parang is usually the result of human activity," but, in the words of our authors (p. 181) generally originates in the following manner:

"When the original forests are removed, and the land cultivated, but not intensively, grasses -- particularly Saccharum spontaneum and Imperata exaltata, tree species, and weeds make their appearance in large numbers. These are frequently removed by burning, which destroys practically everything except the under-ground stems of the grasses, so that with repeated fires the grasses soon form a solid stand. As the tall, coarse grasses make very poor forage, grass areas are frequently burned to secure young shoots for grazing animals. Wantonly set fires are also frequent. On Volcano island the two latter classes of fires were probably more frequent than those set to clear the land for cultivation.

"Where there are no fires, trees occur; and the latter come into the grass when fires are absent for a short period. When the trees begin to form a dense stand, they are again cut down and the above processes are repeated. In this way large areas that are not intensively cultivated become covered with a mixture of trees and grasses."

The destruction caused by the volcano in 1911 was not from lava but from flows and rain of hot mud. Two introduced kinds of bamboos and three kinds of bananas near village sites remained alive under the dejecta and also the under-ground parts of ten kinds of trees which proved to be among those that also survive the fires on cleared land and therefore are found in parang vegetation. (The Tagalog word parang, by the way, is related to Malay padang, grass plain.)

These ten trees all produce seed freely and are those which might well be planted from seed to produce a nurse-forest to be taken over in reforesting grasslands by more valuable species. Aside from the scattered trees, our authors state (p. 243) with regard to the restoration of the plant cover in six years:

"In the revegetation of the island a single species of grass, Saccharum spontaneum, is so much the most prominent of all the invaders that it gives character to the whole vegetation. . . . The revegetation is proceeding slowly owing, probably, to adverse environmental conditions, the most prominent of which are the

presence of excessive amounts of sulphates in the soil; the lack of weathering of the soil particles; the scarcity or lack of humus; the scarcity of nitrogen; the low water-holding capacity of the soil; and erosion."

They had already said (p. 209):

"Another factor that will probably have considerable influence on the development of the vegetation is grass fires. In October, 1916 and January, 1917, there was no evidence of any considerable burnt areas on Volcano Island. By the first of April, 1917, fires had swept over a large portion of the north end of the island. . . . All these fires had occurred during the early part of the dry season; so that it may very well be that before the end of the season nearly all of the areas, in which the grass is thick enough to spread from clump to clump, will have been burned. The fires had apparently not killed any of the clumps of *Saccharum spontaneum*, as, except in the most recently burnt areas, the clumps were producing new leaves. However, many trees, particularly the smaller ones, had been killed. Owing to this fact, it seems not improbable that trees may have been somewhat more numerous before fires of any considerable extent occurred on the island [i.e., before the grass was dense enough to carry fire] than at the present time. Such trees could hardly have formed closed stands, as such stands kill the grass and fires do not burn through them. If fires continue to be prevalent it is probable that grass areas will persist. . . ."

In other words, the effect of man, through fire, is to favor the perpetuation of grassland rather than forest.

Bryan, P. W. (1933) *Man's Adaptation of Nature*. London.

(p. 7) "Anthropogeography, as developed by Ratzel and interpreted by Semple, consists, in essence, of a classification or systematization of natural environment, based on the influence, or rather, in their view, control, which the different types of environment exercise on human activities. Their approach is definitely from the environmental side, and the stage on which human activity takes place, is regarded as being definitely determinative and not permissive. The emphasis is thus laid on the side of physical circumstances, and the fixed character of, and the inevitability of, the control exercised in any given set of natural conditions, is dogmatically asserted. To the views of the Ratzelian school the term 'geographical determinism' has been applied. The Ratzelian view may be criticised on the ground that it prejudices that which it purports to investigate -- the relation between man and his environment -- and that the

facts adduced are insufficient to support the dogma of the generalizations. Further, it is clear that man is in many cases the active agent moulding nature to his will.

"Contrasting sharply with Ratzel's teaching is that of la Blache and Brunhes, which lays the emphasis on man and his activities, and on the power of human groups to adapt the (p. 8) physical circumstances to their needs within limits. Man, while influenced by, and in some respects definitely controlled by, his natural environment is regarded as the master, and not the slave of circumstances. In other words, the subject is approached from the standpoint of man's adaptation of his environment, rather than from that of environmental influence. Thus the unsuccessful attempt to explain everything in terms of physical environment implied in the geographical determinism of Ratzel, is avoided, and the emphasis is laid on cooperation between man and his environment rather than on the coercion of man by his environment.

"As between these two views there is little doubt that the Ratzelian view offers least and the la Blache view offers most for the future of the subject, and is further the more scientific and less dogmatic of the two."

Chapter 2,-3 Analysis of the Cultural Landscape. 4. Study and Observation of the Cultural Landscape.

Burbidge, F. W. (1880) *The Gardens of the Sun: or a Naturalist's Journal on the Mountains and in the Forests and Swamps of Borneo and the Sulu Archipelago.* xix + 364 pp., Illust.

Burbidge, Curator of the Botanical Gardens of Trinity College, Dublin, visited Borneo and Jolo to collect plants for the horticulturist Veitch at Chelsea. In Jolo he described (p. 191) what appears to have been natural grassland on a lava surface:

"We came to an undulating plain of coarse 'lallang' grass four feet in height, while the soil at our feet was thickly paved with vitrified slag or scoriae, the product of the island during its volcanic epoch. It was very hot, and the walking over the sharp stones, hidden as they were in the tall grass, was very troublesome. . . . I made several dips into the patches of old forest in search of plants, but nothing of interest was seen."

This grassland on "clinkers" could never have been cleared for cultivation and the account greatly reminds the writer of Philippine experiences of his own (as, for example, on the island of Culion, where there seems to be a small area of natural grassland). Burbidge's general description of Jolo (p. 203) follows:

"Sulu as seen from a distance on board a ship out at sea, appears to be nearly all under cultivation; but on riding into the interior a good deal of uncultivated land and jungle is seen. The jungle portion has mostly been under cultivation in former years and is now lying fallow previous to its vegetation being again cleared off by fire ready for the rude plough-culture here adopted. . . . One or two of the high hills are quite denuded of the old forest, and cultivation extends to their summits. The two highest peaks, however, are still clothed with the forest primeval. . . .

On his way by native boat from Jolo to Labuan, Burbidge was blown out of his course and landed, again opposite the little island of Lumbedan. Of this locality he noted: "This forest, although originally rich in plants, like that of Labuan, has suffered severely during recent years from the now ever recurring jungle fires of the dry monsoon. We could find nothing."

Finally on Borneo, Burbidge went inland toward Mt. Kinabalu and came to "the splendid village green of Koung," occupying old clearings transformed into grassland. He said (p. 261):

"It is a well watered grassy plain and affords the best pasturage for cattle that I have seen anywhere in the East. Of this the villagers take full advantage, for nowhere have I seen finer kine and buffaloes than here."

In the general neighborhood of Kiau, Burbidge found good wet-land rice and kaladi (caladium, taro) fields and described the dry-land agriculture (pp. 289,290) as follows:

"The system employed by the natives in clearing their new farms is to fell the trees and then to burn them during the dry season. The old stumps are left, and to prevent the rich earth from being washed away by heavy rains, logs are laid against these, horizontally, all down the steep shoulders of the spurs. Land newly cleared yields splendid crops of hill or dry rice, maize, kaladi, tobacco, sweet potato, and other crops. There is very little primitive forest on these lower hill ranges and spurs [of Mt. Kinabalu], nearly all the land not now actually under culture being fallow, in the shape of low jungle. The only really virgin forest is the tops of the hills beyond Kiau, and the spurs of Kina Balu itself on the south and east sides."

In answer to inquiries of a planter from Ceylon who was seeking a suitable area near Kinabalu for a coffee plantation, Burbidge said:

"I told him what I had seen of the country, of the large extent either actually under cultivation by the Dusun or lying fallow as jungle, and that virgin soil in large tracts would only be obtainable by felling the primeval forests on the enormous spurs of Kina Balu itself."

Rather unusual interest is attached to Burbidge's description of the upland clearings because it gives an inkling of how terracing of steep hillsides may possibly have originated, by laying felled logs along contours instead of burning all of them.

Burchell, William J. (1953) *Travels in the Interior of Southern Africa*. Reprinted from the Original Edition of 1822-4 with some additional material and with an Introduction by I. Schapera. 2 vols. London: The Batchworth Press. xxix + 381 pp., 8 pl., 50 figs., map; xvi + 371 pp., 9 pl., 46 figs., map.

When Burchell was in South Africa (1810 to 1815) he visited the Dale of Zondereinde () and there remarked (1822, reprint of 1953, vol. 1, pp. 85, 86):

" . . . not a single tree of any magnitude was to be seen, although many large and decayed trunks were observed along the banks of the Zondereinde. Firewood is an article generally very scarce in the vicinity of a Hottentot settlement; and in all the grazing parts of the colony it is rendered much more so by the wasteful and destructive practice of annually setting fire to the old withered grass, as the means of clearing the pastures. The flames, spreading rapidly, scorch and destroy every shrub and plant in their way, and pervade the whole farm, unless stopped by a river, or a beaten road. In ascending the Dunkerhoek (Dark Corner) mountains, part of the Baviaan's Kloof chain, the devastation occasioned by this custom was very striking, in the final havoc it had lately made amongst the finest plants of proteas, heaths, and the richest variety of shrubs we had passed in our ride. That delicate and beautiful heath, Erica vestita, with white flowers, grows here, as was discovered by one large plant which had escaped the conflagration. Antholyza lucidior and Aulax umbellata were recognized, although quite scorched up. Everything was nearly consumed or destroyed, and the black charcoal-like state of this shrubbery presented a singular but melancholy appearance."

In the Yellow River area Burchell (vol. I, p. 291) remarked:

"The surface of the land was in general sprinkled over with small scrubby bushes; and in many places grew abundance of Kanna-bosch (Kanna-bush, Salsola aphylla, L. or Caroxylon Salsola, Th.) which I had now learnt to consider as an indication of a good soil of some depth, though not always free from a brackish quality. In some parts of the plain the Bushmen had burnt away the old grass, for the purpose of attracting the game by the young herbage which subsequently springs up. At this time it had already begun to sprout, and had given to many extensive patches

the beautiful verdure of a field of wheat. In some places which had not been in this manner cleared by burning, the green blades were concealed by the old withered grass; a circumstance which ever gives to the plains of Africa a more pale and arid appearance than they would present if the wild animals were able to graze off the yearly crop as closely as the cattle do in the pastures of Europe."

Burchell (1822) reprinted 1953, p. 299, had a very low opinion of Barrow, who, as a naturalist, may indeed have been a poor observer, but we must admit that he could at least see a grass fire!

Burchell (1822, reprint of 1953, vol. I, p. 299) mentioned the burning of grass near Kygariep (about 28° 30'S., 25°E.?) by the Hottentots:

"In those parts of the plain where the herbage had been burnt, the young grass had attracted a great quantity of game." Later, after leaving the "Yellow" [Ky Gariep] River, "and the pleasant woods which mark its winding course" Burchell went northward through grass prairie which had not yet been burned. He wrote:

"We travelled over a plain of boundless extent, producing much grass, in some places, and a few bushes. . . . At this time, all the grass, though still standing, was completely dried up like hay; and if it had been set on fire the conflagration would have spread with the greatest rapidity over the plain."

At Klaarwater [Griquatown, about 28° 40' S., 23°E.] Burchell (Vol. I, p. 351) wrote of frequent but harmless whirlwinds which swept over the plain with momentary fury and carried up every light substance to a height of three or four hundred feet, and travelled at a rate of five to ten miles an hour. "Sometimes they changed their color, according to that of the soil or dust which lay in their march; and when they crossed a track [tract] of country where the grass had lately been burnt, they assumed a corresponding blackness."

The most remarkable event at Klaarwater reported by Burchell (1953, Vol. I, p. 359) seems to have been the ignition of grass by a silent discharge of lightning, a phenomenon which is sometimes alluded to, but seldom authentically recorded. The vegetation was green and lush after the rains, and no fire appears to have followed. Burchell unfortunately made no observations by daylight the next day, or did not report them. He wrote:

"About nine o'clock in the evening as I was crossing the valley [Cape Dutch for "any low grassy spot which receives the drainings of the surrounding country"] or mead, in returning home from a visit to the missionaries, I witnessed an electrical phenomenon, which never presented itself to me but this once:

lightning appeared as if emitted from every quarter of the compass, the flashes following each other in quick succession, but unaccompanied by thunder; all was still and silent excepting a few heavy drops of rain which escaped from some clouds which were exceedingly dense and black. On a sudden I was almost blinded by a glaring flash of light, which seemed to have descended from the Zenith, and, for a moment, every blade of grass around me to the distance of fifteen feet, seemed ignited by the electric matter. There was no explosion, no kind of noise was heard, nor was any effect whatever experienced from it, all was still and quiet, and I continued my walk, in alternate darkness and flashes of lightning, without any repetition of this singular phenomenon. The grass, being of a coarse sort, was, just at that spot, about a foot high; each stalk and blade was strongly illuminated, or rather, as it seemed, ignited; but beyond the distance of about fifteen feet, I saw none of this remarkable illumination."

Burchell and Borrow entertained a cordial dislike for each other. In 1819 Burchell published a pamphlet advocating English colonization of the eastern borders of the Cape Colony. This was very adversely noticed, ("contemptuously"), Schapera says, in the "Introduction" to the 1953 reprint of the "Travels"), in the Quarterly Review by an anonymous writer, undoubtedly Borrow, who said of Burchell that:

"He was, we understand, a 'culler of simples', and he certainly seems to have culled little else." In reply, Burchell in his Travels, made several sarcastic remarks about Borrow, including the devastating implication that his dog could have written such a work also, with the aid of an editor who gets it properly recommended by the "Quarterly Review and an illustrator to put delineavit Wantrouw" (the name of the dog) or "From a sketch by Wantrouw, Esq." at the bottom of a few aquatint or lithographic plates. Such a work, "rightly and humbly dedicated, and well advertised, would be sure to sell." Since the public was too well supplied with books on Africa, however, Wantrouw, specialist on the internal anatomy of wild beasts, but no botanist had given Burchell permission to quote from his memoranda.

Burnett, J. R. (1948) Crop Production. In Tothill, J. D. (1948) Agriculture in the Sudan. Chapter XV, pp. 275-301, q.v.

Burnett has given excellent descriptions of agricultural procedures in the Sudan, the implements used and the manner of using them. The region is interesting as having anciently had terrace agriculture and the equivalent of "contour" cultivation, and as having developed variants of shifting cultivation. The systems which he discusses are as follows:

(p. 291) (1) "Shifting Cultivation . . . Under this system certain

areas are brought under cultivation for a time, and then the farmer moves to new ground, preferably untouched, or virgin forest. . . The move consists in clearing an adjoining area of forest, and so the process goes on until the original farm, through having been allowed to go back to nature and thus regain most of its old fertility, will once more be brought back into cultivation.

"This system of shifting cultivation, or leaving it to nature, has several advantages which may not appear obvious at first glance." (These are that it isn't necessary to grow and dig in a leguminous crop, that it automatically controls diseases and pests.)

"As the farmer frequently returns to his original clearing . . . and cleans the bush which has grown up; shifting cultivation is therefore a modified form of crop-rotation with a long resting period. . . The continual burning of the cleared bush has also a cumulative bad effect on the land, through the destruction of great quantities of valuable humus and of vegetation.

(2) Hariq Cultivation. . . In this case it is not forest land or bush which is required, but rich clay plains on which a thick growth of strong and long grass is found. . . After the first heavy rains . . . and when the new growing grass has sprouted . . . the matted growth is fired. If taken at the right time the heat generated from the burning dry grass is sufficient to kill off the new young grass. The resultant clean land can then be sown, and if the burning has been successful, no subsequent hoeings should be necessary. This type of controlled burning is very different from the uncontrolled fierce hot fires which sweep the country during the dry weather. In fact, good 'hariq' grass is rather difficult to burn properly and only certain grasses are suitable for the purpose."

(These species are listed by Burnett and the absence of Imperata is notable.)

"The ideal accumulation of grass is stated to be a 4-years growth, but this is probably seldom attained . . . A bed of old grass is highly prized and . . . is called 'wad lebūn'."

(p. 293) "The protection of 'hariq' areas is an important village obligation. . . The hot grass and forest fires which rage during the dry winter months are a source of great danger to the 'hariq' grasses which, if burnt at the wrong time, may cause serious financial loss and food shortage to the whole community."

Protection is by cultivating a strip about 100 meters wide around the 'hariq' area, by clearing fire lines around it, and by guarded protective burning of surrounding 'non-hariq' areas.

(3) Termite and Branch Cultivation. This is considered by Burnett to be a variant of permanent rather than shifting cultivation, but might be either. He says:

(p.294) "The plot of land to be rejuvenated is covered to a depth of anything up to 2 ft. with a mulch of tree branches to which the leaves are still adhering. These branches may have been cut from trees situated in the immediate neighborhood of the plot, or they may have been carried from trees growing a considerable distance away. After the mulch of branches has been spread, the plot is generally protected against goats by a small prickly barrier laid around it. In due course the leaves drop off the branches, the branches themselves are rendered into dust by termites, and by the end of the dry season the plot is once more ready for cultivation. Land badly affected by sheet erosion and unable to support a grass cover becomes . . . fertile in the space of about four months. Although the effect of this termite action is undoubted and rapid it is not certain whether the improvement can be attributed to a true manurial process or whether it is due to a sort of earthworm farming in which termites instead of earth-worms perform the work of the soil aeration.

"This system is not confined solely to the Dinka. Many other tribes follow the same practice, but on a smaller scale, and probably confine the spreading of branches to material cleared off the ground actually to be cultivated."

Burns, W., Kulkarni, L. B. and Godbole, S. R. (1931) Succession in xerophytic Indian grasslands. Journ. Ecol. Vol. XIX, no. 2, pp. 389-391. 2 pl. Aug. 1931.

This paper has a bearing on the effect of fire and grazing on land near Poona in the "rain shadow" area to the leeward (i.e., eastward) of the Western Ghats.

The authors fenced an area of grassland which was retrograding because of fire and overgrazing in order to see what the nature of the recovery would be. There was actual recovery to a certain point, but then retrogression to the point of soil denudation which came about in a most unexpected and surprising way, as follows:

"In certain portions of the land we left the grass uncut with the idea of allowing it to rot and so add humus to the soil; the grass, however, was so fibrous that it did not decay but lay on the ground, acting as a denuding agent, effectively killing vegetation, preventing germination of seeds and keeping the rains from reaching the soil. The areas which had been denuded in this manner by the overlying debris were in the following season invaded

by ruderals such as Vicoa auriculata. It will be seen, therefore, that the grass produced must either be cut, grazed (but not over-grazed) or burnt if it is not to form an obstacle to next year's growth."

The authors found that amelioration of degraded grassland was possible by contour embankments to prevent erosion and rotational controlled grazing or cutting. The usual village practice in the region is as follows:

"The village cattle are let loose every morning to roam over these lands, on which there are no fences of any kind. They begin to graze as soon as there is the faintest appearance of a green leaf and they continue throughout the year as long as there is anything left which is eatable. . . . At no time of the year, therefore, is there any tall stand of grass, since it is perpetually cropped level with the ground. In the hot weather, March to May, accidental fires generally sweep over the area, leaving it with a burnt surface."

Busse, Walther (1901?) Expedition nach den deutsch-ostafrikanischen Steppen. Bericht I-VII. [Berlin]: Kolonial Wirtschaftliches Komitee, n.d. [ca. 1900-1901].

In his illustrated account of an agricultural and botanical mission to the hinterland of Dar-es-Salam, Busse included some interesting pictures of east African prairie in which the widely spaced Acacias and palms were interspersed in the luxuriant tall grass. The flat region was not drained by permanent streams, however, although seasonally wet and having temporary ponds and water holes. In the hills, however, a saddle between Muheta and Talagwe Mts. was swampy, and here a running brook originated, where he collected the Raphia palm. From here, looking eastward he said: (1900, VI, p.) "In the evening a beautiful sight, even if seen unsympathetically, was the grass fire set by the natives in the 'Myombo' (Berlinia Eminii) woods, in order to smoke out the bees and get the honey!" After the valley had been burned out the fire ascended the mountains on both sides, later to continue its destruction on the other side of the ridge. The next day he journeyed through more 'Myombo forest' to Tanguli, the next watering place, a little place of poor aspect. Here the people kindled three fires which converged quickly on his camp, driven by the wind. There were indications that these fires were set with the object of smoking out unwelcome intruders rather than bees, but his men were able to prevent any great damage from being done.

The region traversed by Busse varied from saline flats to mountain forest drained by running brooks. The lower courses of the brooks were dry in the dry season, and the sequence of

vegetation from forest to thorn bush and then to grassland could be matched in many other parts of the tropics. The great salt-flat Marenga-makali appeared to be the bed of a former salt lake.

About the role of fire, Busse wrote (1900? V, pp. 2,3) of two old caravan routes from Tshunyo to Kilimatinde, that either would demonstrate to the observer the destruction wrought by caravans of bearers. Everything in the way of forest vegetation that escaped the periodic fires of the natives was gradually wiped out by the caravans. Countless trees were felled in order to use branches only to make temporary barriers against predatory animals, leaving the valuable logs to go to waste. The finest trees were always chosen for destruction. Cooking fires built against the fallen logs for protection from the wind, would be left smouldering, to start fires of greater extent. There were no regulations or local prejudices to prevent such damage, even though the preservation of forest was of the utmost importance in water-poor Ugogo.

Busse found the Mssanga district to be mostly open grassland, only spottily varied by thorn-bush. His camp site at Mssanga afforded a demonstration that the tree-prairie of Ugogo was not a natural plant formation, but a consequence of recurring fire. Only certain fire-resistant trees are to be found, which have escaped destruction either as individuals or as compact clumps. The most valuable of these for building material was the *Pterocarpus* known in Kigogo as mninga. A four hour's march brought him to Issala, reached through countless charred stumps, beyond which were wide stretches of mostly burned over grassland. His trip was made only six years after the exploratory trip of Fonks (1894) which had been preceded by that of Emin Pascha, so all this destruction was a consequence of the indigenous culture pattern, and not of colonization.

In the neighborhood of Ilindi, Busse left the valley, spotted with Hyphaene palm, and after ascending a hundred meters or so entered a forested plateau with such fine trees as he had seen at few places in Ugogo. There were thick masses of resiniferous trees, some, at least, being Burseraceae, and more open woods of the myombo. This type of forest he presumed to have prevailed in Ugogo before the advent of human destructiveness.

Busse, Walter (1907a) Das südliche Togo. In: G. Karsten & H. Schenck, Vegetationsbilder, Vierte Reihe, Heft 2, Taf. 7-12. Jena: Gustav Fischer.

Busse, one of the pioneers in the study of the effect of fire on tropical African vegetation, published a selection of his best photographs taken during a study tour in Togo, and in the accompanying elaborate commentary dealt particularly with the relics of former forest that could still be found fifty years ago

in country invaded by savannah and grassland. He was convinced that in Togo, a former west African colony now absorbed into Tanganyika one could see a vegetation recently subjected to basic changes. Now covered with a true steppe flora, there were numerous indications that not long before more humid conditions had permitted the existence of high closed forest, now represented by isolated individual species, out of place in their existing environment, and of little vestiges of plant associations characteristic of the Guinea forest. The presence of the relict types, obviously just persisting and not pioneer invaders, justified the view that southern Togo formerly supposed a flora much like the rain forest extending from Sierra Leone to the equator, broken only here and there by steppe. Through the action of man, by chopping and fire, reforestation had become impossible, at least with the type of forest that had been destroyed. Rather the land becomes covered with a vegetation appropriate to the present drier climate.

Hardly a day's march from the sea coast the grassland and "tree-step" (Savannah) begin, following the progress of deforestation, climbing the mountains even to the tops, changing the conditions so drastically that the soil has eroded away, leaving a surface on which forest regeneration is impossible. The grass is uncommonly high and thick, growing as much as 2.5 to 3.5 meters tall, and cutting off the view of everything unless near at hand. The growth consists mostly of five species of *Andropogon*, but the moister places in the prevailing xerophytic steppe have elephant grass, *Pennisetum Benthami*.

Every year in the dry season the natives set fire to the grass, which makes a raging conflagration. This, in southern Togo, is a custom connected with hunting. It brings about the destruction of all except fire-resistant plants. Certain trees take on a contorted and greatly branched aspect which Busse calls the "Zwetschenbaumtypus" or the "Combretum-type", naming it for a locally characteristic and abundant genus of the region which is not very tall and has that crooked knotty, contorted growth. Busse named four species that were known only from Togo. The region has intruders from the Sudanese flora to the north, and certain areas favorable for them are taken over by palms, *Elaeis*, the oil-palm, and others.

Among the forest-replacement associations Busse illustrates and describes an elephant-grass area with the introduced American kapok tree a landscape feature, and a grove of *Borassus* palm, which, like the *Hydphaene* or doum palm is found in grassland, transforming it more nearly into what we think of in the United States as savannah. These are not genera of the dense forest.

Busse convincingly presents the pictures of Togo vegetation as demonstrating the southward movement of the Sudanese zone into the former edge of the rainforest, an encroachment favored by the present climate and actually brought about by man.

Busse, Walter (1907b) Westafrikanische Nutzpflanzen. In: G. Karsten and H. Schenck, Vegetationsbilder, Vierte Reihe, Heft 5, Taf. 25-30. Jena: Gustav Fischer.

Busse has given especial attention to certain trees that have been widely distributed by man and that characterize what Ames would have considered primitive horticulture rather than primitive agriculture. Yet they are distinctive features of the tropical African landscape in regions of shifting agriculture.

The oil palm Elaeis guineensis occurs in Amazonian South America but is supposed to be a recent introduction there from Africa. An indigenous American representative of the genus, E. melanococca, has had its status questioned by Warburg who suggests that it may be merely a sport ("Spielart") of E. Guineensis that has been isolated from a complex consisting of various hereditary forms of this widely cultivated species and has become disseminated as a distinctive population but nevertheless a recent introduction. This seems highly improbable.

Elaeis guineensis may well have come over from Africa, an accompaniment of the slave-trade between the Gulf of Guinea and Brazil. It is indigenous in the west of Africa but was disseminated widely throughout the tropical part of that continent largely through the agency of man, but also by animals. It is likely to be found far from human habitation where it appears to be quite independent of man. Still, wherever there are villages of agricultural people, there also is the oil palm. It is a character plant of open places, and the open places are largely man-made. In this Busse agrees with Pechuel-Loesche, saying that it was found most frequently not in pure culture but in "half-culture", by which he meant that it was spared during the destruction of other plants to make a clearing or settlement. In cacao plantings it stands high above everything else, indicating that it was on the land before clearing.

Among the other great trees that are characteristic of village lands in tropical Africa is the kapok, Ceiba pentantra, which with the papaya was an early wanderer from tropical America. Ceiba has become a dominant of the cultural landscape in Africa.

Busse, Walter (1908) Die periodische Grasbrände im tropischen Africa, ihr Einfluss auf die Vegetation und ihre Bedeutung für die Landeskultur. Mitteilungen aus den Deutschen Schutzgebieten Vol. XXI, 2 Heft, pp. 113-139, 11 figs. on 4 pl., map. Berlin: Ernst Siegfried Mittler und Sohn.

This notable general contribution on the subject of tropical African grass fires refers to much literature. It refers to the astonishment and horror with which such fires were

viewed by the ancient Carthaginian Hanno, who was probably the first traveller who wrote about them. In modern times few visitors to tropical Africa have been oblivious of them, whether viewed merely as spectacles or as gigantic agents of destruction, leading to reflection on the reason, purpose and consequences. Every year, Busse wrote, the fires set by the Negroes reddened the night skies and left their mark on the scorched earth. Still, each observer of the burning of vegetation was likely to write about it after limited observation within a restricted area, which made generalization difficult. Busse endeavored to discuss his own observations in east and west tropical Africa in the light of the experiences of others. He called attention (p. 114) to von Danckelman's estimate that at least a fifth of Africa between the equator and the southern tropic had been sadly damaged by fire. Busse himself believed that man's activities determined changes in the total aspect of the earth as importantly as did climate and soil. Busse held that the chief modification of the tropical African landscape had been by felling of forest, and that the latter had begun with the very first and simplest form of agriculture. Agriculture, in other words, had been at the expense of forest, and did not, in tropical Africa, lead to the neat and orderly plantings of permanent agriculture, but to disorderly fields, which, unless reforested after abandonment, degenerated to savanas or grasslands. At any rate, the first objective of the aborigines in clearing forest by fire was to make plantings. Primitive tools in very early cultures were ineffective, but fire could be used for deadening trees.

Since the greatest productivity of a new forest opening followed the first burning, it must have been observed ages ago that there was some relationship between the ashes and the fertility. This would have led to repeated burning. So, Busse states, the second reason for use of fire was to fertilize the soil.

The third aboriginal reason for the burning over of land was that it facilitated hunting. It applied to land already more or less open, primarily to prairie. Busse skips over the point in his argument, but we must suppose that the laborious building of fires at the base of trees to kill them was wholly unrelated to hunting, although it might be to honey gathering.

Busse said that the fourth objective for destruction of forest by fires was local, not general. In East Africa, he said, the bees stored honey high in the crowns of the Savannah trees, in long bark receptacles hung up for them to use as hives. By fires the bees were smoked out and forced to swarm, thus leaving the honey to be harvested by the people.

A final and fifth objective of the natives for burning which applied to grassland, seemed to Busse so absurd that he could hardly bring himself to take it seriously and put an ex-

clamation mark after the statement of the natives that they brought about wholesale destruction of vegetation in order to facilitate travel, -- not liking to push their way through the tall grass!

He also enumerated the more weighty arguments of civilized man in favor of grass-fires that he had found, as follows:

- (1) According to Endlich, the reduction of Texas fever in America by killing of ticks, and the killing of various insect pests, including grasshoppers.
- (2) The control, according to Sander, of the Surrah disease of cattle, for the insect vector (tsetse fly) does not breed in grassland.
- (3) The control of the tick pest in Honduras, according to Sapper.

Down to the time he wrote, Busse found that legal measures had been taken to prevent grass fires in the Congo, in Eritrea, in Natal, in India, in Java, and elsewhere.

He concluded (p. 116) that it was a mistake to think that great steppes of extent similar to those now existing had occupied inner Africa since time immemorial and that they were an original plant formation.

Busse did not question the existence of primitive prairie, not caused by man. As examples of such, he indicated great stretches of the Massai steppe, the Borassus-palm steppe of southern Togo, and similar lands in Kamerun. These ancient steppes and presumably others in the central Sudan and in the region of the upper Congo are contrasted with newer steppes caused by more recent climatic change or by the agency of man. The latter are generally indicated by inclusions of areas more or less unmodified older vegetation which are interpreted as relic rather than adventive. It is the secondary steppe itself which is adventive, having replaced forest. Islands of the latter, such as isolated bits of old "Myombo" forest (of leguminous trees) in Ugogo, indicate the nature of what preceded the grassland. Only most exceptionally can it be considered that there has been complete reoccupation of artificial, man-made, prairie by forest approximating the primary type.

On the contrary, in East Africa and Togo the new vegetation, if steppe disappears, is of a xerophytic thornbush type. The end stage of deforestation and fire in drier areas is steppe. The climate is modified for the worse, soil fertility is impaired, forest resources of great worth are replaced by unproductive wastes.

Campbell, A. (1899) A Santali-English Dictionary. Pokhuria, Manbhumi: The Santal Mission Press. iii + 707 pp.

One of the more useful East Indian dictionaries for botanical or ethnographical reference is that of A. Campbell (1899) for Santali, a language included by Schmidt in a continental group of rather remote affinity to the Malayo-Polynesian (his Austronesian) group. It is spoken by a million and a half people over a strip of Bengal extending for about 350 miles from the Ganges to the Baitarni river. The author says (p iii) "The examples given are intended to show the more common use of the words and have been selected with great care. . . In some instances, rather lengthy references to customs, festivals, etc., have been made but as the work was intended as a help, not merely to a knowledge of the language, but also to a knowledge of the people, such references were unavoidable."

From the standpoint of the shifting (jhum) agriculture of eastern India the following equivalents of words and illustrative phrases are interesting: Jumi or jumin means land suitable for rice cultivation, but apparently not the prepared and sown land, which is barge, garden or field. Jumi may therefore be a Behari borrowing in Santali.

Ghas is grass in a very broad sense, including related sedges, etc. Although the languages are not easily seen to be related so far as similarity of words is concerned, one cannot fail to note the possible connection between Santali ghas and Toba Batak (J. Warneck, 1906) and Malay gagas, meaning abandoned cleared land grown up to grassy brush, second growth, or even forest. Reduplication in these languages is generally a device to indicate similarity or relationship. In the closely related Karo, spoken northward from Toba, the word is gégas (a partial reduplication) and means ground not long out of cultivation. Djoema (juma) gégas is a clearing which has been abandoned one or two years, and has grown up to grass — the ever-invading Imperata, and the re-clearing of such grass and bush land is nggégas. (See Joustra, 1907, p. 107). There are other Sumatran areas to which the word may be traced. (See Bartlett 1935, p. 294.) Khasi (or kasi) ghas is Saccharum spontaneum and the dictionary meaning of khasi is castrated or gelded. Nothing could be less sterile than Saccharum, and one suspects that the designation implies that the ground occupied by Saccharum is rendered unproductive.

There is a special Santali word which seems to be connected with jhum cultivation, namely bonwat, which means only "to relapse into jungle". The illustrative

phrased is translated by Campbell as follows: "it was cleared but has again relapsed into jungle." This is a clear indication of the primitive type of agriculture anciently general among the Santals and still persisting side by side with permanent land utilization with the use of the plow, exactly as in parts of Sumatra and other parts of Southeastern Asia and the Indian Archipelago.

One gets the impression that the few probably cognate words in Santali and the Sumatran languages are borrowings that followed similar ancient cultural contacts. The general vocabulary shows little demonstrable similarity.

Campbell, John (1864) A Personal Narrative of Thirteen Years Service amongst the Wild Tribes of Khondistan for the Suppression of Human Sacrifice, London: Hurst and Blackett. 320 pp., 7 illust., map.

Major-General John Campbell made incidental observations of agriculture in the hill districts of Orissa. This is a region which was renowned in ancient times as a seat of civilization but retrograded for centuries until a century ago it was inhabited by primitive tribes of animistic Khonds who were notorious for the prevalence among them of human sacrifice. In view of the region having once attained a much higher state of culture, one would not expect to find in it any very extensive amount of primary forest, and might even expect much of the area to have reverted to bush and grassland. Campbell found (p. 13) that:

"Much of the Khond territory is little better than a wilderness, although it comprises some thousand square miles, where valleys and stretches of level ravines occasionally intersect the forest of thick brushwood. Wherever the land is cleared, it is cultivated for rice or dhall, a kind of bran much prized for food. . . . Coarse grass and shrubs cover . . . acclivities, where no attempt at cultivation has been made. It is therefore interesting even if not surprising to find that the Khonds practised the most primitive form of tillage that is adapted to heavily sodded land, namely, turning the surface under by crow-bars. In 1838 Lieutenant Kittoe (quoted by Campbell, 1864, pp. 7; 8) found such tillage at Atturva, a village on the banks of the Brahmini. He wrote:

"I here observed a method of tilling the land quite novel to me; the fields are dug with long and heavy crow-bars; each clod, as it is turned up, is bruised with the bar, and thus prepared for the seed without using the plow; indeed, the stiff nature of the soil would not permit of

its being ploughed in the dry season. This practice I found to prevail throughout the valley of the Brahmini, which tract is very fertile."

The area where Campbell observed was the chain of hills extending north and south from the Mahanuddy to the Godavery rivers, 84-85° E, 19-21° N. He wrote of these hills (p. 37):

"They are almost inaccessible, and in 1836 there was not a single tolerable approach known to us The common bamboo, with the damur tree, is found in profusion, and covers the elevations on every side. . . . When once the summit is reached, . . . the eye beholds a well-watered and open table-land, producing luxuriently rice, oil-seeds, turmeric, and sometimes large crops of dhall(a kind of pea) and millet. Of the science of agriculture the people know absolutely nothing; they exhaust the soil with intermitted crops until the land is barren, then they abandon their fields and clear fresh jungle for future crops."

Further, Campbell said of a specific place, Tooamool, which was at such a high altitude that they often had hoar frost and thin ice:

"The inhabitants subsist on different kinds of maize, grown on the slopes of their hills, which are almost cleared of jungle, and cultivated to the top. Their rice cultivation is very scanty.

The whole Khond district is of especial interest because its regression in human civilization is a matter of historical as well as archeological record. The region was visited by the Chinese Buddhist pilgrim and some of the places which he visited have been satisfactorily identified.

Campos, Gonzaga de (1911) Mappa Florestal. In: [Brazil] Ministerio da Agricultura, Industria e Commercio, Relatorio apresentado ao Presidente da Republica dos Estados Unidos do Brazil pelo Dr. Pedro de Toledo. Vol. III, pp. 1-98. Rio de Janeiro: Directorio Geral de Estadistica.

An interesting commentary apparently intended as propaganda for the preparation of a phytogeographic map of Brazil (which, map, if ever published, the reviewer has not seen) was written by Gonzaga de Campos. It has an excellent bibliography of botanical exploration and travel, as well as a classification of Brazilian vegetation

and vegetational areas. He tells us, regarding the occurrence of campos along the Amazon, that from the mouth of the Xingu to the Trombetas the climate is drier and the vegetation is not so rich as either above or below, and that there are extensive campos and campinas bordering the river in the western part of Para.

Much of the Brazilian forest is secondary, not primary. The second growth (capuêrões), according to Campos, has essentially the same species as virgin forest, if closely surrounded by the latter, after twenty or thirty years of recuperation. He indicates that in general the method of cutting and burning forest had been taken over from primitive practice and was generally used by the Brazilians, and refers to the frequent destruction of forest not to plant crops at all but merely to plant capim gordura for cattle.

Carey, Bertram S. and Tuck, H. N. (1896) *The Chin Hills: A History of the People, our Dealings with them, their Customs and Manners, and a Gazetteer of their Country.* 2 vols. Rangoon: The Superintendent, Government Printing, 1896. Vol. I, v + 236 p. charts, 27 pl.; Vol. II, [i + ii] + cclv pp.

Carey and Tuck described the agriculture of the Chin tribes of Burma adjoining Assam and Manipur (21° 45' to 24° N.; 93° 20' to 24° 5' E.) before they had undergone any modification through foreign contact. They described it (p. 210, seq.) as follows:

"The land is never manured, but is enriched by burning the weeds and stalks of gathered crops on old ground and by burning the fallen timber on new ground which has been cleared for the first time. . . .

"In addition to the da [chopping knife] the only tools of husbandry are the short axe and the short hoe, neither of which is ever more than four inches broad at the edge. . . .

"The rice fields on the eastern slopes of the Letha range and all new clearings are prepared by chopping down all the trees and undergrowth on the side of a hill during the cold weather. These lie as they fall and are not burned at once as the high winds would scatter the ashes, but when the leaves and boughs are thoroughly dry and the time for rain approaches, fires are lighted and the timber is burnt as thoroughly as is possible.

"Rice can be raised on a new clearing two or three seasons running before it is necessary to let it lie fallow, and before each crop is sown the stubble and the larger timber which could not be consumed the first year are burned at the proper season. . . .

"The rice grown in the Southern Hills is not raised on heavy timber clearings as in the north or in dense bamboo jungle land as in the Lushai country but is grown on the ordinary soil on the ordinary hill; consequently the crop is always meagre and very uncertain, and the people grow it rather as a luxury than as a regular article of food.

"Fires in the cultivations are universal from 15th January until the rains, and smoke on the hillsides is so dense as to curtail the view."

The crops first planted in Chin clearings are rice and millet, which are sown separately and broadcast; sometimes cucumbers, pumpkins and melons are sown with the millet. Maize is planted in holes dug in straight lines with the hoe, with one or two grains in each hole, and sometimes millet is broadcast with it. Beans, pumpkins and cucumbers may be planted so that the vines may climb on the corn stalks. Job's-tears may be grown with this complex. The anclauck, a poisonous bean, of which three beans may be fatal, is planted in rows, as the maize is, and matures later than the grains. Its seeds are put in porous baskets and soaked in running water until soft and rotten before they can be safely eaten. In addition there are yams and sweet potatoes, planted at any time during the rains, and harvested by the use of pointed digging sticks. As for tillage of the soil, it is barely scratched. The Chin a half century ago had two types of fields, the distant clearing of big forest as much as ten miles from the village, and those which immediately surrounded the village, which may be presumed to have been used repeatedly after brush fallow. In addition they had kitchen gardens and fruit orchards within the village, and had therefore made a partial transition to permanent agriculture.

Catat, Louis (1895?) Voyage a Madagascar (1889-1890). Paris: l'Univers Illustré. n. d. 410 pp., ill.

Catat divided Madagascar on the basis of vegetation into three regions: (1) the region of the great forests, (2) the region of brush, and (3) the denuded region. He said that forest existed as a belt all around the island, but broadest toward the north, in the east divided into two parallel files, and in the south of little extent. On both East and West coasts the forest belt is separated from the coastal vegetation by a zone of human occupation in which clearings are made. In this zone of clearings bordering the forest are found the Betsimisaraka villages of the East and the Sakalava agglomerations of the West.

The forested region is steeply mountainous with deep valleys. The region of brush he estimated to make up three fifths of the island. The third or denuded region occupied only a fifth, and extended very little to the east and south beyond the countries of the Antimerina (Hova) and the Betsileo. It is in the denuded region that the population is most dense, for here agriculture is largely permanent, that of wet rice fields, and the remainder of the land is grazed by cattle.

The brush region extends toward the south and west from the central region. Catat pointed out certain correlations of two or three conspicuous plants with natural geographic subdivisions that gave a characteristic aspect to the landscape, as, for example the prevalence of the so-called "traveller's palm" (Ravanala) with the east-coast moist forest region and its sparse growth only in that part of the Sakalava region on the west coast where clearing of forest had made village sites. In the greater part of the brushland it was absent. The endemic Hyphene madagascariensis, however, the insular representative of the doum palm of arid to subarid north Africa, was abundant in and characteristic of the bush. Characteristic of deserted clearings only in the east was the ginger relative longoza, a species of Amomum.

Catat said (p. 217) that the only thing that the Sakalava did by way of improving foraging conditions for their cattle and other live-stock, which were never under any conditions fed, was to set fire to the brush and devastate the whole country. In the west especially the brush vegetation began to vegetate in December and was at the height of its development in March, when some of the herbs might have become as much as two and a half meters tall. Then by June or July the herbage and foliage of the brush would have dried up, and the custom was then to burn it off, for, forming a mass several decimeters, it would be an impediment to grazing when new growth appeared. The ashes fertilized the soil and the new sprouts of grass in December were immediately and easily grazed in the same month. In the meantime the cattle subsisted on a starvation diet. Catat condemned the burning over as barbarous, for it killed the young sprouts of trees and charred the bases of the older trees and shrubs. The fire of the Sakalava and the axe of the Betsimisaraka concurred in the general deforestation of the island.

Chalmers, James and Gill, William Wyatt (1885) *Work and Adventure in New Guinea, 1877 to 1885*. London: Religious Tract Society. 342 pp., illust., 2 maps. This book is quoted by O. F. Cook (1921 p. 311) as follows:

"A more primitive and yet distinctly specialized system of cultivation of grasslands is reported by Chalmers and Gill among the natives of southeastern New Guinea.

'The plantations are well cared for. We came upon a number of men in the bush preparing the soil for planting. The long grass had been burnt off. Now, for the digging up of the hard ground, several men stood in a row, each provided with a sharp-pointed strong stake. These are driven into the soil in unison; in another second the hard clogs are flying upward all along the line, reminding one of the perfect regularity with which a man-of-war's crew dig into the water."

Other reports of this method of turning the soil are referred to from New Guinea. Use of the digging stick seems to be exceedingly ancient and to have advanced into Melanesia in advance of the planting of rice. It is still associated with the planting and harvesting of root crops. In the food gathering stage, tropical man would probably have employed a digging stick for securing yams, aroid tubers and other such wild foods, and that would naturally become his first agricultural implement. It has been recently (and probably is still) commonly employed by the aboriginal tribes of India. It is still used in place of the too weak native plough among the Karo Batak of Sumatra for turning refractory sod (see von Brenner) but seems to have become rare as used for this purpose in the Indonesian region, although commonly used in Sumatra, Borneo, and elsewhere as a planting stick. It is used to jab holes in the soft ash-covered surface of newly cleared land, in which seeds of rice and other crops are planted.

Cardinall, Allan Wolsey (1931?) The Gold Coast, 1931
 based on figures and facts collected by the
 Chief Census Officer of 1931. Accra, Gold
 Coast: The Government Printer. n. d. 265 pp., 6 maps.

Cardinall (p. 5) quoted Chipp (maybe from a personal communication or from a census report) regarding the Soudanese zone of the Gold Coast, between the Guinea vegetation and the Sahara, as follows:

"The controlling factor is the annual grass fires which must now be considered in the light of a natural factor. Strips of the original closed forest are still found in its southern edges along water courses and on the south side of the hill masses. Beyond that savannah forest and savannah stretch away to the

north, the forest patches or isolated trees ever becoming fewer. In the west all the country north of 7° 30' belongs to this zone. As one proceeds eastwards the limits bear towards the south. . . In the east of the colony it has supplanted the Guinea vegetation right down to the sea front. It is now steadily progressing along the sea front . . . westwards. . . . The extension of corn and ground-nut farms . . . is causing the tall forests to contract inland rapidly and so preparing for the conversion of this country to the Sudanese vegetation."

Cardinall himself has the following remark on the advance of desert upon the savannah, just as the latter ever advances on the forest.

(p. 6) "Finally, in the extreme north the approach of the desert has already made itself apparent. Thorn-bush and sandy patches are annually growing larger and the writer is personally aware of fields on account of the advance of the sand having been abandoned as no longer fit for cultivation."

The restriction of certain tribes to definite ecological areas is mentioned by Cardinall. Thus he says:

"The population of these various zones differs, both tribally and in density. In the coastal area, at its widest, the greater number of inhabitants belong to the linguistically allied tribes known as Ga, Adangbe, and Ewe, and their area is comparatively thickly populated. The oil-palm and ever-green forest is the habitat of the Akan peoples and except for the more open areas their country is but sparsely inhabited. But even more thinly peopled is the adjacent area of the Savannah forest where the Guang division of the Akan stock is found. To their north is the true Savannah country where the Dagomba and tribally related peoples dwell and populate the country more and more thickly as one proceeds northward."

It is in the northern part of the Gold Coast that there has been least European influence on native life, and yet it was here that Cardinall found a remarkable attainment of permanent cultivation on dry land as opposed to wet, and with use of manures other than ashes. This almost unique development in tropical Africa is described (pp. 105, 106) as follows:

"The northern system of agriculture is unique in the Gold Coast and no full account of it has so far appeared. The general conditions of life in the Province are extremely primitive, and the religious beliefs of the people play probably the most important part in agriculture. The most striking feature of farming, whereby it differs from the practice usual in the Colony, is that permanent cultivation

is employed to a greater extent than shifting cultivation. The cause of this is pressure of population and its distribution and to the fact that the people have been long settled. No compact villages exist and each dwelling is surrounded by its own farm land which often is not sufficiently extensive even to allow of the usual rotation, and since each field touches on neighbouring fields no extension is possible. The crops cultivated are exclusively annuals, of which millet and guinea-corn predominate (75 per cent). Year after year these are grown in a system of mixed farming with other crops. Each year a small portion of land is manured with household refuse and animal manure, and a small portion is periodically fallowed. Many people also work subsidiary farms in the "bush", always some distance from their homes; on these shifting cultivation is sometimes practised, but often these "bush" farms are after a proving period built upon by the overflow from the house which originally started them.

"Such are the conditions prevailing in the Navrongo, Zuarungu, Kusasi and to a certain extent the Lawra-Tumu Districts. Elsewhere the thinness of the population permits of a system approximating that known as shifting cultivation. It is reasonable therefore to deduce that if the people can be taught to become cattle-breeders the area where success is most likely to be attained is that of the Dagomba Districts, and possibly a portion of the Lawra-Tumu District."

Other works of Cardinall which deal most interestingly with the relation of tribal religion and ceremony to agriculture and land tenure are these:

Cardinall, Allan Wolsey () The Natives of the Northern Territory of the Gold Coast: their Customs, Religion and Folklore. . . . With 22 illustrations and a map. London: George Routledge and Sons. New York, E. P. Dutton and Co. xvi + 158 pp.

Cardinall, Allan Wolsey (1927) In Ashanti and Beyond. Philadelphia: J. B. Lippincott Co. 288 pp., illust., map.

Chamisso, Adelbert von (n. d.) Reise um die Welt mit der Romanzoffischen Entdeckungs-Expedition in den Jahren 1815-1818 auf der Brigg Rurik, Kapitän Otto v. Kotzebue. Erster Teil, Tagebuch. Zweiter Teil, Anhang, Bemerkungen en Ansichten. Vols III and IV in: Chamissos gesammelte Werke herausgegeben von Max Koch. Stuttgart: Verlag der Cotta'schen Buchhandlung. n. d.

Chamisso, poet-botanist and naturalist of the Romanzoff Expedition, visited the Philippines and went to see the region devastated by the great eruption of Taal Volcano in 1754. The following description of the vegetation (vol. IV, p. 78) is scanty indeed, but interesting as indicating something about the revegetation of tropical areas denuded by volcanic action, which must, throughout all time, have been one of the erratic agencies that provided space for the continuous survival of grassland vegetation and for evolution of the species that are characteristic of areas cleared by man and kept open by fire and grazing.

He reported (as other visitors have also) that there was no lava flow in connection with the great eruption, only ashes, sand, mud, fire, and water, and that Taal island on which the volcano is located had scanty grass sufficient for the grazing of a few cattle. The forest which extended from the abrupt declivity that bounds Laguna de Bay, in which Taal island is located, to the shore south of Manila was interrupted by savannahs which alternated with forest all the way to the coastal mangrove belt. These savannahs Chamisso described as being burned either to prepare them, as he supposed, for cultivation, (but actually, of course any preparation of land for cultivation was forestland, from which fires might spread to the grassland) or to improve the grazing by providing the herds with younger grass. He told how birds followed the fire across the grassland, apparently in order to feed on the insects that flew up ahead of it.

Champion, H. G. (1936) A Preliminary Survey of Forest Types of India and Burma. Indian Forest Records, n. s., Silviculture, Vol. I, No. 5.

This frequently cited monograph has not been available for consultation and the following brief but exceedingly important paragraph is quoted from Bor (1941, p. 5):

"Champion (1936, p. 14) remarks 'in India it seems very doubtful if there are any examples of tropical Climax grassland, though grassland is common enough as a secondary seral stage and it may be a very stable pre-climax under the influence of fire and grazing.'" The author [i.e., Bor] agrees with this belief and with his further opinion (loc. cit.) 'the typical savannah type of other countries is also apparently absent as a true climatic climax, closed deciduous forest grading into thorn forest without any open park-like stage in the absence of biotic influences.'"

Since man is the chief biotic agent and since India has much grassland the conclusion is that much of the apparently non-cultural landscape of India is man-made. One is accustomed to regard as inevitable the transformation of forest into genuinely used permanent culture land, but it is shocking to realize that India, with a too crowded and largely undernourished population should never have developed any economic utilization of lands abandoned to unprofitable grass. Cattle raising and grazing are under present conditions largely uneconomic and detrimental to India because the superstitious reverence for cattle prevents their proper utilization. As a compromise to complete elimination of cattle, few might be maintained as objects of ritual, and the way would then be clear for solving one great problem of India, namely, the utilization of waste land now used only for grazing. The elimination of the half-starved herds and the reforestation of the grass lands or their effective use for agriculture would raise the level of human subsistence if the more "biotic" part of the human population did not promptly respond in the manner of the well-known rabbits of Australia.

Chapotte, _____ Garde General des Forêts (1898) Les Forêts de Masoala. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. IV, 19^e Livraison, pp. 870-889. July 1898.

Masoala is a peninsula between 15 and 16° S. on the east coast of Madagascar east of the bay of Antongil, which contained a mostly forested mountain mass of some 4,000 square kilometers, throughout which forest conditions were not greatly unlike those of most of the east coast region. The rainfall, however, is unusually great and there is no definite dry season. The rains diminish from September to December but there is no time when the forest clearings can surely become dry enough to be burned over. Here there is a region surely exceptional in Madagascar in that conditions do not favor fire.

Chapotte estimated that a tenth of the area was flatter and more fertile than the rest lying not too far from access by canoe, and that it was already being cropped, in pasture, or fallow. Most of the rest was difficultly accessible and the forest was essentially virgin. It contained no human habitations whatever. The landscape was characterized by much Ravenala (Traveler's palm). Only the perimeter of the peninsula was inhabited then by a small population of Betsimisaraka who exercised a disproportionately destructive effect on the lower-lying forest because they practiced only

one type of agriculture, namely the shifting cultivation of upland rice in clearings which were utilized for only two seasons and then allowed to revert. A substitute woody vegetation would restore soil fertility in from five to seven years.

From the standpoint of forestry a regrettable amount of the land had been or was in danger of being cleared for rice. Chapotte thought this could be prevented by establishing permanent wet rice fields where this could be done, and by restricting the land on which shifting agriculture would be allowed to that already cleared or fallow, amounting to a tenth of the total area. By using this limited area in a regular rotation and supplementing its yield by permanent wet rice fields, production could be maintained, but he thought the scattered population would have to be brought together into villages near which the fields would lie, if control were to be effective. The people preferred clearing old forest to second-growth if possible.

In addition to clearing land for temporary cultivation, the natives gathered forest products, especially ebony. The forest most easily reached for exploitation contained too great a diversity of species, and too few large trees of valuable species, for the latter were constantly depleted by selective cutting by the inhabitants for making canoes and for other purposes of construction.

At any rate here was one area where man had been unable, because of high rainfall and too definite a dry season for primitive agriculture and fire to destroy much of the native flora. The forest here should still be of great interest from a botanical standpoint in that it is not in such precarious equilibrium with the environment that it is likely to have been entirely destroyed or any of its species to have become extinct through man's agency. It occupies an area which has always been moist so far as there is evidence, and where the distinctive xerophytes of the Madagascar flora have never existed. The latter evolved in the center, west, and south, where, it would seem natural long-continued climatic change made their tenure precarious and man upset a system already in unstable equilibrium by the introduction of fires and grazing.

Charon, A. (1897) Etude sur les Prairies et l'Elevage du Boeuf dans le Pays Sihanaka et le Haut-Bouéni. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. II, No. 12, pp. 561-591. Tananarive: Imprimerie Officielle. Dec. 1897.

A. Charon was one of the several French occupation officials in Madagascar who published their observations on the replacement of forest by grassland, and on the deterioration of the grassland by burning, but their conclusions have been largely ignored by botanists who have developed the subject more recently. Charon fully realized that the forest of the east had formerly extended farther into what had become, before the turn of the century, devastated prairie. He made a collection of plants and an album of 32 pictures, the latter for preservation in the museum at Tananarivo, to authenticate his use of vernacular names of grasses and other plants. Part of these were identified for him by someone, but a certain degree of unfamiliarity with the scientific names is revealed in such misinterpretations of the botanical collaborator's presumably bad handwriting as the misspelling "Armiis" for "Arundo". Such little faults are easily recognized, however, and the article is a worthy pioneer effort to interpret the prairie of the central plateau of the province Imerina and a great extent of the adjoining regions. He clearly pointed out the disadvantages and danger that resulted from the brush fires and the necessity of limiting them even if they were to some degree essential for the industry of cattle raising. The latter, in view of the almost complete restriction of agriculture to wet and irrigated lands, was the other chief subsistence occupation.

Charon's general account of brush and grassland burning is excellent. He recommended two reforms in general procedure in the matter of pasturage, namely, the making of hay for feeding during the dry season and some sensible and enforceable restriction of the general burning-over of land. He stated that burning, carried out by everybody on anybody's land, was so general that it was practically universal, and an unburned piece of land was exceptional. Burning during the time of the Hova conquest of the other tribes had some justification in that it enabled villagers to have a wide view to the horizon for a time, to see if enemies were approaching. Burning-over for the purpose of improving the pasturage had been believed in for so long that it was a well established tradition to burn, and everyone ignited whatever dried grassland he could, because it was believed to be an essential and useful custom. Charon condemned it as harmful and savage, and the impulse to burn as a hereditary mania!

Chemin-Dupontès, Paul (1909) La question forestière en Indo-Chine. Bul. Comité de l'Asie Française, Vol. IX (Année 1909), whole No. 101, pp. 340-348. Paris: Com. Asie Française.

One of the great difficulties of establishing forestry on a sound basis in Indochina was the ancient practice called ray, a local word for shifting agriculture. It had been going on since time immemorial, and had the familiar aspect of felling forest, burning the debris, cultivating the clearings for a season or two, and then repeating the process. The French policy was not to prohibit ray, but to confine it to the areas where it had most recently been practiced, assigning to each social unit that lived by shifting agriculture an area sufficient for a ten-year rotation from clearing to cultivation. The forest would have grown enough in ten years so that the ashes of the new growth would serve to fertilize the soil, and no cutting of untouched old forest would be required to keep the system in operation.

The ten-year cycle would attach the inhabitants to a definite locality and would stabilize the population, which would be impossible as long as people could shift location as they wished and destroy the forest on any unoccupied land that they wished to clear.

Ray had been responsible for the disappearance in great part of the primary forest in Indo-China. The ten-year cycle system was first put into operation in the province of Honquan, Cochin-China, and in the provinces of Son-la and Quang-yen in Tonkin. The initiation of such a system, looking toward the ultimate prosperity of the country, would probably never have come about except under the colonial system, and the land would ultimately have been as thoroughly devastated as much of China.

The transformation of ancient destructive customs could not fail to arouse some antipathy at first but as Chemin-Dupontès said, from whatever side one looked at the question of forestry, one could only come to the same conclusion which was that the forest had to be conserved, developed, protected, and exploited to the advantage of all, and because it was indispensable for the amelioration of climate, the regulation of streams and the agriculture of the whole country. One hopes that recent political events have not resulted in the release of restraints so wisely imposed by the colonial government.

Chevalier, Aug. (1909) L'extension et la régression de la forêt vierge de l'Afrique tropicale. Comptes Rend. Acad. Sci. Paris, Vol. 149, No. 8, pp. 458-461. 30 Aug. 1909.

Chevalier pointed out that the flora of the virgin forest of the Ivory Coast was remarkably uniform from the coastal plain up to an elevation of 1200 m., higher than which there were no forested summits. The virgin tropical forest of the equatorial type was however in process of retreat on its northern border before the Sudanese forest bush or savannah. Agricultural clearings abandoned after two or three years were reforested by the Sudanese bush type of vegetation, and the same thing was likely to take place within the forest at higher altitudes, where the replacement vegetation down to about 700 m. elevation might be a mixture. In some places within the lower forest, but not at the edge, the replacement species were from the equatorial tall forest, but there were some thirty or perhaps ten times as many as grew in the original forest. So the virgin forest, in spite of apparent continuity, was in retreat at the north and clearings within were not the rich entire forest but an impoverished mixture of certain species with easily disseminated seeds. So, in 1909, Chevalier advocated that colonial governments should take measures to regulate forest clearing and to reserve rich forests yielding useful products.

Chevalier, Aug. (1928a) Sur l'origine des Campos brésiliens et sur le rôle des Imperata dans la substitution des savanes aux forêts tropicales. Comptes Rend. Hebdomad. Acad. Sci. Paris Vol. 187, No 22, 26 Nov. 1928, pp. 997-999.

Since the time when Sainte-Hilaire (1831) classified the prairies of central Brazil as campos limpes, without trees or with only depauperate ones, and campos cerrados, with isolated trees, the artificial ones had been gradually extended by a century of deforestation, abandonment of agriculture, and annual fires. Chevalier observed that there were two types of primaeval forest in middle Brazil, the one equivalent to the equatorial virgin forest of the Amazon, of equatorial Africa and of the Indo-Malayan region, the other xerophilous with deciduous-leaved trees, similar to the Sudanese bush and to open forest of Indo-Malaya. The first type is that generally destroyed for agriculture in Brazil, now, and by primitive man before him. In both hemispheres the reason for premature abandonment of the cleared land

is the growth of grasses of the genus Imperata, called sapé in Brazil. The savannahs thus formed are the alang of Java, the cogonales of the Philippines and the sapesaès (or sapesales) of Brazil. If Imperata prairies are invaded by trees secondary forest (the caapueras) are constituted, and the Imperata disappears within a few years as the shade increases. This, however, is generally prevented by the annual prairie fires which constitute a factor comparable to the effect of climate, and cause continued degradation of the ancient forest soil.

Chevalier, Aug. (1929b) Sur la dégradation des sols tropicaux causée par les feux de brousse et sur les formations végétales régressives qui en sont la conséquence. Comptes Rend. Hebdomad. Acad. Sci. Paris, Vol. 188, No. 1, pp. 84-86.

Chevalier, continuing the topic of the preceding article (1929a), calls attention to the reduction of endemic species to the vanishing point in forest lands of Brazil cleared for agriculture, abandoned, and subjected to burning. On such areas, if the soil is not too acid, the introduced African grasses Melinis minutiflora and Tricholaena rosea are likely to become dominant. On acid areas Pteridium aquilinum (Pteris caudata of Saint-Hilaire) takes over the land. If brush fires (or "wild" fire, to use the expression of Perrier de la Bathie) continues, hardly anything will survive except pantropic plants adapted to surviving fire and certain woody plants called pyrophytes or fire plants which develop a special type in the burned-over land, being dwarfs capable of flowering constituting, Chevalier believed, veritable races. [Such natural selection of possible genetical types by fire should by all means be investigated experimentally, as Brandis so long ago hoped would be done in India!] In Brazil the pyrophyte flora seemed to Chevalier to be analogous to that which Perrier de la Bathie and Humbert described for Madagascar.

Chevalier believed that the formation of laterite was accelerated on burned over prairies. Although he may have been one of those who think of "lateritization" as a process that happens quickly, he guardedly considers the possibility that laterite may merely have appeared at the surface following the burning-out of humus from the top soil and the removal of the latter by erosion. In reading of "rapid lateritization of the soil" in the publications of tropical agriculturists and others one is tempted to wonder if they mean "rapid appearance of laterite at the surface following erosion."

Chevalier compares extremely degraded states of the prairie in Brazil and Madagascar, pointing out that the last grasses to persist in both belong to the genus Aristida, -- A. pallens in Brazil and either A. similis or A. rufescens in Madagascar. The meager clumps of Aristida are so far-spaced in Madagascar that the prairie which they characterize will no longer propagate a fire. In West Africa, according to A. Lacroix, the last stage of degradation is that in which the unconsolidated lateritic soil has been eroded away from a hard shield of denuded ferruginous conglomerate, on which there are no higher plants except those rooted in fissures and certain Cyperaceae which appear to grow somewhat in the manner of epiphytes, accumulate little deposits of humus from dead leaves etc. and eventually provide places for the germination of other plants. Such is the process by which ferruginous flats become covered by humus and vegetation in French Guiana. Likewise in some centuries lateritic shields such as those in the Haut-Chari, for example, might become revegetated.

Chevalier, Aug. (1933) Le territoire géo-botanique de l'Afrique tropicale nord-occidentale et ses subdivisions. Bull. Soc. Bot. France, Vol. 80, No. 1-2, pp. 4-26. Jan. - Feb. 1933.

This article of Chevalier reduces his African phytogeographic studies of a third of a century to small compass, in the form of a geobotanic map of West Africa and comments upon it. Chevalier, long a prolific and frequent author on the botany of West Africa expressed a very intolerant opinion of the work of Shantz (1923) which would seem to be based largely on difference in point of view. He stated that Shantz had not visited West Africa, but had based his mapping of that part of the continent upon Chevalier's earlier map of 1912, re-published in 1920, but with the addition of certain modifications, which, Chevalier said, corresponded to no reality but sufficed to dress up an African phytogeographic map in many tints corresponding to the most extreme fantasies.

The present reviewer does not happen to know whether Shantz replied to this onslaught or not, but ventures to suggest that mapping of a whole continent required not only what travel one person could reasonably undertake but likewise the use of the literature, not only the many useful publications of Chevalier, but others as well. Likewise, the various aspects of the same vegetational area may not have impressed different

observers alike. Some are greatly impressed by geographic limitations of certain families or particular species, whereas others are more concerned with landscape, with the appearance of vegetation in the mass. Some are soil-conscious and others not. So, without wishing to seem critical, one wonders if Chevalier's "geobotanic" map is not somewhat fantastic itself. It represents six zones crossing West Africa more or less parallel to the equator but trending somewhat to the southeast. In this he agrees with others. His subdivisions (there are twenty in all) are mostly (except along the Guinea coast) achieved by arbitrary straight north and south lines, than which nothing could conceivably be more fantastic. He mildly apologized for this, but explained that in the absence of more precise information despite his own 75,000 kilometers of itineraries and 43,500 numbers of herbarium specimens, nothing better could be done. He might have tried referring more extensively to the literature, as Shantz did!

From the standpoint of tropical agriculture and grazing we are especially concerned with the advance of the failure of closed forest to reestablish itself on cleared land at the edge of the nuclear equatorial forest. Chevalier (p. 18) said on this point that a greater part of the Guinean region had formerly been occupied by the great forest. The conditions parallel those of the savoka of Madagascar. As primitive agricultural clearings eat into the edge of the forest there is no return of the same kind of forest. The replacement vegetation is brush or savannah which is submitted every year to fire and which survives only underground. Consequently nothing persists which has no capacity for renewing its growth seasonally from below the soil level. Thus all possibility is precluded of the rich and highly diversified flora of the old hygrophile tall forest reestablishing itself. The gallery (boundary) forest of streams is almost all that remains in the devastated region to indicate what the vegetation was formerly like. In addition there are some islets of tall forest that more or less accidentally remain as isolated remnants. In contrast with these are certain areas of primitive savannah isolated within the forest, as well as here and there along the sea where they are subject to periodic inundation.

Chipp, T. F. (1926) Aims and Methods of Study in Tropical Countries with special reference to West Africa. Chapter X (pp. 194-237): in Tansley and Chip (1926) q. v. Chipp (p. 226) said of The West African rain forest:

"In regions where the forest is not in contact with the Parkland, it is only the destruction of the forest for shifting cultivation that changes its composition. Forest certainly reappears when farms and villages are abandoned, but it is an impoverished forest, comprising only some thirty species of trees as compared with the 250 to 300 species of big trees in virgin forest. . . . All of these have light wood. . . . Thus the virgin forest . . . is being transformed by shifting cultivation into a comparatively worthless type, although the forest still appears to be continuous and superficial inspection does not detect the difference." . . . "Whereas within the Closed Forest destruction normally gives secondary forest, and so, by long stages, succession leads back to the Closed Forest climax, in the forest ecotone adjoining the Parkland, destruction is more often followed by invasion of the surrounding Parkland flora and conversion of the vegetation into Parkland with grasses, herbs, and trees of a different nature.

"Within its climatic zone, Parkland vegetation may be considered a climax. The climatic factors, to which must be added fire, prevent its ever becoming an entirely closed forest, but the herbaceous covering is complete except where interrupted by stretches of bare rock. This type reestablishes itself if permitted, but is more subject to man's interference than the closed forest, and is more likely to be succeeded by the treeless grass vegetation which normally occurs under more arid conditions."

(p. 228) "Fire plays such an important rôle in most parts of the tropics that it merits very careful consideration, both in regard to the causes contributing to its influence and in regard to its effect. Pre-eminently the fire problem depends on the shifting-cultivation system . . . and its concomitant evil of the grass 'farm-cleaning' fires, though grass fires are also to be attributed to other causes, such as hunting. Instances have been recorded of fires originating from what may be considered as natural causes, such as lightning, and boulders falling onto rock, when the sparks from the contact start fires, but they are very rare, and in West Africa have not been observed. . . .

"When once fires have been started, they may carry on over enormous tracts of country, and may, or may not, occur over the same area each year. These annual grass fires, which sweep over the savannah country in all parts of the tropics, have occurred for such ages that they must be regarded as natural -- albeit an anthropogenic -- factor of the environment. The origin of the vast majority of the fires

is twofold. . . In the one case it is the farmer who fires the grass to clean his farm, and, in the other, it is the hunter who fires the grass to drive the game.

Retreat of virgin forest [is] not due to fire, but to shifting cultivation. There is no doubt that the virgin African forest formerly extended well beyond its present boundaries. Its destruction and withdrawal are not due to fire as the causal agency for it is only where the forest has been cut and allowed to dry off that fires can develop. . . . In the virgin forest the general burning of vegetation never occurs. . . . Where the original forest no longer exists as a whole, but traces of its former extent are seen as fringing forests or isolated relict clumps, it is solely due to the native cutting the trees to make clearances for farm, that the destruction has taken place. . . .

(p. 230) "Where the forest is replaced by Parkland vegetation most interesting problems are presented in the relations of the two regional floras concerned, namely, the invading Sudanese vegetation and the retreating Guinea forest."

(p. 232) "The study of the distribution and habits of the native populations is important, because to these may be attributed removals of large areas of forest, changes of trade routes, or, through political insecurity, the abandonment of farming in open country, with a consequent change in the vegetation.

"Examples have been well described by Meniaud in his treatise [Haut-Sénégal Niger] on the economic geography of the French Sudan, where he discusses the pasturing of the flocks and herds of the nomad tribes. The destruction of vegetation by pasturing is most apparent in the 'Zone Sahélien', that is, on the northern outskirts of the area of vegetation to the south of the great desert. There, where herbaceous vegetation is only occasionally met with in the prolonged dry seasons, the nomads are obliged to feed their herds on the leaves and branchlets of the shrubs and plants. . . ."

(p. 233) Occasionally patches of woodland or forest [in West Africa] have their composition altered through the reservation by man of certain species for economic purposes, or the cutting out of others which he specially desires. Forest, in which, for instance, Cola acuminata (The Cola of commerce) occurs, is gradually turned into a natural Cola stand by the natives, who free the mature and young trees by cutting the forest immediately surrounding them, and thus encourage the growth of naturally

regenerating seedlings. The reverse is seen in the areas of the dense forest in which the African Mahogany trees (*Khaya ivorensis*, etc.) have been exploited, but which still retain their original composition except for such species as are removed for timber purposes.

"In the open country similar instances are observed. The *Butyrospermum* in West Africa, the *Chlorophora* in East Africa, the *Hymenocardia* in the Congo savanna country, are present in excess of their natural occurrence through being spared and sometimes encouraged by the natives for their economic value, while trees that naturally occur with them are neglected, cut down, or burnt.

"Instances have been observed, though very occasionally, of the natural regeneration of forest in savannah country through man's assistance. Areas which have been protected from fire have been encouraged to grow the oil palm, and in the shelter of these 'palmeries' the forest species have reappeared and taken possession, turning such areas into forest.

Chipp, T. F. (1927) *The Gold Coast Forest: a Study in Synecology*. Oxford Forestry Mem. No. VII. Oxford: Clarendon Press. 94 pp., 36 figs., map.

Chipp conducted a notable survey of the vegetation of the Gold Coast. The results were of profound significance as a warning of what might be expected to happen, in the wake of what has already happened, if man's uncontrolled destructive activities in deforestation were not curbed. The following quotations indicate the findings of his valuable ecological study in so far as they relate to the advance of desert conditions resulting from primitive agriculture and fire.

(p. 7) "In addition to the productive economic aspects of such a study the protective economic side is of equal importance. Such a study will reveal what parts of the country it is vital to keep afforested, for instance, to stay the incoming effects from the desert to the north, over what areas forest will naturally replace forest after destruction, what protection is required for the natural water resources of the country, and whether hill systems or isolated peaks may be deforested with impunity. . . . The value of the economic interpretations resulting from such study cannot be overestimated in the case of a country almost entirely dependent on the character and maintenance of its vegetation,

not only for its material wealth but ultimately for the very existence of its inhabitants. A narrow strip of country abounding in natural and easily exploitable wealth and actually 'sandwiched' in between an ever-encroaching desert and the sea is literally dependant on scientific management to retain its existence".

(p. 17) ". . . . it is within the coastal belt of vegetation that the Gold Coast Forest is situated. . . . Behind this [mangrove and swamp] strip the lower altitudes and at least the valleys of the uplands are occupied by high Closed Forest freely interlaced with lianes, but there also exist large cleared areas covered with tall grass and carrying an agricultural population. Further inland [i. e., to the northward] again the mountainous regions, or, in some cases, the undulating plains and laterite plateaux are covered with isolated trees or open woodland standing in a closed grass cover and resembling in general physiognomy the Parkland vegetation. . . . In this type of country the river courses are often bordered by a thick tangle of vegetation or strips of Closed Forest."

(p. 21) "North of the forest belt the distribution of the flora is in general direction east and west right across the Sudan to East Africa, with north and south connections along the east side of the continent. The area of Parkland immediately surrounding the Gold Coast Closed Forest, however, contains representatives of the Forest flora left behind in its retreat towards the coast, as well as the advanced migrants of the Sudanese flora."

(p. 66) "What the original transition area was like when Forest and Parkland held each other in check in a state of nature cannot be surmised from the evidence provided in the Gold Coast at the present day. Before the local inhabitants had become tillers of the soil and were still primitive hunters fire was probably used to drive their game, and so man's aid has been given to the Parkland against the Forest for so many generations that all traces of the original forest edge or the conditions under which it existed have long been swept away."

(pp. 66, 67.) "In the south of the country a broad wedge-shaped area of Parkland vegetation has been driven between the forest and the sea. . . . The destruction of the forest, which is progressing year by year, is here entirely due to farming. The fire factor is not so pronounced, however, as it is along the eastern and northern edge of the forest. . . . Some of the abandoned farms are covered with grasses, but over large areas they change to pure stretches of the Oil Palm which arise from seed introduced and assisted by the farmers when these areas are under cultivation."

"The transition along the inland edges of the forest is in marked contrast. Islands of grass with typical burnt Parkland trees occur some distance within the Closed Forest on the sites of abandoned village farms [i. e., shifting agriculture]. Year by year, as patches of ground are cleared by fire, these islands of grass and trees grow bigger and bigger. After a while the intervening emaciated belts of the original continuous forest are broken through and the grasslands become joined. The aspect of the countryside then becomes changed and it is the forest that appears as islands in the long sinuous stretches of Parkland. Later still it is only in association with streams, swampy ground, and escarpments with their springs that forest patches can hold out."

(p. 68.) "In the transition area surrounding the Closed Forest the general factors favor the Parkland vegetation except where additional ground water supplies permit development to the state of forest. Forest is not able, however, to develop over all such areas favorable to it, for the biotic (human) factor is thrown into the balance against it in favor of the grass vegetation.

"The comparatively dense population along the edge of the Closed Forest practises its shifting system of cultivation continuously; always, however, at the expense of the forest. Cultivation is naturally carried out at first over the higher ground and the swamps and low-lying forest ground are left. Grass follows on the abandoned farms, but in the wetter areas the density of the original forest is able to keep out the grass for a considerable period. In course of time these areas of forest become narrowed to 'Fringing Forests' and are all that are left of the original forest of the country. Later, again, they become further reduced and finally exterminated as the Parkland inhabitants destroy them in cultivating their domestic crops."

Here might be added, by way of reviewer's comment, that in its later stages reduction of forest puts ever greater pressure on what little fringing forest remains, as a source of timber for boats and other construction and for fire-wood, so that fringing forests ultimately go even if the land is unsuited for cultivation. Chipp goes on to say (pp. 68, 69):

"In the Fringing Forest the floristic composition is that of a Closed Forest community except where mictia [admixture from other plant associations] occur through the invasion of Parkland species; Elaeis guineensis [oil-palm] is common, arising from habitation and farming; no regeneration of Fringing Forest species was noticed; Thus the Fringing Forests are

this area are simply to be regarded as the last points at which the retreating Closed Forest holds out under the most favorable edaphic circumstances."

The grassland into which the closed forest is transformed is described by Chipp (p. 69) as follows:

"Where a view is permitted the traveller sees a rolling country with scattered, more or less stunted trees, with islands of woodland, and with scattered and grouped bushes forming dense thickets, while through all runs the carpet of herbs and grasses, many of the latter reedlike, or almost like slender bamboos, reaching a height of 6, 9, or even 12 feet. A few steps farther and the view is lost, the winding beaten track enters again between the impenetrable walls of tall grasses, which shut out view and breeze and leave the traveller to wend his way under the burning sun in sharp contrast to the moist cool shade of the forest. . . . In the season of drought a more extensive view can be obtained when the grass and foliage has been burnt; the bare trees stand out clearly in relief, their twisted, gnarled, and blackened branches contrasting oddly with the well grown and vigorous forest trees which fringe the streams and water-holes.

"In December and January the desiccating Harmattan wind blowing from the desert to the north. . . . withers the herbs and causes the trees and shrubs to shed their foilage, thus preparing for the great fires which sweep over the plains until brought up against a wall of humid forest along a watercourse. These fires have occurred for so many centuries that they must be regarded as a natural factor. . . . The origin of these fires in the remote past appears to be the same as it is today, namely, the hunter firing the grass to ensnare his game or the farmer clearing ground for his crops. Small fires lighted for the convenience of the villager extend to a mighty conflagration, which sweeps across the whole country. That they have occurred from time immemorial may be gathered from the chronicles of Hanno's voyage, which took place before 480 B. C.,"

Cleghorne, Hugh [Francis Clarke] (1861) *The Forests and Gardens of South India*. London: W. H. Allen and Co. XV+412 pp., 13 pl., map.

It is now a century more or less, since Cleghorne, Conservator of Forests, Madras Presidency, was concerned with the problem of kumari cultivation (shifting agriculture) in Madras. The background of the subject of forest conservation (or conservancy, as the English say) in India and Burma is briefly indicated by Cleghorne as follows (pp. v-xi):

"It is only of late years that attention has been drawn to the importance of conserving tropical forests. The necessity of organizing a system, whereby it would be possible to control the clearing of indigenous forests, did not at first present itself, especially as advancing civilization and an increasing population apparently indicated an opposite course of procedure. . . . The matter of complaint was that throughout the Indian Empire large and valuable forest tracts were exposed to the careless rapacity of the native population and especially unscrupulous contractors and traders, who cut and cleared them without reference to ultimate results and who did so, moreover, without being in any way under the control or regulation of authority. The results of this wholesale and indiscriminate denudation gradually became apparent, and rendered it imperative that measures should be taken to organize a system of forest administration to economize public property for the public good. . . .

"The forests in the Tenasserim provinces were brought at a comparatively early date under a system of conservancy. . . . The somewhat chequered history of these provinces exercised an important influence on the question of forest administration, both in Madras and Bombay. The earliest reports published are those by Dr. Wallich, the first of which was dated as far back as 1827, and refers to the Salween Forest, north of Moulmein. The result of his labours may be said to have laid the foundation of a system of conservancy, without which it would soon have become impossible to maintain even the existence of our most valuable Eastern forest. . . .

"In 1805 the Bombay Government for the first time laid claim to the indigenous forests of the western coast. . . . From this period up to 1822 a partial and somewhat ill-advised attempt at conservancy was made, but it thoroughly failed in its object and all the restrictions which had been imposed during its existence were removed. This relaxation or, rather, abandonment of law, however, in course of time led to results which threatened the speedy and complete destruction of the forests. . . .

"It ought to be stated that the greater part of the contents of this volume are on record in the Archives of the Madras Government. . . . It is simply a compilation of papers followed by a memorandum on Kumari, -- an injurious practice, which destroys vast quantities of the most valuable timber. . . ."

The document on kumari or slash-and-burn agriculture is the most extended one that we have for the period. It consists of a series of letters and opinions of supposedly informed persons, pro and contra, addressed to the Government and various official documents including a final order regarding kumari.

Extracts follow:

(p. 126; Cleghorn's own recommendation of 1858): "It is not possible, nor is it desirable to suppress the kumari cultivation altogether, as the growth of the various millets is necessary to the alimant of certain classes of people; but I think it should be greatly limited, and not permitted on the banks of navigable rivers, on the sea-shore, close to trunk roads, or in any locality where superior timber exists. The revenue is trivial compared with the value of the wood lost to the state, and it is well-known that in the unfrequented valleys of the ghats much kumari takes place without the knowledge of the Revenue officers, European or native. In every case when kumari takes place without sanction, the cultivator should be severely fined. In this way the destruction of virgin forests has been brought under both in Mysore and in the Mahratta country. I do not here allude to the private lands of Malabar, with which I have nothing to do."

(p. 127; recommendation of T. L. Blane, Collector of Canara, to Board of Revenue): "The practice of kumari cultivation is one of so wasteful and improvident a nature that it ought not to be tolerated except in very wild and unpeopled country, and the time seems to have arrived when it would be most advisable to place it under considerable check and regulation if not entirely to prohibit it. This latter course, I must observe, the authorities in Mysore have only within this last year thought it necessary to adopt. It was never permitted under the Rajah's government, and can only be said, therefore, to have been in operation for twelve or fifteen years at most; yet, so rapidly has it increased, that the superintendent of the Nuggur division has determined on putting a stop to it, with a view to the prohibition of the woods which still remain."

It will be observed that the ancient practice of kumari had been prohibited for an indefinite time prior to about 1833, for Mr. Blane dated his letter 1847. How long it may have been in discontinuance does not appear, but the twelve to fifteen years of kumari which preceded 1847 had allowed the destruction of too much forest. Still, Mr. Blane continues, one presumes with reference not to Mysore, but to southern India in general, as follows (pp. 127, 128):

"I am not disposed at present to recommend its entire prohibition; but I think it would be well to do so in all places accessible to the seaports whence timber and firewood could be brought down, and to place it under regulation in every other part of the district. The revenue paid upon this destructive kind of cultivation is very trifling; and if the wood were preserved in accessible spots, the duty upon the export of timber and firewood would, under proper regulation exceed it tenfold. I have particularly noticed the destruction which has taken place of forest on the hills immediately above the fine port of the Tadri, where it would have been very valuable, from its

vicinity to the coast. The forests which have been here felled and burned, and the magnificent trees which have been left to rot on the ground, would have supplied the market at Bombay with firewood for years. The same fact has been noticed by Mr. Forbes, my head assistant.

"I have referred above to the manner in which the practice of kumari cultivation has increased of late years. It was formerly confined entirely to the race of wild and uncivilized people who dwelt habitually in the jungles; but others have since taken it up, and many of the ryots from the plains, and others who have come from the Mysore and Mahratta country, have adopted it as a means of livelihood. There is little doubt also that the prohibition of this practice in the Mysore country will drive a great many of those who have carried on their operations in the forests of that country into Canara, and the destruction will thus be carried on more rapidly than ever, until the woods are finally exhausted. Independent of these considerations, it is not a pursuit which it is at all desirable to encourage the people newly to engage in. It has no doubt some attraction for those who are impatient of control, and are fond of a wild roving life; but it leads to unsettled habits, and takes many away from the regular cultivation of a fixed spot."

The writer of the next communication quoted by Cleghorn disapproved of kumari cultivation but without any vision of the future needs of the country and without looking beyond the crude means of transportation that existed in 1847. Furthermore, he had no conception of the need for forest cover to prevent erosion and floods. Mr. G. S. Forbes, sub-collector of Canara, wrote (p. 128, 129):

". . . . To abolish this species of cultivation would deprive a great number of persons of their accustomed means of support, and I have only therefore to suggest that the cultivation of kumari be forbidden in all localities where trees for timber or firewood are likely to be felled; such localities may be determined by the means of carriage which exist. On hills and on tracts distant from the lines of water-carriage, the timber consumed could not be turned to any other account (it being always understood that no teak or sissoo, &c., should be touched). The above remarks apply chiefly to the forests situated below ghats, and which extend several miles from the hills towards the sea, and from the Goa boundary to the river Tadri, which bounds the Ankola taluk."

The next quotation was from a coffee planter, Mr. Thomas Cannan, who observed (p. 129) that:

"In an old kumari the jungle trees grow up again, but they are of kinds unfit for building purposes. . . . The more I think of kumari, the more surprised I feel that it has been tolerated for such a length of time. . . ."

The final quotation from a non-governmental source was that of J. Beaumont, manager of the iron-works at Beypur, Malabar. He called attention (p. 130) to:

" the wanton sacrifice of tracts of forest by a practice prevailing to a large extent in Malabar the cutting of maiden forest by the Malai-karen and native landowners for the purposes of cultivation. . . . The tract of land denuded can only be cultivated profitably once in five, or sometimes in twenty years. It will readily be perceived that these wholesale depredators, being unable to cultivate the same land except during one year, will remove to another locality where maiden jungle stands, and there resume the work of devastation. It is unnecessary for me to enumerate the numberless tracts of magnificent forest which, during my short residence in Malabar, I have seen swept from existence. . . . Unless Government take some steps to check this system of wanton destruction, in a very few years the chief portion of these magnificent forests will present nothing but a barren waste. . . ."

Certain of Cleghorn's quotations are minutes and memoranda of hearings from the pen of J. D. Bourdillon, who has sometimes been quoted at second or third hand by certain recent writers without any indication of where his statements might be located, and as though he were still, after a century, so well known that everyone should know, as a matter of course, who he was! He was "Secretary to Government," and brief extracts from his statements follow:

(p. 131, 132) "As the term kumari is peculiar to the Canara district it is necessary in the first place to explain what it is Kumari the name given to cultivation which takes place on forest clearings. A hill side is always selected, on the slopes of which a space is cleared at the end of the year. The wood is left to dry till the following March or April, and then burned. In most localities the seed is sown in the ashes on the fall of the first rains, without the soil being touched by implement of any kind, but in the táluk of Bekul the land is ploughed. The only further operations are weeding and fencing. The crop is gathered towards the end of the year, and the produce is stated to be at least double that which could be obtained under the ordinary modes of cultivation. A small crop is taken off the ground in the second year, and sometimes in the third, after which the spot is deserted until the jungle is sufficiently high to tempt the kumari cutter to renew the process. In the south, where land is more scarce compared with the population, the same land is cultivated with kumari once in 12, 10 or 7 years; but in N. Canara, the virgin forest, or old kumari not cultivated within the memory of man, are generally often selected.

"In some parts of Bekal, which is the most southerly of the táluks of Canara, kumari cutting forms part of the business of the ordinary ryots, and as many as 25,746, or one-sixth of the population, are supposed to be engaged in it; but to the north of that

taluk, it is carried on by the jungle tribes of Malai Kaders and Mahratais to the number of 59,500.

"In Fasli 1266, [i.e. A.D. 1856] the area under kumari cultivation throughout the whole district was 17,084 acres, of which 8556 acres were Sarkar kumari, that is, kumari carried on in forests not claimed by the owners of estates, and 8528 acres, of which 5983 acres were within the limits of the Bekal taluk, were attached to wargs or holdings of proprietors."

Cleghorn (p. 139) stated that variants in name of shifting agriculture, but not in practice, existed in Malabar, where the same system was called punam that would be called kumari in Canara. He quoted P. Grant, Esq., Collector of Malabar, as authority for saying that 22,897 acres had been the extent of punam cultivation in his district in the five years, 1854-1858. Grant was quoted as follows: (p. 141)

"I beg to inform you that Punam and Kumari cultivation are the same.

"Punam cultivation is carried on extensively along the slopes on the W. Ghats, and on many of the other lower ranges of hills; but as they are mostly private property, I do not think that anything can be done by Government to put a stop to it.

"Once a jungle has been felled and burned, and the land cropped, a period of eight or twelve years is allowed to elapse ere another crop is taken off the same land.

"The Punam crop is generally a heavy one, and remunerative to the grower. Say a piece of land yields 100 parahs of paddy, 40 go towards the expenses of cultivation, leaving 60, of which the Government share, at the rate of 25 per cent, is 12 parahs; the balance, 48 parahs, goes to the grower.

"When the crop is supposed to be ready to be cut, the Government officials proceed to estimate it as it stands on the ground; considering the localities in which it is grown, their distance from bazaars, &c., it is natural to conclude that the ryot has many circumstances in his favour.

"In accessible parts of the country, the rising value of timber is likely to lead the Jenmis to put a stop to Punam cultivation in many jungles."

Punakad was the erratic system of rude cultivation carried on by the Malaiális, a hill tribe inhabiting the Shevarai and Chittérs Hills. He goes on to say (p. 140):

"The system of the hill cultivators is nearly the same in different countries. The Irulars and Kurumbar on the Nilgiris,

the Maláíális on the Shevarais, the Karens in Burmah, the Punam cultivators in Malabar, the Kumari Mahrattais in Canara, all endeavour to obtain a precarious subsistence by scattering grain after burning the jungle, and thus avoid the toil of careful cultivation.

"In a thinly peopled country like Burmah, there is little objection; but in the limited plateau of Yerkád, where the best land is almost all taken up for coffee plantation or fruit-gardens, and in the balaghat táluks of North Canara, where the remaining timber is much enhanced in value, and not more than sufficient for present demands, there are strong objections to this wasteful and barbarous system. I think that in Government forests, before clearances are made, permission should first be obtained from the Revenue authorities in communication with this department, the locality and extent of the clearance being defined."

Bourdillon's final memorandum included the following statement:

"With regard to Sarkár Kumari, it seems to be a great evil even as respects the interests of the cultivators themselves. It appears certainly to retard the improvement of the forest races, and tends to keep them in their present degraded condition. It has been already noticed, that in Mysore the practice of Kumari cutting has been entirely abolished; and that in the jungle districts of Bombay it has been so very nearly. The Government now prohibit Sarkár Kumari, or Kumari cultivation in Government forests, without previous permission. This permission should be given sparingly, and never for spots in the timber forests."

Clements, J. B. (1933) The Cultivation of Finger Millet (Eleusine coracana) and its relation to shifting cultivation in Nyasaland. Empire Forestry Journal Vol. XII, No. 1, pp. 16-20.

J. B. Clements (1933) wrote one of the most satisfyingly detailed accounts of the growing of a special crop under the shifting cultivation method. He found that in Nyasaland enormous amounts of Eleusine coracana were used for brewing beer, and that this crop made very specialized cultivation necessary. It would not yield satisfactorily if grown in the same place two years in succession, and its cultivation was therefore responsible for a most unusual amount of new clearing. Also, it was only sufficiently productive, the natives thought, on land that had been heated by fire. Whether true or not, the effect was the same. Although Clements did not use the term, the cultivators generally grew it by the chitemene system. Their good forest having mostly disappeared, the Angoni of the Mombera district could not rely upon clearing that for finger millet, and so they chopped coppice and sucker growth from five or ten times the area of the Eleusine

clearing and piled the wood evenly over the surface. Trees were also pollarded to supply fuel. When dry, the layer of wood was burned, in November and a pure crop of Eleusine was planted a month later when the first rains fell.

In the South of Nyassa a pure crop was not grown and the finger millet was grown in a clearing where maize was also grown in "hills" (mounds) or ridges for several consecutive years. The part used for Eleusine, however, was rotated and "burned" in the year of planting. The Eleusine was grown flat, but if the plants were too thick some were transplanted to the sides of the maize hills.

Until Clements wrote this admirable little account of Eleusine coracana as a crop for beer making no one had known how extensively it was grown or what it was used for. European visitors are generally too impatient of the curious medleys grown in native clearings to give them more than a casual glance! Clements found that the land that had been intensively "burned" for finger millet was peculiarly susceptible to erosion, and that the cultivation not only exhausted the fertility of much land but resulted in the excessive loss of top soil by erosion.

Cointet, Lieut. de, (1897) De Tananarive a Ankavandra. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. I, No. 1, pp. 3-17; No. 2, pp. 59-68; No. 3, pp. 113-121; No. 4, pp. 169-177.

Maps had shown forest but none was found in part of central Madagascar traversed by Lieut. Cointet between the capital and Ankavandra, which lies to the westward and somewhat northward, and about 100 km. from the west coast. From the upper reaches of the Bebao R., a right-hand affluent of the Manambolo, one could see at about 10 kilometers to the north a wooded region which might be a southern extension of the great forest. There were also little forests at the heads of streams and along the ravines. The plateaus and heights east of the Manambolo, with soils from granitic rocks, were in general without forest, which facilitated military marches and operations. Westward from that river were the plateau areas of Bemaraha, with soil derived from the Jurassic formations, which were forested and without any notable summits. The general aspect of the granitic central region was desolate and nude, especially where on higher slopes the bedrock had been exposed by erosion. Intermediate elevations were covered with herbs which provided grazing for the cattle. Lower down, part of the seasonally swampy land and heavier soils which could be irrigated or seasonally flooded were occupied by wet rice cultivation. At any rate the central area was already deforested except at the southeast of Lake Itasy and had long been so. One must assume that during the long

period of evolution of the highly distinctive, largely endemic, flora of Madagascar there were areas intermediate between the desert southwest and the central prairie region, and also on greatly eroded slopes of forested regions around the less arid forested circumference of the central area, where there were appropriate habitats for the herbaceous plateau vegetation. Consequently we must assume that a nuclear prairie or grassy bush land region was geologically ancient. In Madagascar man's agricultural activities were at first made at the expense of forest. This added more prairie to the nuclear area by continued destruction of adjacent forest, and the development of the cattle complex always prevented climatically marginal forest from reverting to forest after it was once cleared. Burning to improve pasturage was a controlling factor in preventing reforestation wherever the rainfall was low and seasonal, whereas natural reforestation took place at the northeast where the climate was wetter.

It seems to be a fair conclusion that in recent but pre-human geological time the basic outlines of plant geography in Madagascar must have shown the same basic pattern as today. Man's onslaught on the forest for slash-and-burn agriculture and a cattle cult like that of East Africa, irrational, uneconomic and largely harmful, has caused great degenerative effects on the land, through loss of forest, erosion following denudation of water-catchment areas, loss of fertility by burning, and profound deterioration of natural resources. Even though he may have neglected to weigh much of the evidence, Humbert seems to have reached conclusions that entitle Madagascar to be looked upon as a type region for the destruction of a tropical flora by man, largely through fire.

Cointet (p. 14) was very specific about the nature of the vegetation of the central plateau in 1897. It was herbaceous in the east, but as one approached the western edge, where the level dropped abruptly, the edges of ravines dissecting the edge were more and more forested. Little woods were composed generally of an undergrowth through which emerged large and beautiful trees. At the foot of the falaise declivity of Bongolava extended a forest belt difficult to traverse, crossing along the flanks of the slope and extending along the rivers and the swamps which founded them. The forest along the crocodile-infested branches of the Marolaka was an impenetrable thicket from which arose superb trees supporting innumerable lianas.

Cointet (p. 121) mentions that relics of forest were to be found within 60 kilometers to the westward of Antananarivo ("Tananarive") only on mounts Anjohy and Ambohitraina. Otherwise, on the traverse to the Ikopa River, he found trees and shrubs only surrounding the villages. Farther west in a 12-km. march from Maharidaza to Ambohitromby there was little wood except in the bottom of valleys and on the peaks of Mount Ambatovato (p. 169). From Moratsiazao to Analabé, a distance of 28 km., wood was rare and the only trees were around villages. From Analabé to Bevato (23 km.) there are numerous little scattered woods in or along

ravines. From Bevato to Tsiroanomandidy (25 km.) Cointet said the country was almost depopulated desert, devoid of resources except cattle, but with thick undergrowth in the bottoms of the valleys, dominated by great trees. From Tsiroanomandidy to Miadanarivo (Ankavandra) the country was for most of the distance (100 km.) absolutely uninhabited. Descent to the coastal plain was impracticable. All of the ravine bottoms were wooded, and there were scattered small woods. Another but longer route between the same points on the right side of the Manambolo (170 km) was absolutely desolate and desert. The deep ravines were forested. The steep descent of the Bongo-Lava from 1000 m. to the region of sedimentary rocks at 230 m. brought one to forested country where the rivers were bordered by swamps teeming with crocodiles.

Collins, W. B. (1943) Is Iroko Doomed? Farm and Forest or Land Use and Rural Planning in West Africa. Vol. IV, no. 1, pp. 44-45, February, 1943. Ibadan, Nigeria.

Apropos of the approaching extinction of species, one may mention the most valuable timber of Nigeria, iroko (*Chlorophora excelsa*) which Lamb believed to be reproducing spontaneously and abundantly in the kurmi forests of Northern Nigeria. It was believed by W. B. Collins (1943) to be approaching extinction in Western Ashanti. He found in the remaining forest areas a relative plenty of big, old trees but almost no evidence of reproduction. In 16 months of assiduous observation he found only one sapling and not a single pole. In the face of the lack of any small trees and of the depletion of the old he thought it not unlikely that in a hundred years some forester might record the discovery of a single survivor "presumably the last in the locality ... in a relatively unfrequented part of South Fomang Su Reserve." Lamb in a note appended to Collins's article thought an unnecessarily gloomy picture of the future had been painted, but P. C. Lancaster (1943) said that Collins's conclusions were in accord with conditions in Qwerri Province.

Consigny, A. (1936) Considerations sur les Feux de Brousse, leurs Méfaits et la possibilité de les enrayer. Bull. Econ. de l'Indochine, XXXIX, pp. 183-195, 5 pl. Mars-Avril, 1936. Hanoi, Gouvernement General de l'Indochine.

The Indochinese equivalent of *ladang* agriculture is that of "ray", a forest clearing. It has been studied or observed by many, but Consigny (1936) has given it especially careful consideration. He wrote that every year during the dry season,

there were numerous fires in Indochina, which, thanks to the practice of "ray", annexed each year to the domain future desert land covered by old and beautiful forests. The fact that in spite of undeniable individual efforts and wish to restrain them, the opposition had not proceeded more energetically and effectively, proved that the majority of functionaries considered the conflagrations as an inevitable evil and of no great importance. In fact there were defenders of the fires, which, if not put an end to, would lead to disaster.

Consigny distinguished two sorts of fires, (1) those started with an evident idea of utility, and (2) those from which no good to the community could be expected. The first, however unfortunate for the future of the land, were those set for burning the felled trees in the forest, not only to get them out of the way, but to fertilize the soil with ashes. The pattern conforms with that of every other uncontrolled tropical area with any forest remaining. The second fires also conform to pattern in that they rage over artificial grasslands and abandoned "ray" that is thus transformed into grassland. If protected from fire it would be regenerated through the growth of secondary forest. In Indochina, however, the conditions are such that brush fires spread into actual old forest and consume it. Burning has been defended as necessary for maintenance of pasture and for increasing in certain regions the proportion of useful dipterocarps and pines in place of useless soft wooded trees and oaks. Even this result, however, depends upon control of fire rather than repeated ravages.

Shortly after the appearance of the article by Consigny, there was one by P. M. Allouard (1936) in which it was categorically stated that in Indochina there were no true forest fires, in the sense that trees were burned, but only in the sense that dry shrubs and herbs were burned. He said: "La forêt dense, elle ne brûle pas."

He urged energetic prosecution of measures to prevent the fires, and wrote mainly of what could be done in the way of popular propaganda and education, of actual means of control when started, and of rewards for prevention or control.

Cook, O. F. (1908) Change of Vegetation on the South Texas Prairies. U. S. Dept. Agric. Bur. Plant Industry, Circular No. 14. Washington: Government Printing Office. Sept. 10, 1908. 7 pp.

Cook (1908), who was the chief American observer of the effect of fire in the tropics, also wrote an important article on the revision of South Texas prairie to woodland when it came to be fenced and protected from the annual fires that had formerly swept it. He said:

"Forest fires in northern countries arise from accumulations of fallen leaves and other debris but in the warmer parts of the world . . . the forests do not burn with their own fuel, but may be invaded and driven back by the adjacent grass. In this respect, as in several others, south Texas may be reckoned as a part of the Tropics. . . .

"The traveler in Mexico and Central America encounters many illustrations of the advantage enjoyed by grasses over other vegetation in the presence of fire. Large areas of land formerly cultivated by the native Indians remain barren of everything except the coarse grasses which afford the fuel of the fires that prevent the growth of trees and the renewing of the soil. In regions not subject to such fires the forest is rapidly renewed and the land can be cleared and planted again at intervals of a few years.

"Even where the grass-grown land has not been cleared by man it is possible for wild grasses to drive back adjacent forests with the aid of fire. In this way a species of wire-grass (*Epicampes*) is destroying forests of alders and pines on the upper slopes of the Vulcan de Agua in Guatemala. Before the access of fires this grass appears to have been confined to the crater and to the very dry upper slopes where the pine trees are small and scattering. Now that the belts of humid forests lower down have been broken by clearings the grass has the assistance of fire and is destroying the larger growth with increasing rapidity. . . . The lower the grass comes, the more luxuriant its growth and the more destructive the next fire."

Cook makes the point that dead grass accumulating for several years makes a more intense conflagration than the accumulation of a single year, and that under some conditions annual fires may therefore be less dangerous and destructive than those at intervals of several years. He continued:

"Settlers in South Texas early adopted the practice of burning over the prairies every year; partly to protect their homes against the fires, partly to give their cattle readier access to the fresh growth of grass. The fires were often set near the coast, the strong breeze which blows in from the Gulf spreading the flames over many square miles. . . .

"The primitive Indian agriculture which accomplished the devastation of this region [between Houston and Victoria] as of many others in Mexico and Central America was here, as elsewhere, a self-limiting process. Lands once cleared and abandoned were kept by the fires from becoming reforested until the forests were all gone. That age of primitive agriculture ended in an age of grass and prairie fires, of wandering buffaloes, and nomadic hunters.

"European settlers brought in the age of cattle, of diminishing quantities of grass, of weaker fires and advancing

bushes, the pioneers of a new conquest by the forest. But the forests and swamps will not be permitted to return, for south Texas is being plowed and planted."

Reversion to shrubby land with mesquite, which Cook viewed a precursor of forest, followed fencing and fire control. He continued:

"South Texas is being rushed under the plow to escape the invasion of bushes. Large tracts to the north of Brownsville . . . are already lost, at least to the present generation, for the bushes are so well entrenched that the cost of clearing would greatly exceed the value of the land. . . The south Texas farmer of the future instead of being a cattle king may even find himself without a place to pasture his milch cows except in his tilled fields. . .

"If reforestation were to continue uninterrupted by fires or other forms of human interference, the Gulf plains of Texas would again become covered with dense subtropical forests, and with the then impeded drainage would form vast swamps, such as doubtless existed before the advent of agricultural man, as shown by the now isolated remnants of the earlier forests. . .

"The Texas palmetto (*Inodes texana*) [*Sabal texana*] which now seems to be closely confined to the banks of the lower Rio Grande, appears to have extended formerly over two hundred miles farther north. Tall palmettos were seen in Jackson County as late as 1876 by Mr. J. D. Mitchell, of Victoria."

Cook, O. F. (1909) *Vegetation effected by Agriculture in Central America*. U. S. Dept. Agric., Bur. Plant Industry, Bull. No. 145. Washington: Government Printing Office. 30 pp., 8 pl.

O. F. Cook was the first American to give more than casual attention to the problems of shifting agriculture and fire in the tropics. His observations were made chiefly in Guatemala. The following quotations are from his most extended publication on the subject.

"To invoke other than the human agencies to account for the present lack of forests in many parts of Central America is superfluous, for the destructive abilities of the Indians are everywhere in evidence. Reforestation is everywhere going on, but the Indians are also busy cutting down and burning the woody vegetation. If the burning over of the land were limited to areas ready for planting the general results would be far less disastrous, but the fires are usually allowed to spread wherever there is fuel to carry them, and large tracts of land are thus kept in a permanently barren condition. At night in the farm clearing season the burning mountain slopes gleam with lines of light like the streets

of distant cities. By day the sky is darkened and the air is heavy with smoke. That regions now so barren as the valley of Salama in Central Guatemala may be artificial deserts cleared by human agency can readily be understood when the facts are viewed at first hand. The devastation which can be worked in a single corn-planting season will go far to convince the careful observer that the native methods of agriculture have wide-reaching effects.

. . . With the exception of a limited use of wheat and of broad beans at very high elevations, no European field crops have been adopted by the Indians, much less any European methods of cultivation. Thus the present agricultural conditions may be relied upon as giving us a correct idea of the agricultural influences which have long been at work in these countries.

"The problem of tracing relations between agriculture and natural conditions in Central America is much simplified by the fact that one staple crop is grown over the whole area In spite of endless local diversities among the native inhabitants they have a general agricultural unity, for they all depend on Indian corn, sometimes to the almost complete exclusion of other kinds of food."

(p. 11) "The usual system of corn culture involves the repeated burning-off of the woody growth. . . This causes a gradual deterioration of the crops. . . With each cutting the interval has to be lengthened, until finally the land becomes thoroughly occupied by coarse grasses which are not killed by fire . . . and the grassy areas are gradually extended. The Indians know well enough that the frequent burning-over of the old corn fields keeps the land from being used again, but their interest in the future is seldom strong enough to lead to any precautions against the spreading of the fires."

Cook recognized that if fires were prevented, under moist climatic conditions, forest was reestablished over the grassland. Thus he accounts for the lack of truly unmodified primitive forest in Central America, as he interpreted conditions. He found archeological remains in the most dense forest, especially land terraced in antiquity, and estimated the age of high forest by the extent to which organisms completely exterminated by fire had reoccupied devastated areas. His indicators of antiquity were the small palms of the forest floor and humus-inhabiting organisms such as millepedes. He likewise found pine roots in deciduous forest, miles from any living pine. Reforestation took place, after the passing of temporary successional stages, from vestiges in rough inaccessible places. He concluded that even the desert valley of Salama would eventually be reforested "if there were no men to cut down the trees and kindle fires."

Cook, O. F. (1921) Milpa Agriculture, a primitive tropical System. Ann. Report Smithsonian Institution . . . for 1919. pp. 307, 326; 15 plates. Washington: 1921.

Cook said (p. 308) that it was doubtless the utter simplicity of the primitive system of shifting agriculture that long tended to keep it from being recognized or studied as a factor of tropical life, though of world-wide distribution. He wrote: "The upland cultivation of rice among the primitive tribes of tropical Asia and Africa follows the same methods as cultivation of maize in the New World Tropics. Specialized, permanent systems of terrace agriculture were developed for the culture of maize in ancient Peru and in Central America, and similar systems of terracing are used for water cultivation of rice and other aquatic crops in eastern Asia, but in both hemispheres the more advanced nations are surrounded by primitive neighbors who use the milpa [forest clearing] system."

(p. 307) "Under the primitive system followed in most tropical countries, production not only is less continuous than in temperate regions, but may decline rapidly and even cease altogether. . . . Primitive civilizations destroyed the very basis of their own existence. Nations may pass without history, and yet leave marks of devastation. Instead of the natural resources of production being still untouched, most of the tropical world is far from a virgin state, a fact too often overlooked in tropical undertakings. The woody vegetation of many tropical regions is 'bush', or secondary growth, instead of original virgin forest. Very old bush approximates the original forest, but it is possible to distinguish many stages of reforestation and to estimate roughly the time that has elapsed since the land was used for agricultural purposes, whether decades or centuries ago."

(p. 312) "The permanent terrace agriculture of the maize belt of Peru and the still more laborious turf-land cultivation of the high-altitude potatoe belt are examples of specialized systems that replaced milpa agriculture in limited areas. . . . Large areas of permanently productive artificial lands were made by terracing, filling, and covering the surface with a thick layer of fertile soil. The terrace system was applied both to steep slopes and to the bottom of the valley, with the stream beds straightened, narrowed, and walled in.."

(p. 313) "Among the coffee planters of eastern Guatemala, in a forested mountain country with many fertile valleys, the carrying capacity of the land for Indian laborers is estimated on the basis of 100 to 200 acres per family. In a partially denuded or impoverished country even 500 or 1000 acres per family might be required for a permanent food supply."

(p. 313) "The natives of West Africa always prefer to cut the 'big bush', knowing that the forest soil is more fertile. 'Young bush' is cut when older growth is not accessible. The zone of grass-covered 'old fields' around an African village is

continually widened, and when there is no more forest within reach the village is moved to an unoccupied district, if such can be found. The grassy "fields" persist long after the other signs of human habitation have disappeared."

(p. 315) "Native villages in West Africa usually occupy the same site for only a decade or two. With nothing in the way of permanent buildings or other improvement to interfere, a new location is sought as soon as all the forest has been cut within a convenient radius of 2 or 3 miles."

(p. 314) "The fact that all the so-called "Old Empire" cities of the Mayas in Central America have been found buried in deep forests shows what the country was like before it was occupied by the builders of the ruins. But wide areas of the Maya country must have been cleared when there were people to build such cities."

(p. 317) "Different forms of ancient agricultural terraces are found in several districts in Guatemala and southern Mexico, none as carefully constructed as those of Peru, but sometimes covering large areas, as in the region of Comitán and Ocosingo in southern Mexico. Terraces, with retaining walls of rather crude stonework, are found in many of the mountain valleys in eastern Guatemala, usually at altitudes of 2000 to 3000 feet, but some of them as low as 700 feet. In the eastern valleys of Peru most of the terraces are at altitudes between 12,000 and 6000 feet, with little or no terracing below 5000 feet."

It is interesting that the lack of means of transportation in ancient Central America limited the growth of centers of population, and that was of course increasingly true as the cities became older and the soil more and more unproductive. The only alternative to abandoning sites where great labor had been expended to build great monumental buildings was to devote ever increasing energy and time to transportation.

Cook said:

"People [in Central America] who have exhausted neighboring lands go farther out until they find good soil for milpas, and carry the crops home on their backs. . . . To bring in the harvest from the distant milpa may require several trips by the whole family. Forty man-loads of maize were considered as a normal supply for a family, according to Bishop Landa, who wrote of the Mayas of Yucatan about 1566. The mecapal, a woven band or strip of leather across the forehead to support the load on the back, is a characteristic feature of this long-distance milpa agriculture. Even a young child wears his little mecapal, and carries a small bag of corn."

Copland, Samuel (1822) A History of the Island of Madagascar, comprising a Political Account of the Island, the Religion, Manners and Customs of its Inhabitants, and its Natural Productions. . . . London: Burton and Smith. 1822. 369+2 pp., map.

Copland's History was a compilation. It does not appear that he ever went to Madagascar. The earliest printed book that he consulted was that of Flacourt, and he names various later ones, but his unique and important source was archival and consisted of the reports and letters of the representatives to the London Missionary Society between 1818 and 1822. Copland does not say that he was commissioned by the Society to write the book, but that it had their approval is implied in the dedication: "To William Alers Hankey, Esq., the Benevolent Treasurer of the London Missionary Society, and the Zealous Promoter of Christianity and Civilization." He states that his map is corrected by one in the possession of the Missionary Society, lately drawn from actual survey, but that for political limits of the 28 mostly unassociated tribes or kingdoms he had to go back to Flacourt, for no intervening writers had paid attention to such matters.

As to the distribution of prairie and forest, the herding of cattle and the nature of the agriculture, Copland (p. 4) has the following:

"The European traveller is lost in astonishment, when traversing the vast plains and forests of Madagascar; the former, clothed with eternal verdure and covered with numerous herds of cattle; . . . the latter overhanging the sides of the mountains. . . ."

"The continuity of the plains is agreeably diversified by gently rising grounds, on which the natives build their towns and villages. These are surrounded by plantations of rice, barley, yams, etc., the most fertile spots being selected for that purpose"

About the individual "provinces" we find:

"Anossi . . . is surrounded by mountains covered with trees and shrubs. . . ." (p. 9).

"The Vale of Amboule . . . is very rich. . . The oxen and cows are extremely fat, having the richest pasturage to rove over. . . ." (p. 9).

"The province of Machicore . . . was devastated and ruined by wars some years ago, the natives being obliged to conceal themselves in the woods, . . . subsisting upon roots and wild cattle. This, and four adjoining provinces, were formerly governed by one chief, named Dian Baluoalen, or Lord of a Hundred Thousand Parks . . . and flourished . . . but upon his death war broke out among his sons which was carried on with so much animosity and fury, that it ended in their entire destruction. . . ." (p. 10). The title of the Lord of a Hundred Thousand [i.e., an indefinite, large number] Parks suggests prairie openings in forest, perhaps old clearings grown over with grass.

"Eringdrane . . . is extremely fertile and has large herds of cattle on the sides of the mountains." (p. 11).

"Vohitsongombe . . . is called by the Portuguese Terra del Gada, or Land of Cattle, from the vast herds that are fed there." (p. 12)

"The province of Voolou-Voolou [i.e., Vulu-Vulu; the name belonging to the General Malayan series of words for bamboo, usually bulu]abounds with pastures and cattle. . . . The Ongleby is a beautiful stream. . . . On its banks are meadows of the richest pasturage. . ." (p. 15)

"The Voulou . . . is a kind of Indian cane. . . . Their plenty in the province of Voulou-Voulou gives the name to the country -- bamboos and rice being almost the only produce; the former are cut down by the natives and burnt, the ashes being as a manure for the latter. Some of them are as thick as a man's thigh, tall, black and round, constituting the chief beauty of the country; every three years the tree bears a fruit of the size of a small bean; -- flour, equal in goodness with that of European wheat, might be made of this fruit." (p. 323)

In order to fruit every three years bamboo of such large size would have had to be present in several age classes or different kinds, for the communal flowering and fruiting of the large species takes place only at much longer intervals than three years. The region described is just north of Tamatave, chief port on the east coast, and is the same area where Flacourt saw and heard the burning of the bamboo. The reference to the ashes is most interesting, for it suggests a Malagasy equivalent had developed there of the Central African chitemene system of agriculture.

"Ghalemboule is the next province. Its coast is belted with a forest of lofty trees, two leagues in width, which runs along its whole extent. . . . The meadows produce plentiful pasturage, though they have fewer cattle than some other provinces." (p. 16)

"The country of Boyana lies on the western coast between the 14° and 16° of latitude. It is a flat country with few woods, but consisting of immense plains, watered with numerous streams, and covered with thousands of wild oxen, which belong to anyone who can catch them." (p. 17)

Although Copland named only three provinces in confirmation of his general statement, he said (p. 20):

"... though agriculture is much practiced the only manure used by the natives is wood ashes, which they procure by burning large heaps of bamboo and other wood. In many of the provinces there are large plains, where the soil is a stiff clay, of a reddish colour, producing abundance of grass. . . . In the

southern districts are some extensive plains, consisting entirely of sand, of an arid quality: these are destitute of springs or rivulets, and produce nothing but a few trees, and the aloe, called tetch, which latter, however, is very plentiful." (p. 20, 21)

"Storms and hurricanes are unknown at Madagascar; and were the cultivation of the land on a more regular and extended scale, the draining of the marshes and the clearing of the forests in the vicinity of the towns to take place, the principal causes of disease would be removed. . ." (p. 22)

". . . . in the provinces of Ghalemboule and Manghabei the women and children are employed in this work [of planting the clearings]. It being a season of festivity with them, their manner of conducting the operation is extremely entertaining; -- they make a hole in the earth with a stick, amongst the ashes which are strewed on the surface, and throw in two or three grains of rice, which they cover with their feet, singing and dancing all the time in the most cheerful manner. Both men and women in these districts are very industrious, being employed in the fields from sun-rise to sun-set; the men in cutting and burning canes for manure, and the women in planting, weeding, or harvesting the rice and other grains." (p. 24)

"Many of the Madagascar farmers are very rich, both in cattle and grain; some, in the northern part of the island, know not the number of their oxen by two or three thousand. There is no regular appropriation of the land; any piece of ground that is clear, is free to the use of the person who chooses to cultivate it, upon paying a small quit-rent to the chief of the district, who is considered as the only rightful lord of the soil. . . . The principal enemies the farmers have to contend with (next to their own species) are the wild boars: these come from the woods in droves, both by night and day, and, if not well watched, make terrible havoc amongst the yams and potatoes." (p. 25)

"As we have before observed, that no other manure than wood ashes is used: nor is any other necessary. In such a country, where the proportion of good land is so great, compared with the population, it is unnecessary to occupy one piece of ground many successive years; so that fresh land, of the finest quality, may be brought into cultivation every year, if requisite. Nor is this all: the great accumulation of vegetable matter, which the warmth of the climate continually throws up, forms a rich manure of itself (especially if fed off, or trodden down by the large herds of sheep and oxen which rove unconstrained over the country) and thus furnishes fresh stamina for a new produce."

Coventry, B. O. (1915) *The Olive (Olea cuspidata) Forests of the Punjab*. Indian Forester, Vol. XLI, no. 11, pp. 391-398. November, 1915.

The author points out that vestiges of a formerly extensive forest of the valuable timber tree Olea cuspidata formerly extended over a wide area in the Punjab. Vestiges remain, for the tree withstands every agency that tends to destroy it, growing to a large size even where its roots can only penetrate clefts on limestone exposures where the soil proper has been entirely removed by erosion. Coventry says (p. 394):

"In the better type of forests in the Salt Range and in parts of the Kalachitta Range well-grown trees with girths up to four or five feet may be met with, but over the greater part of the forests the trees are more of the nature of clumps of coppice shoots or root-suckers and show evidence of mal-treatment in the past by reckless cuttings and browsing of goats. Occasionally fine trees of very large girth are met with in the neighborhood of shrines, where they have been regarded as sacred and thereby escaped molestation. . . . (p. 396) "The denudation of the surface soil in the Kalachitta and Khairimut forests is probably due to reckless cutting of the forests in the past and the overrunning of the forests by numberless goats of which extensive flocks are still kept in the neighboring villages. It is quite clear . . . that if natural regeneration of olive from seed is to be obtained . . . measures must be directed towards stopping further denudation and encouraging the accumulation of soil and humus. . . ."

Coventry, B. O. (1929) Denudation of the Punjab Hills. Indian Forest Records, Vol. XIV, Part II, VI+30 [49-78] pp., 7 pl. Calcutta: Government of India, Central Publication Branch.

Although the Punjab is beyond the tropical part of India, and therefore beyond the strict scope of the reviewer's assignment, the paper of Coventry on denudation of the hills in that province is too important a part of the general literature on fire and grazing as agencies of land deterioration to be neglected.

Coventry states of the Punjab hills that ". . . the cause of their denudation is solely the result of man's action by means of fire and grazing of his cattle, and that the obvious remedy appears to be the introduction of organized pasture management. . . . Ignorance and apathy are factors difficult to contend with. The former can be overcome by education and propaganda, but . . . the average individual cares little about the future conditions of the country. . . . It is not improbable that the present barren condition of the plains of Sind is the result of great floods on the Indus river which have followed the denudation of the hills of the Indus valley, and there is little doubt that the denudation of these hills is solely the result of man's action by fires and grazing. The fact that in

other parts of the world there are large tracts of country which are known to have previously been in a fertile and flourishing condition, but which are now in a barren, desolate condition gives rise to the question as to whether the Punjab is threatened with a similar fate."

(p. 6) "The most striking fact which is brought to light from a study of the vegetation of the Punjab hills is that the forests still in existence almost everywhere are undergoing deterioration or are in a state of 'retrogression', there being a general tendency for the climax or other mesophytic types to become replaced by more xerophytic types, indicating a gradual change from moist to drier soil conditions. . . .

"The phulai [Acacia modesta] and sanatha [Dodonaea viscosa] forests may be regarded as xerophytic types, whereas the olive forests represent a 'climax' formation. . . . On travelling up the Jhelum valley road from Rawalpindi to Kashmir it will be observed that the forests on the low hills consist almost entirely of brushwood forests of sanatha with scattered trees of olive [Olea cuspidata] among them, whose dark green foliage is easily recognized against the lighter green foliage of the sanatha.

"These scattered olive trees are the remains of olive forests which are disappearing. . . . It is also very noticeable that many of the village sites are clearings in old olive forests the remains of which are olive trees of large girth. In the village lands bushes of olive, the result of felling, and subsequent browsing of the coppice shoots, are everywhere to be found. Groups of fine old olive trees are also to be met with in graveyards where they have been regarded as sacred and left unmolested. In the Manga village about three miles from Tret there is an acre of old phulai forest surrounded by cultivation, in the centre of which is an old tomb said to be two to three hundred years old. The hills surrounding the cultivation are covered with brushwood forests of sanatha, but scattered amongst them old olive and phulai trees in a mutilated condition are still to be found. . . . Although the olive is a mesophytic species which establishes itself on moist humus soil it appears to grow under more or less xerophytic conditions for a very long period, attaining an age of a thousand years or more. It is not uncommon to find old olive trees growing from bare solid rock from which the soil has been completely eroded away. . . .

Coventry proceeds to discuss the pine and oak forests which show deterioration as marked as that of the olive forests. Areas of bare rock are shown in the plates where old trees still remain rooted into crevices but where most of the surface has no trace of soil or vegetation. In general summary of his description of the Punjab forest, Coventry (p. 11) said:

"A considerable proportion of the hills are bare but it is evident even to the most casual observer

that these bare hills were previously densely wooded everywhere within the limits of tree growth and at no very remote date. . . . There is evidence in old historical records of hills which are now in a denuded condition being previously densely wooded. For instance, in the Gazetteer of the Kangra district there is an interesting account taken from old records of the conquest of Mau and Nurpur under Shah Jahan, about 300 years ago, in which reference is made to the 'impenetrability of the jungles' at that time, but these jungles are no longer existent. Again, some of the old Atlas sheets prepared from surveys made 60 to 70 years ago show tracts of low hills as densely wooded, which are now in a denuded condition."

Seeking causes of other than man's direct or indirect destructivity, Coventry discussed possible climatic change and concluded:

"There is no evidence to show that there has been any appreciable change in the climate within historical times, and in fact such evidence as is forthcoming from the meteorological records and from a study of the vegetation appears to indicate that there has been no such change either on the plains or on the hills."

"If . . . erosion has always been in progress to the extent to which it is taking place at the present day, it becomes impossible to explain how the hills ever became clothed with forest vegetation and especially with the climax formations on deep deposits of humus soil. This can only have taken place when there was a condition of more or less equilibrium and it seems evident, therefore, that some factor has come into play which has upset this previous condition. . . . All the evidence shows very definitely that this factor is man, by means of fires and grazing of his cattle."

(p. 14) "For the purpose of clearing lands for cultivation, providing grazing grounds with ample supplies of fodder, and protecting cattle against wild animals, wholesale destruction of the vegetation by means of fire has taken place in the past. In fact, man has destroyed the forest vegetation wherever it has been possible to do so by means of fire, and the forests which are still in existence on the hills at the present day are simply the residue which man has not been able to destroy by fire owing to the dampness of the locality, or to the forests being of a non-inflammable type (i.e., forests of broad-leaved species, or consisting of species immune against extermination by fires (e.g., chir pine forests).

(p. 16) "From time immemorial it has been the custom of the people on the hills to feed their cattle by sending them out to graze at random over the hillsides without regulating the grazing whatsoever. . . . With the exception, therefore, of only a comparatively small area kept closed for special

purposes practically the whole area of the hills is subject to unregulated and continuous grazing. The soil becomes denuded the cattle loosen the surface soil, especially on steep slopes [and] also form tracks all over the hillsides which often develop into deep nalas [gulleys].

(p. 17) "In localities where over-grazing has resulted in a shortage of grass, the people have generally resorted to heavy lopping of the broad-leaved trees for fodder and this is rapidly leading to the extermination of the broad-leaved species."

"Goats are the most destructive of all animals to the vegetation. . . . Most species of broad-leaved trees on being felled reproduce themselves from coppice shoots, but when the land is overrun by goats, the coppice shoots are browsed down and only develop into bushes instead of trees. . . . All stages of transition from densely wooded hills to denuded hills caused by the browsing of goats can easily be recognized. The destruction of the vegetation by goats is invariably followed by great erosion."

"The trans-Indus hills of the North-West Frontier Province are mostly in a denuded and dessicated condition which is usually attributed to climatic conditions, but such vegetation as still exists tends to show that these hills were at no very remote date densely wooded, and with vegetation more or less similar to the vegetation of the western Punjab. On the lower hills scattered olive trees are still to be found sufficient evidence that these hills were previously densely wooded with forests similar to those of the Punjab and to conclude that they have become denuded and dessicated solely by the action of man, by means of fire and grazing as is taking place at the present day on the Punjab hills."

In his concluding chapter Coventry made the quite obvious suggestion that keeping fewer and better-fed cattle, fed during the drouth season on hay instead of wandering at large for starvation forage, with regulated pasturage, would result in great advantage for everybody. He recognized, however, that ignorance and popular non-cooperation would prevent the inauguration of any economically sound policy for dealing with the problem of cattle in India.

Coventry concluded: no one who understands the disastrous effects of denudation can maintain that people have a right to destroy a fertile country and hand it down to their descendants in a barren, desolated condition. It is a moral obligation on the part of each successive generation to maintain a policy of insurance of the hills against denudation where this is within the control of man."

Crawfurd, John (1820) History of the Indian Archipelago. . . .
 3 vols. Edinburgh: Archibald Constable and Co. . . .
 VIII + 520 pp., pl. 1-14;; VII + 563 pp., pl. 15-31; VI + 554 pp.,
 pl. 32-34, map.

Crawfurd, in 1820 recently British Resident at the Court of the Sultan of Java, wrote that the most essential distinction that could be made in the agriculture of the Indian Archipelago (and he wrote especially of Java, where he believed East Indian agriculture had reached its greatest advancement) was between wet and dry. He wrote (Vol. I, p. 344):

"The lands appropriated by their situation to the wet culture are, in the Javanese and almost all the other languages of the Archipelago, termed Sawah and the dry lands in the Javanese Tagal."

He described four forms of tillage, of which only the lowest and most primitive need concern us. Of this he said:

"The first is that which consists in taking a fugitive crop of rice from forest lands, by cutting down the trees and burning them along with the grass and underwood. In the languages of the western tribes this is termed humah or ladang. It is only practiced in the least improved part of the country, and in lands not yet appropriated. It, of course, implies the rudest beginnings of agricultural industry.

. . . . (p. 360) The ground is turned up with the mattock, and the seed planted by dibbling between the stumps of the trees. . . . This mode of cultivating rice is followed only among the more savage tribes who want skill and industry to undertake the more difficult but productive modes, or among the more improved tribes in such dry and sterile tracts as do not afford lands suited for the latter. The practiced traveller recognizes the traces of this culture in a few green patches among the thick forests of the mountain villages."

The more interesting points in connection with Crawfurd's account are that in Java the most primitive form of agriculture, at least where he observed it, had already advanced to the state of hoe agriculture. In the more ancient type of shifting cultivation the soil was not turned after burning off the felled forest, but the seed was dibbled into the soft ashy soil without any digging in of the ashes. The fertilizer salts were introduced into the soil simply by solution in rain water and percolation. The reader will have noticed, also, that Crawfurd described not the cutting and burning of primary forest, but of secondary, and rather young or considerably deteriorated forest at that, for it mentions the cutting and burning of trees and grass. So we may infer that the population of Java was even then so dense that land available for agriculture was being used after a relatively short brush and tree follow. Notable is also the use of humah (Original Indonesian uma) as a Javanese equivalent of the Malay ladang or upland-rice field.

Criado, Matías Alonso (1907) *La República del Paraguay*. Segunda Edición, Montevideo: Cosa Editora, Talleres Gráficos A. Barreiro y Ramos.

Quite certainly similar to the tropical river swamps of the Brazilian side of the Rio Paraguay must be those on the Paraguayan side. The map of Paraguay compiled by M. Alonso Criado (1907) shows a large area of swamp to the westward of the bluffs lying along the river westward of Corumba in Matto Grosso, the point from which the Rondon-Roosevelt narratives have provided us with a picture of the vegetation northeastward into the Amazonian forest. There is no such vegetation description of a traverse across tropical northern Paraguay, but the swamp area mapped is northeastward from the Rio Otuquis ó Negro. Such slight indications of dry campos to the westward and southward of Corumbá are provided by such a name for an area surrounded by hills, as Campos de Jacadigo. The latter is between 19° and 19° 30' S., and near 58° W. Westward the map indicates nothing regarding the vegetation in this latitude until great salinas stretching southward are indicated by the map between 60° and 60° 30' W. So there is a transition to the westward across northern Paraguay from Corumba, Brazil into desert scrub at the center of the Chaco where there is no drainage and the vegetation is halophytic.

As for aboriginal population, there are some indications of the Indios Chamacocos to the westward of the Rio Paraguay, in about latitude 21° S., and of the Otuquis of the river of the same name.

Crowther, Frank (1948) *A Review of Experimental Work*. Chapter XX, pp. 439-592, in: Tothill (1948), q.v.

Crowther (p. 489) wrote of shifting agriculture in the Sudan as follows:

"In the Nuba Mountains growth of vegetation, mostly grasses, during the rains limits the areas which can be cropped, and hand-labour for hoeing is so inadequate that the cultivators have developed the practice of burning the grasses (called 'harīq', the Arabic for 'burning') after the rains have started instead of during the dry season, thereby utilizing the flames fed by the mature grasses to destroy the growth of young grass. For 'harīq' to be successful the mat of old grass must burn freely, and it is on this basis that the areas to be burnt are selected; certain types of grass are better for burning than others, and these must have reached a sufficient degree of spread."

Some experiments have been conducted in sowing different grasses on old cultivated land in order to secure a growth sufficiently combustible and continuous for burning. Crowther

(p. 490) said: "Not only is the all important crumb-structure of the soil restored by a period under grass, but possibly the very heating itself is beneficial to the soil, for T. W. Clouston has obtained large increases in the yields of Gezira crops by firing the surface soil."

So, in seeming to appear as one of the few advocates of destroying soil humus, Crowther cited such support from the literature as he could, and developed his argument about as follows:

In India and the Sudan there are naturally impermeable colloidal clay soils that become worse through puddling when the unprotected surface is rained upon. Roots penetrate such soils with difficulty. The effect is attributed to the capillary spaces between the larger particles becoming clogged by finer particles suspended in the percolating rain water. It was found in India that the texture and productivity of such soils are improved by scraping up and "burning" the surface soil in bonfires with cotton stalks, and then spreading it as a top dressing on the same land. The effect was ascribed to the filling of the shrinkage cracks formed in the clay during dry weather by the permeable "burned" material, allowing deeper penetration of rain water but that was denied. Another explanation was that the "burned" soil on the surface acted by protection of the "crumb" structure of the unburned soil below it; another that nitrification was promoted. At any rate it would seem that the remedy might in the long run be worse than the disease. Possibly mere fertilization by the salts freed in the burning of the humus plus the plant residues would account for the effects observed, and the destruction of harmful fungi may also have been a factor.

The editor of the volume (Tothill) mildly intimated his dissent from his deceased collaborator's apparent approval of top-soil burning. Crowther () had cited Virgil's Georgics as a sort of a justification of soil burning, but the passage quoted really had no bearing at all, for it merely referred to burning stubble, which might eliminate pests and provide immediately available soluble salts.

Dacanay, Placido (1932) Reafforestation of Grasslands in the Philippines. *Empire Forestry Journal* Vol. 11 No. 1, p. 13. 1932. (Quoted from the Manila Tribune, 4 Jan. 1931)

"It is estimated that about five million acres of grass-covered lands resulting from abandoned shifting cultivation require planting up. Over 600 species have been tried, and of those finally selected the following are the most important:
. . . "

The list follows, led by Leucaena glauca, a species which, on account of the great success attending its use in the Philippines, has been recommended for use on the great denuded areas of tropical and subtropical China, where it might either function in the reestablishment of a forest by enrichment with species possibly more important for timber, or frankly for its own great value for producing a "crop" of fuel wood.

Dampier, William (1697) *A New Voyage round the World ... Illustrated with Particular Maps and Draughts. The Second Edition: Corrected.* London: Printed for James Knapton. [x] + vi+550 pp., 5 maps.

Dampier, the amiable and scientific pirate, was remarkable for the breadth of his interests and the accuracy of his observations. In the account of his travels around the world we find several descriptions of uncultivated grassland.

He described (p. 44) prairie or savannah in the coastal region north of the Santa Marta Mountains of Columbia near the Rio la Hacha, which was still Indian in population in 1681 when he was there. He wrote:

"The land is but barren, it being of a light sand near the Sea; and most Savannah or Champian: and the grass but thin and course, yet they feed plenty of Cattle. Every man knoweth his own and looketh after them; but the Land is common except only their Houses or small Plantations where they live, which every man maintains with some fence about it. They may remove from one place to another as they please, no Man having right to any Land but what he possesseth."

Nearly two hundred years had passed, of course, since the Spanish had introduced cattle. The aborigines had had no pastoral phase in the development of their culture, but slipped into it readily from the stage of hunting and shifting agriculture.

Leaving the Caribbean region for a journey far to the southward he visited the island of Juan Fernandez which is far

out of our geographical range. He gave a good description of the island which led him to a discussion of savannahs in general, so we may quote the whole (p. 87):

"The sides of the Mountains are part Savannahs, part wood-land. Savannahs are clear pieces of Land without Woods, not because more barren than the Wood-land, for they are frequently spots of as good Land as any, and often are intermixt with Wood-land. In the Bay of Campeachy are very large Savannahs, which I have seen full of Cattle; but about the River of Plate are the largest that ever I heard of, 50, 60, or 100 miles in length, and Jamaica, Cuba, and Hispaniola have many Savannahs intermixt with Woods. Places cleared of Wood by Art and Labour do not go by this name, but those only which are found so in the uninhabited parts of America, such as this Isle of John Fernandoes; or which were originally clear in other parts.

"The Grass in these Savannas of John Fernando's is not a long flaggy Grass, such as is usually in the Savannahs in the West Indies, but a sort of kindly Grass, both thick and flourishing the biggest part of the year. . . .

"The Savannahs are stocked with Goats in great Herds. . . . The west end of the Island is all high Champion ground without any Valley, and but one place to land; there is neither Wood nor any fresh Water, and the Grass short and dry."

Voyaging northward they reached what Dampier called the "Mexican" coast near Cape Blanco, 9°56'N., which is now Peña Blanca, on the Guanacaste Peninsula, Costa Rica. He said (p. 112) of the neighborhood of a "small Brook of very good water running into the Sea":

"It is very rich Land, producing large tall Trees of many sorts; the Mold is black and deep, which I have always taken notice of to be a fat soil. About a mile from this Brook towards the N. E., the Wood land terminates. Here the Savannah land begins, and runs some leagues into the Country, making many small Hills and Dales. These Savannahs are not altogether clear of Trees, but are here and there sprinkled with small Groves, which render them very delightful. The Grass which grows here is very kindly, thick and long; I have seen none better in the West Indies. Toward the bottom of the Bay the Land by the Sea is low and full of Mangroves, but farther in the Country the Land is high and mountainous. The Mountains are part Woodland, part Savannah. The Trees in those Woods are but small and short; and the Mountain Savannahs are clothed but with indifferent Grass. From bottom of this Bay, it is but 14 or 15 leagues to the Lake of Nicaragua, on the North-Sea Coast: the way between is somewhat mountainous but most Savannah." In his references to savannahs Dampier generally says nothing about fire. At about 24°N., which was near the river Coolecan, to reach the town Massaclan:

"Our men marched through a Savannah of long dry Grass. This the Spaniards set on fire, thinking to burn them. . . ."

This may be taken as sufficient indication that burning the savannah here as in all other parts of America was an established procedure, for as an aid to hunting the Indians must have done it many centuries before Europeans arrived.

Dampier then voyaged across the Pacific, and, by way of Guam, which he called "a pretty high Champion Land" [i.e., plains or prairie land] came eventually to the southeastern corner of Mindanao, where there were two small islands [now called Sarangani and Balut] about two leagues off shore. Four leagues northwest of these islands was a small bay [Sarangani Bay] running seven "miles" [i.e., the old mile which was between 4 and five statute miles] inland to the N. N. W., only a couple of miles wide at the mouth, but three miles wide inside. On the eastern side the land was high and wooded: on the western side low, and described by Dampier as follows (p. 347):

"On the West side of the Bay the Land is of a mean height with a large Savannah, bordering on the Sea, and stretching from the mouth of the Bay a great way to the Westward. This Savannah abounds with long Grass and it is plentifully stocked with Deer. The adjacent Woods are a covert for them in the heat of the day, but mornings and evenings they feed in the open Plains. . . . I never saw anywhere such plenty of wild Deer. . . . We saw a great many Plantations by the sides of the Mountains, on the East side of the Bay. . . ."

This latter observation is important as bearing out the conclusion that shifting agriculture is at the expense of forest. The east side was the forested side.

The next point at which Dampier recorded observation of grassland (but not of fire) was at the northeast corner of the island of Hainan, at that time still having some lowland forest. He wrote (p. 406):

"It was the 25th day of June [1687] when we made the Land; on the N. E. end of St. John's Island. This Island is in Lat. about 22 d. 30 min. North, lying on the S. Coast of the Province of Quantung or Canton in China. . . . It is partly woody, partly Savannahs or Pasturage for Cattle; and there is some moist arable land for rice. The skirts or outer part of the Island, especially that part of it which borders on the main Sea, is woody. The middle part of it is good thick grassy pasture, with some groves of Trees, and that which is cultivated Land is low wet Land yielding plentiful Crops of Rice, the only grain that I did see here."

The only inhabitants that Dampier saw were Chinese, for the natives, of Malayan racial affinity had already been pushed out. The interpretation of the landscape as Dampier saw it would be that the shifting agriculture of the aborigines had left the open grassland, used by the intrusive Chinese for grazing and undoubtedly kept open by fire, and that the more advanced agriculture of the Chinese used only wet land for the cultivation of irrigated rice.

Dampier's voyage took him next to the Pescadores of which he said (p. 416):

"These Pescadores are moderately high and appear much like our Dorsetshire and Wiltshire Downs in England. They produce thick short Grass and a few Trees. They are pretty well watered, and they feed abundance of Goats, and some great Cattle. There are abundance of Mounts and old Fortifications on them, but of no use now, whatever they have been."

The climatic conditions in the Pescadores, as in Formosa and the tropical part of continental China, are such that the natural vegetation, prior to deforestation and use of the grasslands for grazing, would have been forest.

Dampier was the first to describe the Batanes Islands, northern outliers of the Philippines, but other features engaged his attention beside the vegetation, so, aside from useful notes on cultivated plants, we find only this (p. 426):

"The soil is indifferent fruitful, especially in the Valleys; producing pretty great plenty of Trees (though not very big) and thick Grass. The sides of the Mountains have also short grass. . . ."

This brief glimpse of the islands would have applied to Basco in 1935, when the Batanes were visited by the reviewer, and it fits many Philippine localities where primitive agriculture has resulted in replacement of all but vestiges of the old forest by secondary forest or grassland.

Dansereau, Pierre (1947) Notas sôbre a biogeografia de uma parte da Serra do Mar. Revista Brasileira de Geografia, Vol. IV, No. 4, pp. 497-520, 12 figs. Oct.-Dec. 1947.

Since most authors on the plant geography of Brazil have given relatively little attention to the higher altitude of the coastal region, Dansereau's papers are particularly welcome. This paper describes several localities, one of which is the National Park of the "Serra dos Orgãos", the Organ Mountains, which has also been more elaborately described in a phytogeographical monograph of H. P. Veloso (1945).

Dansereau gives us an idea of the effect of fire along the boundary between high mountain grassland and the forest below it. The uppermost forest on the mountain at about 2,040 m., had trees only four or five meters tall, of *Baccharis*, *Clethra*, *Miconia*, *Roupala*, *Macropeltis*, *Abatia*, and a lauraceous tree. Then came the "Campe dos Antas", a little prairie covered with tall clumps of the grass *Cortadera modesta*. The greatest impression made by this grass, at first glance, was its resistance to fire. The humus between the clumps was in large part destroyed down to mineral soil, but the dense bases of the grasses resisted burning, and formed tussocks which protected much of the organic matter produced by the grass itself, and the humic covering of some of the rocks that occurred among the tussocks. So the elevated tussocks, conserving humus, became separated by relatively bare soil. It seemed less likely that the *Cortadera* association was the climax vegetation at this altitude than that it was a disclimax dominated by *Cortadera* because of the unusual resistance of this grass to fire.

The higher part of the Pedro do Sino (2260 m.) had no trees. In the more protected places, however, there were various lesser woody plants and a considerable number of herbaceous species, in addition to the grasses. The climax vegetation would seem to be treeless campo with *Danthonia montana*, another grass, the little bamboo *Chusquea*, and a *Sisyrinchium*.

Dansereau, Pierre (1948) The Distribution and Structure of Brazilian Forests. Bulletin du Service de Biogeographie, No. 3 Montreal: Univ. Montreal. 17 pp., 6 figs. (Repaged reprint from Forestry Chronicle, Vol. XXIII, pp. 261-277. 1947).

The extent of forest in Brazil has been variously estimated as between 48% and 58% of the total area. Of course the figures, as Dansereau says, depend upon one's definition of forest, in contrast with savannah, parkland and brush. A broad classification of the major units of Brazilian vegetation can be achieved with seven main subdivisions, namely, (1) the Amazonian rain-forest; (2) the coastal rain-forest; (3) the Paraná pine (*Aracauria*) forest; (4) the caatinga, or scrub-forest of seasonally subarid to arid land in the north-east of the country; (5) the cocões, largely dominated by palms, with a longer moist season than the caatinga; (6) the campos cerrados or grassland with scattered trees; and (7) the extratropical pampa of the extreme south, in the state of Rio Grande do Sul.

Of these we are of course especially concerned with the campos, which vary from prairie to savannah, and their gain upon the forest as a direct or indirect effect of human agency.

Dansereau has an interesting comment (p. 12) on the cooler, high-altitude forests of the coastal area. He says:

"A montane rain forest at about 1800 metres in the Serra do Itatiaia consisted mainly of *Cabralia* (about 15 metres high) and an understory Somewhat above that level, between 1800 and 2000 metres the forest, if not actually elfin, is much reduced in size, and is dominated by *Roupalea lucens*, *Weinmannia* sp., and *Clethra brasiliensis*. These trees have been almost entirely destroyed by fire and replaced by a small bamboo (*Chusquea pinifolia*), shrubs of the Compositae family and grassy steppes and bogs.

Secondary forests of many types, however, are a more familiar sight. . . . Much of the escarpment that borders the eastern edge of the Coastal Range is covered with second-growth forest. . . . Several species of *Cecropia* (always a sign of disturbance) occupy different ecological positions. . . . Palms and bamboos are very quick to fill in gaps in the forest. Another interesting species, because of its present rarity, is 'pan brasil' (*Caesalpinia echinata*) the tree that gave its name to the country. It seems likely that it also was a subclimax species, as it seems to have occurred in stands of some density."

Of the scrub forest, climatically so placed that retrogression under continued adverse influences is easier than progression, Dansereau (p. 5) says: "The damage to primeval vegetation is especially grave, and seems, in many cases, irredeemable." Of the Campos cerrados he says (pp. 5, 6):

"This name is misleading and has caused some confusion in the mapping of Brazilian vegetation. Its meaning in various parts of the country is quite different. At all events a mere glance at the extension of cerrado carries the conviction that a broad climax is involved. The Brazilian savannah occupies a central position, and, as such, comes in direct contact with almost all other types. In the centre of Goiaz, the W. of Minas Gerais and the E. of Mato Grosso, it is almost certainly climax. . . . On many marginal areas, it probably owes its advance to fires and deforestation. Its outline in Sao Paulo, described by Rawitscher and his students (1943, 1946) seem to be fire disclimax or at most preclimax relics.

"The cerrado consists of more or less continuous grassland with scattered trees. The trees are small, of a rather open form, and belong to two principal types: the coriaceous broadleaved evergreen and the finely dissected partly deciduous-leaved. . . . The grasses are luxuriant during the rainy season and dry up almost completely in winter. . . . A third and most curious category are small plants (chamaephytes) of restricted aerial growth (height: 20-30 cm.) with

an almost incredible root development, 15-20 meters down to the water table (Rawitscher; Ferri e Rachid, 1943): Jacarana decurrens, Anacardium humile, Andira humilis, etc."

It seems not certain yet, in spite of the many years that have passed since Brandis called attention to the need for simple experimentation of obvious nature to be undertaken to find out whether the woody chamaephytes of fire ravaged country with their enormous underground development are environmental response forms or genetically different from the similar tree types of unburned areas. It is perfectly possible that some of the chamaephytes are genetical deviates, persisting because of peculiar adaptation to arid conditions and fire. They are so unlike the similar trees that systematists, lacking experimental evidence of hereditary difference, have had to consider some of them as being distinct species.

About the extension of campos into the Amazonian forest, even close to the river itself, Dansereau comments (p. 10):

"Huber (1900) who has probably given the best account of the vegetation of the lower Amazon, considers them of recent alluvial origin and therefore seral (although he obviously does not use such a word. [Ecologists use it to denote a stage in progress toward climax vegetation.] He draws arguments from their geomorphological contours, their level, and their flora, to show that they are immature topography. An interesting feature is the character of the islands of forest scattered in these campos: they do not resemble that of nearby islands in the river, and would seem to conform to a now extinct pattern. That would make the campos subclimax and the forest islands preclimax!

"Warming (1899) has been very insistent in respect to the relative youth of the campos cerrados and their comparative poverty in species: the tertiary cerrados of Central Brazil having fewer species than the neighboring forest, and the quaternary cerrados of northern Brazil and Venezuela having still less."

One may believe, however, that the flora of the campos has been recently impoverished and that it was sufficiently distinctive and diversified in the pre-human period to be very ancient, i.e., reaching back into the Tertiary, if one considers the great diversity of endemic types in such a group as the Eriocaulaceae, and conceives that perhaps other groups have become, during the period of human interference, greatly reduced in number of localized species by the action of fire. The campos as a climatic climax without annual fires or at least with only very infrequent fires may have been floristically much richer than it is after perhaps thousands of years of devastation by fire, for man had surely established the habit of burning over the savannahs and grasslands many centuries or millenia before Europeans entered the scene.

After discussing the economic problem of utilizing the vast diversity of timbers found in tropical forest, Dansereau writes (p. 14):

"Also, Brazilian forests are very badly damaged, and are in a very poor state of conservation because of irresponsible and unplanned lumbering and because of fires. There, too, the myth of the inexhaustibility of natural resources has brought about waste, fire, erosion, floods, and so on. The losses in soil fertility through deforestation are incalculable, inasmuch as the recuperation of fertility in the tropics is much slower and in many cases apparently hopeless (Rawitscher, 1946).

"Today, forest legislation is very severe in the texts of the law. Souza (1945) gives an excellent outline of the principal items. However, these rules are largely unapplied. Forest reserves and national parks are too few, and mostly too small, and even there the law is not enforced. . . . There is no forestry school in the country It is rather illusory to contemplate educating the general public in forest conservation when so little is actually known of soil and vegetation dynamism. The application of ecological methods in the study of tropical conditions is still in an early phase."

Dansereau, Pierre (1949) *Introducao à Biogeographia*. *Revista Brasileira de Geografia*, Vol. XI, No. 1, pp. 1-92, 78 figs. Jan.-March 1949.

This general introduction to the subject of plant geography is notable for the freshness of its point of view. Other papers of the author which deal with Brazil are reviewed here insofar as they bear upon primitive agriculture and fire. The present "Introduction" is not especially or even largely on tropical ecology but gives its author's ideas on conservation as a science based on ecological concepts and which has the objective of protecting and improving natural equilibria.

Dansereau, Pierre (1950) *Ecological Problems of Southeastern Brazil*. *Scientific Monthly*, Vol. LXXI, No. 2, pp. 71-84. Aug. 1950.

Fire is unable to maintain tropical grassland after it becomes degraded by over-grazing, for the amount of fuel provided by the grass becomes insufficient to support a continuous or hot enough fire. Dansereau makes this point (p. 75) as follows:

"Since man's interference has degraded almost the entire upland [of coastal Brazil] today, many stages of succession may be observed, from the bare, raw, eroded land to the secondary forest. In general, after coffee and sugar-cane cultivation, pasture has set in and over-grazing has resulted in considerable stretches of shrubby fields. Imperata brasiliensis is a grass that will tolerate burning, and even produce large quantities of tender green shoots after a fire. Many other grasses, both indigenous and introduced, are found in these pastures. With decrease in fertility and deterioration in structure of the soil, they are soon unable to compete with shrubs such as Cordia curassavica and Baccharis schultzi. . . ."

At about the elevation of the great central plateau (400 to 800 meters) are high valleys running parallel to the coastal ranges. Taking the Paraiba Valley as an example, Dansereau (p. 77) says:

"These valleys were once forested and have been considerably modified by human occupancy. The rain forest that covered the upland was probably quite similar to that of the escarpment. . . . Altogether, in fact, very little forest remains in these broad valleys outside the steep ravines and slopes, for most of the land has been cleared long ago and planted to coffee and later to sugar cane. More recently it was given over to extensive pasturing. The present level of fertility is low, and relatively few of the original native plants have persisted. By far the most successful species is Melinis minutiflora. This African grass is fairly good fodder. Its pink color and sweetish smell are quite characteristic, and in the minds of travellers and natives are as closely associated with that part of the Brazilian landscape as sagebrush with the western Great Plains of the United States or rockroses with the French Mediterranean maquis."

Dansereau has an excellent picture showing a degraded area that was once forest, now occupied by Melinis (the molasses grass) which is giving way to the invading shrubs Baccharis Schultzi and Cordia curassavica.

Dansereau (pp. 80, 81) gives interesting information about the relict forests of Araucaria angustifolia (Brazilian "pine") of the Mt. Itatiaia region, isolated areas of localized relatively cool climate which must once have been more continuous. Three of these areas are commented upon:

". . . . Campos do Jordão alone still has large stands of Araucaria; at Campos da Bocaina and Itatiaia they have been ruthlessly lumbered. . . . The highest part of the mountains has often been called the 'campos level', because of the prairie or steppe vegetation that prevails there. In fact, however, it was originally wooded. It is a great pity that so little remains of the primeval elfin forest. . . ."

In each one of the areas where the segregates of this old forest type appear, the epiphytes, the shrubs and the herbs that it harbors show interesting local or regional affinities. . . . The forest has been extensively destroyed, however, mostly by fire, and is now replaced by more or less continuous grassland or tussockland."

Delgado, Juan J. (1892) *Historia General sacro-profana, politica y natural de las Islas del Poniente llamadas Filipinas*. Manila: El Eco de Filipinas de D. Juan Atayde.

Padre Juan Delgado, who went to the Philippines in 1711, composed a history of these islands between 1751 and 1754, but it lay in manuscript until 1892. Although largely botanical in content, it has very little relating to agriculture. His work does, however, allude to the high development of rice culture in wet fields (sawah) in Luzon, where the monumental terraced, mountain-sides of the Mountain Province indicate an age for permanent land utilization of many centuries. Of the other islands, however, Delgado (1892, p. 71) mentioned only Panay as having an advanced agriculture. He said that it was only the islands of Manila (Luzon) and Panay that the carabao was used for working the rice fields, and he gives a particular description of the Rio Mayon, which was one of the rivers of Panay which like the Nile seasonally overflowed its banks, and provided perfect conditions for rice cultivation. Undoubtedly the overflowed lands of the Cotabato River, and probably others that he had not known about, would have been sites of wet rice cultivation in his time, but still his experience was wide enough so that we may accept his statement that in general the Bisayas limited this agriculture to caingen, or clearing of dry fields cleared of the smaller trees by human labor with the machete or chopping knife (bolo). He leaves us to infer that the larger trees were perhaps not felled, just as even today they are left to succumb to the effects of fire.

That the ultimate result of kaingin agriculture was grassland, then as now, Delgado (p. 87) indicated by his description of the island of Masbate, especially beautiful because of its green rolling hills covered with cogonales, or prairies of cogon grass. Cogon, he says, grows in the manner of rice or wheat, has white florets that float off in the breeze, and when in seed and white-topped, the wind blowing across a plain covered with it made waves like those of the sea.

Demmon, E. L. (1935) *The Occurrence and Causes of Forest and Grass Fires in the Eastern United States, with particular Reference to Colonial Days.* U. S. Dept. Agric., Forest Service, Southern Forest Exp. Sta., New Orleans, Louisiana, mimeographed p. 41 "Literature Cited", 6 pp.

Demmon (1935) has reviewed much of the older literature of exploration and travel in tracing the history of forest fires and grass fires in the area of the eastern United States. He was particularly concerned with what evidence he could gather that such fires did not originate with European settlement, but that they were regularly employed by the prehistoric Indians, who used fire in hunting. The references for the subtropical Gulf coast of the United States are definitely pertinent to this review of the literature on the influence of fire on tropical vegetation, for the Caribbaean region may be considered a geographic entity regardless of the fact that it lies partly outside the tropics. For the Gulf region the earliest record that either Demmon or Robertson found was that of Alvar Nuñez Cabeza de Vaca (), whose observations in Florida dated from 1528 to 1536. Demmon quoted Bandelier's translation () of the passage on Indian hunting as follows:

"In the same manner they kill deer, encircling them with fires, and they do it also to deprive the animals of pasture, compelling them to go for food where the Indians want. For never they build their abodes except where there are wood and water, and sometimes load themselves with the requisites and go in quest of deer, which are found mostly where there is neither water nor wood."

Readers of the frequently quoted passage (above) from Bandelier's and Buckingham Smith's translations of Nuñez Cabeza de Vaca's "Naufragio" will note that one translator renders "vacuna" as "animals" instead of "cattle", as though it referred to the just mentioned deer, for the translator probably doubted that "cattle" had been hunted in Florida. Buckingham Smith, however, had "cattle" which seemed to him to refer to bison, mentioned immediately after. Nuñez Cabeza de Vaca proceeded from Florida westward and crossed the continent, so undoubtedly referred to the buffalo and in his narrative, written after the events, may have anticipated his knowledge of the Indians' method of hunting the latter by the aid of fire.

Demmon's other references to Indians hunting with the aid of fire, and being imitated by colonials in so doing, are too extra-limital for the purpose of this paper, but important for establishing the general thesis that the Indians burned over great areas of woodland (pine-land, clearings, etc.) as well as prairie.

Denis, Ferdinand (1823) *La Guyane, ou Histoire, Moeurs, Usages et Costumes des Habitans de cette Partie de l'Amérique*. 2 vols. Paris: Nepœu. Vol. I, ii + 183 pp., pl. des matières. Vol. II, ii + 237 pp., pl.

Ferdinand Denis (1823) was an extraordinary prolific author who reviewed most of what had been written about Guiana in general and French Guinea in particular down to his time. He evidently looked upon the American forest (as most Europeans did in his day) as merely something that was in the way of agricultural development but that still should be left for getting what value might be in it until after the unforested lowland had been utilized for cultivation. He said (I, p. 40) that the country was composed of vaste plaines interrupted by hills and marshes, where one saw everywhere immense forests that needed only the axe of the industrious cultivator to give place to plantations of all sorts. In general the soil was fertile, but it could be divided into two distinct sorts, that of the hills, and that of the lowlands. The former was covered with majestic forest, and was ordinarily the first land to be cleared. At first it offered the cultivator an experience of good yields. The ashes of the burned timber fertilized the land which produced well for a few years, after which it was seen that the top soil, no longer replenished by the detritus of the forest, had all been washed away by the rains, so that one was constantly confronted with the necessity for cutting and burning fresh forest. The only thing that could lead to permanent agriculture, he said (I, p. 45), was to follow the advice of the Dutch for cultivating the lowlands. So the marshy savannas ought to be ditched and put into use for sugar cane, cacao, and even coffee. These lands received detritus by erosion of the hills, and would hold their fertility for a long time. The forested hills could be left to furnish excellent woods for general construction and cabinet work. In having such excellent insight into the immediate needs of the situation, even if he did not see forest as a permanent resource, Denis was far in advance of his time.

The heavy work of the colonists, Denis indicated, was not done by indigenous Indians but by African slaves, who were most abominably maltreated, but he said (I, p. 120) that the Indians carried out the same procedure, with certain modification. Thus, when several trees could be made to fall in the same direction, the chopping was done so that the fall of the first tree would bring down the others that lay in its path. The Indians were the canoe makers, and took especial pains in felling trees for canoes, to avoid splitting the trunks. They built up staging from which to chop the great trees with buttressed bases.

Dickerson, Roy E., in collaboration with Elmer D. Merrill, Richard C. McGregor, W. Schultze, Edward H. Taylor, and Albert W. C. T. Herre (1928). *Distribution of Life in the Philippines*. Monographs of the Bureau of Science, Philippine Islands, No. 21. Manila: Bureau of Printing. 322 pp., 42 pl. and maps.

(p.128) "A method of agriculture common to various tropical countries is practiced also in the Philippines, where it is known as the caingin system. The caingin is merely a clearing in the forest, and if the cleared land were continuously cultivated, no harm would result. The caingin is seldom thoroughly cleared; the smaller trees are cut and when dry are burned. Nearly all the large trees in the field are killed in this process. . . . Corn, rice, sweet potatoes, or yams are then planted. For a few seasons good crops can be taken off a caingin without much labor, but grass soon becomes so well established that the farmer finds it easier to make a new caingin than to struggle with the grass. Among such Mindanao peoples as the Manobos, Bagobos, Bilans, and Tagabilis, the caingin is used but one season, except under very unusual conditions. Around their barrios, which are moved at short intervals, grass quickly becomes well established and, upon abandonment of the caingin, holds the area for a short time and then is supplanted by second-growth forest.

"In the part of the Archipelago having distinct wet and dry seasons (that is, the western half) grass areas tend to remain in grass. The grass is frequently burned during the dry season, either by accident or by intention; and thus any forest-tree seedlings that have entered the grass are killed, while the deep-seated perennial rhizomes of the grasses are uninjured. After the first rain the grass soon produces luxuriant growth. . . . On the eastern side of the Islands there is a nearly continuous wet season. Here the more uniformly moist condition prevents grass fires and the grassland is soon invaded by tree species and gradually returns to forest, first by the establishment of characteristic second-growth species, usually quick-growing forms, and eventually, if undisturbed for a long time, by the establishment of primary-forest species.

"If the population of a thickly inhabited island decreases . . . some of the rice fields are abandoned. These, even when bordering forest, do not grow up to the old-forest species of trees, but are at first covered with a rank grass and later with species of shrubs and second-growth trees or by gregarious bamboo forests. . . . If the region be one of marked wet and dry seasons, it will be very difficult for the forest species to regain a foothold in an area from which they have been removed."

Durand, A. (1897) Chez les Tanalas d'Ambohimanga-du-Sud. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. II, no. 12, pp. 513-522, Dec. 1897. Tananarive: Imprimerie Officielle.

This article is one of the itineraries of an official which is definite enough in its record of forest conditions en route so that it would be very interesting for a botanist to retrace the journey after the lapse of sixty years in order to record the changes that have taken place. The whole group of such journeys afford material for a check on the progress of deforestation. Some of the places on Durand's route may be located on a map of the same year (1897) which accompanied the report of Lefort and Jacquier, published in the same volume (pp. 143-161; map) and which shows probably only approximately the boundaries of the narrow forest strip which this far south was all that was left of the "Great Forest". This occupied the declivity or escarpment between the flat to hilly coastal region and the central plateau. The forest area seems, from the map, to have varied in width from five or six miles at the narrowest place bounding this particular Tanala province to perhaps 30 miles, with an average of perhaps 16 miles.

It is interesting that there appears to have been no forest at an elevation up to the place of which the Malagary name, translated, meant "foot of the mountain," at 930 meters elevation. In the next fifteen minutes of travel the route ascended to 1010 meters. At a place called Mahatsara they turned westward into the edge of the forest, then turned northeastward, followed its edge, passed over Mt. Tangia (1130 m.), descended, leaving the forest at 1000 m., and reached Antanambao at 1810 m. Soon dipping into the forest again they left it at Betampona. It continued to several kilometers from Betampona but had been recently devastated by fire. Durand encountered charred trunks in great numbers along the route, debris which indicated a luxuriant vegetation destroyed, he said, by the ignorant vandalism of the natives. Near Betampona it was customary to burn a part of the forest each year and to sow in a few days the amount of upland rice that would suffice for subsistence of the population. This picture could doubtless have been duplicated all along the eastern mountain rim of the central plateau of Madagascar at the time of French occupation.

Duruy, S.-V. (1897) De Tsaratanana a Nossi-Bé. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. II, no. 11, pp. 413-445, Nov. 1897. Tananarive: Imprimerie Officielle.

The admirable report of a military reconnaissance by Lieut. S.-V. Duruy of the French army of occupation in Madagascar, made before the turn of the century, illustrates a neglected resource which botanists

have had for studying the course of vegetational change in what is considered almost a type region for demonstrating the destructive effect of human activity on natural vegetation. It would only be necessary to retrace some of the several excellent published itineraries which have remained unutilized by phytogeographers in order to appraise even if not to measure the changes of over a half-century. Duruy's botanical observations although scanty, are definitely localized and indicate that reconsideration is called for of such sweeping generalizations as those arrived at by some botanists and others, who, in their natural and commendable enthusiasm for conservation may have been unrealistic in their conclusion that nearly the whole of Madagascar before the advent of man had vegetation somewhat like that of the humid strip of forest extending down the east coast, occupying the declivity from the central plateau and formerly extending over the low hills and plains, long since cleared, which border the Indian Ocean.

Granting the major conclusion of Perrier de la Bathie and Humbert that man has been so destructive as to have effected great vegetational changes, one may still remain unconvinced that the actual detailed reports of recent topographic and climatic conditions in Madagascar indicate that the present vegetation could have been derived from mesophytic forest entirely through human agency. Rather, the present types of vegetation seem to have come about by man's serious disturbance of a series of vegetational formations of geological antiquity, climatically determined, and in such unstable equilibrium that each suffered destruction or degradation when man, with cattle and fire, interfered with it.

Now the reviewer may recount some of Lieut. Duruy's observations in October, on the west coast, where he traversed when it was driest, a stretch of seasonally arid country.

(p. 413) After leaving the arid and dry valley of Betsiboka he was agreeably surprised to find in the valley system of the Mahajamba veritable forests in the valleys, although the hill tops were denuded. Tsaratanana had an aspect of prosperity as though it had not declined greatly through the disorders of the insurrection. Here the flat valley of the Mahajamba was only five or six kilometers wide on the right side. Lower down, at Maromoka, the Mahajamba entered the plain and marsh region of eastern Bouéni.

The almost instinctive wish of some Europeans to see land neatly cleared and cultivated is shown by one of his notes on the vegetation (p. 417). East of the village of Ampassamentera he traversed a plain, wooded at the center but otherwise covered with scrub and tall herbs, which the inhabitants used only for pasturage. Around the two little villages there were plantings of sugar cane, but it would take a serious job of clearing, he observed, to make this vast plain suitable for anything but stock raising!

Between Ampassamentera and Amparihy the country changed. It became more broken, the marshes were mostly dry but at some places one sunk to the knee. The lakes or ponds of Sinjo, he observed, have water at all seasons and in the wet season communicate with the Ampassamentera. Then comes the almost absolutely flat region of Matety extending to the Amparihy, where one finds veritable forests of satrana. On the plain of the Amparihy there were shallow lakes of considerable extent. The plain was of no utility except for pasturage, but Duruy described it as absolutely deserted, with three abandoned villages, a result of the internal strife and warfare that had prevailed.

Traversing more plains with shallow ponds, he came to the Anjabony, an affluent of the Bemarivo, where on the right side there was a forest parallel to its course but higher land bounding its basin on the east, and the whole of the west side were almost entirely deforested. Other bits of forest were noted as he proceeded. For instance he remarked (p. 421) that the water shed between the Mazava and Ankajambo valleys was feebly indicated by a line of well wooded low hills. Then the plateaus of the Mahamavy had forest only in the ravines. On the other side of the Bezomanga, on the contrary, the Ankandrina upland was wooded. The plain of Ambakoana was wooded: it wasn't a forest but a succession of clumps of trees. Between Amboloboza and Benavony there was abundance of rafia palm. Here the swamp of Androfebe for three kilometers was covered with a forest of magnificent rafias which couldn't be cleared away(!) for even in October, the time of absolute drouth, the muck was knee-deep, and the path to Benavony had to make a long detour around the palm swamp.

Duruy has a chapter (pp. 428-431) on the flora. In the entire region traversed, he said, one would search in vain for a forest worthy of the name although the country was more or less wooded. One marched hours through thickets, but not trees. The wooded western zone extended truly only to the confluence of the Ramena and the Sambirano. It presented open spaces and others with only bush, to which it was difficult to give the name "forest." The slopes of Masokoamena, the gorges of Tompoketsa and the ravines of the massif between Maivarano and the Anjingo were the places, with the great massif of the Analabe, at the southwest of the lower Sambirano, where one found the largest trees.

The rest of the country was absolutely devastated by the habit of all the Malagasy, even in passing, to set fire to the herbage, under the pretext of improving the pasturage, even if there were no herds. Considerable stretches had been wooded where he saw nothing remaining but charred trunks. Only in the ravines, where humidity persists a long time, the trees persisted, but on the slopes and summits of the hills, the forests or woods had been more or less succeeded by brush. Duruy had seen a conflagration to the north of Benavony, at

a day's journey from the coast, which the inhabitants regarded with complete indifference.

For the rafia palm and the traveller's palm (Ravenala) Duruy gave precise localities. The baobab (Adansonia) he saw as fine specimens, up to 2 meters in diameter at Amboloboza, near the confluence of the Ramena and Sambirano rivers. This is a character plant of a definitely dry phytogeographic region, which extended up into the highland, and does not at all correspond to the strip of rain forest on the eastern aspect of the island. As in continental Africa it indicates a more arid flora, and its special habitat in Madagascar is old enough for endemic species to develop. This and many other facts lead the reviewer to disbelieve the conclusions that the more extreme writers would have us accept, i.e., that a distinctive subarid-land flora with localized endemic species evolved in a mesophytic forest. Man is convicted, in Madagascar as almost everywhere else, of being so bad a villain that he should not be blamed for climatic as well as floristic deterioration until there is better evidence.

Duveyrier, Henri (1864) Exploration du Sahara: les Touareg du nord. Paris: Challamel aîné. xxxiv+499 pp., 30 pl., map.

This work is the authority which has been referred to by Stebbing and others as indicating the presence of forest in recent historic time, at specific localities in the southern part of the Sahara, which are now entirely desert. From the standpoint of indicating that the Sahara is "on the march" the work concerns us, although the area treated is extra-tropical. The Touareg have gradually pushed southward and the southern branch of this people extend into the tropics, occupying part of the basin of the Niger. Regarding the southern extension of the Tuareg Duveyrier refers to Barth.

In the list of Touareg words relating to habitations (p. xxxi) occurs "houma; quartier, village. (Mot de l'île de Djerba.)"

Ellis, William (1838) History of Madagascar. 2 vols. London and Paris: Fisher, Son, & Co. xvi+517, xii+537 pp., illust., map, chart.

In 1830, only two years after the publication of Copland's work, materials for a new History of Madagascar were sent by the missionaries, and William Ellis, Secretary of the London Missionary Society, was instructed to write the work in 1833. Events required postponement until 1838, and by that time there was vastly more information. The notion of a continuous high mountain chain down the center of the island had been displaced, but such a recent map as that of Chase Osborne () copied or compiled from French sources, of course, (but he had travelled the whole length of the island and several times across it, and therefore knew the general topography) shows no land lower than 1000 to 1500 meters in the continuous hilly axis, which, to be sure is much nearer the east coast than the west, but actually runs the whole length of the island. It is interesting to observe that there is more similarity than difference between Ellis's map and Osborne's.

Describing almost deforested Ankova, the province of the capital city Antananarivo Ellis (Vol. I, p. 91) says of one of its three subdivisions:

"The general appearance of Imamo is not inviting. It is hilly, but with extensive pieces of level ground, and fertile valleys. In order to secure good pasture-land for the cattle, the inhabitants burn the grass which grows luxuriantly on the sides of the hills. They set fire to this about the close of the dry season; at which season of the year the fires may be seen at an immense distance illuminating the horizon in a most splendid manner, for many miles in extent. As soon as the rains fall, the young and tender grass springs up, and a fine rich pasture is provided."

Following the best description that I have found of the perennially used wet rice terraces and the manner of irrigating them, Ellis (Vol. I, p. 299) added:

"Besides the rice grown in the manner now described, there is another kind grown on high ground, generally the gently sloping sides of the hills. In preparing the soil for the latter, the wood is felled, and the least valuable parts of it burnt on the ground. The rice-seeds are planted among the ashes, and watered by the heavy periodical rains, generally yield as rich a harvest as that planted in the low lands, and so frequently covered with water. The latter kind is called horaka, the former tavy."

These two words for rice have counterparts in other Malayan languages, but the verbal affiliation of the former may not have been pointed out. It seems to be related to Batak

and Malay (of Asahan, in Sumatra) harangan, abandoned land on which upland rice has been grown. The suffix -an denotes "place of". Several writers have pointed out that tavy is equivalent to padi (Malay), palay (Tagalog), and many other variants.

Regarding the extent of forest in Madagascar in the early half of the last century, Ellis said (Vol. I, p. 315):

"Forests of varied extent abound in different parts of the country, and an immense belt of forest, of two or three days journey in width, surrounds the interior of the island. . . . Timber is exceedingly dear at the capital, being brought from the extensive forest of Angavo, which stretches to a great distance on the north and south of Antananarivo, from which it is about forty miles distant."

Ellis (vol. 1, p. 424) had something to say of the superstitious fears which formerly preserved some vegetation, at least a sacred tree or all the surrounding vegetation near the reported grave of the ancient aboriginal inhabitants of Madagascar, who are called vazimba. He wrote:

"In some cases, as at Ampanibe, 'the place of abundance of the fany' (Fany or Fano, a species of mimosa), near the capital, the altar is enclosed with a fence constructed of sticks, wattled with the zozoro or rush. The trees growing around give it the appearance of a small natural grove." The Christian converts were urged to desecrate these places by the missionaries, with the laudable desire to do away with the superstitious fear that they had for them, but unfortunate from the standpoint of the botanist, who would wink at the retention of a single superstition among many, if it led to conservation of a bit of natural vegetation.

Ellis (vol. I, p. 427) gave some examples of the effort to break down reverence for sacred groves and hilltops. For instance:

"While on a journey some time since, near the high mountain of Andringitra, the missionaries were informed that on a hill not far distant was a Vazimba of high renown, but extremely fierce. They requested two of the scholars [i.e., boys in the mission school] to go and fetch a few of the sacred stones and some branches of the fany, or sacred tree. They complied, but the people, struck with astonishment and horror, warned them of their danger. . . ."

Elshout, J. M. (1926) De Kenja-Dajaks uit het Apo-Kajangebiet: Beidragen tot de Kennis van Centraal-Borneo. s¹Gravenhage: Martinus Nijhoff, 523 pp., ill.

The Kenya Dyak of Central Borneo, who were studied by Elshout in an area to the eastward of Sarawak, are one of the more primitive agricultural groups of Indonesia, in that they subsist by the produce of dry rice fields, ladang, rather than continuously occupied wet rice fields, sawah, which they do not have at all. In their own language they call ladang (Malay) by the name oemah (umah) which is a cognate of Sumatran djoema (juma).

Elshout states that in the Ao-Kajang area each Kenja (Kenya) stem has its own defined territory for ladang agriculture. His account is particularly interesting because he describes the amazing amount of ceremony and ritual connected with it, all of which is important as indicating that what is technically simple is nevertheless a crystallized system that has endless complexity.

The Kenya divide the whole procedure into three stages, namely (1) pégisè, the selection and clearing of the ladang, (2) noegan, the planting, and (3) adjau or madjau, the harvest. The Pégisè requires negotiations with many spirits, those of omens and those of the earth. The supplications do not always take place when logic would seem to demand, because so many other conditions must also be observed, such as planting in the propitious phase of the moon. The neogan (burning) requires many additional ceremonial procedures. The propitiation of well disposed spirits, the expulsion of evil ones, and all the ceremonies that are magical and social as well as religious, occupy the attention of the people throughout the year. Elshout gives a calendar of all the observances of a full crop year that covers the period 11 July 1914 to 28 June 1915 with hardly any cessation of some ceremonial procedure. The whole social, economic and religious life of the people is so deeply rooted in the apparently simple agricultural system that it ceases to be simple at all when understood. However useless the ritual may be from a technical standpoint, it gives labor and community life such a rich meaning that one wonders what would remain if it were taken away by the employment of the people on a European plantation. A system of agriculture in which even the children participate, which has grown up through generations, and which intellectual satisfaction as well as subsistence is not to be lightly condemned. In the long run it brings about its own destruction by devastation of the area it occupies, but it should obviously be replaced by a permanent and scientific type of agriculture with full understanding of the good as well as the bad points of the old.

Estridge, H. Watley (1885) *Six Years in Seychelles; with Photographs from original Drawings.* n.p., 1885. 59 pp., illust.

On the island of Mahé, the chief of the Seychelles group, the English visitor H. W. Estridge ascended one of the peaks known as the Three Brothers, covered then with mossy forest, and apparently, his trifling book indicates, gathered a few plant specimens. He likewise seems to have started a conflagration of which he says:

"This mountain was the scene of a most glorious fire - I speak of the sight of it - which, having been accidentally lighted on the western side, took firm hold and burnt some 200 or 300 acres of forest land. I shall never forget the sight when the flames came over the top of the mountain, licking up all the great trees on their way. It descended some distance down towards the town, and it was only by the extreme exertions of the police and others that it was beaten under. A curious sight to see a great tree in flames come toppling down some 100 feet, and falling into the brushwood below!"

"My second attempt at Three Brothers was on the 13 September, 1884, when the same friend and myself went up. Sir J. Hooker wished for some of the Capucin nuts, flowers, and milk, and so I endeavored to get them for him. We first stormed the previous mountain, but found nothing on the way but the charred remains of stumps, etc., which made the climbing rather dangerous till we got to the top, and there we found one Capucin apparently uninjured, and one nut upon it, which I took. The pitcher plants apparently had all been destroyed."

On one of the other three peaks they found that the Capucin had nuts of a different shape, and that there were no pitcher plants.

Our writer's statistics for Mahé indicated that the total area was 35,000 to 40,000 acres, of which 1500 was forest, 12,000 waste land and the remainder in cultivation. So of the small extent of forest this silly nitwit's "glorious fire" destroyed a fourth or fifth.

The capucin of which he speaks was a *Sideroxylon*, "a most useful tree, very hard, nearly indestructible by water or the air; it is used for everything but is very expensive." This species had been referred to by Baker (1877, p. 194) as follows: "The Capucin of the Seychelles . . . is probably . . . unnamed . . . but I have not seen flowers."

Evans, Ivor H. N. *Studies in Religion, Folk-Lore, and Custom in British North Borneo and the Malay Peninsula.* Cambridge: University Press. 1923. ix + 300 pp.

Interesting details are given by Evans of magical procedures connected with selecting places for clearing forest by the Sakai of the Malay Peninsula. He tells of the making of a hearth or fire-place (but he does not call it that) at the proposed spot for a clearing and of burning incense for a smoke omen. For the square frame of the hearth he uses the name galang dapor which he does not explain, merely calling it "a Malay phrase". In Sumatra it means the frame of the box-like hearth within a house or the framework of a grave, in which offerings are placed, incense is burned, and the grave post erected. It may be, then, that the ceremony has to do with finding out if the omens are propitious for building a house as well as making a clearing. In the most primitive Malayan society the two things would have been the same. (See the discussion of the significance of uma, which in some languages has come to signify the house and in others the clearing.)

Evans shows that the clearing procedure of the Sakai is largely identical with that of the Malay. The Sakai customs may be very ancient ones still not forgotten by the Malays or they may be mere borrowings from the Malay. In either event they are the great weight of ceremonialism that surrounds agricultural operations and that make the supplanting of traditional ways by new and better ones such a difficult matter among primitive people. It would be interesting indeed to know whether rice cultivation by the aboriginal tribes of the Malay Peninsula preceded the coming of the Malays, but the rice ceremonies are common to both and throw no light on the problem.

Falconer, Thomas (1797) *The Voyage of Hanno translated and accompanied with the Greek Text; explained from the Accounts of modern Travellers; defended against the Objections of Mr. Dodwell, and other Writers; and illustrated by Maps from Ptolemy, D'Anville, and Bougainville.* London (T. Cadell Jun. and Daviss) 1797. 105 pp., 3 maps.

Several writers refer to the observations of the ancient voyager Hanno on fires in east Africa. The pertinent passages from his "Periplus" follow:

(p. 11) "Towards the last day we approached some large mountains covered with trees, the wood of which was sweet-scented and variegated. Having sailed by these mountains for two days, we came to an immense opening of the sea; on each side of which, toward the continent, was a plain; from which we saw by night fire arising at intervals, in all directions, either more or less.

"Having taken in water there, we sailed forwards five days near the land, until we came to a large bay, which our interpreters informed us was called the Western Horn. In this was a large island, and in the island a salt-water lake, and in this another island, where, when we had landed, we could discover nothing in the day time except trees; but in the night we saw many fires burning, (p. 12) and heard the sound of pipes, cymbals, drums and confused shouts. . . . Sailing quickly away thence, we passed by a country burning with fires and perfumes; and streams of fire supplied thence fell into the sea. The country was impassable because of the heat. We sailed quickly thence, being much terrified; and passing on for four days, we discovered at night a country full of fire. In the middle was a lofty fire, larger than the rest, which seemed to touch the stars. When day came, we discovered it to be a large hill, called the Chariot of the Gods."

Falconer (p. 34) quotes Bruce's "Travels" for the explanation of the "streams of fire that fell into the sea", as follows:

"After the fire (which was lighted for the purpose of destroying the cover for the animals which they hunt) has consumed all the dry grass in the plain, and from it, done the same up to the top of the highest mountains, the large ravines or gullies . . . are the latest to take fire, though full of every sort of herbage. The large bamboos, hollow canes, and such like plants, growing as thick as they can stand, retain their greenness, and are not dried enough for burning, till the fire has cleared the grass from all the rest of the country; at last, when no other fuel remains, the herdsmen on the top of the mountains set fire to these, and the fire runs down in the very path in which, some months before, the water ran, filling the whole gully with flame, which does not end till it is checked by the ocean below. . . . This I have often seen myself, and been often nearly enclosed in it, and can bear witness that at a distance and by a stranger

ignorant of the cause, it would hardly be distinguished from a river of fire."

Farrer, Reginald (1908) In Old Ceylon. London: Edward Arnold. xi + 351 pp., plates.

An extraordinarily interesting book which has only a remote bearing on the topic of primitive agriculture is that of the botanist Farrer on Ceylon. It does have some relation to our topic, for Ceylon is a land where the flora was so devastated by a brilliant civilization that developed with the incoming of Buddhism and flourished until broken down by the infirmities of old age and the repeated impacts of piratical Hindu invaders, who conquered and pillaged until Ceylon was hopelessly enfeebled.

One cannot help suspecting that one of the infirmities may have been inadequacy of agricultural production, for clear down to modern times a system of shifting cultivation persisted in which such European observers as Willis could see no good. During the flowering period of Buddhist civilization great cities arose whose remains are now buried in jungle, and we may of course be sure that the vegetation of archeological sites is secondary, even if partly derived from ancient sacred sites where some primary vegetation may have been preserved. One wonders if the agricultural surplus from areas of permanent rice-terrace cultivation which had been developed (and which largely remain) could have afforded subsistence to the non-agricultural population without being supplemented by the produce of shifting cultivation by the aboriginal population of which the only recognizable vestige in modern times was the Vedda group. We presume from the Mahavansa that aboriginal Ceylon two thousand years ago was on a very lowly cultural plane, and that except as agriculture by irrigation developed through the centuries the chief dependence for food must have been on shifting agriculture and the horticulture or gardening which develops along side of it wherever settlement becomes permanent, or perhaps one should better say, long-continuing. Ceylon seems to have reached a state of unstable equilibrium which was upset by the Hindu invaders, so that by the time European colonialism began the country was devastated, the great religious centers had grown up in jungle, and most of the former area of shifting agriculture had become a dreary waste of secondary vegetation such as bamboo jungle and unproductive grassland, in which a feeble and lethargic population carried on shifting agriculture under the chena system.

There has been marked recovery, of course, under British rule, but the glory of old Ceylon had been long departed, almost forgotten and recuperation has been slow. Some paragraphs may be quoted from Farrer. Of his visit to the great reliquary of Maha Seya a half century ago he wrote (pp. 344, seq.):

"We are looking straight across the west. Below us runs out over the jungle the last grass-clad spur of Mihintalé, to end in the green eminence on which stands the ruin of Et Véhéra, last of the sacred buildings on the range, and beyond this there is nothing but the stupendous and overwhelming plain of the jungle-sea, sliding away in shades of azure across the receding curve of earth. Far, and far, and far -- seeming illimitable as the apparently illimitable sea of Birth and Death -- the great Northern Plain goes stretching from horizon to pale horizon, one undecipherable motionless ocean of jungle, broken only here and there by those sudden purple islets of mountain and pinnacle. Larger, wider, more infinite than anything I have ever seen, is that prospect from the rim of Maha Seya Dâgaba; it almost makes one gasp with a sense of looking on something too large for mortal sense, too calm, too eternal to be grasped by frail mortal understanding, to be borne by mortal endurance; so apt as we are to be terrified and overwhelmed by the suggestion of realms immeasurable in terms of time and space.

"And there, full in the middle of the view, lies sleeping the Sacred City. From end to end its relics lie extended before us, and from their extent we suddenly realize that all this eternal sea of woodland was once crowded with a glory of building that its creators deemed to be no less eternal than we, to-day, conceive the unbroken silence of the forest. Anuradhapura lies far across the world from east to west. Anuradhapura now is nothing but a memory -- a phantom dimly to be recalled amid the dense wilderness that holds its place. Only above the verdure the three royal lakes -- silver shields forgotten in the forest -- throw up clear gleaming surfaces amid the vast monotony; and, one by one, as the eye learns to pierce the levels of the prospect, the five great dâgabas stand high above the jungle, hillocks of greenery above the green, where once they were mountains of snow and gilding, above innumerable lower ranges of golden palace and cloister. Out in the north, lonely and splendid, Jétavânarâma keeps guard over all the unguessed miles of ruin that fill the forest at its feet; then comes Abhayagiriya, towering over the invisible little hamlet which is modern Anuradhapura." ". . . From here one can track all the patches of culture, past and present -- the plan of the parks, the rich forest along the lake embankments, the rice-fields and brilliant stretches of cultivation that lie on the skirts of the Sacred City towards Issurumuniya and Vessagiriya, towards Jétavânarâma and Abhayagiriya."

"The whole purpose of the thing lies apparent from here -- its whole history, its whole doom. Nowhere in the world is the utter grandeur, the utter ruin, of a city and a nation so apparent as when one looks from Mihintalé out across the interminable jungle that was once the gorgeous capital of Ceylon. Almost beyond guesswork the splendour has receded into the unfathomable past, and yet, in a way, its scanty bones, its very abandonment of hopelessness, enable one to feel more keenly than ever the

splendid things that once were, by contrast with the jumbled tragedy of what now is." ". . . . Gone and vanished are the golden Kings and abbots; of their palaces remain but sordid, naked beams of hewn stone, lost in the grass, standing at drunken angles in forgotten gloamings of the forest, glimmering in the green depths of the jungle-sea like weed-grown wreckage of great galleons foundered a hundred centuries since. Their ghostly life is now but the life of the forest; lizards flirt their tails in the blurred faces of the statues, and wise-faced apes go swinging foolishly from bough to bough of the Sacred Tree itself."

Faulkner, O. T. and Mackie, J. R. (1933) West African Agriculture. Cambridge: University Press. 168 pp.

This work deals with Nigeria.

Each family among the agricultural people of southern Nigeria owns a few sheep and goats but (p. 24) "the milk of animals is not used . . . even for children; to drink the milk of animals is to them an unnatural and repulsive idea".

In Northern Nigeria, on the contrary, although some farmers own cattle, the authors state (pp. 25, 26) "in the main the cattle industry is in the hands of the Fulani herdsmen who are not farmers at all. . . . These herdsmen live mostly on milk and meat. . . ."

"The main crops are grown on the farm proper which may be some distance from the compound. The native farmer does not ordinarily farm the whole of his available land. Every year, part of it is under cultivation and part of it is under bush conditions."

Near Ibadan, the chief place in Southern Nigeria, the rotation of crops and labor is as follows (p. 36):

"1st year. Bush cleared and burnt in July, and late maize planted on the flats in September. Hills for yams made in November and yams planted in the same month.

2nd year. Early maize planted through the yams in March, cotton planted through the yams and maize in early August. . . . In addition, edible beans and gourds. . . .

3rd year. Early maize with cassava. . . .

4th year. Cassava.

5th year. Reverted to bush."

In the north, cultivation is more extensive.

In shifting agriculture many stumps are left sufficiently undamaged so that they sprout, and a type of bush is produced in which some of the original species are present.

(p. 44) "Where there is high forest still available, it is preferred to any secondary bush. . . In large parts of Nigeria, especially in the provinces of the south-west . . . all high forest has already disappeared, and the shifting cultivation would be more accurately described as a system of rotational 'bush fallows' in which the time in fallow exceeds the time that the land is cultivated. There the system involves no deliberate waste and gives fair returns. . ."

The soils of the delta are highly acid and sterile. Other soils are not improved by phosphate or potash, since the limiting factor is nitrogen, dissipated by burning. The natives realize the value of manuring.

Favre, [Pierre Etienne Lazare] An Account of the Wild Tribes inhabiting the Malayan Peninsula, Sumatra and a few neighboring Islands, with a Journey in Johore and a Journey in the Menangkabaw States of the Malayan Peninsula. Paris: Imperial Printing Office. 189 pp.

(p. 55) "I have seen amongst the Jakuns of Johore some who had large fields of rice: they cultivate this grain in the following way: they choose in the forest a place where the ground appears to be favorable for such a purpose, they cut all the trees in a space more or less large according to the number of persons and the quantity of rice they intend to plant; they put fire, and burn all these trees that are fallen pell-mell; when the branches are burnt the fire ceases, and some time after the rice is planted, it grows up amongst all the trunks of the fallen trees, and other larger branches which were not destroyed by fire: after the harvest the place is abandoned and another is selected for the next year."

(p. 56) "In several places in the interior of the forest are found durian trees, always in a body together to the number of about ten or twelve trees: such places are for the Jakuns an object of great attention, and a matter of work. They cut with great care all the other trees which surround the durians, that these by receiving more air may grow up more easily, and give finer and greater quantity of fruit; they build there a small house of which I will hereafter speak, and they then return to their ordinary habitation, which is sometimes distant from such places one or two days journey."

(p. 60) "When the durian season is come, a good number of Jakun families leave their houses, men, women and children repairing

to the places I mentioned before, where are found durian trees. They then again clean the ground in order to find more easily the fruit, which falls when ripe, and, dwelling in the small house of leaves, prepare themselves to enjoy the treat which nature presents to them. For six weeks or two months they eat nothing but durians. When the season is over, the place is abandoned until the next year."

Favre in a trip to the headwaters of the Banut River in 1846 encountered grass-covered marshes in which there was standing water and which may well have been natural grassland.

"Part of the forenoon", he said (p. 124) "we spent traversing a country covered with rank grass, which reached to the height of eight or ten feet; the ground was low and covered with water, in which grew the above mentioned grass. We proceeded on our journey, having for a long time muddy water up to the knee; a little after it reached as high as the thighs, and finally we found ourselves in mud and water up to the waist."

Eventually they emerged near a Jakun village of three houses and eighteen persons. He said:

(p. 127) "These Jakuns have inhabited the place for many years; they have a large cultivated kampong well furnished with mango-steen, champadah and many other kinds of fruit trees. I remarked likewise a number of betel trees and sugar canes, and a large paddy field."

Ferguson, H. Equatoria Province. In: Tothill, J. D., Agriculture in the Sudan. Chapter XXXI, pp. 875-918. 1948.

(p. 884) "The vegetation of Equatoria Province ranges from almost desert to almost tropical rain forest. The characteristic, and by far the most common, type in the province is broad-leaved woodland. . .

(p. 886) "All types of vegetation have been adversely affected by fires, grazing and cultivation. The general effects of these have been discussed elsewhere (The Report of the Soil Conservation Committee. Sudan Govt., 1944) but admitting the existence in places of a balanced fire-climax vegetation, it bears repeating that uncontrolled fire does immense and irrevocable damage to vegetation and soil."

(p. 887) The chief Nilotic tribe, and by far the largest tribe in the province, is the Dinka with an approximate population of 500,000. . . They form a solid block inhabiting the flood plains of the Bahr el Ghazal area. Their main and almost sole interest is cattle, with which most of their customs and habits are connected."

In contrast are the second largest tribe, the Zande, about 200,000 in number. Of them Ferguson says:

(p. 888) "They . . . are very good agriculturists and have never owned cattle. . . The Zande entered the Sudan from the southwest and were rapidly advancing till Egyptian and British rule stopped them. . . Generally speaking, the best pastoral areas and the best agricultural areas are the most thickly populated, and it is the strongest tribes -- the Dinka and the Zande -- which occupy the country best suiting their requirements. It will be seen that the natural conditions and native culture in Equatoria Province are widely different from those of the northern Sudan and . . . associated with those of Uganda and other central African countries."

Fig. 377 illustrates "a fierce forest fire near sources, Yubo", and Fig. 378 "Grass fire in the Kinyeti valley with cloud forming above. As seen from Itobol (over 6,000 ft.) in the Imatong Hills."

(p. 891) "One of the main factors contributing to general erosion is the grass fires made annually by the natives for hunting and collecting honey. Grazing in certain places is an important contributing factor."

(p. 392) "With regard to livestock, though cattle cannot be kept in all areas [because of the tse-tse fly] all tribes have a few goats, a few poultry and usually a few sheep. These are often maintained as a form of wealth, being often used for bride-price. Animals are of course used also as a source of milk and meat, but where they are scarce, . . . there is not enough meat to satisfy the dietary requirements of the natives. . . Animals are never (p. 893) stall-fed, nor are special forage crops grown for them. Their dung is used to a greater or less extent as manure. They are not used for drawing any implement or for threshing."

In the Zande area:

"Where the country is not too fire-damaged these soils [of the ironstone catena, with a little of the red loam type] contain much organic matter and probably have reserves of nitrogen like the tall grass areas in Uganda. . . The primary vegetation consists of dense woodland with gallery forest in all the river valleys and occasional forest trees in the broad-leaved woodland. There is much bush and little grass. . . In the better areas . . . the wetness and the nature of the vegetation itself protect it from severe fires. . .

In the somewhat drier Yei area, however, (p. 898) "The large amount of grass results in intense fires which prevent humus formation and expose the soil to erosion."

On the flood plains of the Bahr el Ghazal, inhabited by Dinka:

(p. 910) "Shifting cultivation is practiced only on the soils bordering the ironstone; elsewhere crops are grown every year on the same land. Fertility is maintained by tethering livestock on the cultivation area before sowing and sometimes after harvest, and by the termite method described in Chapter XV. . . . The grass plains provide most excellent grazing for the large herds. Good pasturage is obtained . . . in the dry season . . . by burning to encourage a growth of fresh young grass."

(p. 911) "Sometimes the best bulls are castrated to make them grow larger (negative selection) and be special pet or "song" bulls."

Ferrars, M. H. Journal of a tour into the Karenee country, east of Toungoo. Indian Forester, Vol. I, No. 2, pp. 107-123. Oct. 1875. Calcutta: Calcutta Central Press Co.

The status of shifting agriculture in Burma in the early days before all of the country had come under British government is clearly shown in a day by day diary of M. H. Ferrars, an Assistant Conservator of Forests (temporarily deputized as Inspector of Schools!), who made a tour of over a month in the mountains east of Toungoo in March and April 1875. This district was then independent and there had been no forestry control or policy of conservation. He made notes almost every day which indicate that toungyah (or simply yah) cultivation in that part of Burma under British control had not been a system of deliberate reforestation, practiced by the natives and invested by themselves, as British enthusiasts for introduction of the "touggaan system" into Africa seem recently to have supposed, but was merely shifting agriculture of the usual primitive type. The project of transforming shifting agriculture into a system of controlled forestry, as advocated by Kurz and Brandis, was a conception of the colonial forest officers, based upon their observation of occasional plantings of useful trees in toungyahs (clearings) by the natives before the latter were abandoned. As a distinctive "system", however, toungya in the modified sense of a deliberate reforestation with select species, following clearing and temporary cultivation of the land, was a conception of the forest officers, not of the Burmese, and more known in the land of its birth by breach rather than observance. The modification of toungyah advocated by the British would have established a clean-clearing system of forestry with a useful forest grown in a regular rotation with temporary agriculture in place of the spontaneous scrub, and with fire control to keep down replacement of forest by grass.

Some of Ferrars' observations follow.

"Paylawā to Bangalay. . . . The road lay through scrub of a few years' growth on old toungyahs (coomrie clearings); stunted teak trees were frequently met.

"Bangalay to Kyay-choung. . . . The whole country within sight occupied by toungyah (coomrie) cultivation, the yahs (clearings) of enormous extent, and in most cases but recently cleared. Teak trees lopped and mutilated. The forest that has yielded to this toungyah system probably the evergreen, to judge by the patches left standing.

"Kyay-choung to Moo-choung. . . . Toungyah scrub alternating with poor teak forest.

"Moo-choung to Moh-gyoh-pyit-choung. . . . Nothing but toungyahs far and wide. . . . Betel gardens commencing. . . .

"Moh-gyoh-pyit-choung to Kwat-tyay. . . . traces of evergreen forest. . . . Toungyahs reach up as far as the belt of stunted forest. . . . at 3500 feet. . . . A remarkable difference in the vegetation is observable on the northern and southern aspects [of the watershed]. The southern is covered with stunted forest of a very open and sparse character, and a sort of long meadow grass forms the intermediate covering of the ground. The northern declivity is clothed with the densest evergreen forest. . . . A little below the highest point of the watershed, 4,700 ft., toungyahs were again met. . . .; the wild tea plant was one of the chief components of the scrub growing on the abandoned yahs. Here the first pine tree, (Pinus Khasyana) in the shape of a few isolated struggling specimens of different ages. . . .

"Kwat-tyah to Koo-saloh. . . . Striking to the east for Karenee the landscape presents a perfectly novel appearance, namely, that of toungyah cultivation in more or less hardy pine forest. . . . The pines appeared to be spreading on the fresh yahs, and were there the most striking element of the fresh relay of vegetation; they were also the principal element of the older blocks, although still rather sparse. . . . The same stadia in the development of the pine forest which we find in Europe were noticeable here; the birch scrub, with large brake ferns and long grass has its perfect anti-type here. . . . Ascending a steep eminence -- 4500 ft., the decided pine forest was reached. . . .

"On the crest of the hill the forest might be called intact, i.e., the trees had reached their maturity. . . . The faces of the great slopes were under the toungyah system. . . . Reproduction was observed to take place very readily on deserted yahs. . . . Seedlings were found on all places where the thick layer of humus had been recently removed by fire and where fires had not subsequently taken place. . . . Forest

was seldom cut for yahs where the trees were over 4 feet in girth. . . . The size of the clearings made in a year is here strikingly less than that . . . in British Burma; it may be that there are fewer cultivators, or that the land is more productive. At any rate the forest gets a fairer chance -- a perfectly fair chance indeed -- for there is a tolerable surplus of virgin forest which is not to be found in the great toungyah districts of British Burmah. The less accessible hills in the Karennee pine forest seem to be altogether intact."

The remainder of Ferrars' account contains very interesting notes for the plant geographer.

Ferrars, Max and Bertha. Burma, London: Sampson Low, Marston & Company. 1900. xii + 278 pp., 454 figs.

(p. 147-149) "The Karéns get their living by making hill-forest clearings (taungya) on which they raise one crop, and remove to fresh sites every season. . . . The hill-cultivation is greatly at the mercy of the seasons, from burning-time in April to harvest in October. The hardship is aggravated by a superstition of divination-bones (Kyeyyo) which often taboos the most eligible sites. Scarcely have the crops been garnered than the clearing of a fresh site for the village begins. . . . From February to April each household is hard at work clearing its cultivation plot of four to eight acres of forest on the hill-side. Bamboo forest is preferred; occasional trees of large size are killed by ringing, or are lopped to get rid of their shade; many trees are felled. . . . The lumber is left to dry for burning, till the rain clouds begin to gather. Sometimes an unexpected break of the monsoon prevents the burning and renders the whole labour futile. After the first burn the residue is stacked against the standing trees and burned again. When the rains have set in the seed is sown. A man goes in advance and makes rows of shallow holes with a hoe mounted on a long and tapering bamboo staff; the free or wide end is furnished with openings in the side, which cause the bamboo to emit a musical note at each stroke. Women with seed-bags follow; they put in the rice and the secondary crops (hnan, cotton, and, in a few localities, teak-seed for the government. . . .) in alternate rows, and close the soil. . . . The rice crop is generally ripe before the last rains fall. . . . The secondary crops ripen later. . . . In the moist ravines they cultivate the betel-palm and betel vine, and they have taken to orange gardening at the foot of the hills."

In this account the more unusual points are (1) the indication that reforestation is not a customary procedure of the taungya system, but carried out at the behest of the government, and (2) the statement that in addition to the clearing for annual

crops an orchard or more permanent planting is also established, a more lasting resource, which, if the village did not move, would be a substantial step on the way to permanent land utilization. It may be viewed as intermediate between mere enrichment of wild land by useful plants, as reported by Bartlett for lowland Batak in Sumatra () and the establishment of island-like village orchard-gardens by the highland Batak. The statement about oranges reminds the present reviewer of the seasonal gathering of wild or wildling or possibly planted oranges by the Karo Batak in the lower forest on Mt. SiNaboeng (Bartlett, p.)

Fickendey, E. "Tierra Calcinada" en los Tropicos. Madrid (Consejo Superior de Investigaciones Cientificas, Instituto de Estudios Africanos) 1950. 16 p.

Fickendey (1950) a resident of Spanish Guinea, in discussing the "burned land" of the tropics, has expressed the conviction that the chief cause of retrocession of forest is to be found in the system of burning successive parcels of forest in order to cultivate the clearings. In forests of high seasonal rainfall, repeated fires in the abandoned clearings result in the formation of grassland or savanas. Fickendey cited his own publication (1913) on the savanas of Borassus palm in Camerun and the extent of "lalang" grassland in Sumatra. Of the former he describes a curious phenomenon of unilateral development of savana on the two sides of the mountains. On the eastern side the sabanas occupy in part rich volcanic soil and in part alluvial sand, and are to be ascribed to lack of rain from the prevailing winds which falls on the other side. The volcanic soils have an abundance of tall, spaced herbs, with only a few scattered palms whose fronds are elevated enough to survive fire. Lower palms and many other plants are killed. On the sands the herbage is scant, so that even young palms survive the fires, and, as a result, there are many wild oil palms, interspersed with Borassus.

Fickendey (1928) had likewise observed personally the stands of Pinus Merkusii in Sumatra and attributed their origin to the same causes.

He had likewise observed in Java growth that teak survived the burning over of land used for temporary agriculture. The wild oil-palm in Camerun, the pine in Sumatra, and the teak in Java all represented the growth of fire-resistant species in repeatedly burned-off land.

He said it would require the exercise of great force on native populations as well as much time before the "burned lands" could become a thing of the past, and permanent cultivation could

fuse with animal husbandry as it has in a few places, as for instance, on Ukara, a densely inhabited island of Lake Victoria.

Finley, John Park (1913) The Subanu. Studies of a Sub-Visayan Mountain Folk of Mindanao. Part I Ethnographical and Geographical Sketch of Land and People. Washington: Carnegie Institution of Washington. (Part I, pp. iv, 1-4, 2 maps, in Publication 184).

The Subanu of Mindanao were studied by John Park Finley, a former governor of the Zamboanga district, who gave especial attention to their agriculture in order to do away with the evils attending the system of shifting agriculture, generally known in the Philippines as kaingin, even if this Tagalog word is replaced by others among speakers of other languages. His account of Subanu agriculture may be taken as typical of that of various other groups.

(p. 15) "The very name Subanu constitutes the possessor thereof a farmer. His life is spent in the fields and forests. His sustenance is drawn from the earth by primitive agricultural methods. He seeks the isolated and wildest portions of the interior and relies upon his strength and native ingenuity to cope with nature and wring from it a means of living for himself and his family.

"The method of cultivation pursued by the Subanu is known as the kaingin system. It consists of clearing a piece of forest and planting the land by the use of a sharpened stick to make holes in the ground to receive the seed. The ground is not plowed, spaded, or harrowed, and after the second season is usually abandoned for a new clearing.

"The kaingin method of farming involves a great waste of labor and materials and must be eventually interdicted by appropriate laws, rigidly enforced."

(p. 17) "At the beginning of the third year the old kaingin is abandoned if the cogon grass shows strong development and the second tree growth has made vigorous headway. A new kaingin is now sought, the forest cut down and burned, and the same process of cultivation and harvesting followed as in the first and second years.

"If the old kaingin is cultivated for the third and fourth years the same method is observed as in the first and second years, but with diminishing success, by reason of the lack of proper tillage.

"The kaingin farmer can not successfully develop the cogon clearing, his only implements being the pes (chopping knife), with a blade about 14 inches long and with a round or square head; the

hilamon (digging knife), smaller than the pes; the gwasay (grubbing knife and adze), a sort of axe with a blade about 13 inches long and about 5 inches wide at the cutting edge, and tapering back to about an inch at the head. This knife is fastened in a handle corresponding in form and size to that used with the American axe. For harvesting rice and digging roots and tubers smaller knives of various shapes are used.

"Cogon grass is a rapidly growing plant of tough fiber and sometimes reaches a height of 10 to 12 feet. When thrown down by the wind and rain it forms an impenetrable, tangled mass which will yield only to the knife and fire. When young and about 10 inches high the grass is tender and excellent for grazing. When 18 inches to 2 feet it may be cut for cattle fodder. When 5 to 8 feet in height the grass is cut for thatching, especially when the nipa palm can not be obtained.

"The kaingin method of farming has deforested many thousands of acres of the finest timber in the Subanu country and has been very destructive of such natural resources. The practice still prevails to a large extent, both in and out of the Subanu territory. The law prohibiting the system is ineffective for want of sufficient forestry inspectors and lack of funds to employ them. It is evident that this system is not profitable either to the government or to the hill people, nor is it the best that can be done by the government for the welfare of these people."

Fischer, Arthur F. (1932) Annual Report of the Director of Forestry of the Philippine Islands for the Fiscal Year ended December 31, 1931. Separate from the Annual Report of the Department of Agriculture and Natural Resources for the year 1931. Manila: Bureau of Printing. ix + pp. 523-905, chart.

In the Philippines there was a long series of excellent and detailed reports of the activities of the Bureau of Forestry. These reached a somewhat standardized form under Directors Arthur F. Fisher, whose last report was that for 1936, and Florencio Tamesis, whose reports for the years 1937 through the first half of 1939 were published in the same form by the Commonwealth government, after which there may have been others that failed to reach the present reviewer. These reports are perhaps unique in giving an annual indication of the extent of the shifting type of agriculture which in the northern Philippines is generally called kaingin.

This particular report for 1931 is typical in most respects in reporting (1) current proclamations removing certain areas from the public domain for use as communal pastures,

(2) establishment of forest reserves, (3) the placing of a Penal Colony under the control of the Forest Service, (4) the allotment of lands for exclusive use by non-Christian groups, (5) surveys for proposed reserves, (6) the classification and requests for classification of lands, (7) status of mapping, (8) legal decisions affecting forest decisions and policies. It is chosen for review because it recorded the beginning of the new "Division of Forest Fauna and Grazing" and the beginning of close supervision and scientific control of a great national asset, the Makiling National Botanic Garden, a laboratory area for the School of Forestry of the University of the Philippines, and a place of resort for tropical investigations by botanists and zoologists from many countries.

The remarkable progress that had been made was shown by the table (p. 575) indicating that out of a total of 1219 municipalities or municipal districts, land classification in 899 had been partly or wholly done, which provided a basis for the establishment of an almost complete system of communal forests and grazing areas. In 54 provinces there had been complete or partial classification in all municipalities or municipal districts of 26. More than half of the municipalities and municipal districts have been wholly or partly classified in 18 more provinces, leaving only ten with less than half of the projects not yet started, and only one province entirely unreachd.

Nevertheless, the concentration of use classification had not extended to the greater part of the Philippine land area, where actual conditions required no immediate attention. So only 38.6% on an areal basis had actually been classified, 11% as timberland and 27.6% as agricultural, the latter being "alienable and disposable". The remaining 61.4% of the area remained unclassified.

The difficulty of preventing illegal kaingin operations was indicated by the fact that 23 instances were detected within the limits of the Makiling National Botanic Garden in 1931 (it became later Makiling National Park) in addition to 38 cases of timber stealing. In order to be as sympathetic as possible in overturning ancient traditions of forest waste and as reasonable as possible in administering the kaingin law, permits were also granted for clearing certain areas that were of little prospective value as forest with the existing cover, and were therefore selected for clearing to precede reforestation. In these areas the basic operations would be performed by the "caingineros", those to whom permits were granted. Also free fire-wood was granted to near-by families (who got mostly ipil-ipil thinnings) and contracts were made for regulated timber cutting of mature trees on a commercial scale.

The newly created Division of Forest Fauna and Grazing was to be actively concerned with problems of conservation of the native animals, to establish and administer game preserves or

refuges, and bird sanctuaries, to maintain appropriate conditions for fish in lakes, to establish and maintain communal pastures, just as communal forests were already being set up, and to study the problems of grazing intensively. It was reported (p. 718):

"There is a vast extent of land fit for grazing purposes. . . . Most of the open cogon [kogon; Imperata and Saccharum spontaneum] land, of which there are 5,598,597 hectares, is, under present conditions, suitable only for grazing and for growing forests. Not less than 1,000,000 hectares may ultimately be reforested, mainly for the protection of forests and to prevent overflow. Another million or two may be put under cultivation. What must remain should be developed and managed for the interests of the livestock industry."

Frequent fluctuation of policy and organization indicated more or less political interference in forestry and conservation matters, but there has been constant appreciation of land-use problems in the Philippines and a growing desire among the more intelligent people to prevent further wastage of Philippine forests and wild life.

Flack, Captain (1866) A Hunter's Experiences in the Southern States of America; being an Account of the Natural History of the various Quadrupeds and Birds which are the Objects of Chase in those Countries. London: Longmans, Green, and Co. iv + 359 pp.

A certain "Captain" Flack, otherwise unnamed by bibliographers, wrote of the Texas prairies in 1866 (pp. 24-25) as follows:

"During the spring months of the year the settlers are in the habit of setting the prairies on fire, for the purpose of clearing off the old and coarse grass, that it may be replaced by a sweet young growth. Some States allow this by law, though in the extreme West laws can hardly be said to exist; at all events, they are seldom carried into execution, and therefore the prairies are frequently set alight, either from accident, or from a wanton spirit of caprice, or mischief.

"Not less grand than the forest on fire is the prairie, when seen in a mass of blazing flames. The smoke rolls up heavenward in dense, heavy, black columns, while, beneath, the flames leap and dart in one red line extending for miles. At night the whole horizon appears like the gates of Tophet, and then can be heard more distinctly than in the day time, the crackling caused by the fierce flames as they lick up the light grass and reeds in their onward course.

"Instances are not wanting of bands of Indians, or even parties of white emigrants, losing their lives in these fierce fires; especially if they have been overtaken where the grass is four, five, or six feet in height. In such cases it forms an impediment through which a man cannot travel so fast as the flames behind him.

"On an ordinary prairie the traveller can generally make his escape, if he acts with promptness, and does not lose his presence of mind. If he fires the prairie before him he can gradually advance, so that by the time the flames behind him reach the spot, he is scores of yards off on the smoking ashes which his own hand has caused. Sometimes it happens that streams, or chasms (cañons), check the progress of the flames, or a sandy ridge intervenes, or a part which has recently been burned, on which the grass has not yet attained sufficient growth to serve as fuel. But at other times, when the wind is rough, showers of sparks, overleaping these barriers, continue the work of destruction on the other side."

A prairie fire was observed in Texas by Flack in 1866 (perhaps another volume of the same year) and quoted by Cook:

"Sometimes grand sights are seen in the woods -- a dense jungle or cane-brake is set on fire, perhaps by lightning, or by the carelessness of some hunter. Thousands of acres will fall a prey to the flames, and the sight, once seen, will never be forgotten. High above everything . . . roll dense masses of smoke. Below, the red flames leap and twist and twine round the trees like thousands of huge fiery serpents, as they consume the light vines and scorch the branches of the oaks. The canes blaze and crack with a loud noise, much resembling a continued fire of musketry. . . Terrified herds of wild cattle dash through the jungle by sheer force of numbers and weight, snapping the thick canes as though they were bull-rushes. The frightened deer rush swiftly through the more open parts of the wood towards the prairie, while high over head the turkey, snipe, and other birds fly in straight lines toward a secure resting place."

Flacourt, Estienne de (1661) *Histoire de la Grande Isle Madagascar avec une Relation de ce qui s'est passé es années 1655, 1656, & 1657, non encor veuë par la premiere Impression.* Paris: Chez Pierre Bien-fait. [xxiv] + 1-202; [x] + 203-471 pp., plates, maps.

The earliest record of shifting agriculture in Madagascar seems to be that of Flacourt. He described the east coast from 18° 30', at Tamatave (or the "Port of Prunes" of the French) northward to 15° as rich and fertile, a land of rice fields and good

pasturage where the people used their cattle only for milk and for sacrifices. He said (p. 23):

"They plant their rice in the hills and valleys, after having cut the woods which are largely of certain coarse canes which are called Voulou throughout the island and in the great Indies Bambu or Mambu. When dry, they are set afire and burn with a noise to make the earth tremble for a mile around, for these thick canes have nodes a foot apart and each has more than forty nodes. The canes are close together, an infinite number, little and big, and when the fire reaches them the air imprisoned between the nodes tends to expand, each node making a noise like a culverin, and so the noise is as great as that of an infinite number of cannons, culverins, fauconneaux, muskets and pistols all going off together. . . . When the woods have been burned, all the ground is covered with ashes, which are moistened by the rain. After some time they plant the rice in a curious manner. It is that all the women and girls of a village help each other in planting, marching side by side as a front, each having a pointed stick in hand with which they punch holes in the ground, dropping into each two grains of rice, covering the hole with the foot, all doing the same thing in unison, dancing and singing. They do it so quickly and adroitly that nothing could be more so. . . ."

This is a description that might almost have applied in Sumatra a generation ago, and probably still would. It is typical of that island and indicates, of course, the source of the Malagassy culture which Ferrand () and others before him traced to Sumatra or at least to the Malayan region.

By way of contrast with the rice-growing people, we may turn to another, also described by Flahault (p. 14), meat eaters who lived almost exclusively from their enormous herds of cattle and other domestic animals, except for gathering certain wild roots.

The country of the Mahafalles [Mahafaly] when Flahault wrote, was forested, and the people, except for the family of one grandee named Dian Manhelle, [Don Manuel?] who died in 1653, did not cultivate the soil. Except for spoils of war and the booty from depredation and robbery, they were almost strictly pastoral. They moved their herds as the pasturage became depleted within a range of thirty five or forty leagues of their temporary encampments, for they had no villages or permanent place of residence but had huts or cabins in the woods adjacent to the prairies ("parcs") where they kept their herds and flocks. Flacourt gives the impression of a very wasteful economy, with livestock vastly in excess of the requirements for subsistence. The country of the Mahafalles extended to the Sacalite river (about 24° 25'S.) along the Manomba and Machicora rivers. These he described (p. 40) as small streams about half a league apart. The Mahafaly as described by Walter D. Marcuse (1914) are still

at about the same latitude as in 1650, extending to the west coast. Their chiefs have a tradition of white ancestry and one seen by Marcuse was blue-eyed. Their culture may have been modified by some early Portuguese settler.

[Fokkinga, J.] (1948) Verslag van de Dienst van het Boswezen in Indonesia over de Periode 1940 t/m 1946. Buitenzorg: Archipel Drukkerij. 159 pp.

The first post-war report on forest administration in Indonesia appeared under the direction of J. Fokking (1948) under the auspices of the short-lived Republik. It opens with two pages of names under the heading "In Memoriam", which rather conditions one for a sad tale to follow. It seems, however, that the reduced staff carried on with such enforcement of forest regulations as possible after the close of the Japanese occupation. For some areas no data were available on the effect of the war years. In Banka and Billiton there had been extension of ladang agriculture during the war. The same was true of Borneo, Celebes, Moena and Lombok. On Bali 51,000 hectares were burned over. Wide-spread burning of alang-alang grass (*Imperata*) on the artificial grass-land had led to damage of some of the forest reserves. Forest fires on Boeroe were enormous, resulting in almost total destruction of the kajoe-poet () oil yield. The fires on Ceram were of catastrophic dimensions.

Nature monuments were somewhat devastated, but fortunately some escaped damage altogether, since they were not near centers of population.

Forbes, Henry O. (1885) *A Naturalist's Wanderings in the Eastern Archipelago: a Narrative of Travel and Exploration from 1878 to 1883*. New York: Harper and Brothers. xx + 536 pp., illust., 6 maps.

No work on the East Indies is more packed with interesting and scientifically valuable observations than that of Forbes. His observation of the origin of grassland and disappearance of primary forest -- in Java at first (near Kosala in the province of Bantam and later at Pengelengen in the Preanger Regencies) follows:

(p. 61) "One of the most terrible scourges of the island, and for which no remedy seems possible, is the spread everywhere of a species of tall, slender cane -- useless for fodder and good only

for thatch, -- which the natives call alang-alang. Every spot unoccupied by forest, falls a prey to it; and when once it gets the upper hand, forest seeds refuse to root in it. Neither the incessant rains, nor the driest droughts of summer kill it. The fire may sweep the surface bare, but it fails to touch the roots, which spring again in fresher vigour through the ashes. Deep shade alone seems to check its growth. The native in the hill regions does not make sawahs (which are good from year to year), but constantly takes in his fields by felling, where he lives, in the unbroken forest. As, after reaping for only two seasons this new land, (on which he scatters his seed between the fallen trunks), he deserts it for a newer patch, broad tracts of the island are every year becoming covered with this ineradicable exhauster of the soil, and by-and-bye the virgin forests of this country will have entirely ceased, if some sharper supervision be not exercised by the Government over the timber-felling mania of the native. As Colonel Beddome remarks of the like devastation in India: "the value of the timber thus destroyed by one man, calculating it by the number of logs it might have yielded, is at least twenty times as great as the value of the crop of ragi obtained in the two years that cultivation is continued. The low jungle which comes up after desertion of kumari land is more injurious to health than lofty forest open below. Besides health considerations and decrease of rain and moisture, this rude system of culture [results in] the destruction of valuable timber . . . and rendering of land unfit for coffee."

(p. 103.) "In the month of January 1880, Dr. Scheffer, the then Director of the Buitenzorg Gardens, wrote to me [in Bantam] that, as much virgin forest was being felled among the mountains not far from the Government Cinchona Plantations in the adjoining province of the Preanger, a good opportunity offered itself of increasing my herbarium."

It seems amazing that as late as 1880 there should have remained virgin forest in densely populated Java that was still not earmarked for preservation.

Leaving Java, Forbes went to much more thinly populated Sumatra. Even here destruction went on unrestrained. In the Lampong district he wrote:

(pp. 131,132) "In south Sumatra, though rivers abound, and there is much level land, the natives, till very recently, took always their rice crops from forest land, which produces a far less return of grain, of a quality, too, much inferior to sawah (or wet-field) grown corn. To make this ladang the native goes after the virgin forest, leaving his old fields to produce a new crop of trees, if the alang-alang grass does not get the upper hand."

"The virgin woods contain the really interesting and valuable vegetation of the country; these trees being, to a great

extent, the lineal descendants of the vegetation that has always existed on the island since it came into its present condition at least. Perhaps indeed some of the aged giants may have actually witnessed the young days of the present geological cycle. In the virgin forest death and decay are just as rapid as anywhere else; individual trees are constantly falling out of the ranks, but their place is taken by younger members either of the same or of neighbouring species. When, however, this ancient forest is devastated to any great extent, either by natural means or by the woodcutter's axe, the trees that arise belong to a different lineage, the new wood is in great bulk of different species, which, strange to say, were but rarely to be found in the old forest.

"As in Java the original forest is rapidly disappearing; each year sees immense tracts felled for rice fields, more than is actually necessary, and also much wanton destruction by wilful fires. Trees of the rarest and finest timber are hewed, half burned, and then left to rot; amid their prostrate trunks a couple of harvests are reaped, then the ground is deserted, and soon fills up with the fast-growing and worthless woods, or falls a prey to the ineradicable *alang-alang* grass. Our children's children will search in vain in their travels for the old forest trees of which they have read in the books of their grandfathers; and to make their acquaintance, they will have to content themselves with what they can glean from the treasured specimens in various herbaria, which will then be the only remains of the extinct vegetable races."

From the summit of the Dempo volcano in the Palembang region of south Sumatra Forbes was amazed at the vast extent of the land that was treeless. He wrote:

(p. 214) "Nearer [than the ridges of Korintji] stood out the Kaba, with its smoking top; and could that sharp cone smoking on the horizon be the peak of Indrapura, with its 13,000 feet of stature three degrees of latitude away? From its sides the eye glided to the flat forest-clad plateau of Ulu-Lintang, an old inland lake-floor which lay utterly hidden beneath a great cloud-sheet spread out close down on its tree-tops, reflecting the sun like a mirror; thence to the distant verge of the broad Passumah below the mountain, void almost of trees save a few by the ravine sides and on the precipitous slopes of the gorges, over which lay fringes and patches of cloud demonstrating the attracting power of even a slight arboreal vegetation. Out of this undulating plateau, with its waste of grass, amid which its flashing tabats [fresh-water lakes or ponds] looked like glittering specks of glass scattered over it -- the eye passed to the south and south-western cobalt peaks and domes of the Barisan, studded with flocky hummocks, and followed them till their summits projected themselves on the Indian Ocean at the point where the eye commenced its survey."

Forbes's final visit was in Timor, an island of which less is known than of most others. Here there had been the usual

devastation of primary vegetation, but some bits were almost too carefully, even religiously preserved, because they were places held by the natives as sacred to the spirits. There is no better instance in the literature of the preservation of at least small samples of a vanishing flora in sacred groves.

His account follows:

(p.453.) "Where the spur of Tahaolat commenced to rise towards Mount Ailor -- 4200 feet -- I rode close past a pond full of ducks of the species *Tadorna rajah*, whose very tameness and utter disregard of us might have told me, even if I had not been carefully warned, that they were on Luli ground, where I dare not shoot; even the scarlet algae covering the surface of the water, it was sacrilege to touch. A long and gradual descent brought us at last to the Rajah's of Bibiguçu, where we were assigned a guarda on a windy bluff at 3200 feet above the sea, commanding a view of the whole country along the southern coast from beyond Cape Luca in the east to far past Allas in the west, its low littoral grooved by broad blue-black river-beds margined with casuarinas. Within the neighbouring kingdom of Manufahi the Peak of Kabalaki, with its rugged battlements and beetling crags, reared its majestic summit over 10,000 feet into the air. The whole region was hewed up into narrower and more precipitous valleys than any I had yet traversed -- features awesome and imposing, but with little to commend them to a kindly place in the affections."

(p.454.) "In travelling south, after crossing the Kaimauk river, a considerable change is observable in the flora. The *Melaleuca* greatly diminishes in numbers, while in the ravines *Casuarinas*, *Urostigmas*, and species of *Ficus* become more abundant; and *Acacias*, aromatic *Labiatae*, shrubby *Malvaceae* and *Melastomaceae* cover the more exposed slopes, where also clumps of tall, dark foliaged bamboos, with graceful nodding plumes, form quite a feature in the landscape. Whenever considerable patches of trees have attained the dignity of a wood, one may be sure that there the land is Luli -- sacred territory -- where, if he is permitted to enter, the botanist may not break or cut a single branch. These spots -- often the highest peaks of mountains -- having been lulied for generations, must be the richest storehouses of all the rarest plants and trees in their localities.

"How aggravating to the spirit it was to be prevented from collecting there it is needless to describe."

At Mount Sobale, which Forbes reached from Samoro, travelling N. 21°W., he had a final experience with luli, the equivalent on Timor of the well known Polynesian taboo. After a dangerous ascent, he wrote (p. 474):

"At 5000 feet, where we reached a safe road on the mass of the mountain itself, I could freely turn my attention to the

thousands of violets, geraniums and labiates that decked the ground, and the profusion of ferns that loaded the banks and the trees, among which I observed, in the forest that covered the upper 2000 feet of the peak, abundance of Pandans, Casuarinas, and other Pines. To my infinite disgust and disappointment, I overheard the Rajah's son tell my interpreter to warn me that all the forest was rigidly Luli, boding ill for my next day's prospects. By dropping behind, however, out of sight, I that night made sure of all that I could possibly carry, and followed quietly through little belts of vegetation of the greatest interest to Funuruan, the little house-cluster on a lower spur of the mountain where we had arranged to camp.

"I retired to rest with a well-laid plan of rising early and slipping off to the mountain without being seen or followed. There was little inducement to lie late, for my couch was uncomfortable and the night-wind cold; I was therefore easily ready for the field before daylight. After a hasty breakfast I stepped quietly away for Sobale attended by my Hindoo corporal, and thought I had succeeded in escaping unperceived, especially as a dense mist enshrouded the mountain. Alas! we had not gone far when I discovered that quite a little crowd, following the Dato of the place, was on our trail. There was no time to be lost, so I hewed away right and left on the slopes below the summit, building up a high pile on the ground of the most delightful specimens.

"The unwonted operations of a white man, the first who had probably ever ascended their mountain, kept them for a while at a little distance watching my operations in silence. My hopes began to rise that perhaps I was mistaken in what I had overheard the day before. It was a vain delusion: for their low murmured reproaches at last found distinct utterance in complaint and remonstrance. The corporal was besought to restrain me, and save myself as well as them from the retribution of sickness and death that certainly would follow on the violation of the sacred precincts. I told my Dilly interpreter to express my deep regret, and that I would at once desist; but I gave him to understand that he was not to bring me any more of their messages nor heed me in whatever I did. Moving off to some distance higher up, I recommenced on a new clump, which perhaps might not be Luli, and, like a drowning man catching at his last opportunity, I gathered with a will, unhindered for a long time; and it was not till I had another great pile heaped up on the ground that their excitement and superstitious fears became too marked to be longer disregarded. Luckily, the thick mist which had been resting on the mountain-tops all the morning came down in a heavy shower of rain, and gave me a good excuse to return to quarters, with my trophies a five-men's load, without appearing to have recognised that I had been offending. It was useless to attempt to force an ascent to the top; there would have been an outbreak, for the crest of the mountain was evidently one of their most sacred spots. What I had already done excited them greatly.

"Retracing our steps, as if to Sobale, we descended to the right into and across the Buarahu river, ascending to Manuleo -- 4000 feet above the sea -- through a rich grassy landscape in which thousands of sheep ought to have been pasturing, were a shepherd's not too peaceful a calling to be attracted to a region where keros might be a possible feature of their fields. Such a warning pole raised its ghastly arms against the sky before us. It was surmounted this time with the veritable head of a thief caught in the act of abducting a horse, whose skull seemed to mock with its grinning line of teeth, its abductor's, to which it was joined by the halter which in former time encircled its neck. It does seem a singular custom for the owner to sacrifice his stolen horse the moment it is recovered, to add to his retribution of the thief. A horse once stolen is gone for good, it would seem."

Forsyth, James (1889) *The Highlands of Central India: Notes on their Forests and wild Tribes, Natural History and Sports.* London: Chapman and Hall. xi + 475pp., ill., map.

It was this work from which Stebbing (Vol. I, pp. 216, 217, seq.) quoted at length in regard to destruction of primary forest in Central India. In the districts of the Central Provinces inhabited by the aboriginal tribes and not yet under firm British rule, the problems of land ownership and occupancy were very confusing. In the hills no one would claim ownership of even the land he used if he could help it, and much land had gone out of cultivation, for the assumption of ownership "led to robbery and extortion from the owner by the chief robber who happened to be paramount for the time in the district." Consequently, "most of the hill chiefs were admitted to the full ownership of the whole of their enormous wastes." The aborigines were Gonds, Kols (extending into Chota Nagpur), Kurs or Korkus, Bygas, Bhils, and some other lesser groups. Little was known of the forest resources of the Central Provinces when this administrative area was created. Stebbing says (Vol. II, p. 221): "It was only their detailed exploration which revealed the extent to which the forest areas had been exhausted of large timber. And their devastation was mainly attributable . . . to the practice of shifting cultivation, known in Central India as 'dhya'. The method of procedure carried out in the Central Provinces was lucidly described by Forsyth."

Among the Korkus of Puchmurree in the Mahádeo Hills, Forsyth (1889) found dhya agriculture, in some respects as primitive a system as it could well have been without reverting to the use of stone axes, but with the cycle of cultivation prolonged by a method resembling African chitemene. He said:

(p. 101) "Though large tracts of splendid level land lie untilled on the Puchmurree Plateau and in the valleys below, the Korkú has no cattle or ploughs with which to break it up. He has nothing in the way of implements but his axe. . . . He prefers a place where young straight teak poles grow thick and strong, as they are easiest to cut and produce most ashes when burnt. He cuts every stick that stands on the selected plot, except the largest trunks, which he lops of their branches and girdles so that they may shortly die. . . . By the end of May it will be just like tinder, and he then sets fire to it and burns it as nearly as he can to ashes. With all his labours, however, (and he works hard at this spasmodic form of toil) he will not be able to work all the logs into position to get burnt; and at the end of a week he will rest from his labour and contemplate with satisfaction the three or four acres of valuable teak forest he has reduced to a heap of ashes, strewn with the charred remains of the larger limbs and trunks. He now rakes his ashes evenly over the field and waits for rain. . . ."

Sowing was by simple broadcasting. Various crops were planted in the dhya clearings. Forsyth continued (p. 103):

Such is the fertilizing power of the ashes that the crop is generally a very productive one. . . . A fence against wild animals is made round the clearing by cutting trees so as to fall over and interlace with each other, the whole being strongly bound with split bamboos and thorny bushes. The second year the dead trees and half-burnt branches are again ignited, and fresh wood is cut and brought from the adjoining jungle, and the same process is repeated."

It is this enrichment of the field with the ashes of more trees than it has produced that marks a distinct similarity to the chitemene system of African agriculture, as described for Nigeria and the Kalaharj region.

Regarding forest recovery Forsyth wrote:

"The abandoned dhya clearings are speedily covered again with jungle. The second growth is, however, very different from the virgin forest destroyed by the first clearing; being composed of a variety of low and very densely growing bamboo, and of certain thorny bushes, which together form in a year or two a cover almost impenetrable to man or beast. . . . In such a thicket no timber tree can ever force its way into daylight; and a second growth of timber on such land can never be expected if left to nature. The scrub itself does not furnish fuel enough for a sufficient coating of ashes to please the dhya cutter; and so the latter never again returns to an old clearing while untouched forest land is to be had. Now if it be considered that for untold ages the aboriginal inhabitants have been thus devastating the forests, the cause of the problem that has puzzled railway engineers -- namely, why in a country with so vast an expanse of forest-covered land,

they should have to send to England, or Australia, or Norway for their sleepers -- will not be far to seek. Stand on any hilltop on the Puchmuree or other high range, and look over the valleys below you -- the dhya clearings can be easily distinguished from tree jungle -- and you will see that for one acre left of the latter, thousands have been levelled by the axe of the Gond and Korku. In fact, I can say, from an experience reaching every teak tract in these hills, that, excepting a few preserved by private proprietors, no teak forest ever escaped this treatment, unless so situated in ravines or on precipitous hillsides as to make it unprofitable to make dhya clearings on its site."

"The larger village, where the chief of a sept, and the Hindu traders . . . reside, is usually the only stable settlement in a whole tract, the rest of the people spreading themselves about in small hamlets of five or six families, at such intervals as will give each a sufficient range of jungle for several years of dhya cutting. . . . It costs them but the work of a day or two to shift such a settlement as this in accordance with the changes of their dhya sites."

Forsyth tells much more that is of some interest in the present connection, but it is too lengthy to quote.

Froés Abreu, Sylvio (1931) Na Terra das Palmeiras. Rio de Janeiro: Estudos brasileiros.

In its vegetational aspects, according to Froés Abreu, () the available information regarding Brazilian landscape permits consideration of five main phytogeographic types, namely:

- (1) Forest (Matta)
- (2) Prairie (Campo)
- (3) Open xerophytic scrub forest (Catinga)
- (4) Coastal vegetation (Vegetação costeira)
- (5) Marsh (Pantanal)

These may be considered in order.

- (1) The designation "forest" may be taken to cover lands derived by human agency from forest, including clearings (capoeiras), artificial campos, cultivated areas, and, of course sites of cities and towns. If the latter were all studied historically, it is hardly to be doubted that most present cities arose at the sites of aboriginal villages, where the original European occupation was facilitated by some clearings already made and cultivated.

All tropical Brazilian forests are not of a single kind. Basing his distinctions largely upon Maranhão, our author divides them into the Amazonian forest, that of the Hylaea amazonica, and all others, which he treats as "Maranhensian forest" with the highly developed forests dominated by the palm babassú its chief type. He gives no precise boundaries but says that the babassu occupies the zone of transition between the great equatorial forested region and the drier northeastern type, that it is one of the three associations which are dominated by a single palm species, this one being the cocal and the other the carnaúbal (carnaúba palm association) and the buritisa (buriti palm association).

Notes from Froés Abreu

Campos.

(p. 49) The campos give the greater part of the Maranhão coastal region a peculiar aspect (feição).

On the map of Gonzaga de Campos they represent about 50% of the area, but under the name campos two different types of vegetation are included, the campos of the lowland and those of the high plateau. Considered together, they constitute one of the most characteristic aspects of the phytogeography of Maranhão. According to the estimate of Gonzaga de Campos, the forests occupied at one time 42% of the area but this has been reduced by deforestation in such places as the valleys of the Mearim and the Itapecurú. Abreu quotes from the Euclides da Cunha that man never ceases to destroy, doing away with hectares of the Brazilian flora every day.

(p. 50) The floristic map of Cezar Diogo, modified from the primitive one of Gonzaga de Campos, makes a distinction between the inundated campos and those that are dry and (p. 51) of the cerrados. The transition from the latter to the dry campo of the high plateau is sometimes imperceptible. Anyway, it is as useful to make the distinction as it is to distinguish the tropical forest rich in palm lands (palmares) from the forest of the Hylaea.

Professor A. J. Sampaio, in a work (1926) on the forest problem of Brazil, speaks of the "palmetos" as an association of palms, but actually the palmares are notable as being associations of a single species, which seldom occur in Brazil, and the three types of palmetos or palmeiras in Maranhão are those of babassú, of carnaúba, and of buriti. Other palms are secondary features in admixture with other trees forming mixed forest. These are the (p. 53) cocal, the carnaúbal and the buritisa.

(p. 57) Speaking of the campos of the interior of Maranhão, Froés Abreu says that overgrazed campo passes into cerrado, which resembles African savana.

Fürer-Haimendorf, Christoph von (1943) *The Aboriginal Tribes of Hyderabad*. Vol. I, *The Chenchus*. London: Macmillan & Co. xxii + 391 pp. 78 ill., 2 maps.

The Chenchus of Hyderabad are an aboriginal people who presumably still live largely in the hunting and collecting stage of culture. According to Fürer-Heimendorf (pp. 75-77) they seem to have found the transition to pastoral life easier than to any modern form of agriculture, but that agriculture is a late development with them is negated by the persistence among them of one of the most primitive forms of cultivation. Fürer Heimendorf says:

"Attempts to introduce plough-cultivation on the upper plateau have failed almost completely. . . . In Koman Penta the peddamachi [] cultivates with a plough and grows jawar (Sorghum vulgare) and ragi (Eleusine coracana). . . . No other cases of Jungle Chemchus embarking on plough-cultivation exist, but during the rains a few men in some villages sow small quantities of jawar millet and Indian corn by a more primitive method of agriculture. They choose a flat piece of ground near their settlement, giving preference to places where in the preceding months graziers have herded their cattle at night and the earth is therefore well manured. The soil is cleared of grass and the earth superficially turned over with simple wooden stakes, usually cut and sharpened for the purpose and afterwards discarded. Sometimes broad tapering batons are smoothed and used; these better finished implements may be kept from one year to another. . . . When planting the seeds a man moves in a straight line, stopping at every step and making a hole in the ground with his digging stick . . . ; into each hole he drops a few of the grains and then shovels the earth over it with a sweeping movement of the foot. . . .

"The great advantage of the primitive digging-stick cultivation in the eyes of the Chenchu is its freedom from taxation. . . .

It is not impossible that the origin of digging-stick agriculture may be found in the use of digging sticks by hunting and collecting tribes for digging up the wild roots upon which they largely subsist. Comparing the Chenchus with other peoples of primitive culture in south India, Fürer-Heimendorf (pp. 289-290) wrote:

"The aboriginal tribe whose geographical location is closest to the Chenchus are the Yanadis of the Nellore District in Madras Presidency, with whom they are also related in physical type. On the south-eastern fringe of the Nallamalai Hills they live side by side with the Chenchus. . . . In their jungle life they employed similar methods of gathering food, using digging-sticks with iron points for unearthing tubers. . . .

"Of all Southern India it is the dense forests of the Western Ghats that have offered the safest refuge to the remnants of the Malid population, and in this remote retreat we encounter a number of jungle tribes comparable to the Chenchus in cultural level and economic position, but racially even more primitive and less modified by progressive elements. Some of these tribes, as for instance the Hill Pantarams of Travancore, the Kadars (or Kadirs) of the Anamalai Hills and Cochin, and the Paliyans of the Madura district are today even poorer in material culture than the Chenchus, in so far as they do not possess bows and arrows. Their principal implement is the digging-stick, but the Kadars, Paliyans and now even some of the Hill Pantarams also use bill-hooks. . . .

"Jungle tribes subsisting solely by hunting and collecting are today in a minority as far as southwestern India is concerned, for most of the aboriginal tribes who live in this area practice a primitive form of cultivation entailing the frequent shifting of fields. Thus in Travancore the Kanikars, Muduvans, Mannas, Uralis, and other hill people work their own fields superficially scratching over the surface of the ground after the jungle has been burnt and cultivating each plot for two or three years. They have neither ploughs nor hoes, but use wooden stakes in the same way as the aborigines of the Nicobars and many Melanesian tribes, and the wide-spread existence of this extremely ancient form of agriculture in the south-west of India as well as among certain tribes of the Deccan would seem to suggest that the rudimentary digging-stick cultivation of the Chenchus may also be of considerable age."

Fürer-Haimendorf says (p. 29):

"The mainstay of Chenchu economic life is the digging stick. Indeed, if we were to adopt the prehistorian's habit of naming a whole culture after one type of artifice, we would be justified in describing Chenchu culture as a 'digging-stick culture', for without this implement he would soon be reduced to starvation. With its sharp point he loosens the surface of the stony ground and unearths the roots and tubers which form his staple diet, and those who sow grain use the digging stick [kurra kama, more usually called just kurra] to dibble the seed."

Fürer-Haimendorf also has a comparison of the Chenchu tribe with the Vedda of Ceylon, as described by the Sarasins (1893) and the Seligmanns (1911). Until their primitive agriculture disappeared the Vedda were likewise in the digging-stick stage.

Turning back to Fürer-Haimendorf's additional observations on Chenchu agriculture, we find just a trace of a less temporary communal village-gardening type of cultivation in addition to shifting agriculture. He says (p. 77):

"Near every village is a fenced off patch where tobacco is grown. . . . It appears that not all men of a settlement plant

tobacco, but that each year one or two undertake to supply the whole community; the next year the task falls to other men. . . . Tomatoes and chillies are also grown round the houses of some of the permanent villages; Chenchus of one village beg seeds from another, but failing this they buy seeds in the plains. Fruit trees, on the other hand, are practically never planted. The only exceptions which came to my notice were one young papaya tree in Nardi-Penta, and a few bananas near the spring of Boram-acheruvu. . . . The bananas, which incidentally are never allowed to ripen but picked while still green, are shared with evident enjoyment by all the people of the village. Yet it has never occurred to any of the inhabitants to enlarge the grove."

Füerer-Haimendorf devoted much of his attention to considering how the manner of life of the few remaining primitive Chenchu could be adapted to the modern exploitation of forest resources in the region which had historically been their domain. Their area had been one of the first forest reserves delimited. At first too remote to be touched, it has come to resound with the axe of the forest contractors and the squeaking wheels of the carters, and increasing herds from the lowlands are driven up for seasonal pasturage. It is pleasant to state that the government of Hyderabad gave most sympathetic consideration to Füerer-Haimendorf's representations in behalf of the Chenchu, as a result of which they were granted a special dispensation to lead their old life, exempt from the impositions of outside forest contractors and those pests of the old native Indian social order, the money lenders.

Füerer-Haimendorf, Christoph von, in collaboration with Füerer-Haimendorf, Elizabeth von (1943). The Aboriginal Tribes of Hyderabad. Vol. II. The Reddis of the Bison Hills. London: Macmillan & Co. xvii+364 pp., 84 half-tone figs. on plates, 19 text figs., 5 maps, charts.

The second of Füerer-Haimendorf's highly informative volumes on the remnants of primitive culture in India deals with the Konda Reddi, a people living along or near the Godavari River in eastern Hyderabad, who had been previously only barely mentioned in ethnological literature, and proved not only to be almost unknown but to live in a very ancient and unadvanced state. They were totally unrelated to many other distinct and distant populations of Hindu castes also called "Reddi". They had been confused with the unrelated Koya.

Intimidated and practically enslaved by the timber contractors by whom the "sale" of the labor of whole villages was not unknown, as though exploitation of the people as well as of the forest had been contracted for, the Konda Reddi were threatened

with reprisals by their "owners" if they gave the ethnologists any information, and it was therefore at first difficult to establish friendly contacts with those who were so close to the timber concessionaires as to be afraid of exposing themselves to abuse in the future. At the village of Katkur the local forest contractor sent all the able-bodied Reddi to a far-away jungle camp in order to sabotage enquiries. Eventually, however, they established good contacts, as related (p. 8) in the following quotation:

"In Gogulapudi, a small Reddi village some 1000 feet above sea-level, I found conditions infinitely more pleasant than those prevailing in the villages on the Godavari. The Reddis of the hills do not fall within the sphere of influence of the timber merchants; they were natural and cheerful and I found it easy to make friends. . . . Here the Reddis had built us a small palm-thatched house with wattle-walls and during the following three months we lived very much in Reddi style subsisting mainly on local produce: a variety of wild leaves and herbs, bamboo shoots, mushrooms, a few wild fruits, certain vegetables grown on the Reddis' fields, young maize, and the small millets which they began to reap in August."

The Konda Reddi live by a combining agriculture with the gathering of jungle produce. Of all the wild plants that contribute to their living, the most important is the palm Caryota urens, which is used as a source of starch meal as well as of a fermented drink. The former is made by cutting the pith into strips, which are dried, pounded, sifted, and finally bolted through cloth in order to separate the starch-filled pith cells from the coarse and useless fibre. A great deal of dependence is placed on the pinkish meal thus obtained, which is of course a much more nearly balanced food than starch alone, as prepared from the sago palm in the Pacific islands, for example, for by the wet pounding and decantation method of preparation, that is freed from the protein content of the cells, whereas by the drying, pounding and sifting method the entire cell content of the Caryota pith is preserved in the meal. The palm wine from Caryota is prepared by tapping successive inflorescences of the tree, just as in other countries other palms are utilized. The sap quickly ferments and becomes intoxicating, but the women sometimes boil off the alcohol and find the boiled down juice very nourishing.

The combination of utilizing a palm pith for food with shifting agriculture reminds one of similar practices in the East Indian islands, New Guinea and Melanesia. Certain ceremonies connected with obtaining palm sap seem to indicate great antiquity for the practice. There seems to be age-old association of the mango tree with Reddi culture. Not only is the fresh fruit consumed in large quantity, but the dried seeds in abundance are stored away as provision against food shortage between crops. Edible roots are various kinds of gadda, a name suggesting gadong of the Malayan peoples.

Shifting cultivation is known by the term podu, used also by the Maria Gonds of the Central Provinces. Von Fürer-Haimendorf describes it in detail (pp. 77-98) and some of the essentials are covered in the following quotations:

"Throughout the Telugu country shifting cultivation on hill-slopes cleared of forest growth is described as podu, a term which is synonymous with bewar in the usage of the Central Provinces and jhum cultivation in that of Assam. Indeed, comparing the irregular patches of cultivation and young secondary jungle on the wooded hill-slopes in the Reddi country with my remembrance of the landscape in the Naga Hills, I have found little difference except that the podu of the Reddi are usually smaller than the blocks of jhum cleared by the Nagas."

(p. 80) "Large trees are cut with the axe, usually two to three feet above the ground . . . while the bill-hook serves for lopping smaller growth and branches and clearing undergrowth. Only mango and jack-fruit trees are spared, for their fruits are too valuable to be sacrificed. The clearing of the jungle is hard work, and those regarding podu as a lazy method of cultivation should compare the energy expended by a Reddi in felling trees, cutting creepers as thick as a man's arm, clearing the thick brushwood and burning the jungle with the leisurely way in which the Telugu ploughman drives his plough through the soft soil of his oft cultivated flat land. . . .

". . . .The burning of the fields takes several days and at night the slopes are picked out in glowing lines of creeping fire. Usually these fires are kept well under control but tongues of flame sometimes spring up under a sudden wind and leap into the neighboring forest, where, however, they sweep rapidly through the dry grass and undergrowth without doing, at least from the Reddis' point of view, any serious damage.

"After the first firing, half-burnt branches are collected in heaps and then reduced to ashes; the ashes are not raked or distributed over the soil in any way before the seed is sown. Charred tree trunks are left where they lie until the following year, when, together with the still standing stems of the previous crop, the lopped shoots from pollarded stumps and undergrowth, they are burnt before the sowing of the second year's crop. In the Godavari Region some Reddis augment the ashes on the fields cultivated for the second or third year by lopping branches in the nearby jungle and heaping them on the fires, but in the Northern Hills where both soil and forest growth are richer, the Reddis do not seem to practise this method.

"The felling of the jungle is man's work, but men, women and children work together in tidying up and burning the fields. . . . Unlike shifting cultivators of other tribes, the Reddi seldom works first and second year fields simultaneously. He usually cultivates a field . . . for one, two, or three successive years, according to the fertility of the soil and then abandons it altogether and cuts a new podu."

There is a religious festival with sacrifices of chickens and pigs to the earth-goddess before the podu is planted.

"It is customary for all the men to go hunting for two or three days and to start sowing only on the fourth day after the festival, when each householder sacrifices a chicken on his own field, plucks out a feather from the wing, and sticks it in his sowing basket.

"Two methods of sowing on podu fields are practised by the Reddis: the broadcasting of the seed grain . . . and the dibbling of the seeds into holes made with a digging stick. . . . In the south the Reddis grow jawari [Sorghum] and the small millets, usually as a mixed crop. The small millets are sown first; men, but never women, broadcast two or three varieties of small grain. . . . After the small millets have sprouted, jawari is planted, and this work is carried out by both men and women. . . . The holes are made slightly in front of the sower, who stabs the earth with his long-handled digging stick, and bending forward drops a seed into the hole with his right hand; he then steps on the seed thus treading in the earth. . . . Sometimes, I was told, the men make the holes and the women follow in their footsteps, dropping in the seeds and treading them into the earth."

Von Fürer-Haimendorf goes on to state (p. 84) that the Reddi of the Godavari region do not use hoes but use digging sticks for planting sorghum and pulses. Those of the Northern Hills have hoes, do not plant Sorghum, and use digging sticks only in their house gardens (as opposed to podu fields) and for root digging.

Some of the Reddi have begun to use the plough. Some have permanent wet-field rice cultivation, some few have taken to the use of animals to do agricultural work.

All of the Reddi, however, whether primitive ones in the hills or those more acculturated, in the lowlands, have village gardens, with a great variety of root, leaf, and fruit crops. We are told (p. 95):

"Many Reddis plant trees near their houses and field huts, but they do not understand how to take cuttings, and raise such fruit bearing trees as mango, tamarind, lime, orange, guava, and jack-fruit from seed, protecting the young shoots and even the saplings with upturned baskets or wattle screens. These trees become the individual property of the man who planted them and are inherited by his descendants."

Furness, William Henry, 3d (1902) *Home Life of the Borneo Headhunters*. Philadelphia: J. B. Lippincott Co. xi + 197 pp., plates.

Furness's account of the making and planting of forest clearings by the Kayan of the Beram Valley of Sarawak is especially full with regard to the ceremonies and attention to portents attending agriculture. Many prohibitions of customary activities are observed, and these are said to be permantong or lali. Both of these words for taboo find cognates in other Malayan languages. Furness relates the former to pantang of which it is a derivative, which word he found in the language of the Kayan of the Kapuas River in Dutch Borneo. It is also the word in the Batak languages and dialects of Sumatra. "Lali" was the word applied in Timor to the sacred groves, as reported by Forbes, and derivatives are found in other languages: Forbes said it was probably a pure Kayan word whose derivation he did not know. After the omens indicated that a propitious place for a rice field had been found the more practical operations of clearing and planting followed. Furness's description (pp. 160, 161) follows:

"The experienced husbandmen of the household usually select a patch of jungle, which in their opinion will make a good rice-field if the Spirits be favourable; then each family does its share in clearing off the undergrowth.

"During this preliminary stage, when the labour is not as severe as when heavy trees must be felled, the household is not as yet lali; nevertheless, every individual looks out most anxiously for any evil omens."

The actual felling of the big trees follows and cannot be proceeded with unless certain rites are carried out during three days, and favorable omens observed. Then the big trees are cut, in the following way:

"A tree's wide-spreading, buttress-like enlargements at the foot necessitate the building of a scaffold, wherefrom, in the felling, the trunk may be cut through at its smallest diameter. When a tract of jungle is to be felled, the largest trees are cut partly through and left standing, supported only by the trees and by the interlacing vines round about; the largest trees on the confines of the tract are then felled, and in their fall start all the others, and, with a sound as of thunder, the jungle is prostrated."

"When the felled jungle is become dry, it is burned over, and as soon as the ground is cool they dibble in the grain. From the hour when the real labour of felling the jungle begins, until the seed-planting is finished, no stranger is allowed to enter the house or field; should inadvertence or necessity bring a neighbor within the lali district, he must pay a small offering to atone for the trespass. This offering is known as 'Usut,' and is ordinarily a few beads or something of iron, such as a spear-head, or an old knife."

"The crop is now fairly started. The heaviest part of the task of keeping down the weeds falls to the women, who rise with the sun, and, as soon as the household is fairly awake, start off in rain or shine for the fields, in parties of six or eight, armed with their little, short-handled, lop-sided hoes."

"During the harvesting of the 'Parai Agit,' a small patch of rice planted first, and always harvested first, there is a lali of four days, known as the 'Lamali Parai,' (lali of the pregnant rice.) Of the Parai Agit no woman must eat; if she does eat of this rice, she will go mad. Reiterated questionings failed to disclose the origin of this belief, and even the reason for planting the Parai Agit itself."

The "rice-soul" observances with numerous variations are found among many peoples of the East Indies.

Furness had an opportunity to visit a settlement of the Punan tribe a short distance from the headwaters of the Dapoi River. These people were only in the food gathering as opposed to planting stage of culture, he thought, but was undoubtedly mistaken unless they had settled in an old Kayan (Iban) clearing where some manioc remained, for manioc may persist where planted for some years, until shaded out, but it does not spread from cultivation (certainly not so far as the reviewer has personally observed) and is therefore not to be found truly "wild". It is curious that this American plant, in poisonous varieties requiring careful preparation of the food, should have been so extensively taken into cultivation by even the more primitive Indonesian peoples, just as maize was by many.

Furness wrote of the Punan occupying open ground, which would have had to be a clearing, and of the first Punan they met being a girl occupied in straining the starch from grated and trodden "tapioca" through a mat. He entered their village "through a dense hedge of wild tapioca". This was surely planted by somebody, and the Punans had doubtless taken up the cultivation of root crops even if not of rice. The probable misinterpretation of the manioc as wild does not vitiate the interest of the following quotation (p. 176) about a people partly in the food gathering stage, but showing a transition to agriculture:

"It falls to the lot of the women to prepare the tapioca root for food, an operation which takes the place of the monotonous pounding and threshing of rice in other tribes.

"These roots, which look much like sweet potatoes, are first scraped or grated on a piece of the stalk of a rough, scaly palm, and the coarse pulp is then washed and strained by stamping it through a mat while water is constantly poured over it; this washed and strained pulp is then collected in wooden troughs and allowed to settle. The sediment is a thick, white paste, which when boiled makes a very palatable farinaceous diet. The paste may be also dried and preserved for future use.

"I must candidly admit that to me the sight of the preparation of tapioca is not appetizing. In the first place, the hands which hold the tubers while they are being scraped are none too icy clean, they often dabble in the pulp just after they have been successfully busy in alleviating a neglected or troublesome coiffure. In the next place, the finely scraped pulp is taken to a stream and deposited in a mat which rests in a trough, or in a large wooden bowl, on a little platform over the stream. The operator then jumps into the mash and executes therein a lively dance, while, from time to time, a small boy dips up water from the stream and splashes it over the legs of the dancer, to wash down the particles that may have been spattered up, and also to moisten the mash. Strange to say, the paste, when strained, is of the most pure and dazzling whiteness."

Gallieni, [Joseph Simon] (1908) Neuf Ans a Madagascar.
Paris: Libraire Hachette et Cie. xv + 372 pp., 71 pl., map.

At the close of his nine-year administration of Madagascar from 1896 to 1905, General Gallieni (1908) wrote an interesting book on the great island which has achieved botanical notoriety as the site of a great endemic tropical flora largely wiped out by fire. He describes the two eastern belts of forest traversed in travelling from a point south of Tamatave almost due westward to the capital, Antananarivo ("Tananarive"). Leaving the coast he crossed open coastal country, but after leaving Beforona entered dense forest through which the sun penetrated only in a few isolated clearings. This and another forested strip represented two ranges of hills which united northward. He saw beautiful trees, rubber vines, bamboos and magnificent tree ferns. At Moramanga they were in open country again but were still to cross another much narrower forest belt which they entered at Sabotsy on the way to "Tananarive". Again emerging from forest they looked out to the west on a veritable sea of denuded hills with herbaceous vegetation, with little scattered bouquets of woods to break the general monotony.

General Gallieni (Pl. 10, 22, 58) gave two small maps showing some of the forested areas and one map of the whole island which is obviously sketchy but nevertheless very informative, in that it shows coincidence of at least two major areas of remaining forest with the general phytogeographic divisions defined by Humbert (1927, pp. 15-18, Pl. XLI). One of the most interesting localities of which there is a picture in Gallieni's volume (1908, p. 128, Pl. 29) is Ambohimanga, an ancient royal residence, necropolis of the rulers, at the base of a low wooded hill and surrounded by an immense plain of rice fields. The preservation of such an island of trees in a thickly populated place suggests a sacred grove, which one might expect at such a place. Although Gallieni does not say anything to verify such a conclusion, it seems abundantly justified by the prevalence in Madagascar of a cult of sacred trees. The locality is in Imerina Province (the "Emyrne" of Gallieni) just north of Antananarivo.

An indication of the relation of forest to denuded country in the region between Antananarivo ("Tananarive") and the eastern coast is given by Gallieni (1908, Pl. 34) in connection with his description of possible routes for the projected railway system. It is an imaginary bird's-eye view from the Indian Ocean, looking directly toward the capital, and showing the coastal sands, the succession of lagoons, later connected to provide a protected waterway inside the beach, then the coastal grassland, the first range of partly to wholly forested hills and mountains, the Betsimisarakas, the completely cleared valley of Mangoro, the Angava or second chain of forested mountains, and in the background the vast expanse of almost completely denuded

central plain hilly with scattered mountains. Beyond that, not shown, was the less continuous western forest belt roughly parallel to the coast.

Gamble, J. Sykes (1875) The Darjeeling Forests. Indian Forester, Vol. I, No. 2, pp. 73-99, map. Oct. 1875.

So far as the great plains of northern India are concerned, they are out of bounds for the reviewer's assignment, being beyond the tropics, but they must necessarily receive brief consideration in the present connection as being marginal and as showing the present end result of the process of deforestation which has left little if any vestige or even record, of ancient conditions, since the plain, up to the foothills, has been cultivated for many centuries. The narrow and malarious belt along the foot of the Himalayas, known as the Terai, remained largely forest and in the Darjeeling sector in the north of Bengal, and south of Sikkim, between the Mechi River on the west and the Jaldoka River on the east (the boundary with Bhutan), its vegetation was vividly and admirably described eighty years ago by Gamble, whose paper is accompanied by a detailed colored map with almost complete vegetational analysis.

Quotations from Gamble follow:

(p. 76) "On proceeding northwards from the plains towards the hills, and after leaving the rice fields, a gentle slope is ascended leading up to the base of the lower spurs, a slope covered with forest or with the clearance made for tea cultivation. This slope is due to the sandy deposits of the numerous rivers, which now cut through them again, so that their banks are invariably marked by steep ridges reaching up to nearly 400 feet in height in places, Between the rivers and the first ridges are generally patches of sissoo and khair forest; at the foot of the ridges themselves are often bands of evergreen swamp forest, while above, the ridges are occupied either by sal forest or savannah tracts. . . ."

"Formerly, there can be but little doubt, the greater part of the district was forest, and even now the proportion is very large, though the forest area is rapidly diminishing through the extension of tea-cultivation in the plains and the western hills, and the settlement of Bhuteas and Nepalese towards the east. . . ."

(pp.77-79) "There can be little doubt but that formerly the sal tree covered nearly the whole of the more elevated and drier parts of the Terai. It is now, however, chiefly restricted to the sandy ridges between the Balasun and Mechi Rivers, and between the Mahanadi and the Teesta. But there is this difference, that whereas the sal forests in the latter tract lie under the hills and rarely reach further from it than 5 miles, those in the former only begin at that distance from the hills and stretch on down almost to the extreme south

of the district; there western forests differ also materially in constitution from those towards the Teesta, so that while the Teesta forests, owing to extensive fellings, have been in many places almost entirely replaced by long grasses, in the western ones the long grass is scarcely known, and the sal comes up in myriads of seedlings wherever a little light is opened up to the soil. The general appearance of many of the western forests is that of being regularly worked by the system of natural reproduction, where the seed, secondary and final cuttings have all been heavy. . . . These forests cover ridges, and are surrounded by cultivation, and it is remarkable that in many places where the cultivation has been stopped and the land allowed to lie fallow a dense crop of young sal has immediately grown up. Where the seed comes from is a mystery, as it is not of a kind easily transported by the wind, but the fact remains. . . .

"Turning to the Teesta forests the conditions are quite different. When trees are felled, instead of the fine mass of young seedlings already described, long grass comes up thicker and thicker. But this even would make little difference, as the sal seedlings, or rather, in most cases, the shoots of sal described by Mr. Baden Powell show no objection to coming up with the grass; if there were no such thing as jungle-fires to make a clean sweep, year after year, of all low growth, and to torture into every conceivable shape of gnarled and twisted ugliness the few wretched remnants of old virgin forest. This is very particularly noticed in the large private forest of Bykantpore said formerly to have consisted of fine large sal worked to such an extent that only two years ago every tree of two feet girth was cut out, and that now will either be put under cultivation or kept as a perpetual grazing ground. Some parts of the Government reserve are not much better, but as a better supervision is kept up and greater punishments are inflicted on people found igniting the forest it is to be hoped that in a short time we shall be able successfully to strive against fire and grass. . . .

"The general appearance of the Teesta Terai sal forests is very variable; towards the boundaries the aspect is chiefly that of a vast expanse of long grass, dotted with a few sal of stunted and unhealthy growth, a few big-leaved *Dillenias*, the white-stemmed *Eugenia obovata*, and the scarlet-flowered *Butea*. If, however, we examine the ground, we find almost always large numbers of seedlings or stump shoots. The grass gradually disappears as the forest improves. . . ."

(p. 80, 81) "The sal forests of the lower hills and valleys are quite different again. They generally occupy the ridges towards the plains or the rivers and have always a finer and more healthy growth than the plains sal forest; we rarely find any of the long grass which characterizes the greater part of the Terai forest. This is replaced

by a short wiry bamboo-like grass 'Pogonathera' or in the more exposed places by a tall stiff species of 'Erianthus' These forests will not be difficult of management. . . . as the danger for fire. . . . is very much less than it is in the Terai."

(p. 84) "Savannah forests . . . will require but little notice. They are generally large tracts of long grass with here and there a tree where the grass grows high over the back of the elephant you ride, and in the dry season, after the annual fires have swept fiercely over it, serves for the grazing of herds of buffaloes, brought up from the plains of Bengal to seek the short rich young shoots which are so fattening. . . . "

Gamble describes a type of transitional forest which he calls creeper jungle which is selected by the Mechis, the wandering tribes of the Terai forest for their cotton cultivation.

Garnier, Francis (1885) Voyage d'Exploration en Indo-China effectué par un Commission Française presidée par le Capitaine de Frégate Doudart de Lagrée . . . revue et annotée par Leon Garnier, contenant 211 gravures sur bois d'après les Croquis de M. Delaporte et accompagnée de 2 cartes. Paris: Libraire Hachette et Cie. 662 pp.

Leaving Ban Song for the Laotian village of Petoung the French explorer Garnier found the forest to have been burned and transformed into rice fields. This, he said (p. 120) was the only mode of clearing employed by the savages (Kha was the generic term in Laotian for any savages) and encountering such forest clearings announced the proximity of a village. A plateau occupied only by herbaceous vegetation, after having been repeatedly burned over, was large enough so that mountains were visible on the horizon.

(p. 172) From Kémarat to Si Saket, the chief place of a Laotian village, Garnier () ascended the Sam Lan to its confluence with the Sé Moun. On the way the route led through plains cleared by fire, the primitive mode of clearing which had contributed largely to the transformation of forests into herbaceous prairies, as indicated here and there, blackened trunks of burned trees.

(p. 174) From Si Saket to Coucan he entered Siamese territory and the area of the ancient Khmer empire. He mentioned traversing a vast plain sterilized by fire.

(p. 180) Approaching Tchoncán the forest gave place to a sandy and entirely denuded plain, and an entirely denuded area that looked like a dry lake bed surrounded by a belt of trees.

Garvan, John M. (1931) *The Manobos of Mindanao*. Mem. Nat. Acad. Sci. Vol. XXIII, 1st Mem. xvi+265, 14 pl. Washington: Government Printing Office.

Garvan says (p. 73) of the Manobo, one of the pagan groups of Mindanao:

His system of agriculture is in perfect adaptation to his social and political institutions. . . . He builds no embankments, no irrigation ditches, no terraces. . . . He selects a patch of the virgin forest every year, and with the bolo and rude axe, clears and cultivates the land. For a permanent crop he keeps his camote [sweet potatoe] patch, on which he may plant a few bananas and also invariably a sprinkling of sugar cane."

The Manobo call the clearing for a single crop of rice and accessory plants "uma". After calling attention to the signs and portents governing the choice of a site, Garvan says:

"Special attention is here called to the fact that the spot selected must be one of virgin forest. The Manobo never plants his rice in the same place during two successive years, because it would not yield a plentiful harvest."

After various ceremonies, it is essential that work start on the very day that propitious omens indicate that the good will of the spirits has been gained.

(p. 74) "The clearing, like other agricultural operations, is done on the mutual-help system. . . . The average clearing does not comprise more than a few acres, and is completed ordinarily in from two to five days. The first step . . . consists in cutting down the underbrush and small trees. In this . . . the women and children . . . gather these into heaps for burning. . . . The next operation consists in the felling of trees . . . cut down high above the base. . . . Standing on his perch at a distance of about eight feet from the ground, the feller plies his native axe. . . . After the trees have been cut down, all branches . . . are cut and mounted into heaps for future burning. This burning, of course, cannot take place till after the hot weather . . . comes. . . . Unless the clearing was exceptionally free from heavy timber, the ground remains encumbered with the larger trunks and branches, even after the burning, but this is no impediment, for the rice and camotes can be planted between.

Gautier, Emile F., translated by R. Baron, Ed. *Western Madagascar: its Geology and Physical Geography*. Antananarivo Annual and Madagascar Magazine. No. 22 (Vol. VI, Part 2) pp. 137-148. Christmas, 1899.

Gautier explored the western part of Madagascar in 1892, 1893 and 1894, and reported that in general a straight line, terminated at the two extremities north and south, separates the central highlands from the generally less elevated western part of the island. The extreme north and south have extensions from the eastward of crystalline rocks, but the center of the west is occupied by sedimentary rocks.

The Sakalava country of the northwest has a chain of hills near the sea, and since the prevailing winds are from the north-west, the western slopes are forested with impenetrable masses of brushwood and small trees. To the east of the Bemaraha chain there is no continuous forest; it is a zone of poorer vegetation (p. 140).

"The population is found, like the forest vegetation, along the coast and the banks of the larger rivers. The Sakalava inhabit the whole length of the coast as far as Nosibe; but their villages are not found farther inland than about six kilometers. The plain of Ambaliky is devoid of people, being an uninhabited stretch of country running into the central highlands. . . .

"The southern part of west Madagascar . . . is quite different. . . . From Malaimbandy one perceives towards the south bluish masses of mountains. . . . the commencement of a new region, for it is there that the limit exists between the Sakalava plain and the [three] plateaus of the south. . . .

(p. 143) ". . . Two belts of forest cover the [two] first] plateaus. . . . The same causes govern the distribution of the forests in all parts of Madagascar. No parts are forest-clad except the slopes accessible to the maritime winds and influences, whether these maritime winds have direct access to them from being near the coast, or whether in regions more remote from the coast, but standing out more prominently, these winds reach them after having passed over a line of less elevation.

"Between the two successive zones of forest there stretches a savannah besprinkled with trees, generally palms and 'cythère' trees [query, corruption of *sàtrana*, species of fan-palm?]. The forests have the same lack of luxuriance and large trees as those more to the north, so that in this respect there is but little difference between the first two southern plateaus and the Sakalava plain to the northwest."

(p. 147) Third [i.e., most southern] Plateau. This almost desert region, though inhabited, does not extend very far into the interior. Its rapidly increasing altitude very

quickly counterbalances the parching effect of the south wind, and the interior is much less dry than the coast."

(p. 148) "I have thus tried to show plainly the special character of the south part of the island in contrast with the remainder of the west, that is to say, the Sakalava plain. . . . The parching influence of the southern winds has favoured a special vegetation of succulent and spiny plants."

Gautier, Emile F., (1899b) translated by R. Baron, Ed. "Atlas of Ambongo" Antananarivo Annual and Madagascar Magazine, No. 23 (Vol. VI, Part III) pp. 338-349. Christmas, 1899.

This article is a translation of the text accompanying an atlas of several maps, but without the maps. It describes the provinces in the northwest part of Madagascar, more especially Ambongo. The region is largely a high limestone plateau showing itself "to one coming from the interior, as high cliffs with horizontal summits. These are, as a rule, immense level expanses, where great flaggy slabs of limestone pierce a yellow soil almost devoid of vegetation. In some places the limestones have been cut into needles and into tables with overhanging edges. . . . The parts of the limestone plateaux which are thus dug out and cut down are called by the Sakalava tsingy and in times of war they serve as refuges to the conquered party. The majority of the Sakalava kings establish their habitual residence near a tsingy which eventually serves as a natural fortress.

"The limestone plateaux are very dry, and subterranean water circulation plays a great rôle in them. . .

". . . . The presence of tamarind trees, fan-palms, baobabs, and the absence of great continuous forests are characteristic. The island of Madagascar is often represented as surrounded by a girdle of forest. On some quite recent maps the greater part of Ambongo is shown as covered with a forest called Manèrinèrina. In reality, from the time the traveller who follows the route from Fènoarivo (in W. Imerina) to Makarainga, arrives in the neighborhood of the River Mahavavy, he enters a region in which the low grounds and the borders of the streams are wooded. Ambongo and Mahilaka are far from having the desolate aspect of Imerina. They are covered with clumps of trees, but the continuous forest exists nowhere. It can be said, as a general rule, that woods occur everywhere where the soil, for accidental reasons, remains damp throughout the year, thus counterbalancing the influence of the dry season. The slopes of the highest mountains (e.g. Fonjay, Ambohitsosy, etc.) where springs abound, are wooded. It is the same all round the great limestone plateaux. All the rain

which falls on these plateaux is absorbed by the very permeable soil, and slowly restored at the base of the causes. The tsingy are covered with slender and tufted bush, the roots of which run on the white rocks like live things, penetrating into the interstices, and seeking in the depths below the invisible store of soil and humidity. The valley and plains, more or less marshy, and the sea-shore . . . are almost always wooded, and the alluvial soil in these places is richer than elsewhere. . . . Everywhere else a persistent dryness, lasting more than half the year, prevents the development of arborescent vegetation. . . .

"It is impossible to represent on a map the condition of agriculture in this part of the island. On this immense and thinly peopled territory the extent of cultivated land is not even proportionate to the number of inhabitants. Only a small part of the ground, namely, the baiboé (baibò?) which is quite excellent for agricultural purposes, is cultivated. The baiboé are alluvial plains inundated during a part of the year and are generally wooded or covered with tall reeds (bàraràta = Phragmites communis Trin.) which are cleared by burning. On this well watered soil, naturally rich, and thus manured with ashes, the crops grow almost without labour."

Gentry, Howard Scott (1946) The Durango Grasslands. Dissertation: University of Michigan, Ann Arbor, Oct. 1946. M. S. Published in microfilm by University Microfilms, Ann Arbor, Michigan. 165 pp., 16 pl.

According to Gentry, Brand () appears to have been the first to map the long belt of grassland which lies between the pine and oak forests of the Sierra Madre Occidental and the Desert-shrub region of the central plateau of Mexico. Gentry has mapped the plant associations from about 27°N to beyond 23°N, and from 106° to 102°W, showing that the successive continuous or broken belts of vegetation which trend from north-west to south-east are, from west to east, (1) pine and oak, (2) oak and juniper, (3) grassland, (4) shrub grassland, (5) chaparrillo, and (6) desert shrub. The chief irregularities in vegetation are those caused by the Rio Nazas breaking across from west to east in a deep arc toward the south. The same belts of vegetation extend both northward and southward from the area of Durango and Zacatecas which Gentry studied to the more northern area particularly studied by Brand, i.e., middle and northern Chihuahua.

It is immediately obvious that the grassland appears just where it would be expected in accordance with the expectation that non-grassy vegetation would tend to be exterminated, giving place to prairie, where the rainfall was too deficient to support tall forest but, on the contrary, enough to produce a sufficiently dense grass sward to support a prairie fire. Regarding the existence of the grasslands and fires, Gentry quotes, for the

similar region of Chihuahua, farther north, the records of Francisco de Ibarra (1570?) and Wislizenus (). Rouaix (1929, p. 27) devoted a large part of his energy for sixteen years to topographic surveying of Durango and recognized a "Zona de los Valles" or valley zone as one of the four primary geographical (and to some extent vegetational) regions of the state; lying between the semi-arid belt and the Sierra Madre. His valley zone included the grasslands. The latter (to quote Gentry, 1946 p. 4) he described as "a plain covered by an immense carpet of grasses with a multiple variety of species, which produce magnificent pastures. Tree vegetation is sparse, composed of oak and piñon on the low hills at the foot of the sierras, and woods of mesquite and huisache (*Acacia*) on the plains subject to river over-flow." The chief botanical observations on the grasslands in Chihuahua were made by Shreve (1939), who also visited the Durango grasslands (1942). Bartlett made notes and photographs in 1944, and contributed them to Gentry, who, accompanied by the soil specialist Marion Striker, made the detailed study in 1943 which is reported in his dissertation.

Gentry (p. 124) concluded that instead of being an artificial plant formation the Durango grassland, bordered above by montane pine and oak forest and below by desert shrub, was a natural climax formation. He said:

"Physiography indicates that the Durango Grasslands and bordering associations probably have existed throughout the Quaternary epoch. That they are modified considerably from what they were in the beginning is probable in view of the environmental vicissitudes through which they have passed, but the general outline of relationships has endured. . . . It is significant that grass has settled upon the level stable lands, while woody vegetation occupies the physiographically younger rocky slopes. . . . The more eastward limit of Desert Shrub in the mid-Pleistocene implies a broader belt of grassland above, with a concomitant lowering of oak and juniper on the Sierra Madre bajada. The strongest factual link supporting this line of reasoning is probably to be found in the soils and their record in the stratigraphy. The case accordingly will be strengthened or weakened as our knowledge of their nature increases."

Gentry (, p. 109) summarized his argument derived from soil profiles as follows:

"In the chapter on soils it was stated that the mesophytic soils of igneous derivation . . . are consistently reddish brown in color and are Grama Grassland soils, whereas the more arid desert soils (bottomlands excluded) are buff to gray in color and associated with typical desert vegetation. The reddish-brown calcareous soils of successive surfaces of the plateau evolved concomitantly with burial by aggradation, into reddish calcareous sediments. Such sediments extend

back practically throughout the Quaternary column. In Durango this sequence of buried soils, so unusually displayed, was taken to indicate a Quaternary tenure for Grama Grassland; i.e., grassland existed on successive reddish-brown sediments. Recent literature, however, has questioned grassland as a climax of long duration. Sauer (1944) for instance, presents a strong argument for the development of prairie from the burning of woodland by early man. It is now known that early man may have appeared in North America as early as Interglacial III. Hence the changes he may have made, and did make in many instances, were not always perceptible by the time the European arrived."

About the effect of fire Gentry (p. 110) says:

"While the [Durango] grassland through the dry season is highly inflammable, it makes only a quick fire with relatively low temperature because of the dispersion and sparsity of cover.
. . .

"That the Amerindian burned grassland in conjunction with hunting and for other reasons has been known since the days of Cabeza de Vaca in the early 16th century. . . . One of the earliest accounts of fire in grama grass is that of Robinson, who soldiered with Colonel Doniphan down through Chihuahua in 1846. He wrote

"We left our wagons on the burnt place, and encamped on the other side, in order that our horses might get some grass; but about nine o'clock in the evening the fire came down from the mountains . . . and drove us across again. I have never seen a fire scene equal to this, the fire in the mountains forming almost every shape imaginable, as it flashed up the peaks and leaped across the valleys, while the plain was a perfect sea of flame."

"This was along the Laguna de Encinillas, 50 to 60 miles north of Ciudad Chihuahua. Bartlett, heading the United States Mexican Boundary Commission, followed the same route in 1852. Six years after the fire described above he comments on the vegetation of the same spot . . . as follows:

"'At six o'clock we moved again over an excellent road, as before, the grass luxuriant as far as the eye could reach. Antelopes and deer were seen in herds bounding over the plain. . . . We continued . . . for fourteen or fifteen miles, through a plain covered with grass . . . ten or twelve miles wide, bounded on the east by a range of hills, and on the west by rugged mountains'. . . .

"Unless burnings are repeatedly severe, the grammas are not permanently injured."

Gentry found that oaks had remarkable resistance to fire and attributed it to their corky bark and the slight heat

developed by fires of low and sparse grama grass. He found no evidence of replacement of oak by grass as a result of fire, but the reviewer was impressed by the fact that the scattered oaks in the upper edge of the Durango grasslands were large and old, and were not surrounded by seedlings. Even if old trees were not killed, seedlings might be, and when the old trees eventually died fire might have prevented their reproduction. Thus fire would, after all, have replaced oak.

To sum up his argument Gentry said:

"Hypothetically the Durango Grasslands are interpreted as a modern representative of a Pleistocene habitat. . . . Although the rich Pleistocene mammalian fauna (Frick 1937) has vanished, the grassland which supported it has survived although changed in composition because of varied occupancy over disturbed surfaces and the ever active speciation. The over-all physiographic evolution has been and still is the slicing away of the plateau ever westward as the Sierra Madre Piedmont is being degraded by transport of its materials to the Bolson de Mapimi."

Girod-Genet, Lucien (1899) Les Forêts a Madagascar. Rapport d' ensemble de M. l. Inspecteur-adjoint, Chef du Service des Eaux et Forêts. Colonie de Madagascar. Notes Reconnaissances et Explorations, Vol. 5, whole No. 25, pp. 51-85, illust., 2 maps. 31 Mars 1899. Tananarive: Imprimerie Officielle.

Girod-Genet spent over six months in field reconnaissance of the Madagascar forests in 1896 and 1897, and operated his survey also through field agents, of whom the principal ones were Chapotta and Viguerie. Chapotte devoted two years to the work reported. As a result a map was prepared for this report which showed the area up to then by official foresters. That it shows little indication in the west (except for the northwestern region inhabited by the Sakalava) of the peripheral forest which was supposed to surround the entire central plateau of the island is explained by the legend "territory to be explored". For the east and north, however, the forested land that had been traversed was classified into three categories, (1) that of the narrow and exactly coastal belt of mangrove, dunes, etc., fairly continuous but with gaps accounted for by deforestation, (2) that of mostly well populated, lower areas and moderate elevations accessible either from the east coast or from the central plateau, largely cleared, culled, or in second growth, and (3) forests of the less populated and accessible regions of medium or higher elevation, inclosed as islands within the more disturbed areas.

Girod-Genet was alarmed at the extent of destruction of forest that had taken place and that was going on every day.

He said that enough land had already been cleared to produce the needed crops and to provide for the activity of everyone concerned in agricultural productivity, and of course this was true, but the problem was to prevent further devastation and to convert the population to the point of view of continuing to use land which had already lost its pristine fertility.

The moist forest of the east was very narrow and contained at least a good many of the same species, all the way from the north down to its southern extremity at about 250 kilometers northeast from the southern most tip of the island. On the western side of the island, however, the aspect and composition of the forest were the same as on the east only down as far as 16° S.

About the different physiognomy of the forests on the east and west sides he said (p. 58) that whereas the species of the east were mostly evergreen those on the west were mostly deciduous. This to the reviewer indicates very clearly that a different climatic climax of geological antiquity prevailed in the west and that man never did destroy a prevailing evergreen type of forest that some authors believe to have extended over the whole of Madagascar down to the time of human occupation. Girod-Genet not only contrasts the vivid green of the eastern forest with the somber, monotonous western, but points out the increase in Euphorbiaceae and Malvaceae among the Leguminosae as one travels southward on the west side. He also points out that one gets a little of the same impression in going from Vohémar on the east coast to Diego Suarez at the northern tip, for even there the western aspect begins to be apparent except in the massif of Ambre.

The damage and destruction of the forest in Madagascar by indigenous populations who had become dependent upon cattle was done, Girod-Genet said (p. 62) by deforestation with hatchet and fire combined, primarily to create pasturage for increasing herds but also in connection with constant intertribal warfare. Likewise the best examples of the most useful species for constructional purposes were constantly culled out in the most wasteful way possible, for ordinarily the felling of a single large tree in dense forest destroyed a number of others, and the one which was desired usually provided only a single plank, for the log was hewn down from both sides instead of being sawn. There had always been removal of the best species and propagation of the remaining relatively useless ones, as well as abandonment of timber which did not fall conveniently or proved unsuitable, after felling, for the particular purpose in mind. There was vast waste of wood in making charcoal for fuel. A law to regulate it was promulgated in 1881, but was never observed. Both natives and Europeans cut quite unscrupulously young trees that were essential for forest regeneration. Finally, there was quite irrational destruction of species that produced rubber, gums, resins, etc.

Gironière, P. de la (1853) *Vingt Années aux Philippines. Souvenirs de Jala-jala.* Paris: Comptoir des Imprimeurs Unis. 339 pp., plate, map.

Gironière, P. de la (1854) *Twenty Years in the Philippines revised and extended by the Author; expressly for this Edition.* New York: Harper & Brothers. 371 pp., illust.

Gironière, P. de la (1855) *Aventures d'un Gentilhomme Breton aux Isles Philippines. Avec un aperçu sur la géologie et la nature du sol de ces îles, sur les habitants; sur la règne minéral, le règne végétal et la règne animal; sur l'agriculture, l'industrie et le commerce de cet archipel Illustrations d'après documents et croquis originaux par Henri Valentin (des Vosges).*

Of these three editions of de la Gironière's classic book of Philippine travel and adventure, popular a century ago, the American translation has the valuable appendix containing most of the agricultural data. This is lacking in the French edition of 1853 but is included in that of 1855, which is the same work under a different title.

Gironière's remarkable agricultural enterprise on Laguna de Bay. It is largely of interest as indicating the interaction of native and European methods in such a colonial undertaking, and in the description of the growing of upland rice in hill clearings one wonders if the covering of the seed and manuring of the plot by using the latter as buffalo enclosures after seeding and before germination was an original Philippine practice (as seems quite likely) or an improvement that came about from European contact. It is interesting anyway, whether original or acculturative, as an improvement on simple fertilization by the ashes of the felled forest, and as an advance toward prolonging the longevity of forest-clearing agriculture. It leads from such a very primitive practice as the use of planting sticks to punch holes for the seeds in the soft ashy surface to the practice, presumably based upon a knowledge of the fertilizing value of the manure, and (which, curiously enough, most primitive peoples seem to have lacked) to broadcasting on land where the seed would be trodden in by the animals and at the same time the soil would be manured. This would be an advance toward permanent non-irrigated agriculture.

The passage from the American edition follows (pp. 310, 311):

"After the trees or brushwood which had covered the land are cut down, they are burned, and then rice is sown, by making, with a stick or dibble, a hole, into which are thrown three or four grains of rice; or perhaps the rice is sown broadcast, and then, for about a month, a herd of buffaloes is kept on the ground, so that they, by trampling, sink the

seed into the earth. In this kind of tillage, from the abundance of grass and weeds, several hoeings and weedings become necessary; but the labour is amply repaid by an abundant crop, which generally yields a hundred-fold and upwards.

"In the small fields the ears are cut singly, in order afterwards to dry them in the sun. This mode of gathering the crop is troublesome and tedious, but it has this advantage over the process of collecting in heaps, that a great deal of the grain is saved from the voracious birds.

"All the other kinds of mountain rice are sown in the same manner as that called Pinursegui, but this last has the advantage of being fit for harvesting in twelve or fourteen weeks, while the others require twenty weeks."

Gleason, H. A., and Cook, Mel T. (1927) Plant Ecology of Porto Rico. New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. VII, Parts 1 & 2. Feb. 1927. 173 pp., 25 figs., 50 pl.

In the entire Caribbean region the large, natural area most thoroughly devastated by man is doubtless over-populated and consequently poverty-stricken Porto Rico. It has an extraordinarily large weedy plant covering, largely of immigrant species. Gleason and Cook (1927) made an extended study of the vegetation in 1926, and remarked on the different nature of replacement vegetation from that which preceded it. They stated (1927, p. 21):

"An abandoned field in the mountain districts is soon covered, not with forest, but with dense thickets of fern. The clearing of vegetation around a haystack hill is followed by the development of a thicket of peppers."

About the almost non-existent original vegetation, of which vestiges only remained they stated (p. 31, 32):

"A survey of the vegetation of Porto Rico shows at once, the presence of a large number of different plant associations in the natural vegetation. Some of these are of large extent and were originally, before their destruction by man, nearly continuous over wide areas. . . . Some show clearly that their existence is precarious. . . . Others offer no evidence that they are subject to change, except as they have been or may be destroyed by man. Still others show clearly that they owe their existence to man, through his activities in cutting, clearing, or burning. . . . Throughout the island numerous secondary associations are present, in which the vegetation shows distinct changes due to the activities of man. . . . In other secondary associations the original vegetation has been nearly or completely

destroyed, leading to the development, chiefly in waste land or along roadsides, of entirely new assemblages of plants. These we have omitted entirely."

Mention of grassland hardly occurs in Gleason and Cook's monograph. They show (p. 60) a picture of an ancient consolidated dune on the San Juan limestone formation with "the original dune vegetation reduced to a single wind-swept thicket of Coccolobis uvifera, surrounded by a sod of Stenotaphrum secundatum".

Regarding the forests of the higher altitudes they say (p. 108, 109):

"The forests have been almost entirely destroyed. The work of destruction undoubtedly began in pre-Columbian times, in the clearing for agriculture and early abandonment of small tracts by the aborigines, but with a sparse population, and that preferring the coastal hills to the central mountains, little change was made in the natural vegetation. It was probably not until well into the nineteenth century, according to Murphy, that the rapid development of coffee cultivation led to the wholesale clearing of the forests for agriculture. . . In this century of forest destruction, a few areas were fortunately spared. [These were, of course, placed under protection by the American regime at the beginning of the 20th century.] Numerous areas of forest are visible from every highway across the central mountain mass, and tend to create a false idea of the vegetation for the tourist, since, with few exceptions, they are merely coffee plantations, and the forest cover is composed almost entirely of the two species of Inga."

Gonggripp, J. W. (1938) Soil Management and Density of Population. Congrès Intern. de Géographie. Amsterdam, Géographie Coloniale, p. 400, (not seen).

Gonggripp, cited by Gourou (1947), deals with deforestation on the island of Bangka, east of mid-Sumatra. Here there is little in the way of a genuine "dry" season, and burning is therefore carried out with difficulty, but the vegetational succession set up is very conspicuous. The abandonment of a ladang is followed by the establishment of a secondary forest in which there is eventually a predominance of dipterocarps, which are trees of notable value. If there is repeated clearing and burning, however, the result is a dense secondary growth of Schima bancana, of no value, and easily distinguished from primary forest by the prevailing red color of the young foliage. If it is repeatedly fired, the end result is grassland dominated by Imperata cylindrica.

Gossweiler, John, and Mendonça, F. A. (1939) Carta Fitogeográfica de Angola, [Lisbon]: República Portuguesa, Ministério das Colónias, Edição do Governo Geral de Angola. 1939. 243 pp., 76 figs. on plates, chart, col. map.

John Gossweiler (1939) with the collaboration of F. A. Mendonça, has produced a remarkable vegetational map of Angola with a full botanical commentary and illustrated by remarkably fine habitat photographs which are all well described and localized. (It is only too bad that so fine a piece of work should be disfigured by the absurd vegetational terminology of Riibel.)

Except for a little detached area wedged in between French Equatorial Africa on the north, and the Belgian Congo on the south, for the Belgian territory extends to the coast in a narrow strip breaking the continuity of the Portuguese colony, the great area of Angola is bounded on the north by the Belgian Congo. The vegetational belts run in general north, so that each of them enters the Belgian Congo and is represented in that country to the southward of the great equatorial forest. One wishes that political boundaries did not limit the map!

Interesting points are that the 23rd meridian, which is in about the longitude of the upper course of the Zambezi river, runs through Northern Rhodesia where the vegetation as shown on Gossweiler's map of Angola is shown as forest or shrub land of seasonally deciduous species inclosing numerous islands of herbaceous vegetation (i.e., prairies) and heath-like vegetation with grass (therefore chana, the vernacular name for grassland) with other areas in which grasses may be almost absent, and the chief vegetation consisting of wood species of Cryptosepalum, with great subterranean development. The same types with very similar distribution extend westward to about the 10th meridian, except that in the middle there is a large island or tongue which must extend northward across the Utunguila river, which is classified as the savana of the Cassange e upper Cuango rivers.

Nearer the coast (about 13 to 16° E, 7° S, prairie (or various types of savanna) become continuous (except for crossing a belt of evergreen forest), until near 13° E. areas of evergreen and forest and brush are encountered.

The colonist in Angola, according to Gossweiler and Mendonça, employs the term chana a word of the indigenous language, to designate plains covered with grasslike vegetation, but the term is botanically vague. The physiognomy of the type of vegetation called "chana de borupcha", consisting largely of species that are vastly more developed below ground than above, gives a traveller the idea, especially when he encounters remains of carbonized trees, that the vegetation is showing degeneration from forest to desert. Dr. L. W. Carrisso described these plains as denuded and sparsely clothed with grass-like vegetation in which are rarely found stunted deformed trees about 3 m. high.

These he regarded as vestiges of burned forest. There is to be considered, however, a possibility of regressive evolution. There are places where there seems to be too little vegetation to burn, but it must be considered that this may not have been true at the time of first destructive fires, which may have been long ago.

Gourou, Pierre (1936) *Les Paysans du Delta Tonkinois: Etude de Géographie Humaine*. Paris: Editions d'Art et d'Histoire. 666 pp., 125 figs., 48 pl., 9 maps.

In his remarkable monograph on the Tonkin Delta, Gourou (p. 155) has given a comparison between the culture of the vastly more densely populated overflow lands with their permanent rice cultivation and that of the immediately surrounding sparsely populated mountains. The latter resembles that of the Mountain Province of Luzon or the highlands of Java or Sumatra, in that agriculture has developed into the permanent phase of rice cultivation on irrigated terraces, but since not more than 5 percent of a Tonkin upland district (canton) at best is suitable for terracing and likewise has a water supply, the agriculturists must depend considerably upon dry-land rice cultivation. The latter alone cannot support a dense population because the soil is too infertile, and is therefore agriculture of the shifting type which the Annamites call "ray". Fields are used only two years and lie fallow, with whatever woody plant cover follows the abandonment, for about twenty years. The agricultural cycle is the familiar one of cutting and burning, but the technique of cultivation has passed beyond the absolutely primitive in that the hoe is used rather than merely the planting stick. The ashes of the burned trees and brush are the only fertilizer used. It is only under favorable conditions that woody plants return so that the cycle can be repeated indefinitely. On the soils derived from schistose rocks the forest does not repossess the clearings, but a savanna of coarse herbaceous vegetation develops (as in the Lai Châu country. Then "ray" agriculture is no longer practicable, and no use can be made of the land except for stock raising, and the herbage is hard and of mediocre quality.

Gourou, Pierre (1947) *Les Pays Tropicaux: Principes d'une Géographie humaine et économique*. Paris: Presses Universitaires de France. 196 pp + table des (16) figs. + table des matières.

In this work on the human geography of the tropics, Gourou has discussed the rôle of primitive agriculture, fire, and a veritable cult of cattle in modifying the face of Nature. He calls attention (p. 4) to the sparsity of population in both the rainy and dry tropical parts of America and Africa although it is in some of these thinly populated regions that the effect of man in modification of vegetation has been most pronounced. Sparse populations have been generally culturally retarded or have shown retrogression in historical time. The non-Asiatic tropics have 8% of the world's population on 28% of the exploitable area, whereas the Asiatic tropics have 25% on 8%. This difference is correlated with the extent to which permanent as opposed to shifting agriculture has developed. Shifting agriculture prevailed among the aborigines in most parts of tropical America and Africa, whereas there was much greater development of permanent land use (by wet-rice cultivation especially) in tropical Asia, as, for instance, in Siam, Burma and Java.

Gourou makes the striking statement (p. 48) that there is a veritable symbiosis in the moist Tropics between the grassland and the fire. The herbaceous plants that can reproduce and spread by deep rhizomes do not suffer from fire, and at the same time fire guards their domain against the invasion of trees. Without repeated burning-over, the land would be repossessed by trees. He says that the coexistence of trees and of prairie is contrary to nature, that savana park lands with their scattered trees persist only in a semblance of equilibrium, for increased fire will make them into prairie and less fire will allow them to revert to forest.

On areas deteriorated by repeated felling and burning, grassland eventually replaces forest. Destruction of trees without burning generally results in rather prompt replacement by secondary forest of a few weedy species, and the soil does not undergo great deterioration. The basic difference is that without fire humus may continue to accumulate. Calcium, potassium, phosphorus and nitrogen remain in such chemical combination that their release in soluble form is so slow that they are concurrently reabsorbed by the roots of new vegetation which itself remains on the same land from which the nutrient salts were removed.

If the organic material is burned, however, the nitrogen goes into the air in elemental form, and ceases to be available until the slow process of bacterial fixation and spread of the fixed nitrogen, largely by animal life, has had time for renewing it. The alkaline ash has the other fertilizer constituents in relatively soluble form. That part which is not absorbed by the quickly grown agricultural crops is leached out of the

surface soil and lost to the locality through drainage. Leaching accounts for the sterility of most tropical soils where there is considerably more than enough rainfall to balance evaporation.

Depletion of soluble constituents, the fertilizers of the soil, takes place concurrently with the formation of the hard laterite crust which has up to now permanently impaired the value of much land in the tropics. The formation of lateritic deposits takes place only where the climate is wet and hot. In the Planalto of Brazil laterite may be many feet thick. On geologically younger soils it is thinner. It forms most rapidly where the alternation of wet and dry seasons is pronounced. The lateritic areas are generally deficient in all major fertilizer constituents. There are areas where the increasing lateritization of the soil surface has conquered even the grasses.

(Some propagandists for conservation have seemed to confuse the rapid exposure of laterite crusts on deforested areas, by erosion, with the process of formation of laterite. So they sometimes speak of man's effect in "speeding up the lateritization of the soil" when they really mean the loss by erosion of the meager useful humus-containing soil lying upon laterite.)

Gourou discusses the evil of exposing lateritic soils to erosion by deforestation, since they are likely to be of little agricultural value and should better remain forested. (p. 23) He says of curious phosphatic laterites of the Thiés region of Senegal that they are so dense that their agricultural value is nil. He says that the lateritic curasses of Guinea (bowal) and of Senegal are absolutely inutilizable; also that the laterite walls and buildings of the Mérina and Betsiléo of Madagascar are indefinitely respected by vegetation, for not even a moss installs itself on them.

In connection with the aggravating effect of shifting agriculture on the extension of infertile or absolutely barren laterite formations at the surface of the ground, he cites the clearing of the sal (Shorea robusta) forests of Bengal as having probably produced the khoai by erosion of the moveable and relatively good soil which covered the laterite.

Gourou (p. 29) apparently thought that the preparation of a Malay ladang by burning was always done with a supplement of branches from adjoining forest, and that it was therefore equivalent to the chitéméne system of the Bantu tribes of Rhodesia and Nyassaland. This is by no means true so far as the reviewer can learn from the literature or from personally observation on the East Coast of Sumatra. The only supplementary enrichment with ashes after the original rough burning and clean-up burning comes from the effort to dispose of large trunks that resisted fire the first year, and some branches

are piled against these for kindling, but apparently not with the conscious idea of additional fertilization of the land, but only to rid the ladang of an encumbrance. The Malays usually burn twice in the original clearing of the land. The first year's burning of the ladang may leave many large trunks only scorched. These may be left indefinitely, or burned at a second or subsequent trial by building fires against them with branches or small wood which might possibly have to come from adjoining forest. The objective, however, is rather different from that of the Bantu, being to make more planting space by disposing of the big trunks rather than to prolong the life of the ladang.

European colonists in the tropics have in general observed what the natives did, and have then done likewise. Thus, Gourou states that in much of Brazil the Europeans have employed no procedure differing from that of their Amerindian predecessors, except as better tools enabled them to be more efficient agents of destruction.

The choice of land for clearing is by no means random. Primitive peoples were keen observers of natural vegetation and learned from long experience what trees or other wild plants are natural indicators of the best soils. Thus, Gourou cites as the best of the guide-trees (padroes) in Brazil Galesia gorasema. The Boulon of Cameroun prefer the soils on which Thaumatococcus Danielli and Cassia alata flourish. When the best sites have been used four or five years and have become sterile, less excellent ones have to be chosen, unless good land remains abundant, and most tropical soils are notoriously infertile. So, in the course of time, even a relatively sparse population devastates much forest, and, by preference, the best, occupying the best land.

One of the most interesting sections of Gourou's book deals with the cattle cult of eastern Africa.

In the main tropical civilizations would seem to be less advantageously oriented toward pastoral life than toward agriculture. There are areas, however, where as Gourou points out (p. 64) there seems to be a mania for raising cattle, however uneconomic it may be. He points out the prevalence of cattle raising in India, the Sudan, East Africa and Madagascar, regions now having little in common except that they border the Indian Ocean and that their inhabitants have what may be considered a passion for bovines. Historically their connections were doubtless closer, for Indonesian immigration to Madagascar was by way of India, and the Arabs intermingled distant cultures. In this their cultures are markedly in contrast with the great Chinese culture, which ignores cattle except as machines for doing work.

Gourou considers cattle raising in Africa to have been introduced relatively recently, as the whole span of occupation goes, and to have come in with Hamitic peoples from the Northeast, who infiltrated among the black cultivators. Such were the

"Peuhl" (Foula, Foulani) who reached West Africa. Cattle raising reached every part of tropical Africa where diseases did not prevent.

In Gourou's opinion the extension of pastoral activity in Africa did incalculable damage. The savanas which dominate Sudan, East Africa, and Madagascar are essentially maintained, as some of them were even created, he believes, by fire, in order to provide ever more and more pasturage. It is the herders who are chiefly responsible for the fires whose smoke obscures the horizon at the end of the dry season, when the herbage is too hard and dry for the cattle to eat. The annual burnings have become deeply established customs, attended by rites and ceremonies, as among the Baoutchi of Nigeria. To discontinue them unless it can be done permanently seems impracticable, for the accumulation of dead annual stems of grasses and other herbaceous perennials multiplies the destruction caused by fire when it does finally occur. The more fuel, the hotter the fire and the greater the destruction. There is of course a firm antagonism on the part of fanatical herders to legal measures for fire prevention. There have been some experiments in control, however, one of which is mentioned by Gourou (p. 67). In the region between Timbuctu and Kabara the military authorities set aside a reserve of four or five thousand hectares for subsistence agriculture for troops. Nomads were excluded. In sixty years a forest of western Sahara type (forêt Sahélienne) was reconstituted with trees 8 meters tall. Gourou suggests that the "progress of the Sahara" which has caused anxiety is not an inevitable result of supposed climatic change, but merely the result to be expected from over-grazing and the ravages of fire.

In regions where the possession of many cattle is a social distinction, the tendency to over-graze the pasturage is very strong. The plant cover deteriorates until much bare, unprotected soil is exposed to erosion by water and wind. Nomadic herders have great social prestige over cultivators. A Batousi loses caste so completely if through poverty he passes to the status of cultivator that he ceases to count himself as a Batousi.

The young Masai warriors of Kenya and Tanganyika live entirely on flesh, milk and blood. Among the Dinka, a Nilotic people, the father gives his son a bull which is petted and held in excessive affection. The boy passes his time with it and sings to it; its death occasions great sorrow. Chiefs organize raiding expeditions to steal the cattle of other tribes. Masters of cattle have many more than they can properly pasture. So it is no matter for surprise that the native reserve of Kamba in Kenya had, in 1933, 190,000 adult cattle and 57,000 calves, with a total carrying capacity of not over 60,000 head, and, in addition, 260,000 goats and 150,000 sheep! Elsewhere the situation was the same. The number of cattle so far surpassed subsistence that they were starved and unproductive.

Over-grazing all over the cattle country caused such alarming deterioration of pasturage and soil erosion that whole tribes were forced to migrate, leaving destruction behind, but the cattle-raising cult showed no sign of being given up, as common sense would dictate that it should be.

In Madagascar there is likewise a cult of cattle. Gourou (p. 71) says, quoting Dubois (1938) that they are held in affection as though human, are the objects of lustration, are spoken of with love and tenderness, as though they were sons and daughters. The Betsileo dialect has 120 terms for cattle according to differences of color, markings, etc. Much of Madagascar has been ruined by deforestation for "tavy" agriculture in the first place, followed by fires for improvement of pasturage.

Gourou refers to many other authors, not all of whom have been consulted by the reviewer, and the original source of some of his most interesting material is not specifically indicated and has not been located. The reader of this review will therefore profit by consulting his work.

Graham, David Crockett (1954) *Songs and Stories of the Ch'uan Miao*. Smithsonian Misc. Coll. 123, no. 1. Washington.

The Ch'uan Miao inhabit an area in Szechwan and Yunnan from about 27° 20' to 28° 20'E. and 103° 40' to 105° 20'N. Although considerably outside the tropics, their habits coincide with their relatives to the southward. D. C. Graham (1954) recounts some of their tales which bear upon primitive agriculture and burning.

The Tale of Securing Seed (p. 18): "Where did the Miao come from? From a mountain wilderness. . . When the weather was temperate, during the first moon, and the place was warm, and the sky was dry, and the land was also dry, then the ancient Miao took fire and burnt off a mountain, and the Miao grandfather lighted fires to burn the grass and trees on the mountain. The fire burnt from the two sides, and it spread from the center to unburnt spots on both sides. . ." There follows an account of making wine and inviting relatives to a party to arrange a marriage.

In a tale of two brothers (p. 204): "The younger brother went to watch one field. He cut off the grove on that hill, then came and said to his sister-in-law, 'Now we want to plant seed.' His elder brother asked him: 'Should you first plant seed before setting fire (to burn off a clearing) or should you first burn a clearing and then plant seed?' The evil sister-in-law gave the younger brother the wrong advice, and he got only one stalk for his crop, and that was taken by a hawk, who, to

recompense him, took him to a place below a big star whose excrement was gold, so he became rich. The bad elder brother tried to do likewise and was scorched to death. The field was called fire land.

(p. 274) Footnote. "In earlier times and in some localities today clearings are made by setting fire to the forests and then cutting the trees that are left, or by first cutting down all the trees and shrubbery and then setting fire to them when they are dry. This is very destructive to the forests and should be prohibited, for although it makes available a soil that is very rich for a few years, through erosion it is likely soon to become useless."

Story of an orphan (p. 278): "Every day he went and cut wood in the deep forest. He cut down a place and burnt off the trees and grass, and on that clearing (fire land) he opened up a well."

Story of two sons, one of whom made a clearing, literally, cut down a fire field (p. 281): "The grass and trees are first cut down, and later they are burned. This is a common method in West China, and is very destructive of the forests."

Granato, Lourenço (1918) *A Queima e seus Efeitos na Fertilidade do Solo*. São Paulo: Typographia Levi. 79 pp.

The Brazilian author L. Granato has alluded to the passages in Virgil which mention the use of fire in Italian agriculture of classical times, and concluded his book with reference to Brazilian Latin and Portuguese poetry of folk-loristic interest relating to prairie fires. His book is an interesting popular exposition of the fertilizing value of plant ashes on burned-over land. It will interest ecologists because of its explanation of popular Brazilian terminology for plant associations effected by fire.

Grandidier, Alfred, and Grandidier, Guillaume (1908) *Ethnographie de Madagascar*. Tome premier, les Habitants de Madagascar: [Première partie] Leur Origine. Leur Division et leur Répartition. Paris (Imprimerie Nationale) 1908. iv + 404 pp., unnumb. plates, maps.

Grandidier (p. 197) has given the most instructive ethnographic map of Madagascar, on which, however, most of the little villages of the old missionary accounts of travel will not be found. It does, however, show the starting point of Baron's trip eastward from the Sihanaka country ("Lake" Alaotra--the name means lake or sea, being a cognate of

Malay laut) in the French administrative province of Angavo-Mangoro-Alaoira to Fénérive at the coast north of Tamatave in the Betsimisaraka country (the part which is now Betsimisaraka du Centre).

A search of the numerous volumes by Grandidier, the chief authority on Madagascar, would doubtless yield much scattered information on the topics of these reviews, but there has been no opportunity to undertake it.

Gumilla, Joseph (1791) *Historia Natural, Civil y Geografica de las Naciones situatadas en las Riveras del Rio Orinoco. Nueva impresion . . . corregido por el P. Ignacio Obregón . . .* 2 vols. Barcelona, 1791. (xvi + 360 pp., 6 pl.; iv + 352 pp., 2 pl.). Vol. II, chapter XIX, pp. 227-235: "Modo de cultivar sus tierras los Indios, y los frutos principales que cogen."

Padre Gumilla wrote a chapter on the agricultural practices of the "nations" of Indians in Guiana. Of these "nations" the location of many is shown on his map, and only two of them, he noted, had not progressed to a stage of having some agriculture. The others either cultivated lands hidden away in the inaccessible forests or spacious plains along the rivers, the latter, one suspects, perhaps, somewhat under missionary influence.

Gumilla expressed surprise at the vast labor that was necessary for making a forest clearing. The undergrowth had to be cleared away, the trees felled, and both burned. For this work the Indians made carefully fashioned clubs of extremely hard wood and stone axes. The former, called araco or macana, seem to have been used for smashing down the lower vegetation, or uprooting it and were shaped by the aid of fire, by burning down some parts and saving others, which process took much time and industry. The stone axes were worked down by grinding against other stones, but Padre Gumilla did not see it done.

He says that the land cleared from forest was very much more productive than the open land, being extremely fertile from the ashes. He compared the fertilizing of this cleared forest land by ashes with the way the Catalans fertilized their fields by burning pine branches on them. The cultivation of open land along the rivers consisted in planting in the unprepared moist soil as the floods of the rainy season subsided. The yield was poor, but the labor little.

Guppy, H. B. (1887) *The Solomon Islands and their Natives.* London: Swan Sonnenschein, Lowrey & Co. xvi + 384 pp., illust., map.

In the Solomon Islands, Guppy (p. 81) found little cultivation on St. Christoval and adjacent islands, but much on the islands of Bougainville Straits. He said: "In the island of Treasury [or Mono, the southwesternmost island of the strait immediately south of Bougainville] acres and acres of taro and banana plantations lie in the immediate vicinity of the village; and I passed through similarly cultivated tracts in the east and west districts of the island. The wide and level region, which constitutes the margin of the island, is covered with a deep, productive soil. Cultivation is not confined, however, to the more level districts, large cultivated patches lie on the hill-slopes behind the village; and in other places fire and the axe are constantly employed in the preliminary work of clearing the hill-side."

Guppy, H. B. (1903) *Observations of a Naturalist in the Pacific between 1896 and 1899*, Vol. I. Vanua Levu, Fiji, London & New York: Macmillan & Co. XX + 392 pp., 7 pl., figs., map.

Descriptions of Fijian prairies, agriculture and secondary vegetation in their precolonial or at least early aspects are not too abundant. Guppy's observations on tropical land surface covered with a natural grass association presumably of geological antiquity are therefore of great interest.

The mountain peninsula Naivaka at the west of Vanua Levu was described as follows:

(p. 44) "All around the mountain, except on the upper steep portion on the south side, where it is well wooded, the slopes have the usual character of the "talasinga" districts, being occupied only by grass, ferns, cycads, and the ordinary scanty vegetation of such regions."

(p. 55) The Mbua and Ndama Plains. These rolling plains are a striking feature of the western end of Vanua Levu. They have an arid barren look, are clothed with a scanty and peculiar vegetation, possess a dry crumbling soil often deeply stained by iron oxide, are traversed by rivers without tributaries descending from the wooded uplands of the interior, and in fact have well earned the name given to them by the natives of talasinga or sun-burnt land. Both Seemann and Horne have remarked on the South Australian aspect of these regions which are characteristic of the lee and drier sides of the larger islands of the group. Covered for the most part with grass, ferns and reeds, these low-lying districts are dotted here and there with Casuarinas, Pandanus trees and Cycads, whilst such other trees and shrubs as Acacia Richii and Dodonaea viscosa add to the variety and peculiarity of the vegetation. The origin of these talasinga districts is discussed in the last chapter. [Actually it was left for the second volume.]

(p. 56) Here and there, fragments of limonite, approaching haematite in its compact texture, lie in profusion on the soil, representing doubtless small swamps long since dried up, some of which still occur

in the hollows of the plain. Mingled with these fragments are often pieces of siliceous rocks and concretions, such as are found in the other 'talasinga' districts of the island With reference first to the compact limonite . . . it occurs on the surface either as fragments of hollow nodules two or three inches across or as portions of flat 'cakes' half to one inch thick. . . . These fragments of iron ore, which lie between 100 and 150 feet above the sea, represent the final stage of a process which is now no doubt in operation on the bottom of the neighboring pools and small swamps. Their presence on the surface goes to indicate that this open country has been for ages a land-surface free from forest, as it is in our own time.

"In a similar manner the extensive disintegration of the basaltic rocks that form these plains affords evidence of the great antiquity of these talasinga plains in their present unforested condition."

(p. 128) "The Basaltic Lowlands of Sarawanga and Ndreketi." One of the most striking features of the north side of the island [Vanua Levu] is the extensive undulating plain that stretches from the Lekutu river to near Sealevu on the headwaters of the Ndreketi, a distance of almost 30 miles. . . . Over nearly all its area it presents the dried-up and scantily vegetated appearance of the talasinga regions. It is an open country mostly clear of forest; and it is to this character as well as to its peculiar vegetation that it in some measure owes its barren look. Amongst the bracken, grass, and tall reeds (Eulalia japonica) that clothe much of its surface flourish the Pandanus, the Casuarina, and the Cycad, which give a special physiognomy to the whole area; whilst several sea-side plants, such as Ipomoea pes-caprae, Morinda citrifolia, Cerbera odollam, etc., have spread themselves far and wide over its extent."

(p. 224) "The Wainikoro and Kalikoso Plains. These extensive inland plains occupy a considerable area in this [north-east] part of the island. . . . The region is occupied by the scanty open vegetation characteristic of the talasinga or "sun-burnt" districts. The tall "Ngasau" reed is common, the Pandanus trees are frequent; and amongst the bushes and small trees are represented Dodonaea viscosa, Morinda citrifolia and a species of Hibbertia."

(p. 352) "It may be remarked that nearly all the districts in which the silicified corals and concretions, siliceous minerals, and limonite occur, are scantily vegetated "talasinga" lands with reddish soil. Except in the instance of the Kalikoso plains, the swamps and lakes have as a rule long since disappeared, their sites being alone indicated by the limonite on the surface. In the Mbua plains, however, there are occasional small ponds and swamps, and there is no doubt that the limonite so bountifully represented on the dry districts is still in process of formation."

It seems highly probable that the peculiar talasinga lands of Fiji present an instance of edaphic prairie in a region that

from climatic considerations would be expected to have forest as the climatic climax vegetation. If so, it is another edaphic climax substituting for climatic. The very sterile soil in which iron compounds are dominant suggests comparison with somewhat analogous areas in Madagascar which may always have been barren and essentially unforested.

Gurdon, P. R. T. (1914) *The Khasis*. London: Macmillan and Co. xxiv + 232 pp.

The Khasi of Assam, slightly extratropical (25° to 26° 20' N., 90° 50'—93° E.) are linguistically and ethnically related to peoples of Burma and the Malay Peninsula. According to Gurdon the Khasi district consists of hills and plateaus, described as follows:

(p. 7) "In general features all these plateaux are much alike and consist of a succession of undulating downs, broken here and there by the valleys of the larger hill streams. In the higher ranges, where the hills have been denuded of forest, the country is covered with short grass, which becomes longer and more rank in the lower elevations. This denudation of forest has been largely due to the wood being used by the Khasis for fuel for iron smelting in days gone by. The Government, however, has taken steps to protect the remaining forests from further spoliation."

Gurdon states (pp. 8 and 87): "A remarkable feature is the presence of numerous sacred groves situated generally just below the brows of the hills."

"Ki'lawkyngtang.--These are sacred groves, situated generally near the summit of hills, composed of oak and chododendron trees, which are held sacred (kyntang), it being an offence, or sang, for anyone to cut timber in the grove except for cremation purposes. These groves are the property of the villages.

"The Khasis are industrious cultivators, although they are behindhand in some of their methods of cultivation (e.g. their failure to adopt the use of the plough in the greater portion of the district); they are thoroughly aware of the uses of manures. Their system of turning the sods, allowing them to dry, then burning them, and raking the ashes over the soil, is much in advance of any system of natural manuring to be seen elsewhere in the Province. . . . In dealing with agriculture, the lands of the Khasi and Jaintia Hills may be divided into the following classes:--(a) Forest land, (b) wet paddy land called hali or pynthor, (c) high grass land or ka ri lúm or ka ri phlang, (d) homestead land (ka 'dew kypér). Forest lands are cleared by the process known as

jhuming, the trees being felled early in the winter and allowed to lie till January or February, when fire is applied, logs of wood being placed at intervals of a few feet to prevent as far as possible the ashes being blown away by the wind. The lands are not hoed, nor treated any further, paddy and millet being sown broadcast, and the seeds of root crops, as well as of maize and Job's tears, being dibbled into the ground by means of small hoes. No manure, beyond the wood ashes above mentioned, is used on this class of land; there is no irrigation and no other system of watering is resorted to. The seeds are sown generally when the first rain falls. This style of cultivation, or jhum, is largely resorted to by the people inhabiting the eastern and southern portions of the Jaintia Hills, e.g. the Rhois and Lalungs, the Lyingams and Garos of the western tracts of the district. Wet paddy land (hali or pynthor) is, as the name implies, the land where the kind of paddy which requires a great deal of water is grown.

"The Khasis when cultivating high lands, select a clayey soil if they can. In the early part of the winter the sods are turned over with the hoe, and they are exposed to the action of the atmosphere for a period of about two months. When the sods are dry, they are placed in piles, which are generally in rows in the fields, and by means of ignited bunches of dry grass within the piles a slow fire is kept up, the piles of sods being gradually reduced to ashes. This is the "paring and burning process" used in parts of England. The ashes so obtained are then carefully raked over the field. Sometimes other manure is also applied, but not when paddy is cultivated. The soil is now fit to receive the seed, either high-land paddy, millet, Job's tears, or other crops, as the case may be. The homestead lands are plentifully manured, and consequently, with attention, produce good crops. They are cultivated with the hoe.

In addition to shifting agriculture on dry land and permanent on wet, the Khasi have long had permanent land use for horticulture. Gurdon says (pp. 41, 42):

"The cultivation of oranges in the southern portion of the district ranks equally in importance with that of the potato in the northern. The orange, which is known in Calcutta as the Chhatak or Sylhet orange, comes from the warm southern slopes of the hills in this district, where it is cultivated on an extensive scale. Although oranges do best when there is considerable heat, they have been known to do well as high as 3,000 ft.; but the usual limit of elevation for the growth of oranges in this district is probably about 1,000 to 1,500 ft. The orange of the Khasi Hills has always been famous for its excellence, and Sir George Birdwood, in his introduction to the "First Letter Book of the East India Company," page 36, refers to the orange and lemon of Garhwál, Sikkim, and Khasia as having been carried by Arab traders into Syria, "whence the Crusaders helped to gradually propagate them throughout Southern Europe." Therefore whereas the [sweet] potato was imported, the orange would appear to be indigenous in these hills."

An orangery is prepared in the following manner:--

"The shrubs, weeds and small trees are cut down, leaving only the big trees for the purpose of shade. The plants from the nurseries are planted from 6 ft. to 9 ft. apart. When they have become young trees, many of the branches of the sheltering trees mentioned above are lopped off, so as to admit the necessary amount of sunlight to the young orange trees. As the orange trees increase in size, the sheltering trees are gradually felled, The orchard requires clearing of jungle once in spring and once in autumn."

Sweet potatoes are an important garden crop and Gurdon gives an account of their cultivation. The quick adoption of this American introduction by primitive peoples of the Orient was a remarkable phenomenon.

Grigson, W. V. (1938) *The Maria Gonds of Bastar* London, etc.: Oxford University Press. 350 pp., 8 figs., 24 pl.

Grigson said that the Maria Gond tribes of Bastar State were perhaps the most primitive to be found in modern India between the Godaverī and the Ganges. Far from meaning this in any disparaging sense, he had found their original social organization unsuited for assimilation to that of the surrounding civilization which was rated as a thousand years in advance. The old order was doomed by change and population shifts, so Grigson placed on record an account of the way of life of a people about whom little had been written.

Bastar State lies at the extreme south-east corner of the Central Provinces of India, between 17° 46' and 20° 14' N, and 80° 15' and 82° 1' E. Larger than Belgium and only a little smaller than Holland, it was transferred ~~into the Province of~~ Orissa.

Related to the Gonds in Bastar are the Bhattras, who live in open country with miles of good rice cultivation. "They are gradually giving up even their very modified form of dahya or shifting cultivation consisting now mainly of the occasional cutting and carting to their rice fields of forest undergrowth, and burning it there as manure," (p. 38).

As for the Hill Maria country proper, Grigson (p. 28) says:

"On the hill-tops and on slopes exhausted by shifting cultivation, high grass and stunted trees make the country monotonous to the eye and tiring through lack of shade. Where the slopes are nearly cleared and have once been burnt for shifting penda cultivation, often a small grove of trees is left on the summit, like nothing so much as the top-knot of hair on the crown of a Maria's otherwise roughly shaved head. . . .

"To be left to live the free life of the hills, untrammelled by restrictions on his use of forest, earth and water, or his right to shift his village and his penda cultivation, is the unconscious ideal of the Hill Maria."

(p. 126) "In previous chapters, when speaking of the shifting cultivation of the Marias, the term which I have generally used is penda. Central Provinces literature has used the general terms dahia or bewar indiscriminately for all forms of cultivation in which crops are raised on the ashes of trees felled and burned for that purpose. In Bastar dahi is the Halbi term applied to the system of cutting trees or brushwood in the forest and bringing them to an old unembanked field, where they are spread out to dry and then fired just before the rains break. Such fields are always level and not hill slopes. The practice is known to the Hill and Bison-horn Marias, and called parka; but as it is usually applied to old fields that have lain fallow (or occasionally to a rice field which is to be sown with a dry crop), the Hill

Marias make little use of it, but will take more to it now that the substitution of a poll-tax for the former attempt to impose a regular land revenue settlement is encouraging them to re-cultivate old rice-fields and to bring the flat marhan lands under cultivation. It can be seen in the villages between Orcha and Chhota Dongar, on the edge of the Hill Maria country, where the hills begin to open out into broad valleys.

"Flat lands covered with forest growth which is cleared from time to time and burned for shifting cultivation are known in the Halbi language as marhan. The forest growth is felled and spread out to dry in situ in January or February; it is fired toward the end of May, and the ashes are spread evenly over the soil with an instrument like a squeegee with a handle eleven or twelve feet long, called dosna-dang in Halbi and parka-lathi by the Marias, this is used for spreading the ashes in parka or dahi cultivation also. The ashes are plowed into the ground after the first fall of rain. Marhan cultivation is called dippa by Murias and Hill Marias, and erka by the Bison-horn Marias, who subdivide it further into Mudur-erka or timber forest marhan, and marram-erka or scrub-jungle marhan. These flat lands can be cultivated for only two years normally; in the first year the undergrowth is cut, the smaller trees and some boughs of big trees, while the big trees are girdled. To provide ashes for the second year, the big trees girdled the year before are felled, after piles of dry brushwood have been burnt round their feet if the girdling has not prevented some sap again rising. Ultimately, if these lands do not have a long enough rest between successive clearings, the forest loses its power of regeneration; and it is to such former dippa or erka lands that the parka or dahi system described above is applied. Dippa is fairly common between Orcha and Chhota Dongar, and it is because there is plenty of land still available to ensure each dippa, an adequate rest that parka cultivation is so uncommon. But in the more open country of the large Bison-horn Maria villages much land seems to have lost its forest regenerative power, and every remaining non-fruit tree has its boughs lopped year after year to provide fuel to be carted off to the old erka lands for parka cultivation, till it looks, when its new leaves sprout, like a Lombardy poplar in shape. . . .

"Both dippa (erka) and parka are more advanced methods of cultivation than the Hill Maria's favorite penda or hill slope cultivation. For this he fells and burns the forest growth on the hill slopes, which are often very steep. . . . He sows the seed broadcast in the ashes after the rains have broken. . . . The Gazetteer (p. 54) repeats the story that the seed is 'sown along the top of the slope from which the rain water washes it down and spreads it over the field'; the bare idea of this makes the Hill and Bison-horn Maria laugh. . . . The Hill Maria does scarify his rare permanent rice fields with his hoe, and one man in three hundred may use a plough on rice field, parka and erka, and even occasionally on the lower and less steep parts of his penda slopes, while he scarifies with his hoe all that he does not plough.

"In most Hill Maria parishes penda is the only kind of cultivation, and though in much of the Bison-horn country permanent rice cultivation, semi permanent parka fields, and the less ephemeral erka cultivation have displaced it, yet tracts remain like those round Katakalian and Kuakonda, from Paknar to Massenar, where penda still remains supreme, and in late May hillside after hillside here is speckled grey with the fresh ashes of the newly burned timber, or there is dotted with the vivid green of the fresh undergrowth shooting up from the old roots and stumps which have somehow survived the last three years of fire and axe; hard by are patches of pole forest ready for their turn of penda when the newly fired plots are exhausted. Though maps show such areas in the Bison-horn country as forest, they are really all cultivated areas, on which forest is grown in rotation with other crops as a source of fertilizing nitrates [sic!]; and here every slope and every patch of forest has passed into the separate possession of individuals. The extent of penda cultivation in the Abujhmar hills is less apparent to the eye, as the population is far sparser and the parish lands far wider. The slopes successively cultivated get a longer fallow period, and are farther apart.

"The shifting forest cultivation is criticized from two points of view. The forestry enthusiast laments the passing of much fine forest, and foretells desiccation and erosion. Others condemn penda as a lazy method of cultivation. The former forgets that in most of this area the forests have been too remote and inaccessible ever to be exploited, and that, even though some fine timber has been sacrificed, much that has gone was hopelessly over-mature. Vast areas of forest have been reserved by the State, and it has not been possible to work half of these reserves. The Maria does not range through his forests clearing patches for cultivation at random; he has more or less definite rotations, and the clearings after two or three years' cultivation may get twelve or fourteen years' rest, at the end of which they have a dense forest growth. Few signs are apparent of erosion, save in the more open parts of the Bison-horn country where erka has cleared the plains below the hills of forest; and there are no signs of any reduction in the heavy rainfall. In the remaining penda lands of the Bison-horn Marias no good timber is destroyed; whether these lands are at the moment growing grain or bush, they should now be regarded as lands under cultivation. . . .

"It is a superficial criticism that condemns penda cultivation as lazy. . . . Man and woman here have unaided to do all that regular plains cultivators do with ox and plough, and much more besides."

Grigson (p. 107) explains the relation of village sites (paghai) to clearings or penda sites (kaghai) as follows (p. 107):

"It has already been implied that though a village site may be abandoned for superstitious reasons, the predominant reason is economic, the exhaustion of the penda slopes that can

be conveniently cultivated from the existing village. If three or more kaghai (penda sites) can be dealt with from one paghai or village site, then the village may remain on that site for seven or eight years, even though there are other paghai in the other penda sites cultivated from it,..... What makes the old topographical survey maps so useless for finding a modern village is that they mark only the village site occupied in the sixties, generally, too, by the particular name of that site, not by the general name of the village. . . ."

Regarding the rapid transition to permanent land use and land owning, Grigson said (p. 146):

"When the Hill Marias have started permanent cultivation they have in general adopted the methods of the surrounding Murias or Bison-horn Marias, save that very few of them have mastered or attempted to master ploughing, but prepare the land with their gudari digging hoes. . . . If the recognition of permanent cultivation as an improvement could be combined with a determined attempt by the State to teach carting, ploughing and milking, even among the Bison-horn Marias, shifting cultivation would be greatly diminished."

Hagen, B. (1903) Die Gajo-Länder auf Sumatra. Jahresber. d. Frankfurter Ver. f. Geogr. u. Statistik, Jahrgang 66 bis 67, pp. 29-85. Frankfurt am Main: Gebrüder Knauer.

Dr. B. Hagen had the opportunity to accompany two of the early Dutch military expeditions to Gajo land in North Sumatra. They entered from Atjeh to the north, on 27 September, 1901, and travelled southward from Pasangan. The coastal flank of the Geureudong Mountains was forested, but up on the plateau at about 800 m. elevation they found magnificent grassland interspersed with a tree that looked like pine and that he supposed to be *Casuarina sumatrana*. There were well trodden paths. The plateau was cut by deep forested ravines (one was 150 m. deep and 300 m. wide) with clear cold streams. Through alternating alang-alang grass (*Imperata*) and forest they came to a second larger plateau at 980 m., that of Tundjang. Early on 1 October they traversed a great heavy forest and came out on the "kolossal" stony high plain of Tretet, at the foot of the volcano Telong. Here there was a great center of permanent agriculture, that of irrigated rice terraces around the foot of the volcano. In open land the guava (the weedy American bush or tree *Psidium Guava*) was found everywhere, growing luxuriantly, hardly a spot of land without it. Hoping to surprise a troublesome pretender to the sultanate of Atjeh, they hurried on by torchlight through the forest of the last watershed (at 1472 m.) and were the first to see Lake Tawar.

Hagen's general impression of the Gajo region was one of amazement at the collocation of palms and pine trees. The latter were *Pinus Merkusii* and the palms which he saw himself were coconut and *Areca*, which did not reach up to 1200 m. elevation near Lake Tawar, where the fruits grown were bananas and poor lemons. As soon as they went over the watershed into the warmer valleys of Isaq or Linggö, however, both palms appeared again, and Major van Dallen, leader of the expedition, mentioned a third, the "meuriah" palm, as found at Linggö and used for thatch but Hagen obviously didn't believe there was any such tree there. On the contrary Hazen (1907, p. 509) stated that in Gajoland the sago palm (*mériö*) was scarce, and that at Linggö the leaf of it (*oeloeng mériö*) was used for roofing! At any rate Hagen said (p. 45) that the mountains and vicinity around Linggö consisted of pine woods (he says "Fichten wäldern") and grass plains, and presented the peculiar opportunity of looking at pine woods over the tops of palms.

This raises the problem of whether or not the pine woods are a natural plant association there. If so, they afford the easiest possible transition to natural grassland and to man-made grassland at somewhat lower altitudes. In a volcanic region one would be rash indeed to suppose that there had not been natural grassland before the advent of man. At any rate it is easier to suppose that the man-made grasslands

of the properly forested region represent an extension of a natural association than that they originate de novo with about the same aspect and botanical composition without natural predecessors anywhere. One must admit, however, that some regions without vulcanism have similar grasslands, but they may have great new raw alluvial deposits resulting from the rivers shifting their channels which provide room for the grassland vegetation.

But, to return to Hagen, he got the impression that Gajoland was more forested than the somewhat lower and warmer Toba plateau, where a character plant was the sugar palm (Arenga) which did not ascend at all to the Gajo plateau. He considered the Linggö-Serulö Valley as one of the chief subsistence centers of Gajoland. The military reports constantly alluded to travel across grasslands through which large, thick-crowned pine trees were scattered. So Pinus Merkusii seemed to be the chief character tree of the region. Although much of the rice production was from sawahs, there were numerous ladangs, forest clearings for growing upland rice. The landscape would appear to have presented terraced irrigated land at the centers of population with ladangs quite far away, and, in between, grassplains which must chiefly represent, at least below the Pinus Merkusii zone, long-abandoned ladangs. In addition to rice culture in sawahs and ladangs there were gardens and trees around the village houses, for production of sugarcane, fruit, cotton, root crops, maize, etc., which represented, as among the Malay and Batak, gardening and horticulture. Coffee was grown as an ornamental or curiosity, but not used. Permanent agriculture was furthered by pasturing water buffaloes in the sawahs between crops.

Hagen presented a Gajo vocabulary with equivalents in three Batak vernaculars and Malay. The most interesting word in connection with the present subject (primitive agriculture) is omo, the more primitive cognate of juma (Batak) and equivalent to ladang (Malay). Hagen indicated the Malay as that of Deli, which very significantly, from the standpoint of origin of the grasslands of the coastal region to the east, gives ladang and padang as having the same meaning. Elsewhere ladang is a functional agricultural clearing in the forest, and padang is flat grassland.

Hagen gives no description of the preparation of a clearing or of the process of planting, but see Hazen (1907).

Hahn, Ferdinand (1906) *Blicke in die Geisteswelt der heidnischen Kols. Sammlung von Sagen, Märchen und Liedern der Oraon in Chota Nagpur.* Gütersich; C. Bertelsmann, x + 116 pp.

The myth accounting for the worship of the karm tree, Nauclea parvifolia, is entitled "Karma und Dharma": see pp. 87, 88. This myth affords a good example of the background for preservation of sacred groves, which prevails (or did formerly) in this general part of India and was responsible at least for the preservation of seed trees of some species otherwise cleared away by shifting agriculture.

Hahn, Ferdinand (1907) *Einführung in das Gebiet der Kols-mission. Geschichte, Gebräuche, Religion und Christianisierung der Kols.* Gütersloh: C. Bertelsmann. viii + 159 pp.

The slight notice of the sacred groves of the Munda may be somewhat amplified by reference to Ferdinand Hahn (1907) who gives a good description of what he calls the "demonology" of the Kols, a general term for the pre-Hindu animistic groups of Chota Nagpur. "Kol" he considers to be a variant of Hor or Horo, the name for themselves used by the Munda, Santal, and allied stems, among whom other equivalents are Kor, Jur and Kurukh. He tells us that there were originally no temples erected for the good or bad gods or spirits. A much feared special spirit pertains to each old village and resides in the sarna or sacred grove of sal trees (Shorea). Sarna-Burhi is the name of an earth goddess or spirit thought of as residing in a sal tree and as having the function of bringing rain and good crops. Another tree, Nauclea parvifolia, the karm, is sacred to various Kol groups stems, especially to the Oraon, who are a less numerous aboriginal group than the Santal, but larger than the Munda, and to the Kharwar, one of the small tribes. These people revere the karm as a totem, although Hahn regards it as a species of quite undistinguished characteristics. No Kharwar can be induced to fell one, any more than a Munda will fell a sal in the sarna. Field spirits have bhüt-kheta, which Hein calls "devils' acres," left wild for their occupancy, and these are distinct sacred places from sarna. Among the spirits resorting to them would appear to be a spirit of the hunt, Chandi. Reverence for the karm is indicated by legends and songs translated in another work by Hahn (). As the people become more enlightened and freed from belief in spirits, the cult acres as well as the sacred groves are encroached upon. Writing before Roy, Hahn tells us that in 1907 only a few trees were left of the sarna, enough for cult observances, and that the cleared portions had been taken over for agriculture, and some sarna had been pre-empted for mission stations. Thus the beneficial effect of superstition in promoting conservation was overcome by education!

Haig, N. S. (1940) *Native Agriculture. Land Tenure in Buganda Province*; pp. 24-38 in Tóthill (1940), q. v.

Hailey, Lord (1945) *An African Survey: a Study of Problems arising in Africa south of the Sahara. Second Edition.* London, New York, Toronto: Oxford University Press. (1838 pp., 17 tables, 6 maps)

This work is of course well known as one of the most important of those dealing with vegetational devastation in tropic Africa.

A small but instructive map of the distribution of vegetation in Africa shows a continuous strip of Acacia and Tall-grass savannah stretching clear across Africa from the Atlantic north of Dakar to the Red Sea in almost the same latitude. The northern boundary of this zone is flatly arcuate to the southward. Its southern boundary turns gradually southward between 20° and 55° E. longitude and extends with gaps of less desert vegetation to the Tropic of Capricorn. At this latitude there is another great region of desert savannah with the northern boundary strongly arcuate to the southward, and the horns of the lunate northern part of it inclosing the wooded and forested part of central Africa. This consists of the equatorial rain forest, bounded by "Savannah and bush woodland" on both north and south and also dry mixed woodland on the south, transitional to and adjoining the desert arc. A coastal western strip of equatorial Africa reaching up into Angola and ending there, south of the mouth of the Congo, varies from desert to Acacia and Tall-grass savannah.

So the African tropical rain forest is enclosed by transitional zones of vegetation that have somewhat the same aspect to the northward into the true desert areas of the Sahara, and to the southward into the Kalahari Region. The effect of primitive agriculture and fire, followed by grazing, has been to extend the area of savannah or prairie at the expense of rain forest and dry mixed woodland. The effect of grazing and fire has been to reduce Acacia and Tall-grass savannah and to extend thorn-bush subdesert.

Hailey says (p. 1):

"Over immense areas the African soil lacks the constituents which make possible a continuous occupation for agriculture or even pastoral purposes, 'shifting cultivation' is less a device of barbarism than a concession to the character of a soil which needs long periods for recovery and regeneration; and the trekking habit, whether of Dutch farmers or African tribes, has been due to the requirements of that 'extensive' system of occupation which the character of the soil has seemed to

Hailey (Africa)

demand. Again, the feature of Africa which impresses itself most definitely on every modern observer is its relative lack of population."

(p. 2) "We are driven to the conclusion that the low density of population over many parts of Africa is a symptom of a physical configuration which is unfavorable to the rapid growth of the human race". . . If Africa is to be rendered capable of supporting a large settled population, with adequate standards of living, the result can only be attained by the study of the remedies applicable to her unusual needs."

(p. 3) "In general elevation and relief the country discussed in this volume falls into three broad sections.

(1) The northwest extending from the Guinea lands to the western edge of the Abyssinian plateau and south into the Congo, consists of a series of relatively small highland blocks - the Futa Jallon, the Bauchi plateau, and the Cameroons - interposed between wide basins. The middle Niger basin in the region of the great bend was formerly an area of inland drainage, and the river, still flowing sluggishly in this section, floods into many adjacent depressions every summer. An earlier stage of the process is found to the east, where the headwaters of the Benue are slowly cutting back the low divide separating them from the basin in which the waters of the Shari system still empty into the enormous swamp of Chad. A third basin to the east has a northern outlet by which the waters of the Bahr-el-Ghazal and the Sobat, passing through vast swamps, emerge to the Nile. To the south lies the Congo basin, formerly the floor of an elevated lake, in which extensive summer flooding is found.

"2" The eastern highland area . . ."

[3] "South of the Abyssinian highland, and separated by a low but arid belt, is the highland of the Great Lakes. . .

(p. 879) "Native agriculture generally took the form of a shifting cultivation of subsistence crops. . . The ground is used for as many years as it remains fertile, usually three or four years, and is allowed to revert to bush again until it has regained its fertility or until it is again required for use. Where forest land is available for cultivation to secondary bush. In Northern Rhodesia, for example, the branches are lopped, carried to preserve the leaves, and laid in piles, and burnt to form thick patches of ash, and in this process the whole country-side is often burnt. A newly burnt garden has been shown to contain more phosphate than an unburnt one. The amount of potash is also increased, and the reaction of the soil is changed from slightly acid to slightly alkaline. The effect of the burn soon wears off and a move to another forest area is then made. This type of cultivation (chitemene) is the most wasteful, but, as experience has taught the African that burnt forest land is particularly suited to the staple crop of small millets, it is practiced throughout

the forest areas of Africa, and in some areas all high forest has already disappeared. In non-forest areas shifting cultivation has been described as a system of rotational 'bush fallows'. Native cultivation often takes the form of 'mounding', in which weeds and trash are laid as a foundation, and which is said to be based on sound principles. These systems require large operating areas and it is estimated that sometimes twenty years is necessary for the woodlands to regenerate.

"It is an error to suppose that tropical conditions in Africa imply exuberant vegetation and rich soil. . . The continuance of shifting cultivation, or its replacement by a stabilized form of peasant farming, thus depends on the introduction of systems of manuring which will both maintain fertility and also suit native conditions of life and labour, and it is clear that the first step towards the improvement of a system, which is in many areas becoming unsuited to modern conditions of African life, is the study of African methods of cultivation, and an appreciation of the effect of such methods on soil productivity. "

(p. 881.) " The African tradition of cultivation, although empiric, teaches methods of rotation of crops, of usage of soils, and means of fertilization and even sometimes anti-erosion measures, which, though they may not be suited to modern demands on the soil, are often well adapted to the prevailing conditions of labour and climate. The implements of cultivation are the hoe and the axe, wielded with skill and effect. The months are marked by a routine of clearing bush or tree cutting, fertilizing, sowing of crops, fencing and harvesting, which forms the most important activity of tribal life. Journeys are only undertaken when the fields may safely be left; hunting, beer drinking, dancing, and courting are fitted in among agricultural duties. . . "

In some areas shifting cultivation necessitates the continual removal of villages, which are often mere garden shelters. If they are more permanent and cultivation is of necessity extended to distant lands, the population moves to these gardens at suitable seasons and lives in temporary shelters."

(p. 882) "Some cattle-owning tribes, such as the Masai, Nandi, and Turkana tribes in Kenya, and the Hima tribes of Uganda, pay little attention to cultivation; among others in East, West, and South Africa, the care of herds is combined with cultivation . . . domestic animals . . . are regarded as family possessions, measures of social importance, inherited within the family and given to other families as pledges for the good behaviour of women on marriage or for their proper treatment by the husband and his family. Breach of faith involves the return of these animals and often of their increase. Live-stock are used as compensation for injuries. These customs give rise to complicated litigation and react against the sale of stock and

consequently encourage overstocking. Animals are killed for ceremonial reasons, but otherwise are rarely disposed of; their skins were formerly used as clothing, and the family cattle are named and in some tribes even share sleeping quarters with their guardians.

"Even today no sort of segregation or culling of beasts is practiced; the majority of stock remain in poor condition and are often in a state of semi-starvation and of little value for meat. The Native Economic Commission considered that the purely economic conception of cattle held by Europeans is disruptive of the religious ideas of the Bantu, and that overstocking will continue as long as native cattle-holding rests on a religious rather than an economic basis. The Kenya Land Commission of 1933 remarked that in the midst of plenty natives in pastoral and semi-pastoral areas are living under conditions of extreme poverty, and money (p. 883) for food and clothing is practically non-existent and will continue to be so until the products and increase of their herds are turned into some more useful and fluid kind of currency.

"The system of herding at distant cattle posts or in the open has not encouraged the use of animal manure. Thus in Nigeria, where mixed farming is more developed than elsewhere, it is estimated that over two-thirds of the manure is wasted in the bush, and among East African and Rhodesian tribes the use of manure for fertilization is almost entirely ignored."

(p. 885) "As the methods of agriculture remain those of shifting cultivation, the available soil becomes rapidly exhausted. A system which often depends upon an area of two hundred acres or more of woodland for each family cannot endure indefinitely in areas where the population is increasing and forests decreasing."

Wage earning on European plantations has disrupted native agriculture. Natives eat more than they produce. Women as well as men migrate to industrial centers. The introduction of plowing has led to the wide-spread breaking of much land which has soon been abandoned to erosion. Food from hunting has decreased. Hailey says:

(p. 887) "European penetration has not only brought restrictions and difficulties in the way of game hunting but has also resulted in some areas in a wholesale destruction of game; thus, in one district in Northern Rhodesia, since the coming of the railway and the development of the mining areas, several hundred thousand head of game are said to have been destroyed by Europeans, and indiscriminate slaughter by hunters was frequent. . . . African methods of hunting by game-drives did in fact result in wholesale slaughter, but they were carried out during certain seasons only; again, weapons for killing were primitive, and it is said that tribal warfare in the past denied access to considerable areas which virtually became game reserves."

It is sometimes thought that bush or tree fallow is necessary for the restoration to fertility of a soil depleted by agriculture. This is not always true, for Hailey (p. 962) states that at Bukalasa in Uganda land left under elephant grass for three years has been found to regain its fertility. Under old-time native conditions, however, the sod could not be turned by the weak native ploughs. There has been progress, however, for Hailey (p. 963) states that in Northern Nigeria a farmer who has replaced the hoe by the plough can work 8 to 15 acres of land with a pair of working bullocks, but the local "Nigerian dwarf cattle" were found to be useless for draught purposes and others more suitable were brought in from the Gold Coast.

Over-grazing was of course dealt with by Hailey (p. 971) who indicates that the deterioration of pasturage and consequent erosion of land in East Africa result largely from the too great concentration of cattle on the areas free from tsetse fly, and likewise within reach of water. Over-grazing results in exhaustion of the nutritive grasses and trampling of the land, from which recovery requires six or eight months. It is difficult to overcome the evils of over-grazing, however, so long as the purely pastoral tribes retain such a contempt for agriculture that it is difficult to persuade them to grow even fodder crops.

Hailey (p. 973) says that destocking has often been recommended without being put into effect because of the strong dissatisfaction that would be aroused. One exception has been in the Glen Grey District of South Africa where the poor cattle are branded by the authorities and must be disposed of within three months. In Kenya an ordinance limiting live stock to a proper subsistence density should have been but was not adhered to. Destocking trials in the Ukamba reserve resulted in considerable native unrest. Regulations requiring culling of stock are useless where no good cattle are to be found for selective preservation.

Regarding the progress of apparently irreversible deforestation in Africa Hailey (p. 984) concluded in 1938 that the greater part of the central part of the continent was once covered by high forest and that the surviving forest belt, now occupying only 8 per cent of the area of the continent is, to quote Lavauden (1937) only a "relic of itself".

Taking up the possibility of explanation by climatic change, he (p. 985) says:

"The evidence of Roman explorers suggests that the [central African forest] once stretched as far north as Khartoum, over 1500 miles from its present borders. The more obvious cause of progressive deforestation has been native methods of cultivation, which involve the cutting down and burning of high

forest, but it remains a matter of conjecture whether other causes have not also operated; it has been suggested that the action of man may not suffice to explain the rapidity of the deminution of the equatorial forest in recent centuries.

"The tropical evergreen forests of Africa are the only ones at present capable of an important export trade in timber to Europe. Those of the Congo, the Ivory Coast, the Cameroons, Nigeria and the Gold Coast are the most important; those of Kenya and Uganda are smaller in extent. Although luxuriant in vegetation, they are rarely well stocked in the . . . high quality or luxury furniture woods. . . . Only the best trees, which have taken hundreds of years to grow, and which would take an equal time to replace, are acceptable on the European market. . . . For the rest of Africa, the prevailing type of woodland is that known as savannah. . . . Most savannah soils are of low fertility, easily exhausted and easily eroded if their cover is removed; they are perhaps more a source of danger if abused than a source of revenue if well cared for."

"Once forests of the savannah type have been declared closed to cultivation as protection forests, their chief need is safeguarding from fire. Methods are being successfully evolved, in some territories, of 'early firing', in which fierce grass fires of the dry seasons are anticipated by a deliberate burning earlier in the year. . . . The other function of savannah forest has perhaps been less appreciated; it is a basis for native shifting cultivation, quite apart from being the source of all the forest produce upon which the African's existence so largely depends. It may be long before agricultural research will discover means of avoiding the long tree fallow which so much of Africa requires between short spells of agricultural cropping, and until this is done it is not easy to see in what manner the savannah can be protected from the invasion due to the practice of shifting cultivation. But it is important to realize that where the practice follows its traditional course, and allows an adequate time for regeneration between periods of burning or cutting, it may be said that the injury done to the savannah is not serious. . . . Though, therefore, shifting cultivation has undoubtedly done much to reduce the high forest belt, and has caused the substitution of degraded growths for the original timber, it is possible to exaggerate the harm it may have done in the past, or is now capable of doing, to the savannah growth. . . . The repeated shifting of gardens, while giving the appearance of extensive destruction, generally allows the woodlands more chance of recovery than prolonged cultivation."

(p. 987) Union of South Africa. Forestry began in 1876 with a grant of £ 25 and has progressed rapidly. The indigenous forests are only three quarters of a million acres, and these are largely extratropical.

(p. 990) Basutoland has almost no indigenous trees.

Bechuanaland is in part relatively well wooded, and from the Chobe area, adjacent to Northern Rhodesian forests, Rhodesian teak (Baikiaea plurijuga) is felled for railway sleepers. There was no afforestation plan when Hailey wrote.

Swaziland does not have forest enough to repay exploitation.

Southern Rhodesia is about 60 per cent wooded, but unevenly. Large trees are found only along rivers and in the mountains. Former exploitation provided mine timbers and fuel. Much watershed is in private hands and can no longer be protected, though protection is more important than timber production, although the beginnings of forestry have the latter objective.

(p. 994) Nyasaland has nearly 12 per cent of forest, but much has been degraded by shifting agriculture. Since 1926 there has been a plan for village forests, to provide 2 acres for each family. The plan was at first unpopular but by 1936 the idea had been implanted and 3000 village forests had been started, with native cooperation.

(p. 995) Tanganyika. The original forests had been seriously reduced long before European occupation. Small traces only remain of former evergreen forest, but climate and soil indicate a much larger former extent. The Burmese taungya method (as African foresters conceive it) has been used for replanting. Very large free issues of timber are made to the gold mines, which hold extensive concessions.

(p. 997) Kenya. In Kenya rapid destruction of high forest was going on at the beginning of European occupation. Demarkation and reservation reached an advanced stage by 1911. The relics of original forest have been reserved as Crown forests but shifting agriculture may be continued under license in regenerated areas. The remaining forest is only 2 per cent of the land area of the country and further excisions from the area, such as one of 13,500 acres in 1933, would be deplorable. In the native reserves the forest has been destroyed. Elimination of Masai raiding by the British left the Kikuyu free to attack the forest of Southern Mount Kenya which formerly reached almost to the edge of the Masai plains. The Kikuyu destroyed 1,000 square miles of old forest before they were stopped in 1911. The large Masai forest was, in 1938, still unprotected. Reafforestation is hindered by the opposition of the natives. A supposed system of taungya has been adopted.

(p. 1000) Southern Nigeria. In the Southern provinces of Nigeria shifting agriculture some years before 1945 was taking 1000 square miles of high forest a year. "Taungya" methods as advocated by foresters in Burma have been reported as not very successful. Cultivators themselves will not do the replanting. The effort is being made to keep 25 per cent of the land for forest.

(p. 1002) Gold Coast. "In the Gold Coast the northern border of the high forest is receding, as in Nigeria and the Ivory Coast on the west, while within the forest belt farther south extensive areas . . . have been cleared for the cultivation of cacao, other areas have been denuded to supply the mines. . . . The area of high forest remaining today is less than 14,000 square miles; it is estimated that about 290 square miles are destroyed yearly, and that if the present rate of destruction is maintained, little will survive in fifty years time. . . . In 1911 a Forest Law was passed, providing for the establishment of government reserves, but was withdrawn on the opposition of the Aborigines Rights Protection Society . . . by 1926 only 240 square miles had been reserved, although 6,000 were considered necessary. In 1926, despite native opposition, a Forestry Bill was passed and became law; only 2436 square miles of reserves exist, but an attempt is now being made to extend this area to some 8,000 square miles, exclusive of savannah forest . . . if the object is achieved no more timber land will be available for extension of cultivation after twenty-five years. Proposals for reservation follow the lines of protection belts for West Africa, suggested by Professor Stebbing.

(p. 1003) "Sierra Leone has practically lost its high forest belt. There are now only 765.25 square miles of reserved forest, representing 2.74 per cent of the total land area. The unreserved primaeval forest is being reduced every year, and the secondary forest which had replaced it is steadily deteriorating". Taungya plantation work has been begun.

(p. 1005) Ivory Coast. "There has been relatively little pressure of population on the soil, and it is only in late years that serious attention has been directed to the possibility of growing marketable crops, such as cacao and coffee. As a consequence, the colony is still rich in commercial high forest, and the degradation of the savannah forest to the north of it does not appear to have proceeded so far as in the British colonies. It still contains a large percentage of scattered old trees, the relics of the former high forest."

(p. 1006) "Old trees of valuable species standing in the savannah regions are marked by the forest staff for reservation and used as seed-bearers. . . .

Togo. The Germans began forest plantations in savanna, which were planned for 80,000 hectares. By 1914, 3000 hectares were planted, but during the First World War there was no supervision, and much damage by fire. Still, the French have adopted the German methods with modification, and have had considerable success in the Ivory Coast.

(p. 1007) Belgian Congo. A general forestry service and policy were formed in 1936. One hundred and three reservations were made, some to conserve watersheds and some to prevent the

destruction of forests along motor roads.

"It is proposed to extend a system resembling "taungya", which is used by the Nkunku people in the Inkisi and Natadi areas, who plant the seeds of indigenous trees and strip cuttings of other acclimatized trees on fallow land to restore the fertility of the soil."

(See the review of Ferrers (1875) for comments on the quaint conception in Africa that the Burmese "taungya system" was anything but ordinary shifting agriculture, except as basically modified by such foresters as Brandis and Kurz as a basis for a system of forestry.)

Regarding fire-control Hailey said (p. 1067):

"The control of fires is an essential part of veld management. Since time immemorial, pastoral natives have fired dry grazing in order to promote the growth of young green shoots; European graziers adopted the custom and often became its strongest supporters. Perpetual burning weakens or destroys the roots of grasses and plants, increases run-off, destroys organic matter in the soil, and hastens the progress of soil desiccation and erosion. It is particularly dangerous near the headwaters of streams, where devegetation leads to shrinkage of springs and to flooding after storms. The matter has been studied carefully in South Africa. The Drought Commission considered that "the ultimate goal should be to stop all veld fires but concluded that this was impossible and that steps should be taken to discourage them, and to encourage tree planting. Later studies have suggested that total abolition may not always be desirable since veld burning destroys ticks and in some areas (e.g., Natal) suppresses coarser grasses which mark the first stage in a plant progression towards scrub and towards forest." (F. N. Liebenberg). This can only apply, however, to wetter regions and to controlled burning. Experiments in the southern Cape Province suggest that if firing takes place before the grasses are dried out, the heat is less severe, and destruction largely confined to the surface, not affecting roots or surface soil. The conclusion that uncontrolled veld burning is an un-mixed evil is nowhere in dispute. . . .

(1068) Finally, the complex question of the elimination of uneconomic stock cannot be divorced from that of veld management . . . a very large proportion of the cattle and goat population of Africa is uneconomic. The problem is a psychological one: so to change the attitude of the native toward his domestic animals that they become not tokens of wealth or a form of currency, but sources of income. This adjustment would admittedly involve a revolutionary change in a habit of great social and religious significance, but if it could be made, then natives might be taught to adopt . . . above all, the limitation of stock on any given pasture to a number which will not merely

survive, but will thrive on the available feed. . . . One main stumbling block is that the bride-price is generally paid in cattle or goats among both pastoral and agricultural tribes. . . . Various possibilities have been put forward such as Sir Daniel Hall's suggestion of striking coins bearing the image of a goat or cow, or providing special tokens shaped like live-stock and redeemable in ordinary currency, to bridge the psychological gap between the use of animal and of mineral tokens of exchange. No experiments, however, appear to have been conducted".

(p. 1077) "Africa's climatic conditions are specially favorable to the development of erosion. Progressive deforestation has been going on for centuries, thanks to the practice of shifting cultivation, and has resulted in the existence over wide areas of a degraded, open type of vegetation which does not shelter the soil so well as forest, and is more susceptible to drought. . . . The system of shifting cultivation, although wasteful, had the advantage that, after two or three years' use, every piece of land was rested, often for a considerable number of years. This not only allowed the soil to accumulate organic matter, but safeguarded it from severe erosion, since land that was resting reverted to bush and grass. At any given time, therefore, the greater part of the land was under vegetation, and so relatively safe from erosive influences. The effect of European rule has been, in almost every territory, to exaggerate several of the factors which lead to soil erosion."

European rule has led to increase in population so that more land has had to be cultivated. The period of rotation has been reduced. Instead of growing a mixture of crops, helter-skelter, single crops have been planted in rows, often up and down hill. Plowing has not been made safe by terracing, contour plowing or strip cropping. Bush fallow has been shortened. In the most crowded part of the Kikuyu Reserve in Kenya, one acre in three is now cultivated. The ratio used to be 1 to 10 or 12. Cultivation has been extended to steep slopes. Sheet erosion has taken place rapidly. Live-stock populations have grown faster than human. There used to be some control by rinderpest, which used "to sweep over the African plains with the rapidity and ferocity of a veld fire." Livestock have doubled since 1889 in Kenya and Southern Rhodesia. The carrying capacity of the pastures has not increased. Goats are a pest. They are seldom eaten, and their skins bring little. Among many tribes the bride-price is paid in goats, and has doubled or trebled, so that many more goats have to be kept as a medium of exchange.

(p. 1079) Union of South Africa. "In 1919 occurred the most serious drought the Union had experienced . . . the Drought Investigation Commission . . . in 1923 issued the most outspoken report hitherto produced. . . . The report dispelled the generally prevailing idea that South Africa's rainfall had decreased but "the rains of the last generation, falling on unbroken, under-stocked grazing lands, were more lasting in their beneficial

results than rains of equal magnitude falling today on veld overstocked, tramped-out, semi-waterproof, hard-baked by sun and veld fires". Storage dams were soon silted up. Four important reservoirs, built between 1920 and 1925, were, by 1936, silted up 43 per cent, 33 per cent, 25 per cent, and 14 per cent.

Gullying has been extensive. The Brak River (Britstown District) did not exist until within 60 years, but by 1907 was 300 feet wide and 15 feet deep.

(p. 1084) Basutoland has lost 10% of its arable surface by soil wash. Gullies up to 40 feet deep cut across every river bottom. Over-grazing has killed nutritious grasses which have been replaced by inedible and poisonous weeds. Control measures are now being taken.

(p. 1085) Swaziland is being eroded because of up-and-down-hill plowing which is a common practice.

(p. 1085) Southern Rhodesia has very little cultivated land but the superficial soil loss of what there is in Mashonaland is a fourth of an inch per year. There is great overstocking and an increase in the bride price has taken place, so the goat nuisance has increased.

(p. 1087) Northern Rhodesia. There is serious sheet erosion: Land can only be cultivated for two years, and the natives used to rest it for twenty-five. This is no longer possible. In the old days they had chitemene cultivation, for which the branches of ten acres of forest were burned to fertilize one acre of cultivation. Now the natives are employed in the mines and destroy all the trees completely instead of merely pollarding or trimming them. "Large areas in the northwest have been reduced in this way from forest to poor scrub, showing signs of soil deterioration".

Nyasaland. In the last 50 years large tracts of forest have disappeared. Streams have ceased to flow regularly, or even at all. Once fertile country is incapable of supporting half the population that it had a century ago. Top soil has washed away from mountains leaving bare rock. Once forested plains are treeless. Lowland depressions are filled with silt but are too water logged to be cultivated without drainage. Tobacco lands have been ruined by up-and-down cultivation.

(p. 1090) "In 1932 a Bush Fires Ordinance was issued to control burning and to authorize penalties for those caught illegally starting fires, but it has proved impossible in practice to stop bush fires altogether, but the damage is minimized by controlled burning carried out by the authorities before the traditional grass-burning season arrives."

(p. 1090) Tanganyika. The infestation with tsetse fly has safeguarded large areas from damage by over-grazing, but the driving of people and cattle into districts free from the fly has caused serious over-grazing and erosion. There is now great overstocking. "If land were cleared of tsetse only to be over-grazed by stock, the last state would be worse than the first."

Erosion is widespread, but the cultivation of coffee, largely, occupies only one-thirtieth of the territory. Where soil has become bare, the run-off is 55 times that of soil protected by grass, and the erosion very great on bare plots but nil on grass plots.

(p. 1096) Kenya. The Machakos reserve formerly had forested hilltops, now hardly a tree remains. It is estimated that 37% of the Ukamba reserve of 391,000 acres has been eroded down to the subsoil or more. The stock population of the Wakamba reserve is 250,000 cattle, 269,000 goats, and 50,000 sheep. In 1929 the total carrying capacity was estimated at 60,000 head, and it has declined. Every three acres has to carry 1 cow or ox and 2 goats, but 50 acres should be allowed. The excessive and growing population of goats is harmful and useless, but presents a problem that still defies solution.

The livestock population has more than doubled in the colony as a whole since 1920, but the people are often on famine relief.

Lake Rudolph has been falling a foot a year for 25 years.

(p. 1099) Uganda. Before British rule the natives had little cultivation. They mulched cultivated land with banana leaves. They seldom cut big trees. The introduction of cotton cultivation brought 1,500,000 acres under cultivation by 1936. Plows were introduced to increase subsistence cultivation. The human and live-stock populations have greatly increased. The mountains, fully forested as late as 1896, have been cleared up to 7,000 feet elevation. Ground water level is falling and the lakes are receding. Both gullying and sheet erosion are serious. Where cotton was formerly grown, the soil of certain West Nile districts is now described as "thin skin over quartz rubble." The Veterinary Department was debushing the country to control the tsetse fly, thus inviting the increase of cattle and further erosion.

(p. 1101) Sierra Leone. Degradation of original rain forest to bush and savannah has gone farther in Sierra Leone than in any other part of West Africa. Villages are being abandoned.

(p. 1104) Nigeria. Grass is killed by excessive trampling, burning and grazing, the trees are too frequently pollarded

to feed goats, and so weakened as to be killed. Fine sand blows in from the north. "Doubt has been expressed as to whether the careful and industrious system of agriculture practiced around Kano can survive for much longer, if destruction of vegetation continues at the present rate." In the Southern Sahara rivers have dried up and the water table, now 50 feet or more below the surface, has fallen in the last two or three centuries. Territory that was fairly closely populated until well into the eighteenth century is now desert. "It has only taken some 200 years to depopulate a country as large as the Union of South Africa."

(p. 1102) Gold Coast. Over a million acres of land which were once under rain forest are now under cacao. The forest is still receding. An active policy of forest conservation is needed if the cacao industry, now deteriorating, is to be saved. Control of rinderpest has led to a rapid increase in livestock.

(p. 1103) Nigeria. In the southern provinces the traditional method of cultivation is to grow crops on mounds made by throwing up soil over weeds and grass. This practice is approved and encouraged. The introduction of ploughs is being discouraged. Erosion has produced gullies 100 feet deep in the hills. Grass is being killed by excessive trampling and burning. The Sahara is advancing.

Hall, A. Daniel (1930) The Improvement of Native Agriculture in relation to Population and Public Health. London: Oxford University press; 104 pp.

Sir A. Daniel Hall, who was Chairman of the Kenya Agricultural Commission in 1929 (p. 24) quotes Willis on the evils resulting from chena (shifting cultivation) in Ceylon:

"Vast areas of good forest land have been ruined in southern Asia by this destructive practice, and in most countries chena permits for crown land are now issued under stress of very hard times and failure of the regular crops." This he follows by a quotation from an official publication of the agricultural service in Assam (Bulletin 18):

"A jhum is a temporary clearing made by cutting down the forest and burning it when dry. The usual rule here is to cultivate a jhum for two years and then abandon it. The chief and perhaps the only reason for abandoning jhums after the second year is the excessive growth of a species of couch grass which rapidly overspreads the field and smothers the crop. The people find it more paying and less troublesome to make a fresh clearing than to remove the weeds."

Then follow other quotations:

(p. 25) "Professor Ogilvie (British Association 1934) discusses the destruction of forests by the Awisa and Awauk tribes of the upper Zambisi:

'The felled timber of the Awisa would take a generation to recover. Yet several district reports mention rest periods as short as four or five years: in others these are between ten and twenty, and in Barike thirty to thirty-five years'".

Hall discusses all the suggestions that have been made and tried for replacement of shifting agriculture by a permanent system. As to the equally great need for reform in ideas about grazing he says:

(p. 49) "In a general way it may be said that the status of a man, especially of the chiefs, in any of the Bantu tribes is largely determined by the number of cattle and other live stock he possesses. In one sense they are currency (compare the Latin *pecunia*) and are preferred to money, for, as one chief told me, "Money does not breed and may get stolen or burnt. The owners are indifferent to the quality of the stock; numbers alone count. Consequently, as no sort of segregation nor culling of the males is practiced, the majority of the stock are veritable weeds, and in the state of semi-starvation in which they are living, are of little value for meat; in ordinary commerce the hide alone would be paid for."

As to the destructive effects of over-grazing, Hill cites reports of the Kenya Land Commission (1933, p. 494) as follows:

"We have heard evidence that 20 years ago the Kamasia reserve was still a well grassed country and the Suk were burning their grazing areas every year with a view to controlling the grass. . . Now, in many parts where there used to be grass, there is nothing but bare earth, and although we do not agree with some witnesses that there has been a decline in the annual rainfall, there is no doubt that . . . such rain as falls quickly runs off the hard pan . . . or evaporates. . . Areas which used to be open grass plains are now being overgrown by dense thorn bush. . . Probably about 1920, the main stock areas of the native reserves had attained their optimum carrying capacity. Since then the cattle population has . . . increased to 6,000,000 or, roughly speaking, doubled itself. . . We have . . a preposterous state of affairs . . . a human population of under 3,000,000 owns about 6,000,000 cattle and probably many more sheep and goats. The large majority of that population has little or no milk . . . during the dry months of the year. . . In the midst of plenty, the natives in pastoral and semi-pastoral areas are in fact living under conditions of extreme poverty . . . and will continue to do so until they turn . . . their large herds . . . into some more useful and fluid kind

of currency."

From the Kenya Land Commission Hill quotes (p. 52):

"In the Kamba reserve there are over a million acres, of which 32,000 are under cultivation. Mr. Scott Little estimates that the Reserve contains 190,000 cattle, with 57,000 calves, though he estimates its grazing capacity at no more than 60,000 head. There are also 260,000 goats and 50,000 sheep. A journey through the area east and south of Machakos reveals that over large stretches of hillsides vegetation has been almost wholly removed. . . It is not too much to say that a desert has already been created where grazing formerly was good, and even where cultivation existed, and that the same desert conditions are steadily approaching the land carrying stock and cultivation. The droughts of the past two seasons have intensified the rate of destruction and are causing grave disturbance in the tribe. . . The members of the tribe [the Wakamba] have been known to die of starvation rather than to kill any of their stock for food. . . The Wakamba solution of the difficulties of this tribe is that they should be given more land. But there is no considerable area now open, and even if new land could be found the destruction would only be renewed. No space would be big enough for the Wakamba so long as they only aim at increasing the number of their stock without utilizing them."

Hall quotes from the evidence given before the Kenya Land Commission by a Mr. Hopley:

(p. 55) "There was a beautiful forest on the summit of the Dabida range, but now the ridges are all knife edges; you can hardly walk among them, and few trees remain. It is incredible the change that has taken place in the last thirty years. . . The Dabida range is a fertile island surrounded by Taru Desert, which is absolutely arid country. They are rapidly destroying that area and there is no water, and where they can go to cultivate I am unable to foresee. One of the greatest dangers in Africa today is soil erosion of the native reserves."

"When we turn to the reserves of the Suk, the Njemps, and the Samburn, the position is one of almost unrelieved gloom. The people appear to show absolutely no regard for the ruination which is going on before their eyes, but devote their lives to amassing vast herds of uneconomic live stock, which are fast turning the country into a desert." Major Grogan commented: With regard to the Kavirondo country I was very much struck by the obvious denudation and waste of land that is going on there. You can see it very well from the air. The land practically goes pink over large areas, and wise people leave it alone."

Hall (p. 56) quotes Mrs. Hoernle regarding the Bantu attitude toward cattle as follows:

"The cattle are a trust to the present generation. . . They

are heirlooms; emblems of the status of the family. . . . When an animal is sacrificed, for example, they say, 'Father, here are your cattle; you have asked for cattle; here they are'. That is why, when those cattle are used in marriage the ancestors must be appealed to to accept the transfer of the cattle to another kraal, because they are really the cattle of the ancestors

Of course the wise recommendation has been made that surplus stock should be exterminated, and the interesting suggestion offered that it be paid for in special coins of the value of £2, stamped with the image of a bull, numbered, and registered to the persons to whom issued. These would be of some bright alloy, redeemable on demand for ordinary money, and made so as to be sewn onto clothing for display. Hall says (p. 58) that this suggestion may sound fantastic, "but the situation it is designed to meet is fantastic. It is difficult for us to put ourselves alongside the minds of people who accumulate livestock to the acknowledged detriment of the land upon which they live, and yet do not use them for the very purpose for which man originally domesticated the animals but some of our own sacrifices to attain status among our fellows - honors and prestige - hardly bear examination in the cold light of reason."

(p. 59) "It is difficult for anyone who has not been through the country to realize how far the destruction has proceeded in some areas; one sees nothing but gaunt hill-sides, mottled with red, yellow and purple, where they are bared down to the deep subsoil or the rock, and sparse vegetation in the bottoms, gnawed and broken down by the starving animals wandering through it."

Regarding the religious attitude of the Bantu toward cattle Hall states that although they are the chief agricultural race in Africa, they also have great holdings of livestock which they hardly use at all for food, using little milk and eating meat only on ceremonial occasions. Since the British have stopped warfare and raiding both human and cattle populations have out-grown the traditional wasteful methods of land use for both cultivation and grazing. The system of buying wives by payment in cattle is called lobolo and is of fundamental importance in African sociology. It is largely responsible for the perpetuation of tribal organization. Hall quotes the Report of the Native Economic Commission (711, 712) as follows:

"Thus in so cardinal a matter as marriage . . . the main transaction . . . which makes it legally valid . . . the passing of lobolo, must be grounded and rooted in the religion of the groups concerned. . . . As one witness said: 'Lobolo is to the natives a religion'. Hence the people want to see the living cattle. According to the present-day conception of the Abantu, it is the beast alone which has actual value as lobolo: all

substitutes are inferior. . . (p. 49) The only true wealth among the Abantu, at least since they became pastoral people, has consisted of cattle and other stock. . . It is this kind of wealth that determines the economic status of a family, for there is no possession to compare with it. A beast is 'our' beast; the sense of possession is shared by all members of the family and eventually by the whole society."

Hansford, C. G. (1940) Topography and Vegetation [of Uganda]; pp. 7-14 in. Tothill (1940), q. v.

Harroy, Jean-Paul (1949) Afrique: Terre qui meurt. La Dégénération des Sols Africains sous l'influence de la Colonisation. Bruxelles: Marcel Hayez. Deuxième édition. x+557 pp., map.

This important work deals mainly with the acceleration of degradation of African soils and vegetation which has come about through European influences, but deals also with topics which fall strictly within the reviewer's assignment in this conference. One must call attention at the outset to the striking photograph of a brush fire taken by Harroy in 1937 near Logone, French Equatorial Africa and the frontier of the territories of Tshad and Ubangi-Chari. It shows a typical Sudanese park-savannah with grass as tall as a man and scattered wide-spreading trees, with fire in the background and vast clouds of smoke darkening the whole sky. This particular burning was to clear land for the newly expanding cotton culture, but would doubtless have been done as a matter of habit even if there had been no directly useful purpose.

In order to visualize the constant degradation of the vegetation it is necessary to consider the principal plant formations of the region which Harroy studied, stretching across from the Belgian Congo and Angola on the west to the Union of South Africa and Tanganyika on the east, thence northward and sweeping back westward from Kenya, Somaliland and the Anglo-Egyptian Sudan on the east to the Gold Coast, Sierra Leone and Liberia on the west. The five main zones of vegetation from south to north from the equator would ideally be (1) the closed, shady evergreen rain-forest; (2) the deciduous forest; (3) the wooded savannah; (4) the bush savannah, the prairie and the thorn bush; and (5) the subdesert and the desert.*

*In order not to run the risk of mistranslating technical ecological terms by too vague English the original French terms are as follows: (1) la forêt ombrophile; (2) la forêt tropophile; (3) la savane boisée; (4) la savane arbustive, la savane herbeuse et la steppe à épineux; and (5) la steppe prédésertique et le désert.

Degradation takes place at one extreme by the loss of rain forest and its replacement by deciduous forest, and at the other extreme by the encroachment of desert upon savannah. In between, savannah of course loses ground along its northern border and advances into the deciduous forest. Any change brought about by man has tended toward degradation, toward shrinkage of the equatorial rain forest and growth of the Sahara.

This general conclusion has not gone unchallenged. Thus Harroy (p. 73) cites the diametrically opposite statements made by Stebbing (1938) and F. Rodd (1938) in the same year. Stebbing said the Sahara was advancing all along the line, whereas Rodd said (1938, p. 354): "North of the centre part of the Northern Nigerian boundary vegetation has advanced rather than retreated, within my own experience as well as according to native accounts." Similar disagreement was demonstrated by discussion in the Belgian Congo as to whether or not the equatorial forest was receding. Regardless of whether one accepted the evidences for supposed occasional vegetational advance, the instances were few and overbalanced by contrary ones (p. 79). Harroy (p. 76) quoted with approval a sentence from R. Thomas to the effect that when the vegetation of a region disappeared that which displaced it characterized a drier region. Burning over at repeated intervals was able to maintain what would be climax vegetation in a drier climate, but was actually only what some authors called paraclimax and others subclimax. Recognition of the difference may not be easy. For instance, Harroy says (p. 76) that Scaëtta described certain central African prairies that looked like steppes but on climatological grounds had no right to be such!

Fire eventually eliminates even from prairies the species less resistant to fire. As they become impoverished in species they become more and more susceptible to invasion by alien intruders of weedy habit, species which are not very numerous but almost ubiquitous. Harroy mentions especially the grass Imperata cylindrica, which he views as a historically recent immigrant from America, and the bracken fern Pteris aquilina (Pteridium aquilinum), perhaps the most wide-spread of all higher plants. With the intrusion of such species native species disappear and narrowly endemic species become extinct. Instances of extinction are common, such as various species of *Erica* described from South Africa and now unknown except through herbarium specimens, and maybe only one of those.

On the other side of the ledger are instances of man habitually conserving certain species of utility to him. So the baobab is kept around the Senegal villages, and the natives of the Sudan spare Butyrospermum Parkii and Parkia africana. In the Belgian Congo the oil palm is habitually preserved when forest is cleared. If the population is dense enough so that the same land is used every few years after intervals of forest fallow it becomes a grove of oil-palms by a process of selection.

Harroy has an extremely important chapter in which he discusses country by country the degradation of the soil in each. Turning then to the causes of the disequilibrium he blames as the foremost the intentional firing of land, which results in dehydration of superficial soil colloids, in leaching out of salts, in destruction of organic material, in modification of the soil reaction, and in alteration of microfauna and microflora. Next comes overstocking, which brings about ascendancy of coarse, inedible and sometimes, poisonous species, and the destruction of the turf and the normal soil surface by trampling, which leads to erosion. Then he considers overcropping.

The consequences of overcropping are numerous and vary from place to place, but always it results in impoverishment of the flora, drying up of the country, erosion, both by water and by air, increase of weeds, loss of soil fertility by removal of crops, and deterioration of the soil in physical condition.

In a consideration of primitive shifting cultivation Harroy admits that it varies from "rob culture" to a system of fallow, and does not follow those who condemn it utterly. He keeps a balanced judgement between the extreme views of those, like Willis and Stebbing who considered it wholly pernicious to others, like Worthington, who commended its best aspects.

Harten, J. A. (1953) Beknopt overzicht van de landbouw der Bantus in de Unie van Zuid-Afrika en zyn problemen. Indonesië, Vol. VI, No. 4, pp. 317-329. Jan. 1953.

The Bantu peoples have been thronging into South Africa for at least three centuries and now constitute the predominant part of the "native" population and two-thirds of the total population, although, except for being of African origin, they are as alien to the soil as Europeans. The number of Bantu stems is about 750, which may be grouped into five main classes within each of which there are common ethnological features of importance, often linguistic.

A general characteristic of the Bantu is their inordinate veneration for cattle, which however irrational it may seem, is closely bound up with all of their traditions and folk-ways. The Bantu, 67% of the population, have had reserved for them 12% of the land. On their reserves the Bantu have 3.4 million cattle, 3.7 million sheep, and 2.9 million goats for 8.5 million people. Most of the live-stock is not utilized economically but is merely kept for the prestige that it gives the owner, being passed to another generally only as a bride price. The cattle are so highly esteemed that a laudatory term for a cow is "the god with the moist nose." The whole social life of the Bantu revolves about cattle.

The very poor land does not withstand overstocking. During the annual dry period the soil is pulverized by millions of hoofs, and is so easily eroded when the rains come that innumerable ravines and gulleys have been formed, sometimes kilometers long and tens of meters across, the dreaded donga's of the South African landscape. No attention is often given to contour plowing, and the reserves have been completely denuded of forest.

Hartmann, C. W. (1897) The Indians of Northwestern Mexico. Congrès Internat. des Américanistes. Comptes Rendues de la Dixième Session, Stockholm 1894, pp. 115-136. Stockholm: Imprimerie. Ivar Haeggström, 1897.

Hartmann, who accompanied the Norwegian explorer Lumholz in some of the explorations in the region of the Tarahumare Indians of Chihuahua. They entered this region from the state of Sonora some 200 miles south of the international border, where they were in subtropical country where there were palm groves and bamboo thickets. Eastward at high altitudes of 6,000 to 8,000 feet, they traversed pine and live-oak forest with grasslands which raised the question of whether or not the grasslands were man-made or not. It led to a correspondence with Professor C. S. Sargent of Harvard, and the following extracts will be of interest.

(p. 116) "Virgin forests of dark pine and evergreen oak cover the whole sierra so far as the eye can reach. For hundreds of miles in every direction stretch silent and somber forest-landscapes, only lighted up here and there by some white spots, far distant grass-llanos. We are not in the old hunting-grounds of the once mighty and numerous Apache Indians."

(p. 116, 118 f. n.) "While mentioning the forests here, some observations bearing upon the question of a presumed destruction of the forests by the native Indians, may be allowed. It is the author of 'L'Amérique Préhistorique', Marquis de Nadaillac, who in this work advances the theory, that one of the principal causes of the depopulation of the regions of the ancient cliff-dwellers in the southwest, may have been the change of the climate, the extreme drought that followed on the virgin forests being destroyed by that primitive people."

"During our travels in Sierra Madre, I became convinced that the continuous, immense forests here could never be destroyed by the Indians, and that, in case the forests on the northern extension of these mountains, viz. the Rocky Mountains, are generally composed of the same kind of trees, much less that any destruction has taken place there in early times. For to gain certainty in the matter, I communicated with the greatest living authority on everything touching the forests of America, the author of 'Silva Americana', Professor

C. S. Sargent, of Arnold's Arboretum, Mass., who was kind enough to furnish me with the interesting information given below.

"I here quote the following extracts from the letters exchanged:

'What reasons could induce a primitive race weaponed with stone axes to destroy forests, covering thousands of square miles of mostly steep, barren mountain-chains, where only some small spots could be cultivated? Forest-fires caused by these same savages seem to me to be the only mode through which the Marquis could have imagined that the Indians might have destroyed the virgin forests.

'But if the forests of the Southwest are similar to those of northern Mexico, then they have never been destroyed by fire by the cliff-dwellers or their contemporaries, because the forests of Sierra Madre, forests almost exclusively of pine and oak, are, as far as I know them, from the frontier of Arizona to the state of Durango, absolutely indestructible by forest-fires.'

"When breaking camp in the North, in Apache-land, it happened several times that our Mexicans through carelessness let the fire pass out in the high dry grass, and when it was windy, the fire would sweep over large tracts, burning all the luxuriant grass and shrubs as well as very young trees, but never destroying any trees with trunks thicker than a man's arm, only blackening the trunks and perhaps burning off the lowest branches of some trees - leaving the forest, on the whole, quite intact and green. One of the most common methods of hunting amongst the Apaches in these regions, I was told by Mexicans who, when captives, had taken part in it, consisted in putting fire to the grass of large areas in these forests and driving the game against some narrow mountain-pass or abyss, where they could easily be killed. It was no doubt from similar fires that we found the ground and tree-trunks blackened in these territories, where no Mexican or other white man had entered since the campaign of 1884. When we reached the land of the Tarahumares, still more convincing proofs of the indestructibility of the forests were found. These Indians, the pagans as well as the Christians, keep up the custom of burning off the grass all over the sierras during the very driest season of the year, April - June, believing that the smoke will form clouds that give rain for the crops, wherefore it becomes almost impossible to travel in the mountains during that time of the year, there being no pasture to be found for the saddle and pack animals. Fires are seen continually burning day and night all over the mountains up to the highest crests, leaving the stony ground, blackened and barren, but the forests stand green. The surest proof of all is furnished by the mode the Tarahumares use when preparing forestlands for culture of corn etc., an undertaking that, in the great northern forest districts, where, however, such a drought as here never occurs, would completely destroy the forest. On a level place in the forest, where the humus is rich, and generally near some stream, the Indian will take away a strip of bark 2-3 feet

broad from the trunks of all the pine trees over a tract of a few or perhaps 20 acres or more. Then after 2 or 3 years, the pines are, of course, completely dried up. They are now cut down and during the driest season, when there perhaps has not been any rain for 9-10 months, the whole mass of trunks and broken branches are set on fire and burned to ashes. Some of the trees that stand nearest to this giant-fire are, of course, destroyed, but no forest-fires arise.
Do the forests around the homes of the cliff-dwellers consist principally of the same forests-trees as here? What is your opinion, Sir, about the mentioned theory of the destruction of forests by the cliff-dwellers as presumed by the Marquis?"

"So far as I have been able to observe, the North American Indians of the Southwest never were forest-destroyers: in the buffalo regions, apparently, they burnt the prairies every year to improve the feed for these animals and so prevented the spread of tree-growth. This is proved by the fact that since the removal of the Indians, great regions in Indiana, Illinois, and Iowa which were formerly prairie are now covered with forests of oak, but in the southwest, where there was no such reason for their destroying the forests, there is no evidence that they have ever done so by fire. So far as I have observed, in Arizona and New Mexico the forests have not been destroyed by fire, the only destruction I have noticed being individual trees of *Pinus ponderosa* killed by the Indians in removing the bark for food."

Lumholtz and Hartman found much evidence of permanent land utilization by ancient and now extinct Indians of the Apache and Tarahumare country.

"Earlier than the Apaches, who were nomads, there lived in these woodlands other Indians of an agricultural, house-building race now extinct. Most of their ancient Pueblos are found upon the highest ridges of the very mountain-crests with commanding views of the surroundings. Now only rough walls of stone and, in a few places, of clay are left. In the steep and narrow arroyos of the mountain-slopes, especially in the Western Sierra, there are astonishing numbers of small terraces looking like giant-steps, the one built above the other at a distance of 20-50-100 feet or more, just as the locality may require. They are ancient gardenfields formed by a simple wall of boulders, 6-20 feet high, and are built in this way in order to use the water for irrigating purposes and at the same time to prevent the rush of water during the rainy season from carrying away the soil of the fields thus formed. Some 200 miles further south, on the headwaters of Rio Fuerte, we found the heathen Tarahumares still using exactly similar terraces in cultivating their crops of beans, chili, sugar-canes, squashes, etc."

Hassert, Kurt (1917) Beiträge zur Landeskunde der Grasshockländer Nordwest-Kameruns. Erster Teil: Physische Geographie. Ergänzungsheft Nr. 13 der Mitteilungen aus den deutschen Schutzgebieten. Berlin: Ernst Siegfried Mittler und Sohn. 144 pp., 26 figs on 4 double pl., map.

Hassert (p. 106-109) gave a good discussion of grass fires in (then) German Kamerun, from the standpoint of reforestation. He held that the prairie in northwest Cameroon was in part natural and in part the result of fire. This could be proved from the vestiges of former forest in the grasslands. Natural regeneration of forest he considered to be impossible because of unfavorable climatic conditions, but artificial reforestation he thought possible, if rigorous precautions were taken to prevent fire. According to his observations the damper places, where vegetation was fresh and sappy, were not fire swept, and the type of vegetation that surrounded native villages was hardly disturbed. Only the edges and not the interior of forest was damaged.

His description (p. 106) of the fires was a graphic one. They were lit by the inhabitants yearly, to improve the grazing, or to prepare new land for agriculture, and raged during the dry season in December and January. Day after day the countryside is enveloped in smoke and vapour. At evening the bright or dark red glow of fires dance across the plain and creep over the heights.

Hayes, T. R. (1940) The Development Ox-cultivation in Uganda; pp. 54-59 in Tothill (1940), q. v.

Hazeu, G. A. J. (1907) Gajösch-Nederlandsch Woordenboek met Nederlandsch-Gajösch Register. Batavia: Landsdrukkerij. 1148 pp.

Of all the dictionaries of Indonesian languages that of Hazeu for Gayo is among the most useful because of the wealth of ethnological information which it provides. The reviewer has used it, if not actually to verify what would be the extraordinary occurrence of the sago palm in Gajoland, far from the coastal swamps which are its usual habitat, at any rate to indicate that there is a palm at the high altitude of the Linggö Valley in Gajoland which was similar enough to pass for that and which had almost the name that Hagen (1903, p. 45, quoting van Daalen) gave for it.

Hagen gave no description of the making of a ladang or of the planting of dry-land rice. Hazeu informs us that the planting was done in the primitive manner with the round planting stick, toekol (tukol), which was made of wood and sharpened to make holes in the ground for planting rice and other plants.

Hagen relates oemö (=umö; dry rice field) to Malay hoema (=huma), with the same meaning. The Gajo word for house, which the reviewer considers related, is oemah (umah), equivalent to Malay rumah.

Henry, B. C. (1886) Ling-Nam, or interior views of Southern China, including Explorations in the hitherto untraversed Island of Hainan. London: S. W. Partridge and Co., 511 pp., illust., 3 maps.

The earliest book known to the writer which describes vegetation of the tropical island of Hainan is that of B. C. Henry, although there were earlier notes by Swinhoe touching on the subject. Henry and the Danish missionary C. C. Jeremiasen made the first extensive trip into the interior in October and November, 1882. Hainan is wholly within the tropics and is the southernmost part of China, lying entirely south of the most southern part of continental China. The Hainan Strait, separating the island from the Lui-chow Peninsula is narrow, and the former treaty port of Hoi How is located on it. Henry went westward from Hoi How to Ching-mai and then started inland.

He described (pp. 351-364) the "rolling plains of Lam-ko," originally forested, but probably centuries ago, as follows:

"The country is monotonous but not unattractive; the highest hills we cross do not rise more than one or at most two hundred feet above the sea level. There are few trees to be seen, only rank wild grass and insignificant shrubs, which bend before the wind like the waves of the sea. It seems an ideal grazing country . . . but only a few small herds are seen.

"As we approach the market of the 'Deeply Wooded Hills' the most extensive groves yet seen appear toward the south. A nearer view shows them to be the woodlands encircling several large villages. . . .

"Our course from this point continued in a southwest direction over a rolling country composed of red clay soil. Groves of trees appeared on either side breaking the monotony.

of the plain. . . . One and a half miles out from the 'Deeply Wooded Hills' we passed the boundary of the Ching-mai and Lam-ko districts. . . . "

The land improved as he progressed inland and more was in cultivation, all of it by Chinese, for the aborigines were still far away. Passing Aam-yen, they came to Ne-pe, where there were great plains that could be inundated, covered with rice. Then, at Lam-ko, the land gradually rose to the west. Along the base of a hill were several villages encircled by bamboo groves. Further toward the center of the island were Chinese towns and hamlets surrounded by fine groves of bamboos and fruit trees. Beyond Houlang they had a welcome sight of hills and mountains. Entering the hilly country and ascending the second range they came, near the summit, to a fine forest, with tall trees of magnificent proportions. This was country which had been settled by Hakkas from Kwangtung Province on the mainland, who had come in 120 years before.

Finally Henry passed the last Chinese town, Nam-fung, and was in the Le country. He interpreted all the country he had passed through as having been originally aboriginal land from which the Les had been gradually pushed back into the mountains. The climatic conditions make it impossible that it had not sometime been entirely forested, and degraded to its present state by primitive agriculture and fire. Penetrating the hills, Henry wrote (p. 403):

"We passed several small hamlets which looked forlorn and lonely in the wide grass-grown wastes that surrounded them. . . . The hills over which we passed were grass-grown and treeless, but on all sides appeared the greatest variety of hill and mountain landscapes. Many of the hills in sight were thickly covered with trees, others with fine groves crowning their summits, and their sides bare, while others showed great black spaces from which the grass had been burned, the whole being very attractive."

Halting at the little village of Chi-wán, they stayed three days because of rain. Henry said (p. 405):

"During our stay the clouds did not lift sufficiently for us to see the tops of the hills around, which seemed to be covered with rank jungle grass, with small groves of trees scattered over their sides. . . . The jungle grass, when cut in the proper season, makes excellent thatch for roofs. The great difficulty in breaking up this wild jungle soil appeared in the little fields that surrounded the village. After burning off the surface covering of grass and shrubs, there remains a layer of matted roots a foot thick, which must be grubbed up by main force before the soil can be utilized. If it is neglected for a few years the jungle repossesses it. . . . "

From here they had hard going, up and down steep slippery hills and up the bed of a rushing stream with sharp rocks in the bed, through wild country. Finally they came to a native clearing described (p. 407) as follows:

"It was only a few acres in extent, enclosed by rough stakes, with the stumps of large trees thickly scattered over it, and the long stubble of the rice recently cut."

Henry's further travels add nothing to the picture of an area originally inhabited by aborigines at the cultural level of shifting agriculture pushed back into the most difficult and inaccessible region by invaders of higher technical advancement leaving deforested land to the invaders, and still living with fire as a chief tool in their primitive cultivation. The same exact history is found in other parts of southeastern Asia, as for example in Formosa and in the south of China along the border against Burma.

Heras, Juan (1879) Carta del P[ad]re Juan Heras al R[ev]erendo P[ad]re Provincial, Manila 10 de Diciembre de 1878. In: Cartas de los PP. de la Compa[ñ]ia de Jesus de la Mision de Filipinas [Vol. II] pp. 187-230. Manila: Ramirez y Giraudier. 257 pp.

As an example of the impression made on the Spanish missionaries by the vast cogon prairies of Mindanao, one may cite a published letter of the Jesuit Padre Juan Heras (pp. 227-229). In the delta of the Rio Grande he was amazed by the extent of the rice crops grown on the overflow lands by the Moros. With a companion he traversed the cultivated plain which rivaled or surpassed that of Valencia in fertility and wealth of products, and came to Tumbao at the vertex of the delta. At the south were the mountains inhabited by the Tiruray, who lived there for fear of the Moros of the plain and coast.

Not far from the mouth of the southern arm of the river was a high isolated perfectly conical mountain, called "Cogonal Peak" because it was entirely covered with the coarse grass called cogon. Looked at from a distance a cogonal looked like a sown wheat field but was found to be so dense that unless burned over from time to time, it stopped any effort to traverse it. Having resolved to climb this mountain, he and others braved the scorching sun, grass taller than they were, and with great difficulty got to the top. What a panorama presented itself! — the mountains of the Tiruray to the south, the extended plains of the Polangui R. or Rio Grande to the east, terminating at the high range of Mount Apo, the wild lands of the Agusan, Cagayan and Dapitan to the north, ending in the famous "Punta Flechas."

Such a grassed-over peak as this would probably have been deforested by pagan woodland neighbors of the Moros, if the latter were already growers of rice on periodically submerged lands at the time of their arrival. If any forest has remained, the Moros would doubtless have completed its destruction by using the timber for constructional purposes, and, by continued grass fires, thus completing the transition to grassland.

Heyne, Benjamin (1814) Tracts, historical and statistical, on India, with Journals of several Tours through various parts of the Peninsula. . . London: Printed for Robert Baldwin . . . and Black, Parry and Co....Booksellers to the East India Company, xii+462 pp., 6 plates incl. 2 maps. Tract XIX, "Journal of a Tour from Cuddapa to Hydrabad, in the Year 1809", pp. 288-326.

The naturalist Heyne (1814) described the country from Cuddapah to Hyderabad (14° to 15° 30' N, about 78° 30'E) as it was in 1809, when the country was in very poor condition. So far as one can judge he saw no shifting cultivation and there were frequent indications of great degradation which had taken place, Heyne thought, as a result of Muhamadan domination of the generally Hindu population but might perhaps more rationally have been attributed to deforestation, erosion, and fire. Heyne said (p. 302):

"That this country has been more populous at a former period, and that it has been highly cultivated, appears evident from numerous proofs. Traces of ruined towers and villages are to be found all over the jungle, and marks of the old divisions of the land and of former cultivation may be distinctly seen. It is a sad reflection, but a true one, that as long as this country remains under the dominion of a Mussulman, it will invariably proceed on in desolation and will in a short time be a desert, in which no human being will be found except some straggling lombardies with their herds. Destruction is the delight of a pious Mussulman - he is the destroying angel".

More to the point would seem to be Heyne's observations about fire and grazing. He wrote:

"All over India the months of April and May are the hottest in the year. At that season the hills here are all on fire, and present a spectacle, the magnificence of which is easier conceived than described."

The alkali and salty spots which Heyne described indicate a country of some degree of drought, where, locally, evaporation exceeded water supply. The year before his visit between ten and twenty thousand cattle died for lack of food. As for the flora, there was some remaining forest on the hills of the eastern border of the district. We find:

"The mountainous ranges, which form the eastern boundary, may be remarked as peculiarly rich. Trees grow on many parts of them to a very great height; among which the red sandal-wood tree (Pterocarpua santolinus), which is used about Cuddapa for building, is particularly distinguished,"

In the main, however, there were few trees in the district excepting orchard trees in villages and towns, near irrigation. In general the alternation of an extremely dry season with an abundant seasonal rainfall determined the presence of thorn-bush land, destitute of foliage during the dry months, alternating with grassland and cultivation. Of the latter Heyne remarks that country which could be inundated by the rains bore a rice crop, but that where the ground was higher "of course no rice can be cultivated." He would surely have noticed upland rice if there had been any. Of the country passed through in his second day's journey northward from Cuddapa he said (p. 289):

"The tanks [artificial ponds] of which there are a great number here were . . . full of water and in fact the whole country was quite inundated. This to the Indian farmer is the most delightful sight imaginable, for nothing pays his labours so well as rich crops of rice."

The fourth day they passed through country with fine crops of sorghum and cotton. The country became drier as they proceeded northward, and any rice cultivation was by irrigation from streams, not from direct fall or drainage of rain water onto the land. There was wheat, but maturing when only a foot high.

On the eighth day the country was more "jungly" with Mimosa arabica and Cassia auriculata, which formed "very thin jungle." "Palmeyras trees make their appearance . . . they are a sure sign of a poor and barren soil."

The next day "the jungle increases as we advance, and of course cultivation diminishes in the same ratio. . . . I observed repeatedly small tracts of country with long grass on it. This on black cotton soil I had never seen before; it may be owing to the undisturbed operations of nature. . . . When the process of vegetation is over, the fields become bare in cultivated grounds; and on waste plains, as here, they are covered with dry grass, constituting a kind of natural hay."

On the eleventh day they traversed one fine village with rich cultivation about it, but, our perhaps prejudiced author remarks (p. 299):

"The curse of Moslamism, however, soon becomes perceptible, for at the distance of a few miles all becomes dreary and jungly. Further on the soil becomes barren and stony . . . Palmeyras are now very abundant."

On the fourteenth day, he says (p. 300):

"We passed some tanks, under which rice is cultivated. The country had upon the whole a very barren aspect, at least at this season, when most of the trees had lost their leaves, and the grass, which during another part of the year adorns the country, was completely burned up."

The country traversed was about the same for several days, but on the eighteenth day Heyne wrote:

"The country here still remains a wilderness but the jungle is very productive of fine grass, which yields food to numerous herds of cattle belonging to the lombardies. Here these people seem to be at home, if the place to which they retire with their cattle, after an expedition to the coast, or to distant inland countries, may be called their home; here they reside when they are not upon such expeditions, or when not employed by a campaigning army, to which in India they are an indispensable appendage."

Finally on the twenty-first day of travel they came to their destination at Hyderabad City. From the ~~travel account~~ and the commentary which follows we can reconstruct a picture of a tract from which forest had receded into the higher hills, leaving grassland that was the scene of repeated devastating fires and overgrazing. This was bordered by thorn scrub land capable of yielding one good crop a year after the rains, or more when natural conditions were modified by irrigation. The modern reader is tempted to ascribe to over-grazing by nomadic herders, to fire, and to erosion down to bed rock and boulders, much of the malign effect of Muhamadan government, although of course, conditions brought about by despotic rule either by "Moormen" or Hindus would have accelerated the destruction of natural resources and vegetational degradation.

Hislop, Stephen (1886) Papers relating to the Aboriginal Tribes of the Central Provinces, left in MSS by the late Revd. Stephen Hislop . . . Edited . . . by R. Temple. n. p. [Nagpore?] 1866.

Stephen Hislop, missionary of the Free Church of Scotland at Magpore, India, investigated the Gonds during a period of nineteen years, ending at his death in 1863. This was when forestry and conservation were just becoming of fast-growing importance in India, and the account of shifting cultivation as then practiced widely is of much interest historically. His notes were on the Gonds occupying mountain ranges from 18° 4' to 23° 40' N. and from 78° to 82° 30' E. He wrote:

(p. 2) "The system of cultivation . . . is migratory. . . Here it is called Dáhi or Dáhyá, and is essentially the same with the

practice of the Torus of the Terai, of the Hill Cacharis, the Bodos, the Mikirs, the Kukis, the Rajmahalis, the Kols, etc. On the Western Ghats, near Sattara, it is known as Dal. or Kumari and in the mountainous districts of Burmah it goes by the name of Toungya.

"In the hot weather . . . they cut down the brushwood and lop off the boughs of the larger trees, and place them in layers to dry. . . . Before the beginning of the rains in June they set the whole on fire, and spread the ashes over the cleared space. On these . . . after the first showers, they scatter a variety of inferior grains, chiefly millet, along with one or two species of cucurbitaceae. . . . The third year the land is comparatively unremunerative, yielding little but grass; but the houses . . . are still allowed to stand there until the cultivators have burnt down the jungle on another spot . . . when they remove thither. . . . They do not return to an old piece of ground till after the lapse of almost twelve years . . . when they find it again covered with jungle and requiring the same process of burning and cultivation as before."

Hislop recorded the traditional songs of the Gonds and made a literal translation, which, after his death, was edited and put into the form of a smooth translation by his editor, R. Temple. These songs deal with the creation of the world and of the Gond people, the first life of their culture hero Lingo, including the making of his rice field, his death and restoration to life, and subsequent events. The most interesting point in connection with the tradition of ancient agriculture is that Lingo, miraculously born from a flowering tree, was not the first man, but found others inhabiting the earth who already used fire for roasting meat, but seemed not to use it for clearing land and fertilizing it by the production of ashes. There is no mention of fire as an adjunct to cutting in this ancient tradition of preparing the field. According to the song Lingo's first rice was planted without burning of the forest debris, the deer ate the young rice, Lingo and his four adopted brothers failed to make fire with a flint and went to borrow fire from an old cannibal whom Lingo called "uncle" so as to cook the deer. The verses that pertain to fire and agriculture, beginning with his first meeting with the four brothers and seeing fire for the first time, are as follows:

"He went a little beyond, upon a
precipitous hill, and climbed a tree.
Then he looked around and saw smoke
arising from Kachikipa laingad.
What is this? said he; I must go and see it.
He ascended, and saw the smoke. The four
quickly brought their game, and began
to roast it; they began to eat it
raw or cooked.

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For water they thirsted. On a steep they
ascended to look for water;
But no water appeared, so they descended
from the hill.

Thus they came to a thick jungle of
Anjun trees, where thorny
plants blockaded the road.

They came and stood. A little water
appeared. They plucked Palas
(Butia) leaves and made them into
a trough;

They drank water with it and were
much refreshed.

Lingo said, . . . this is a good place;
After scraping the ground and cutting
down trees, we will sow rice.

(Lingo said) I will sleep a little, you
make a field ready.

The four brothers brought hatchets,
and they all four began to cut
the Anjun trees.

(Lingo) fell asleep and he dreamed a dream.
In his dream

He saw the twelve threshing floors
of Gcnds and he was afraid.

He awoke, and returned while the
four brothers

Cut down the tree;
their hands were blistered, and
each blister was as large as
an Awala fruit.

They threw down their hatchets and
came to Lingo,

(And said): Our hands are blistered, therefore
we threw down our hatchets.

They went aside, and sat down. Then
arose Lingo and held a hatchet
in his hand,

And went on cutting trees; the trees fell,
their roots were dug up.

Thus he cut down jungle. In an hour
he made a good field.

(They said): Our hands are blistered
and not one tree have we
cut down,

But Lingo in one hour has cut down
several trees;

He has made the black soil (appear)
and has sown rice and hedged it
round;

He has made a door [entrance] to it
and has made a shutter [gate]
(for the door).

Then they arose and took their homeward
road and came to their own
houses.

On the first day of the rainy season
...rain began to fall;

When the rain had poured for three
days, the weather became fair;
rice began to spring;

All the fields appeared green. In one
day the rice grew a finger's breadth
high;

In a month it grew to a man's knee."

Then follows the story of the young deer conspiring to eat the young rice, against avuncular advice of their old companion, of their jumping the gate, eating the rice, and escaping. Lingo leads the four brothers on a hunt for them, and all are killed except the old uncle deer and one other. The meat cannot be cooked, however, for the Gonds could not light fire with pieces of flint. So they said:

"Show us where our fire is, and why it
does not come out.

Lingo said, Three koss hence is Rikad
Gawadi the giant.

There is fire in his field; where
smoke shall appear, go there.

Come not back without bringing
fire: thus said Lingo."

So Lingo shot an arrow, which crashed through forest and then through the high grass and then the fence of the Rikad Gawadi, who was, according to the note "a sort of giant . . . The Gawadi may be a corruption of Gawali or Gaoli, a cowherd. The Gaolis were powerful in the early days of the Gond people, and established a dynasty of their own in the Gond country." The brothers were to find here not only the fire that they wanted, but also the old man's daughters, for wives, but first only the youngest brother went, who narrowly escaped being eaten by the old Gawadi and in his haste to get away, had to drop the fire which he had stolen.

So Lingo went himself for the fire, charmed the giant with music of a lute which he made on the way, and then all was well. After Lingo reproached Rikad Gawadi, saying:

"I sent my brother to fetch fire and
you ran to eat him.

If you had caught him, you would
 have eaten him up; and where
 should I have seen him again?

Then the uncle said, I made a
 mistake, O nephew the thing
 that I did is past.

. . . . Hear, O nephew, my word. There
 are seven sisters, my daughters;
 I have them here. Take them
 away. . . . "

This little complication in the matter of getting fire led to trouble. The girls were not evenly divisible, Lingo was killed by the brothers, and they played marbles with his eyes, all of which made Mahadewa very angry. He confined the Gonds in a cave, as a bad lot, and set Basmasur the giant to guard the place. Then he restored Lingo to life, who made such terrific supplications to Mahadewa as to reduce himself to mere bones, impaled as a devotee on thorns, so that the golden throne of the god shook. It was all because Lingo wanted his Gonds back, in spite of the scurvy way they had treated him. By now it appears there were sixteen score of them. Mahadewa offered anything else and consulted Narayan, who said:

"Hear, Mahadewa, All these Gonds
 Were well concealed and were forgotten;
 if they were dead it would be a
 pleasure to me.
 If they come out alive from below
 the earth, they will act as usual:
 They will eat buffaloes, birds, such as
 pigeons, crows and eagles, and
 vultures.
 They will alight here and there; smells
 will arise, bones will be scattered,
 and make the earth look very bad."

In spite of this poor opinion of his Gonds, Lingo was allowed to redeem them by performing a heroic deed of stealing the young ones of the black bird Bindo for an offering. Bindo, an enemy of the sea-serpent Bhowrnag was of such magnitude and fierceness that:

"For food it killed the elephant, and
 ate its eyes; and breaking its
 head, brought the brains for
 the young ones to eat."

Now of course it would not have been in character for Lingo to be so cruel to Bindo, who had already had seven broods of fledglings eaten by the serpent Bhowrnag. So what should Lingo do but destroy the serpent and offer its body in seven pieces to Bindo, who then swore to do anything he wanted. He just wanted

to take the fledglings to show to Mahadewa, who would be satisfied just to see them. It was a six-months journey to the residence of Mahadewa, but Bindo and her husband carried Lingo and the nestlings there in a forenoon. Everyone was satisfied, and the Gonds were liberated. To some of them Mahadewa gave flour of wheat, flour of millet to others, and rice to others. This, presumably, set them in the way of agriculture, and of not eating offensive things exclusively, such as cats, mice, bandi, coots, pigs and buffaloes. The song does not say so, however, and the rest of it has strictly no bearing on cultivation of the soil.

(p. 27) "For the affinities of the Kûr and Kôl tongues we must look . . . at the foot of the northeast Himalayas and still more among the Mons of Pegu and the Benwas, described by Captain Newbold, inhabiting the mountainous regions of the Malayan peninsula" [Relates also with Kuki, Mikur, Karen]

May we not conclude, then, that while the stream of Dravidian population, as evidenced by the Brahuis in Beluchistan, entered India by the northwest, that of the Kôl family seems to have found admission by the northeast."

Hochreutiner [Bénédict Pierre Georges] (1929) Die paraguayische Pflanzenwelt. pp. 91-119 in: Schuster, Adolf N., Paraguay: Land, Voek, Geschichte, Wirtschaftsleben und Kolonisation. Stuttgart: Strecker und Schröder, Verlag 1929. 667 pp.

Hochreutiner wrote a chapter summarizing what was known in 1929 about the vegetational aspects of Paraguay. There had been little available to him on the Chaco, which includes the part of that country which is geographically within the tropics, although much subtropical territory is similar to it so far as vegetation is concerned, for certain plant formations are much like areas extending across the Rio Pilcomayo into Argentina. So far as man's influence on the face of nature is concerned, a great change is the rapid destruction of the Schinopsis forest for production of tanning material, building material and fuel. These dry-land forests are locally known as quebrachales. The map of the Chaco in Schuster's "Paraguay" has rough indication of vegetation types to be of use to the plant geographer, especially in conjunction with what can be gleaned from the same author's text and Hochreutiner's contribution to his book. The quebrachales provided Paraguay with the raw material for an important export industry. They produce Schinopsis Balansae, the quebracho par excellence, and a Clusia with similar utility, namely Aspidosperma sp. sp. sp. The plant formation to which the name quebracho is applied to somewhat

saline thin forest which, in Paraguay, gives way to grazing land for the cattle industry. Hassler (1919) showed that only in a few places did Schinopsis Balansae make up the bulk of the large trees in the formation. Generally the trees were scattered, but wherever the quebracho or tannin extract industry extends, there is use for other types of wood for construction and fuel, so the entire forest goes. Areas entirely cleared and thus artificial pasture land, are called campos just as are natural campos.

Much of the forest devastation in Paraguay is to provide fuel and building material to forest-poor Uruguay and Argentina.

With regard to the effect of fire, Hochreutiner is not one of those who minimizes its importance in modifying vegetation which he recognizes as important in Paraguay, although he quotes botanists who had considered it a minor factor in other parts of the world. Thus, regarding burning-over of the campos, he says:

"In their biological aspect the periodical prairie fires, partly set for the purpose of reducing the weed growth by the owners themselves, partly started by lightning, are of greatest significance. Not only do they destroy all accumulations of dry vegetation, but likewise they destroy the thin deposit of humus which has been built up. To this factor the vegetation must naturally be adapted or tend to be adapted (ampassen). Few annuals occur, but, on the contrary such things as tuber-bearing plants, of which in addition (uberdus) in many instances the rootstocks are protected by a leatherlike (Filzpolster) and the buds by hard, well insulating scales. These last are indeed so developed that B. Malme, for instance, referring to various species of Matto Grosso, was of the opinion that fire was necessary for the development of the buds. As soon as rain follows burning, the burned-over area displays in a few days the most brilliant green and floral display. In the opinion of some students these prairie fires result in the growth of prairie at the expense of savanna, because the woody part of the flora is gradually destroyed. On the contrary in some parts of the world the boundaries of forest and little woods within prairies in the main change very little or hardly noticeably as studies in Ceylon have shown, for instance, in areas where periodic prairie-fires occur."

Hochreutiner comments on the very large proportion of cosmopolites that occur in land from which tall tropical forest has been cleared. Land at first bearing cosmopolites, if not subsequently placed in agricultural use, produced quickly a dense secondary forest of Trema and Celtis. These rapidly growing trees are valued for their ash, from which the alkali is used for making soap. In early days of Spanish and Portuguese settlement cleared areas, if occupied for a time and then abandoned, would have been so widely and abundantly planted with citrus

fruits that veritable secondary orange forests came into existence and persisted, marking especially the sites of the abandoned Jesuit missions and providing for the first export of oranges and citrons to Argentina. Such undesigned experiments in the growing of seedling fruits on a large scale should have provided many well adapted horticultural types to the cultivated flora of Paraguay. There is a parallel in the early introduction of oranges into Florida, and the formation of wild orange groves near Jacksonville and elsewhere, such as were reported at the beginning of the last century.

Hodgson, Brian Houghton *Miscellaneous Essays relating to Indian Subjects*. Vol. I. London: Trübner and Co., 1880, vii + 407 pp. (Sect. I. Essay on the Kocch, Bódo and Dhimal Tribes, pp. 1-160. Original edition, Calcutta, 1847.)

Hodgson, eminent early student of the tribes of Assam, dealt with groups somewhat outside the tropics, from 25° to 27° N., but almost continuous in customs with others farther south. He wrote (p. 142) as follows;

" . . . the arts practiced by the Bódo and Dhimals are few, simple, and domestic. Agriculture is the grand and almost sole business of the men, but to it is added the construction and furnishing of the dwelling house in each of the frequent migrations of the whole people

"The process of culture, emphatically called 'clearing the forest' is literally such for the most part, and would be so wholly, but that several of the species grown being biennials, a field is retained over the first year, so that the second year's work consists merely of weeding and re-sowing rice amid the other standing products. The characteristic work is the clearing of fresh land, which is done every second year, and thus axes and bills clear away the wood. Fire completes what they have left undone and at the same time spreads over the land an ample stratum of manure (ashes). The soil is worked nearly enough in eradicating the undergrowth of trees (for the lords of the forest are only truncated; so that what little additional digging is needed may be and is performed with the square end of the bill. 'Tis no great matter, and firing is the last effectual process. Amid the ashes the seed is sown by a dibbler and a sower, the former of whom, walking erect perforates the soil in quincunxes by sharp strokes of his pointed staff (called Shómán by the Bodo and Dhúmsi by the Dhimals), so as to make a series of holes from one to two inches deep, and about a span apart; whilst the latter, following the dibbler, and furnished with a basket of mixed seeds, drops four to six seeds in each hole and covers them at the same time. All the various produce raised is grown in this promiscuous style. . . The fields, which are much better worked

in eradicating the jungle than those for which the Bengal plough performs the same office, are likewise as much better weeded; and howsoever strange to ~~our~~ ~~English~~ ears the huge mixture of crops may sound, this mixture does not greatly exceed the practice of Bengal, nor is it inconsistent with good returns, though there be no artificial irrigation whatever.

" . . . The domestic animals . . . agriculturally viewed, . . . are a dead letter, not even their manure being employed. . . . They have abundance of swine and poultry, and not a few of goats, ducks, and pigeons, but no sheep nor buffaloes, and cows are scarce. Milk is little used, but not eschewed, as by the Garos it is."

Hodgson says (p. 103) of the Bódo and Dhimál languages:

"What can be more striking . . . than agriculture being expressed by the term 'felling' or 'clearing the forest'; than the total absence of any term for 'village', for 'plough', for 'horse', for 'money' of any kind"

(p. 112) "The Bódo and Dhimáls, whom I communicated with, alleged that they cannot endure the climate of the open plains, where the heat gives them fevers. This is a mere excuse for their known aversion to quit the forest; for their eastern brethren dwell and till like natives in the open plains of Assam, just as the Kóls of south Bihar (Dhángars) do now in every part of the plains of Bihar and Bengal"

Hodson, T. C. (1911) *The Naga Tribes of Manipur*. London: Macmillan and Co., Ltd. xiii + 212 pp., 17 pls. [incl. map.]

The Naga and Kuki tribes of Manipur occupy in part much of the state, which lies between 23° 50' and 25° 30' N; and 93° 10' and 94° 30' E. These tribes practice both shifting and permanent (terraced wet-rice field) cultivation, but some of the Naga are exceedingly migratory within their narrow limits, here today and gone tomorrow, because they have no land suitable for irrigation. Quotations from Hodson follow:

(p. 50) "We have in this area tribes who migrate periodically and practice only the jhum system of cultivation. We have tribes such as the Kabuis (and possibly the Marrings), who keep to their village sites with tenacity, but are compelled to change the area of their cultivation year by year in set rotation. . . . Nearly every tribe has some terraced fields but among the Kabuis, Quoirengs, Marrings, and Chirus, jhum cultivation provides the bulk of their sustenance. . . ." The

jhum system has been described both by Colonel Lewin and Colonel McCulloch as follows:

(p. 51) "The mountain land around the village, within certain fixed bounds, is usually the property of the village. This they cultivate with rice in elevations suited to it, and with other crops in situations unfitted for that species of grain. The spot cultivated this year is not again cultivated for the next ten years; it having been found that the space of time is required for the formation of a cultivable soil by the decay of the vegetable matter that again springs upon it. The chief crop is rice, but the produce is very uncertain, both from the vicissitudes of weather, and the differing richness of the soil which they must of necessity cultivate in their ten years rotation. As, for instance, is the case with Nongba, when, by rotation, their cultivation falls upon the south side of the village, they reap but little and support themselves principally that year on wild yams. This root a beneficent Providence has so diffused throughout these mountains that no native of them able to dig them up can starve. . . ."

(p. 52) "A bamboo jungle of the species called "Maubee" is to cut, compared with a dense tree jungle, easy, but still it is no light labour. After having been cut down, the jungle is allowed to dry, so that it may be fired in season, for if fired out of season, as sometimes through accidental conflagrations happens, the crop to be raised will be most probably deteriorated, or the land even be rendered unfit for it. Great damage has occurred to the hill people from the carelessness of travellers on the Munnipore Road, in lighting fires and leaving them burning in the neighborhood of dry jungle. These fires communicating with the jungle have sometimes been the cause of the premature burning of the newly felled jungle, not of one, but of many villages. A premature fire caused by a hillman is visited upon him with severe punishment, and before a village sets fire to the jungle cut down on the spot about to be cultivated, it gives some days' notice to the neighboring villages of the day on which it means to do so. At the season of firing the jungle cut for cultivation, as all the low uncut jungle is comparatively dry, on setting fire to the former the latter also ignites, and the whole mountain becomes a sheet of fire. This to a person safe from it forms a most magnificent spectacle, but one of fear, and the greatest danger to those exposed to it. If the felled jungle has been thoroughly dried, the whole is, with the exception of the larger trees, reduced to ashes. The soil for an inch or two is thoroughly burnt, and having been scratched up with their little hoes, is mixed with the ashes and becomes ready for the reception of seed, which is sown broadcast. They measure their cultivation by the number of baskets required for seed. Across the field in parallel lines, at no great distance apart, they lay the unconsumed trunks of the trees; they serve as dams to the water which comes down the face of the hill when it rains,

and prevents the soil being carried away with it. In bamboo jungle the bamboo stumps serve the same purpose. The field has to be constantly watched against the depredations of birds and wild beasts, and, weeds being very rapid in growth, to be frequently weeded."

Among all of the tribes there are religious festivals (called genna) connected with both agriculture and hunting which come at definite times in relation to harvest and planting, as well as less regularly timed magico-religious "rain-compelling" ceremonies when the necessity for them arises.

For interesting matters regarding the agricultural and hunting practices of individual tribes the reader must refer to the original work, but it is especially notable that the Kabui had established a perfectly regular ten-year cycle of jhum cultivation and succeeding jungle fallow. They have a three-day festival (genna) called Reengnai in January. Then, Hodson said (p. 171):

"On the termination of the Reengnai they go through the ceremony of taking the omens in regard to their place of cultivation, but this seems to have descended to them merely as a ceremonial relic of former times, for the circle of cultivation is never broken, let the omens be what they may. . . . These festivals over (those for ear-piercing and the omen taking for the year), the cutting of the jungle for cultivation is commenced, which, when finished, is crowned with the festival of 'Oodooee yung', or drinking the juice of ginger. . . ."

Hoehne, F. C. (1910) *Comissão de Linhas Telegraphicas e Estrategicas de Matto Grosso ao Amazonas. Anexo no. 5. Historia Natural. Botanica. Parte 1. Rio de Janeiro: 1910. (Introdução, pp. 5-11.)*

The region of S. Juiz de Caceres, (antiga) formerly Villa Maria, is a plain at the edge of the Rio Paraguay, reaching to the serra do Quilombo at a distance of three leagues to the eastward. It is irrigated by temporary streams in the rainy season but is dry and arid during the remainder of the year. The rachitic vegetation is that of cerrados and cerradões, more or less dense, and, as almost all the campos of the state, in the region of criadores, devastated annually by fire, for which reason the flora is limited to species which can withstand it, springing annually from subterranean parts, as do the most useful annually renewed forage plants.

Of primitive wide-spread plant formations of Matto Grosso Hoehne distinguishes four types, namely: the (1) forests (mattos), (2) the prairies (campos), (3) marshes (pantanaes) and (4) aquatic habitats (lacustres). These are divisible into subtypes.

He has a description of the great flooded areas along the Paraguay River, the pantanales.

Hoehne, F. C. (1914) Expediçãõ Scientifica Rosevelt-Rondon. Anexo N. 2. Botanica. Rio de Janeiro, Nov. 1914.

Part of this publication (pp. 9-19; 22 photographs on 11 pl.) consists of "Observações Phytogeographicas, Physionomia e Aspectu Geral da Vegetaçãõ."

The writings of Rondon and those who accompanied him in his explorations from the great central campos of Brazil through the Amazonian forest are especially interesting from the standpoint of the effect of Indian clearings within and at the edge of the forest. In particular the contributions of the botanist Hoehne must be reviewed.

In our thinking about Brazil many of us have chiefly in mind the great sparsely inhabited flood-plain forest of the Amazon, conspicuous to travellers on the river, about which so much has been written. Actually, however, a large part of Brazil consists of other forest types, alternating with prairie, and the prairie areas are not continuous. The part of Brazil below Rio de Janeiro comprises the extra-tropical portion, the states of Parana and Rio Grande do Sul, which have been the scene of such rapid non-Portuguese immigration that they are culturally somewhat distinct from the tropical states, in which the population, mixed White and Negro, has developed the more typical Brazilian culture aspect.

The two southern states have much open prairie which may be thought of as an extension of that of Uruguay, which, in turn, adjoins and is largely similar to the pampas of Argentina. Here the landscape, utilization, and developmental problems have many aspects that are almost identical with those of the North American temperate prairies, for they are largely grazing lands, but also some aspects that are peculiar. Our North American prairie, for example, affords no exact counterpart to the great stretches of smooth surfaced superficially weathered volcanic rocks, covered with the thinnest of soil, and cracked into small angular chunks separated by thin sheets of soil, which barely provide for the penetration of fine roots. Such a land is all made of bits of half-rotten rock fitted together like a mosaic, and once broken by the plow, becomes a mere mass of rubble without anywhere nearly enough soil to fill the chinks, and that quickly washes down to the undisturbed land. Such prairies are extensive in Uruguay and are said to extend into southern Brazil. In Uruguay, they present the aspect of land that is best adapted to permanent use for grazing, unless perhaps the surface were to be plowed up deeply

enough to provide for tree growth, either for fruit or for timber, but certainly not for ordinary farm crops. Such lands are botanically very interesting, for they have existed for a long time, geologically speaking, - long enough to provide for the evolution of prairie vegetation. Those who believe that all humid prairie is potentially forest land, and remains prairie only by fire control, should study in Uruguay the botanical aspects of ancient lava flows, which in North America have no exact counterpart because they occur in arid rather than in humid areas.

The Brazilian extra-tropical southern prairie has been described as resembling that of Uruguay. Westward from Rio de Janeiro into the enormous state of Northern Matto Grosso the continuity of the prairie is interrupted by forested mountain ranges running north and south but finally an enormous flat prairie is reached, the Planalto de Matto Grosso, with which are associated the minor ranges known as the Serra dos Paresis, the Serra Formosa, and others. These hills are the very heart of an almost continuous central Brazilian grassland or campo of the sort that is seasonally well watered although bearing vegetation that can withstand periods of drouth. Here arise rivers that flow northward to the Madeira and the main Amazon, southwestward to the Paraguay, and southeastward to the Parana.

A true picture of this great region of campos can only be seen by considering not only its typical aspect, but also its boundaries and its center. The reason is that it is not uniformly bounded by moist forest. If it were traversed by an axis running in a direction from southwest to northeast it would merge into lacustrine areas at the southwestern border along the paraguay River, but into relatively dry forest and then arid country to the northeast. This axis would give the most extreme variation in habitat. An axis from northwest to southeast would traverse successively the flood-plain forest of Amazonas along the Madeira, the campos, and then the moist forest of the eastern ranges, interspersed with campos. The intermediate north to south axis would strike from the flood forest of Amazonas across the campos and then unto the temperate type of Uruguayan campo. Any such simplified and generalized description would be far from the truth if the details furnished by hills and river valleys were not left out of consideration. It is almost as grotesque as a biologist's diagrammatic description of the human body as basically comparable with a doughnut, traversed by an opening extending from top to bottom. A basic generalization is helpful even if too simplified.

Hoehne described the extreme headwaters of the rivers that originate in the Planalto de Matto Grosso as arising in forested hills. The latter are by no means insignificant even though isolated islands of forest in a great sea of prairie which in the vicinity of the hills is wet (campo paludoso) but varies to dry at certain seasons. It has a rich herbaceous plant

cover but is mostly completely devoid of trees and shrubs, or with scattered palms or clumps of palms. Wet prairie is replaced on its outer border by hill forest (cerrado) which, like that on the inner side, rises up like a wall (parede) and contains a rich component of those herbs and suffrutescent plants that grow in humid and shady places.

The cerrados or wooded hills of the central plain are largely characterized by the same species of woody plants that are found on the cerrados that surround the Grande Pantanal, (the great river marsh of the upper Paraguay), many being palms. They are species which, if encountered in the surrounding woods, indicate that the campo itself is close at hand. The strict campos which occupy the higher areas of the plateau if having dicotyledonous woody plants at all, have only rachitic and depauperate vestiges of the tree vegetation, generally not over a meter tall, but of the same species that are of tree-like size on the cerrados. Many such plants that persist in the campo do so because they sprout from below the ground after the part above ground has been killed by fire.

Campos destitute of woody plants extend for unbroken leagues over the plateau, so that the observer has a feeling as though he were at sea. The traveller, Hoehne said, seems always to stay at the center of a great concave depression, perfectly orbicular, enclosed by the blue dome of the sky.

The plants of the campo are mostly grasses and sedges, with many viney or suffrutescent Leguminosae, among the latter invariably species of Cassia and Banhinia. If there are woody plants, one finds Anacardium humile L., rachitic Andira, and the widespread sand-paper leaved Curatella americana which extends in prairies and savannahs to Mexico and the West Indies, varying in the degree to which it becomes pauperulous.

Where the woody islets of carrado vegetation appear, and in the more or less forested border of the campo, the bases of the woody species are carbonized by the fires that nearly annually attack them. The herbaceous species of woodland border that persist on burned-over areas are like the few woody ones, those that can sprout from underground parts, and include many Dioscoreaceae, Compositae, Acanthaceae, Orchidaceae, Leguminosae, Labiatae, and Amaryllidaceae. Some of the species are so well adapted by structures for spreading underground that they can soon regenerate colonies several meters in diameter after being swept by fire. In the zone between cerrado and campo the woody plants are merely the vestiges that have escaped destruction by fire.

It is not to be supposed that identical plant associations compose all cerrado or all campo in the Matto Grosso area. Among the cerrados da chapada and those which extend below the hills surrounding the Grande Pantanal, which are intermingled with open prairies, there are some of more or less distinctive

composition. Hoehne mentions, for example, associations of Comelia Hoehnei, Macairea rotundifolia and Macairea Hoehnei which may occupy great areas so dominantly that when they flower, from March to May, they become vast natural gardens.

As for the chief vegetational formations of Matto Grosso, Hoehne regards all of them as primitive or natural regardless of whether or not one regards the effects of fire as a result of human intervention. We may assume from what he says, however, that the position of the sharp line of delimitation between forest and prairie does depend upon the effect of fire.

So far as we find evidence, the Brazilian Indians have been predominantly forest dwellers from ancient times to the present, and modern man has tended also to establish himself by clearing forest. Therefore certain exceptional vegetational areas have resulted directly and obviously from human occupancy. Such are the recent large forest clearings of modern man and the smaller but successively abandoned and reoccupied clearings of the Indians, with at first their interesting primitive agriculture, followed by secondary forest. The clearings (capoeiras) represent the very ancient custom of clearing a patch of forest for only a few years of occupancy. When soil fertility diminished and weeding became burdensome it was abandoned and grew up to a relatively dense tree community of a few quick-growing, soft-wooded species, which would in time be replaced by more lasting kinds of greater variety. In Matto Grosso these capoeiras or Indian clearings, old and new, are frequently encountered, Hoehne tells us, in the regions inhabited by the Nambyquaras, but he leads us to infer that all sparsely populated frontier areas are likely to show modern agricultural practices resembling that of the Indians.

Hoehne considered the region of Brazil traversed by the Rio Paraguay as divisible into hydrophile and sub-xerophile plant associations of various compositions, the first in general of forests (mattas) and the latter prairies (campos). One finds, however, wet prairies or prados and subxerophile forests, the former called in Portuguese pantanaes (Spanish, pantanales) and the latter cerradões. The wet prairie association is not only especially characteristic of the Grande Pantanal of the southwest Brazilian boundary but also surrounds the uplands of the higher rolling or hilly land at the center of the campos.

Hoehne attempts to give some comprehension of the size of Matto Grosso, certainly as much prairie as forest, in spite of the name, by stating that it could hold the entire population of China without being more densely inhabited than Belgium. One should state, however, that such a comparison is only for size since the notoriously poor leached soils of the (at least seasonally) wet tropics have no such carrying capacity as those of a rich temperate land.

Hoehne, F. C. (1915) Relatório da 2ª viagem ao Estado de Matto-Grosso. Anexo N. II (1ª parte), in Comissão de Linhas Telegraficas Estrategicas de Matto-Grosso ao Amazonas. Relatório pelo Coronel Candido Mariano da Silva Rondon. 3º Vol. Rio de Janeiro: 1915

This report covered the period from December 1910 to April 1913 in the general region of Corumbá. Hoehne noted that every year, in July or August, the cerrados and campos were generally burned off.

Hoehne, F. C. (1916) Relatorios dos Trabalhos de Botanica e Viagens executados durante os annos de 1908 e 1909. Comissão de Linhas Telegraficas Estrategicas de Matto-Grosso ao Amazonas. (Publicação n. 28. Anexo n. 4.) Rio de Janeiro, 1916.

On 6 April 1908, Hoehne (p. 34) left Tapirapôan for Jureuna, passing through Aldeia Quemada, Rio Verde, Uaicoacorê and Aldeias, arriving at Juruena on the 19th. He made daily collections to the hills and forests and took occasion to visit the large clearings (derrumbadas) made by the Nhambiquaras for growing manioc and milho, who had abandoned three aldeias near Juruena.

The area along the Rios Paraguay and Sepotuba between San Luis de Caceres and Porto dos Bugres is almost entirely forested. The less swampy parts have the best forest, in which Orbignia speciosa predominates. The forest becomes very rachitic where lowest and most inundated. Away from the river, forest is succeeded by more or less open campo which at Porto do Campo approaches the river. These open campos are splendid for grazing, and alternate with groves of palms. The more open of the "palmeiras" are known as "auacuryzaes" because "acury" (the local name for 2 species of Attalea) dominates.

(p.40) In places more remote from the river, the forest, destroyed by repeated fires, is replaced by great stretches of "sapézaes" which are especially characterized by the grass Imperata brasiliensis Trin. This grass develops with great rapidity by subterranean rhizomes and forms great accumulations of dry leaves which burn with incredible rapidity when ignited. The trees that resist the first conflagration will assuredly succumb to being repeatedly fire-swept. Hoehne notes that Imperata brasiliensis and the manner of its spread by fire is no more characteristic of the Matto Grosso than of the state of Rio de Janeiro and some other parts of Brazil.

Hoehne, Federico Carlos (1937) *Botanica e Agricultura no Brasil no Seculo XVI (Pesquisas e Contribuições)*. São Paulo: Companhia Editora Nacional. 410 pp. (Bibliotheca Pedagogica Brasileira, Ser. 5a, Brasiliana, Vol. 71)

In his useful compendium on the botanical observations of the early writers on Brazil, Hoehne has called attention to several observations regarding the effect of primitive agriculture, fire, etc., on the original vegetation.

One of the first indicates that the early Brazilian agriculture was not on the campos but in forest clearings. Hans Staden was a prisoner of the Indians, and in spite of the expectation that he might at any time become the chief part of a cannibal feast he recorded good observations on whatever he saw, and published a book in 1556. He said that in the places where they wished to plant mandioca they first had to fell the trees and let them dry for one to three months. They then burned them, and in the ashes, among the carbonized trunks, they planted the roots which they called mandioca.

The same information was given by Padre José de Anchieta, whose letters of 1554 to 1594 in the original edition constitute one of the rarest items of Brasiliana. (There was a Brazilian edition in 1933.) He said that the staple food of Brazil was mandioca root, and that when it was to be planted forest was cut and burned.

Hoehne himself remarked on how little had changed in the mode of planting and utilizing manioc in the course of the centuries that have followed since these early observers wrote their books. He might have added that the plant has gone around the world in the tropics and has everywhere been adopted into a system of shifting agriculture similar to that of aboriginal Brazil.

Holdridge, Leslie Besselaer (1947) *The Pine Forest and adjacent Mountain Vegetation of Haiti considered from the Standpoint of a new Climatic Classification of Plant Formations*. Dissertation: University of Michigan, Ann Arbor, Feb., 1947. (M.S. published in microfilm by University Microfilms, Ann Arbor, Mich.) iv + 186 pp., 24 pl.

Our chief properly localized and mapped information about Haiti results from the field work of L. R. Holdridge () who has studied especially the pine forests and adjacent vegetation in the region of Morne des Commissaires. He presents (1947, Plate 1) a detailed map of the pine forest, the hardwood forest together with the garden land of the natives, so grouped because the extension of agriculture has always been at the expense of broad-leaved forest, and savanna. The region is easily located on any map of Hispaniola because it is located in the right-

angle which points eastward near the southern end of the boundary between Haiti and the Dominican Republic. Holdridge has the following references to clearing for primitive agriculture and to fire:

(p. 5) "Surrounding and sometimes in patches within the pine forest are stands of broad-leaved trees which the natives refer to as "bois raque". This portion of the region, including areas cleared for agricultural use, is designated as the hardwood section. . . . Clearings for agriculture have almost completely destroyed the original hardwood forest and it is doubtful if any one area may be taken correctly as virgin or original forest."

(p. 16) "On deeper soils . . . profiles show only two distinct horizons, the black upper layer up to two feet in depth and the red layer below reaching to the parent limestone. Under the pine forest, red soils predominate and the black layer is only a few inches in depth. On trails where natural vegetation is excluded, and on sloping agricultural plots where erosion is unimpeded and vegetable refuse is repeatedly burned prior to seeding, for several years, the black layer is completely absent or is largely replaced by red-colored soil. However, most gardens are abandoned before complete degradation has taken place."

(pp. 17, 18) "The black soils are apparently extremely fertile. . . . On the contrary, the red soils of the pine forest area or those exposed in degraded garden plots are extremely infertile. The lack of humus in the pine forest is readily traced to the intermittent fires which have swept through the area. The abandoned areas within the hardwood sections and the complete lack of cultivation within the pine lands in a region where the population pressure on agricultural lands is so heavy, provide the best evidence for assumed infertility of the red soils."

(pp. 30, 31) "In the late thirties, the wide-spread massacres of Haitians in the Dominican Republic sent the remainder fleeing back across the border to their mother country. . . . One of the colonies set up to handle such poorly equipped immigrants was located at Savane Zombi in the southern portion of the Morne des Commissaires area and following this period great areas of original or second-growth hardwood forest were cleared and burned to make way for garden plots. In 1939 the clearing of the forest at Savane Zombi was under way, but it was noted that some of the forest being felled consisted of almost pure stands of Brunellia comocladifolia. As this is a weed tree which invades abandoned garden plots rapidly, it was evident that such plots had already been under cultivation from 20 to 50 years previously."

(p. 32) "The clearing of all these garden plots around the pine forest left few areas of hardwood intact. . . . Since population pressure is greater today than ever before,

patrolling and permit systems have been found necessary to protect the few remaining areas. . . . Probably the peak of land pressure . . . has been reached as soil erosion and land degradation move on inexorably. Already, [1947] many of the peasants complain of the poverty of the soil and plots are being abandoned."

(p. 33) "The practice of shifting cultivation is not restricted to Haiti. It is a wide-spread system of agriculture in the tropics and works well if the population is kept in balance or as long as there are new lands to absorb an increasing population. When there is no more virgin forest, standards of living drop, and wide-spread poverty and suffering follow.

"To do the Haitian peasant of this section justice some explanation of other factors is necessary. His system of shifting cultivation is not entirely of his own making. . . . When questioned as to why they do not plant coffee or other permanent crops, they reply simply that if they worked hard to develop a valuable plot it would very likely be taken away from them by someone of more importance to the government."

(p. 40) "Pinus occidentalis occurs in solid stands in the higher mountains and plateaus of Haiti. . . . The pine stands are usually open. At higher elevations, the undergrowth . . . consists predominantly of shrubs. At lower elevations, grasses and ferns are much more common and impede walking off of the trails, especially in areas which have escaped fire for periods up to five years. . . . Where fires have been absent for a longer time, reproduction [of pine] may form a dense understory."

(p. 46) "On rich soils where fires have been excluded, only a few years suffice for an irregular growth of brush and hardwood seedlings or sprouts to rise above the grass and fern layer. The most common hardwood trees to be found are Weinmannia pinnata and Garrya Fadyenii, usually several-stemmed as sprouts from persistent bases. . . . The largest hardwood trees found distinctly away from hardwood stands are Lyonia microcarpa and these reach diameters of only 4 to 6 inches. The latter is very common as a shrub in the pine forest and has a very interesting protective adaptation which protects it against fire-killing. Right at the surface of the ground, it develops a plate of stem tissue one to several inches thick which may reach two or more feet in diameter. Large trees of the same species may be seen in adjacent hardwood stands attaining a height of 50 to 75 feet, and a diameter of over two feet."

(p. 54) "Grasses and sedges are a very important component of the ground vegetation under the pine forest. They are more numerous and conspicuous at lower elevations and in sections where fires have been most numerous.

(p. 64) "At first sight, the distribution of the pine without preference for any particular rock formation or type of soil appeared to correlate with the fact that occasional fires allowed the pine to maintain itself on those areas in the mountains

which dried out sufficiently to burn. However, such an hypothesis was found untenable for geologic time between the immigration of the pine and the first exploration of settlement of runaway slaves in the mountains, which could not have preceded the sixteenth century. Electrical storms are confined to the wet season, and therefore offer no reasonable explanation for the initiation of sufficiently frequent widespread fires. Climate, and specifically temperature, appears to offer the most logical solution for the persistence of this species."

Holdridge's hypothesis is that the pine persisted naturally above the frost line, throughout recent geological time. He says: (p. 66) "Apparently, the pine stands below the frost line were less extensive in pre-columbian time and occurred as patches or scattered trees mixed with hardwoods in the frost hollows, on areas of poor soil and along the crests of the ridges. As soon as man entered the area, occasional fires began the process of pushing back the hardwoods from sections which the pines were able to invade because local sources of seed were available and to hold because the pines are quite fire-hardy except when young. At the present time, the pines hold those areas which become sufficiently dried out to burn over during the dry season."

(p. 67) The biotic factors have increased the extent of the pine lands at lower elevations through burning, but too frequent fires and agricultural clearings are working in an opposite direction towards a decrease in density as well as area of pine in unprotected sections."

(p. 68) "The hardwood forest has been reduced to scattered remnants as a result of the long continued clearing and burning preceding the establishment of agricultural plots. . . . The abundant clearings have favored the increase in numbers of weedy species, and, at the same time, have brought about almost complete extermination of those species which occur as scattered individuals in the natural forest and do not reproduce readily."

Holdridge's classification of vegetation recognizes Tropical Savana as a basic type of tropical vegetation. His sequence of tropical types (Plate 9) runs as follows: (1) Desert, (2) Desert Bush, (3) Thorn Forest, (4) Savanna (or very dry forest), (5) Dry Forest, (6) Moist Forest, (7) Wet Forest, (8) Rain Forest. He considered tropical lowland wet savanna as an edaphic modification of the tropical "Wet Forest". (It appears to coincide with seasonal flooding, drought, and sterile soil.)

The Haitian now completely destroyed or modified hardwood forest is a climax which under continued human attack is no longer completely attained. Small clearings surrounded by still relatively complete forest grow up quickly to forest which has a predominance of the "weedy" species that are most

easily seeded, but the rarer species may establish themselves. After secondary forest has been repeatedly felled and burned in adjacent or nearly adjacent areas two stages are interposed between primary and secondary forest, namely, the herb and grass stage and the climbing bamboo and liana stage. Needless to say, repeated fires would indefinitely retard restoration of real forest. Flowering and seeding of bamboos, without following fire, would result in rapid forest restoration.

From the standpoint of human modification of the tropical forest, it is nearly always the "Dry Forest", with precipitation from 1000 to 2000 mm., which is preferentially destroyed by shifting agriculture. In Africa Holdridge considers the high-grass, low-tree savanna of Shantz to be the equivalent, as affected by long-continued use of fire.

Holdridge's tropical savanna is exemplified by the llanos of Venezuela and Colombia, with precipitation from 500 to 1000 mm. He considers the Acacia and tall grass savanna of Shantz to be the African equivalent. The rainfall is from 500 to 1000 mm. He suggests that extensive bamboo forests of India may very well be savannas composed of giant grasses. The equivalent in the Caribbean would be what Beard termed "cactus scrub".

According to Holdridge (p. 167) after man occupied southeastern Haiti "fire-hard pine has been favored over the hardwoods. . . . by the firing of those sections which dried out sufficiently to burn during the dry season. The occasional brush and grass fires in the pine forest have resulted in open park-like stands with a distinctive flora very different from that of the surrounding hardwood forests. . . . The burning of litter and humus has impoverished the soil and saved the pine forest from the inroads of shifting agriculture. In the surrounding hardwood areas the richer soil has resulted in the almost complete destruction of the natural forest through clearing for gardens. Succession within the cleared hardwood areas proceeds ordinarily through a brief herbaceous stage into a rather long-enduring grass stage. Woody vegetation gradually takes over sections from the grasses. . . ."

Hooker, J. D. (1909) Botany. Vol. I, Chapter IV, pp. 157-212, in: The Imperial Gazetteer of India. . . . New Ed. . . . Oxford: Clarendon Press.

Hooker gave little attention to the modified flora in his sketch of the phytogeography of India and adjacent regions, but remarked (p. 195) of the grasslands of Ceylon as follows:

"Remarkable features in the vegetation of Ceylon are the Patanas, grass or shrub-covered stretches of country, most

prevalent in the south-east of the island, from the sea to 5000 ft. altitude. They are partly natural, and partly due to the destruction of the forests and their replacement by subsequently abandoned field-crops. A peculiar, endemic, pale green Bamboo, *Ochlandra stridula*, so called from the crackling noise caused by treading on its broken stems, covers hundreds of square miles in these Patanas."

Humbert, Henri (1923) *Les Composées de Madagascar*. Caen: Imprimerie E. Lanier. 337 pp., 6 pl.

From the standpoint of changes in the vegetation of Madagascar this work is an important one, for in it Humbert maps the geographic distribution of the compositae, a part of the flora which he collected with especial attention. He follows Perrier de la Bathie in recognizing five phytogeographic divisions of the island, namely, (1) plains and hills of the east coast, (2) high plateaus and mountains of the center, extending almost to the north end of the island and almost to the south end, (3) the plains and plateaus of the west and the north, in two disjunct areas separated by a small interpolation near the north end of (4) the distinctive Sambirano region, and (5) the subdesert coastal south and southwest, extending as a narrowing fringe up the west coast for a third of the length of the island. These divisions do not entirely accord with those of his predecessor Baron () who recognized only the first three, and placed the line between the first and second regions in a different place, along the contact of the prairie and the edge of forested declivity from the central plateau to the eastern coastal plain. Perrier de la Bathie followed by Humbert viewed the marginal prairie as artificial, caused by the brush fires, and therefore placed the phytogeographic line a little farther west.

The maps show the remarkable facts (1) that the species have very small areas of distribution, (2) that each little area generally falls entirely within one of the five phytogeographic regions, but (3) the indicated distribution seldom shows a good spread of collections over the whole of one of the natural distributional areas, although one or two non-cosmopolitan species are also considered to occur as far away as South Africa or the Congo.

In explanation of these peculiar phenomena Humbert states that the prairie, which covers 80% of Madagascar, is not a primitive formation, but, on the contrary, the result of periodic brush fires. In this conclusion he states that he accords with the views of Perrier de la Bathie. He therefore concludes that there has been wide-spread extinction of species which had no means of adaptation to such a regime. He says (p. 228)

that plants capable of accommodating to periodic fires are the exception, not the rule, and that the majority are mostly cosmopolite grasses. The few endemic-species which persist in the meagre and largely wide-spread prairie flora are infrequent and have a precarious tenure of place among the abundant non-endemics which are mostly those of fire-swept regions of other tropical countries. There are certain endemic species of Compositae which find conditions more favorable to propagation in wholly artificial habitats, such as the lands cleared by chopping and fire for cultivation or human habitation (weedy places called by the Malagasy 'tany voa volo'). Among these adaptable species are a few trees and shrubs, many suffrutescent and herbaceous perennials, and various annuals which are veritable satellites of cultivated plants. Among the annual weeds as a group, the majority are cosmopolites.

In the humid east coastal region the land cleared for "tavy" (shifting cultivation) and abandoned becomes occupied by a dense growth of a few species, dominantly, perhaps, by one or two. (In such places are found small or seedling trees, shrubs, and coarse monocotyledons with rhizomes. A densely overgrown clearing, with its few species, is known as savoka, and it may consist largely of indigenous species, but they are likely to be subordinated to the composite tree Psiadia altissima of which Humbert says (p. 175) that it is one of a plexus of hardly distinguishable subspecies and varieties in a polymorphic group in which he cannot make clear distinctions, and which extends widely over continental Africa and reaches Arabia.

Humbert (p. 234) goes on to discuss species in course of regression and species in course of extension. His thesis is that following man's disturbance of the ecological equilibrium by deforestation and continually renewed burning over of the land, the great majority of the endemics, especially those making up dense forest, were in process of rapid extinction, as the forested area diminished from year to year.

On the contrary there were a minority of other endemics, chiefly light-loving plants of habitats of limited extent, such as rock exposures, the edges of streams and ravines, etc., which took possession of abandoned tavy land immediately, showed considerable genetic variability, and, by natural selection from vastly expanded populations on fresh areas, provided points of departure for evolution of new varieties.

Other endemic species, but relatively few have maintained themselves in prairie when the latter quickly succeeded forest by the burning of savoka, and even if the prairie was then repeatedly burned.

On the whole, however, every extension of prairie at the expense of forest and every burning-over of prairie reduced the native flora and extended the introduced flora of cosmopolites.

The latter as time goes on, come more and more to be the species to take possession of tany voa volo, the man-made habitats, Prairie plants are mostly non-endemic and of wide distribution, whereas the shrinking original forest is composed almost entirely of endemics.

Humbert, Henri (1927) La destruction d'une flore insulaire par le feu: Principaux aspects de la Végétation a' Madagascar. Memoires de e' Academie Malgache. Fascicule V. Tananarive, 1927. 79 pp., 41 pl,

A classic in the literature of the effects of fire in the tropics is this strikingly illustrated, important work of Henri Humbert, perhaps more often honored by being referred to at second-hand than by being read, since various authors, copying each other, have called its author "Henry Hubert". There may actually be an author by the latter name, but the present reviewer has failed to trace him.

Humbert relied chiefly upon the observations of Perrier de la Bathie and his own in drawing his conclusions. Except for reference to the earlier work of the English missionary Baron and H. Poisson's Paris thesis of 1912 he cites no literature specifically on the flora of Madagascar except that which appeared within the decade of his own contribution. In order to have some basis for appraising somewhat critically the validity of Humbert's conclusions the present reviewer has gone to considerable pains to search farther back in the literature on Madagascar, which is by no means scanty, but has not had access to all of it.

The general conclusion must be that Humbert's thesis is in the main borne out by the descriptions of older writers, but that someone would do well to undertake reconstructing the original phytogeography, in doing which as many as possible of the localities of old travellers should be reexamined and their routes retraversed. There is no reason whatever to doubt that the original vegetation has been largely destroyed, that many

endemics have become rare to the point of extinction or at any rate largely replaced by introduced weeds, that original phytogeographic delimitations have been largely obscured, that forest of indigenous species has receded almost everywhere, and that this has come about by clearing for shifting agriculture, fire, and excessive grazing.

On the contrary, there is no evidence to bear out the supposition that most of Madagascar was generally well forested within the period of human occupation. A critical reader will note that what Humbert has written about is the destruction of a tropical flora, not exclusively of the destruction of a tropical forest. The flora would include the plant associations of all phytogeographic areas, ranging from desert or subdesert in the southwest to the rich rain forest of a narrow belt along the east coast. The destroyed part of the flora would include differentiated herbs of highly diversified vegetational areas as well as woody plants, endemic species of prairie as well as those of forest. It is easy to misinterpret an author whose conclusions are inferred rather than read.

Humbert does, however, make the rather extreme statement that the vegetation of Madagascar, prior to the establishment of man in the island, was made up entirely of forests of very diverse types except for the vegetation of subdesert country of the south and southwest, which was occupied by euphorbiaceous brush, and of high summits, which were occupied by ericaceous brush and the xerophytes of rocky exposures. Whether this is true or not would depend upon the definition of forest, and Humbert's conception of forest must have been a very inclusive one, covering any plant association with any scattering of trees. If park-land with isolated specimens of *Adansonia*, thorn-tree and palm clumps or other individual trees scattered through grassland were considered as forest, then it would be true, for such land, in a state of unstable ecological equilibrium would be readily transformed by annual fires into grassland. Likewise, thorn-scrub might become desert. If, however, we think of forest as consisting of trees close enough together to provide considerable closed canopy, there is no evidence that such forest ever extended over most of Madagascar in the period of presumed human occupation. Furthermore it seems probable from the highly developed recently extinct avian fauna of grassland or savana, which would have required a long extent of geological time for its evolution, that phytogeographic and vegetational relations during the Pleistocene might have been in general outline the same as now. There has surely been profound degradation of flora and fauna, destruction of isolated forests, recession of great forests, and corresponding vast extension of prairie as a result of man's occupancy of Madagascar.

Humbert says that very ancient isolation of Madagascar as an island had resulted in its possession of a flora extremely rich in species, including thousands of kinds of higher plants which were not found, for the most part, in any other region.

Of the autochthonous forest only fragments of unequal extent remain, some exceedingly small. Their study gives evidence of how actual deforestation has surely taken place over great areas, and continues alarmingly, until now certain types of forest are all but gone, with the plants and animals that were characteristic of them. The most beautiful forests still existing when Humbert saw them were in process of being gnawed away, prior to their complete disappearance. This would soon result from shifting agriculture, called tavy in Madagascar, abusive exploitation, and prevention of reforestation (or maintenance of the grassland which had followed forest) by annual, or frequent fires.

Tavy Humbert considered to have existed from the most remote period of human immigration, as the easiest mode of agriculture using land for temporary cultivation which could not or would not be used for the prevailing type of permanent wet-rice agriculture by being flooded or irrigated, until no more forest remained to be destroyed.

Abusive exploitation is a modern phenomenon, no less nefarious than tavy, and the work of logging concessionaires greedy to realize the greatest immediate return from the forest without care for the future.

The firing of land by cattle herders to "improve" the pasturage for their herds had led, especially on the hilly areas, to ruinous erosion, which had exposed indurated laterite lying not far below the surface, and forming a new surface as dry, sterile and unproductive as can be imagined. The denudation and consequent deterioration of grazing land had increased the pressure of population on the little forest that remained, so that destruction accelerated. Only in the desert south, where there was not enough grass to propagate fire, was there a chance for endemic plants and autochthonous types of vegetation to maintain themselves.

In conclusion Humbert made a plea for the establishment of protected national parks and natural reserves, botanical and zoological. It would now be interesting to know how much change of policy came about that may have resulted in rational conservation procedures.

Humboldt, Alexander von (1850) Aspects of Nature in different Lands and different Climates; with scientific Elucidations. . . . Translated by Mrs. Sabine. Philadelphia: Lea and Blanchard 1850. 475 pp.

Humboldt, pioneer in the study of the geographical relations of vegetational types as well as of individual plants and plant groups, completed the third edition of his "Ansichten der Natur" in his eightieth year, and tells us that in between the dates of publication of the second and third editions he was able to revise considerably his conception of the relation of steppes and deserts to each other.

Perhaps the most interesting point in his discussion of the llanos, the campos and the pampas is his clear statement that human occupancy and therefore agriculture in America was originally in the forest. Students of ethnology have loved to interpose a pastoral phase between the food-gathering and hunting phase of human culture and the agricultural, but, as Humboldt observes, no pastoral phase intervened between food gathering and agriculture in America. Furthermore, the winning of agricultural land, every evidence indicates, was at the expense of the forest. It is to be greatly doubted whether even in the old world a pastoral phase was older than agriculture except perhaps in highly anomalous habitats. The use of the savannahs, llanos and campos of tropical America to primitive man was surely for hunting and never for agriculture. Humboldt's pertinent remarks follow:

(p. 33, 34) "But although the South American Steppe is covered with a thin coating of mould or fertile earth, and although it is periodically bathed by rains, and becomes covered at such seasons with luxuriantly sprouting herbage, yet it never could attract the surrounding nations or tribes to forsake the beautiful mountain valleys of Caraccas, the margin of the sea, or the wooded banks of the Orinoco, for the treeless and springless wilderness; and thus, previous to the arrival of European and African settlers, the Steppe was almost entirely devoid of human inhabitants.

The Llanos are, indeed, well suited to the rearing of cattle, but the care of animals yielding milk () was almost unknown to the original inhabitants of the New Continent. Hardly any of the American tribes have ever availed themselves of the advantages which nature offered them in this respect. The American race (which, with the exception of the Esquimaux, is one and the same from 65° north to 55° south latitude) has not passed from the state of hunters to that of cultivators of the soil through the intermediate stage of a pastoral life. Two kinds of native cattle (the Buffalo and the Musk Ox) feed in the northern prairies of western Canada and the plains of arctic America, in Quivira, and around the colossal ruins of the Aztec fortress which rises in the wilderness, like an American Palmyra,

on the solitary banks of the Gila. The long-horned Rocky Mountain Sheep abounds on the arid limestone rocks of California. The Vicunas, Huanacos, Alpacas, and Lamas belong to South America; but the two first named of all these useful animals, i. e., the Buffalo and the Musk Ox, have retained their natural freedom for two thousand years, and the use of milk and cheese, like the possession and cultivation of farinaceous grasses, () has remained a distinguishing characteristic of the nations of the Old World."

Humboldt seems not to have thought of maize as a "farinaceous grass". His discussion continues:

"If, then, pastoral life, that beneficent middle stage which attaches nomadic hunting hordes to desirable pastures, and prepares them, as it were, for agriculture, has remained unknown to the aboriginal nations of America, this circumstance sufficiently explains the absence of human inhabitants in the South American Steppes."

(p.36) "...Since the discovery of the New Continent, the Llanos have become habitable to men. In order to facilitate communication between the Orinoco country and the coasts, towns have been built here and there on the banks of the streams which flow through the Steppes. () The rearing of cattle has begun over all parts of these vast regions. Huts, formed of reeds tied together with thongs, and covered with skins, are placed at distances of a day's journey from each other; numberless herds of oxen, horses, and mules, estimated, at the peaceful epoch of my journey, at a million and a half, roam over the Steppe. The immense multiplication of these animals, originally brought by man from the Old Continent, is the more remarkable from the number of dangers with which they have to contend."

Humboldt has no remarks on the annual burnings of the grasslands.

Hutton, J. H. (1921 a) The Angami Nagas; with some Notes on Neighboring Tribes. London: Macmillan and Co., Ltd. xix + 480 pp., illust., 4 maps.

Hutton found that among the Angami Naga of Assam the very anomalous situation had arisen that so much of their land was in permanent irrigated-land cultivation or relatively short-term jungle-fallow rotation that too little grassland was actually available to supply thatch for roofing. Of this truly extraordinary situation Hutton said:

(pp. 77,78) "Of what might be called natural crops, the principal is thatching grass, which is, in some villages with little jhum land, of great importance. It is protected from

damage and encroachment, but not otherwise cultivated, and is usually village or clan property. Wood, including bamboo, is also preserved near the villages, and private property is well recognized in it, plantations being highly valued and carefully looked after. Pollarding is practised with a view to reducing to a minimum the destruction of trees, which are used not only as firewood, but for fencing fields. There is also a recognition of property in special trees, though they may grow on the land of another person - so much so that a dispute will arise as to the ownership of a tree which is actually growing on the ground of a third person not a party to the dispute. It is apparently enough for a man to say that he is preserving such and such a tree, and, provided that no one has previously set up a right to that tree, the tree becomes the property of the preserver, and he can claim damages for destruction or injury. This custom, generally speaking, is only applied to trees valuable for their timber for constructive purposes, and is not universal. Paths, streams, trees, and natural features of any sort may serve as landmarks, or there may be no landmark at all, while in the case of terraced fields the embankment of the field itself serves. When land is demarcated large stones are used, unless advantage is taken of water or some other natural boundary."

(Hutton's remarks on trees are very reminiscent to the reviewer of private ownership of particular planted trees among the Batak in Sumatra.)

In Hutton's time the Angami must have still had some older forest, for he wrote:

(p. 77) "Among Angamis 'Jhum' land is cleared by first felling the trees and then burning the low jungle and as much of the trunks of the trees as possible. The land is then cleaned, and before sowing, the fresh weeds which may spring up again are cleaned away at least twice. After sowing, the land is cleaned from three to six times before reaping."

Most land used for temporary unirrigated fields (jhum) was, however, not allowed to produce trees of very great size. Hutton states:

(p. 77) "A 'jhum' field is cultivated for two successive years, when owing to the excessive multiplication of weeds it is allowed to lie fallow for from five to fifteen years, according to the amount of land available for cultivation. It is usual to sow rice in a 'jhum' which is newly cleared, following this crop by millet, maize, or Job's tears in the second year, unless rice is sown again."

(p. 76) "For dry rice, terracing is not ordinarily employed, but when the hillside is very steep logs are placed at irregular intervals to keep the earth from slipping down hill. In some villages, notably Mozema, terraces are built for jhum almost as elaborate as those made for wet cultivation. These dry terraces are plentifully supplied with pollarded alders, which were doubtless saved when the fields were first cleared of jungle."

Hutton, J. H. (1921 b) *The Sema Nagas*. Macmillan and Co., Ltd. xxii + 463 pp., illust., map, charts.

The Sema Naga occupy a small tract in Assam to the northeast of the Angami, and, according to their traditions, migrated to their present territory from the south. The 26th parallel bisects their land, which is by no means as fertile as that of the Angami. Their agriculture is described by Hutton as follows:

(p. 59, 60) "The genuine Sema method of cultivation is jhuming pure and simple. The land is cleared and cultivated for two successive seasons, after which it is allowed to go back to jungle again for a cycle of years which varies according to the amount of land available. When there is enough land, seven years is usually reckoned the shortest time in which the land can become fit for recultivation, and ten or twelve years is usually regarded as the normal period for it to lie fallow, while fifteen to twenty is regarded as the most desirable time to leave it untouched, though land near a village, being more convenient for cultivation, is rarely if ever left so long as that. In the Tizu valley, however, and in parts of Kileki valley where the population has much outgrown the supply of suitable jhuming land, jhums may often be found cleared after only five years' rest, and in some villages even after three, while loads of earth have to be sometimes actually carried and dumped down in the rocky parts of the field to make sowing possible at all.

"The reason why jhum-land has to be left fallow so long is no doubt partly due to the fact that it becomes exhausted if deprived of the natural manure in the form of falling and rotting vegetation, and very largely to the fact that when the larger trees and heavier growth of vegetation are cleared away, weeds and low vegetation quickly spring up and increase at such a rate that by the third year it becomes almost impossible to keep the sown crop clean enough of weeds to give a yield even remotely proportionate to the labour expended."

(p. 60) "In jhuming the Semas do not, as some tribes do, first burn and then clear, but they clear the land, cutting down many of the trees, and then burn, afterwards cutting down the burnt trunks of the remaining trees, and then clearing up the fields and digging the ashes into the soil. Neither do they all imitate, at any rate to the same extent, the excellent Lhota practice of stripping the trees of all their branches and leaving a bunch of green leaf at the top so that the tree does not die, but branches out again when the two years' cultivation is finished. On the contrary, many of them cut the trees down and burn them entirely. The staple crops consist of rice, Job's tears, and millet, but a large number of

subsidiary crops are grown in among the first two in small quantities, and Job's tears themselves are often treated as just such a subsidiary crop to rice. "

The primitive use of planting sticks would appear to have been lost, as indicated by Hutton:

(p. 63) "The sowing is done, not by scattering the seed broadcast, but by sprinkling it carefully into little hollows made usually by the men with a blow of the small digging hoe (akupu) and scraped over by the women following with the horseshoe-like scraping hoe of bamboo or bamboo and iron (akuwo)."

Im Thurn, Everard F. (1883) Among the Indians of Guiana: being Sketches chiefly Anthropologic from the Interior of British Guiana. London: Kegan Paul, Trench and Co. 1883. xvi + 445 pp., 53 ill., map.

Everard Im Thurn found that in British Guiana the Indian agriculture was always conducted at the expense of the forest, although there were both forest and savannah Indians. He described the settlement of Cephias, Chief of the Indians on the Essequibo River, more than half Carib but with curly hair indicating some Negro ancestry, as follows:

(p. 9) "Some little distance from the river, on top of a hill, the three or four huts which form the settlement stand, surrounded by charred trunks of trees, by cassava and other plants cultivated by the Indians, and by razor grass (*Scleria scindens*) and other weeds, in a clearing walled by tall forest trees."

Describing Quatata, a Macusi village on the savannah belt at the Brazilian boundary, he said:

"This, which is one of the largest settlements on the savannah, consists of ten houses, all oval or round. These, as always on the savannah, are not mere open sheds, as in the forest, but have thick walls of wattle and mud, surmounted by high conical roofs of palm thatch.

(p. 205) "The savannah houses are almost invariably round or oval. There are no signs of cultivation around them, with the exception, perhaps, of a few stunted and untended white-podded cotton plants or faroah shrubs [*Bixa orellana*, used to paint the body red] loaded with their beautiful crimson fruit; for the fields belonging to these houses are far away, in the center of one of the thickets which line the gullies or edge the streams of the savannah country."

(p. 250) "The fields of the savannah Indians are . . . almost invariably at some considerable distance, often indeed very far, from their houses; for the ground round the houses is unshaded, stony, and unproductive, and it is only in the moist and shady coppices that provisions flourish.

. . . This is how the field is made. A fitting place having been chosen -- cassava, the main object of cultivation, flourishes best in sandy soil -- the men cut down the undergrowth and fell the trees. Then, when it seems likely that the weather will be dry, they set fire to the fallen refuse, . . . The fire smoulders long, often for many days; and when at last it dies out, there is an open space in the forest, floored with hot white ashes, and empty but for prostrate trunks, the crooked branches of which stand up into the air. . . The men have now finished their work.

(p. 253) . . . The field is deserted after three or four crops have been taken from it; and a new clearing is made and planted. Th

reason of this periodical desertion of the old and clearing of new ground is uncertain, but it is perhaps connected with some superstition."

On one occasion im Thurn made a three day trip from Quatata across almost uninhabited savannah to Euwari-manakuroo, a border settlement of Nicari-karu Indians, an ill-defined group of Portuguese admixture, who curiously enough, used the quippu to keep events in memory, just as the Inca did. Here forest occupied hills and mountains; the flat land on the contrary, was savannah. That some of the savannah had been in ancient times forest, is suggested by a curious fact that im Thurn related:

(p. 39) "One point of interest in this neighborhood was the comparatively frequent occurrence of stone hatchets and other similar instruments. Stone implements, though no longer used in Guiana, are to be found in greater or less abundance throughout the district."

As for the present distribution of forest and prairie in British Guiana, im Thurn says:

(p. 1) "The country may be said to consist of four tracts, lying one beyond the other, parallel to the coast line. Of these only the outermost or sugar tract . . . is at present cultivated and inhabited to any considerable extent. Next to this is the timber tract. . . This extends toward the interior as far as the lowest cataracts on the various rivers. . . The forest tract immediately succeeds the timber tract, and lastly, farthest from the coast, lies the savannah tract. . . . This must be distinguished from the meadows, also called savannah, of the coast and forest tracts. Again, along the banks of the Berbice and Corentyn rivers, often not far from the sea, there are considerable patches of open grassland; and these, too, are called savannahs. But the chief savannah, that which forms the savannah tract, is of all the land of British Guiana, farthest from the sea; it borders on the Brazils . . . and it is continued without any significant interruption into the great grass-plain which occupies so much of the interior of South America."

Inglis, John (1882) A Dictionary of the Aneityumese Language in two Parts. I. Aneityumese and English. II. English and Aneityumese. Also Outlines of Aneityumese Grammar. London and Edinburgh: Williams and Norgate. 200 pp.

In the Aneityumese dictionary (Inglis 1882) field or land under cultivation was uman; the land of the dead or land of spirits was uma atmas. There were other unrelated words, however, indicating that uma was probably one of the borrowed words from a different source than the oldest Melanesian, and belonging to

Indonesian culture. This word uma is traceable throughout the Malayan linguistic area.

If an acceptable idea of the prehistory of the migrations of agricultural peoples into the Pacific is ever to be worked out, it will depend to a considerable extent upon following the migrations of words. For this reason the reviewer has not hesitated to include in this sampling of the bibliography of his topic three or four dictionaries (of which many might be cited), as an indication that such materials are likely to be of great assistance in regional studies of any nature whatsoever, and are not to be neglected.

[Ishii, S.] (1911) Government of Formosa. Report on the Control of the Aborigines. Taihoku: Bureau of Aboriginal Affairs. iii + iv + 45 pp., many illust., 3 maps.

This work is mostly concerned with the military control of the aboriginal tribes, of Malayan affinity, but is elaborately illustrated and the pictures have good legends. The aborigines had been pushed out of the flat and fertile lands of western Formosa by the pressure of Chinese immigration through several centuries, and when the Japanese took over administration of the island they were confined to steep and exceedingly rugged mountains, except for a little coastal plain in the south-east, occupied by the Ami tribe, who had permanent agriculture with wet rice fields. In 1926, when the present reviewer visited the savage districts and crossed Formosa, they even grew glutinous rice, less productive than ordinary starchy rices and considered a luxury food rather than a staple. The reviewer crossed Formosa from east coast to west, including a trip to the summit of Niitakayama, and made cursory examination (crops were out of season) of the agriculture of the Taiyal, Bunun, Paiwan, and Tsuou tribes, which was of the shifting type.

The granaries, so far as observed, contained millet rather than the more frequent upland rice of other areas of Malayan ethnic affinity to the southward. The interpretation of Ishii's pictures by the present writer is therefore based upon personal observation of the region some fifteen years or more after they were taken. They are unnumbered plates.

For northern Formosa Ishii had a photograph of a Taiyal house with houselike granary beside it. In the background is a mountain slope showing scrub forest (secondary or badly culled). Between forest and house is a forest clearing still showing stumps and unburned debris, and beside it the area of grassland marking the place of a former clearing. The following picture shows the devastated condition of most of the lower parts of

the Taiyal country, mostly tall grass with brush and scattered trees, all fallow after shifting cultivation. It shows, "A Group of Taiyal Savages" who had been cleaning up a current clearing in brush land, for no big stumps or logs are visible. The next picture shows "A Taiyal Village" in clearing at the foot of steep mountains covered with apparently primary forest, and after that "A Taiyal Hill Clearing", with tall stumps evidently of secondary growth.

Ishii said (p. 3) of the territory occupied by the southern tribes that it was largely (he had reference chiefly to the area of the Bunun tribe) that it was in most parts barren hill-land, not fitted for cultivation. "Only the forests in the mountain region west of the Niitakayama (Mt. Morrison) including the Ari forest are available for timber, while on account of the ruggedness of the country inhabited by the northern tribe [Taiyal] the arable land is very scarce."

The picture "A House of the Bununs" shows in the background a mountain largely denuded but with some thin secondary forest, with one large new clearing and a patchwork of outlines of older abandoned ones.

The photograph of a "Hill Clearing of the Tsuou Aborigines" shows a grain field surrounded by a wall of piled-up rocks, some banana clumps, and a background of devastated mountains, covered with grass or brush, and with vague indication of old clearings.

Jacobs, Julius (1894) *Het Familie- en Kampongleven op Groot-Atjeh. Eene Bijdrage tot de Ethnographie van Noord-Sumatra.* 2 vols. Leiden: E. J. Brill. viii+408; iv+271 pp., 31 pl.

In the northern end of Sumatra is the sultanate of Atjeh, which became advanced in certain technologies such as making fine silks, but nevertheless, had not advanced to as high a condition in agriculture as some otherwise less advanced parts of the East Indies. Jacobs in 1894 published an exhaustive study of the social anthropology of Atjeh based upon observations made as early as 1879. At that time the chief culture was rice, grown either in wet rice fields or in dry. Elaborate irrigation systems for utilizing streams from the highlands for terrace cultivation in the diked fields, called blang or sawah, were little or hardly at all developed, but there were three other kinds of wet rice fields also called sawah, corresponding to the Javanese tarikan, tadah and rantja, these being dyked flat fields which impounded only the rain water that naturally fell on them, and fields in which was impounded overflow water from a stream, or which utilized swampy low lands in which there was seasonal fluctuation of water level. Generally in the highlands there were two kinds of dry fields, the one called ladang (as in Malay), and planted with a planting stick in the most primitive manner, corresponding to Javanese hoema (huma) and the second, empoeh, corresponding to the Javanese tipar, requiring the use of the plow. More in old times than when Jacobs wrote, the enrichment of the ladang with pepper and other plants during the period of rice growing led to the permanent pepper gardens which were important in the days of the pepper trade with Salem and other ports in the early 19th century. Transfer of the American pepper trade to other parts of the Indies on account of acts of piracy, and, later, the long decades of war with the Dutch caused retrogression in agriculture and almost complete abandonment of pepper gardens, which must have been a very interesting development on the way toward permanent land utilization. Pepper cultivation was practically a thing of the past in Jacobs's time. Atjeh then had lost its chief export product and had little more than a broken-down subsistence economy. There were numerous closely adjacent "villages" of only a few structures in an island-like grove of useful plants, surrounded in the lowlands by wet rice fields and in the uplands by lands occupied in a cycle of dry field cultivation, but separated by woods from adjacent villages, whether near the coast or far back. In spite of so much of the land being wooded that a view of the coast from the sea gave the appearance of a continuous forest, Jacobs expressed the opinion that in the whole of Great Atjeh there probably remained no primary forest but only secondary forest of various ages. The uncultivated lands were called: (1) tanoh (Malay, tanah) rimba, oldest forest land, even though actually primary; (2) tanoh padang prairie land, which by repeated use had gone over completely into Imperata grass; (3) tamah or abandoned ladang land of three types, namely, (a) tanoh cebit, if the new woods growth could be cut like brush, with the chopping knife called bilong

(Malay, belloeng), (b) tanoj rajoet, if the new woody growth was of tree-like dimensions, and (c) tanoj rimba, secondary forest called rimba by courtesy, as it were, since nothing older remained that could be cleared for cultivation. These terms implied that the land was available for reclearing. If a former occupant, however, had enriched the ladang so that fruit trees, such as mangos and coconut palms, or, in the old days, pepper, were growing on it, the planted useful trees or other plants were his, and could not be disturbed by anyone else. If he had made a house of other than flimsy construction, and had continued to make permanent plantings, it is a fair inference that a new "village" or kampong would have been established, which, if it prospered, would come to be like older ones and have its ladangs at a distance. In brief, the Atjehnese, like most other Malayan peoples, have in their village groves or orchards a beginning of permanent, or, better, continuous land utilization, in conjunction with shifting agriculture without land ownership but with right of continuous possession as long as used. In most Malayan communities land that has gone out of use, in the sense of producing no cultivated produce for the planter, is subject to reassignment by the chief to someone else.

Burial places of those who had died in the odor of sanctity become kramat (Mal. kèramat), sacred and inviolate spots, (which in other parts of the Indies might have been in sacred groves of old forest) with certain adjacent or more distant lands assigned to the keepers for maintenance, and the same was true of mosques, no matter how small and unpretentious. Lands developed as wet rice fields had to be surrounded by a dyke wide enough to walk on. Right to occupancy of any kind of land depended upon actual use. It cost nothing to have it assigned but a gift to the district chief (tribute) was customary when the crops were harvested.

Jaeger, Fritz, and Waibel, Leo (1920) Beiträge Zur Landeskunde von Südwestafrika. Mitteilungen aus den Deutschen Schutzgebieten . . . Ergänzungsheft Nr. 14. Berlin: Ernst Siegfried Mittler und Sohn. viii + 80 pp., 37 figs. on 6 double pl., 4 maps.

This work has an agricultural map of the former German Southwest Africa showing the zonation of the land parallel to the coast. The narrow coastal Namib Desert is in general a hundred kilometers wide. It merges into a grassland suitable for stock-raising but with insufficient rain for growing crops. This in turn merges into land which has sufficient rainfall in favorable seasons for a crop of maize. The farmed area is restricted to adjoining parts of the last two zones, with cattle raising or cultivation depending upon availability and certainty of sufficient water. The cultivated area stretches from extra-tropical South Africa northward to the Ovambo river at about 19° 20', thus well

within the tropics, but with no essential change in the zonation, nature of the vegetation, etc. to correlate with the latitude except that the part suited for agriculture is mapped as being entirely south of the Ovambo.

The authors state (p. 57) that the pasture belt is covered with low thorn bush interspersed with grass. The nomadic population are accustomed to burn off the grass at the end of the dry season so that the new growth will not be intermixed with the old dead stems. The wind spreads the fire afar, especially after years of good rainfall which has promoted a thick growth of grass. This constitutes a menace to the sedentary farmer and also prevents the growth of trees in a wood-impooverished land. Erosion is excessive on the burned-over land. The tenderer grasses are supposedly reduced in quantity with corresponding increase of the hard ones. The German administration therefore forbade but could not prevent grass fires which often got out of bounds. In some years there was only enough rain to start the grass, after which it quickly dried up and afforded insufficient pasturage. Consequently cattle raising, to say nothing of growing crops, was on a precarious basis, and the population necessarily nomadic in its habits.

The monograph of Jaeger and Waibel is especially notable for its thoughtful discussion of climatic change as a cause of increased drought, as opposed to the operation of human agencies such as overgrazing and fire. They have investigated the ratio of run-off to precipitation in order to estimate the loss of water by evaporation, finding in two successive years that this ratio could vary from 1:13.9 to 1:6.1. They have considered Passarge's theory that use of underground water which constantly lowers the ground water level is in the nature of mining a resource from past time, and that it cannot be relied upon as an undiminishing resource. In other words, it is likely not to represent an underground flow from some distant catchment area, but rather a shrinking localized resource. They call attention to E. H. L. Schwartz's idea that coastal streams have captured and drained streams that formerly watered inland lakes or swamp areas. Finally, they discuss the human agencies to which, for German Southwest Africa they call attention to the earlier ideas of Schinz (1891, p. 482). They agree that deforestation has led to the formation of grassland, that ~~over~~-grazing of the grassland has bared the soil, that the exposed surface soil has been removed by erosion, and that the less permeable subsoils whenever rain fell too rapidly to be absorbed, were responsible for excessive runoff.

Much of former German Southwest Africa normally has a vegetation of shrubs and subfrutescent plants a foot or two high. In good rainy seasons the space between these permanent plants is occupied by grass and annual herbs. The grass of the south is short, soft, and nutritious. That of the north is all and coarse, soon too hard and tough to be easily grazed by cattle, being when fully mature and dry practically worthless.

Such grass does not decay within a year but accumulates, which is the reason why the natives adhere to the custom of annual burning. The wind spreads the fire far, especially after a good rainy year, when the growth is thick.

Jeannelle,----- (Garde Général des Forêts) (1900) Les Forêts dans les Provinces de Tamatave et de Fenerive. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. VI, whole No. 30, pp. 219-232, map. Tananarive: Imprimerie Officielle, 30 Juin, 1900.

The forests here described are located on the east side of Madagascar south of Tamatave, the chief port on the Indian Ocean. From the standpoint of soil, the underlying rocks if exposed are mainly schist, micaschist and gneiss, with no trace of eruptives, but with white blocks of leptinites, granular associations of quartz and feldspar. Along the sea is a sandy belt of varying breadth, consisting of dunes, among which are lagoons with relatively pure water and others, less salubrious, with deep muck bottoms; then swamp areas with a deep mucky soil, succeeded by drained but not greatly elevated land with an alluvial soil and subsoil, largely organic at the surface but deeper showing stratification, possibly indicating, by various colors, periods of differing rapidity of erosion, and corresponding, Jeannelle rather rashly ventured to suggest, to periods of rapid deforestation.

The entire coastal region of alluvial deposition has an average width of about 35 km. and has been largely cleared for irrigated-rice agriculture. Beyond the coastal region there is a rapid ascent to the central plateau which causes numerous rapids and falls in the rivers and puts a limit to the use of streams for transport. The lower slopes to the highlands are the limit of continuous forest and also the region of dry-rice cultivation, much as when Madagascar first came under European observation.

Jeannelle states that it is fortunate that these forests cannot be burned without previous felling and drying. The humidity is too great to permit the entry of fire any great distance into standing forest. If these forests were as easy to ignite of the pineries of the south of France there would remain in Madagascar only vestiges of forest. In spite of all natural agents of protection, however, if one were to allow free rein to the devastating propensities of the natives there would gradually come about the complete destruction of forests.

The width of the east coast forest in the region he mapped was estimated by Jeannelle as about 40 kilometers or not more than 45. All along the eastern edge to a distance of 15 kilometers one found a great many carbonized logs on the surface of the ground,

perfectly preserved, that must have been remnants of the clearing of a formerly more extensive great forest, and that he could hardly believe had lasted over fifty years since being cut and partially burned. He would not accept the theory that they were remains of trees that had grown in the open after the forest had been cut, for they were of the tall, straight-trunked sort without low branches, forest grown without any doubt.

For upland-rice cultivation the natives adopt a five to eight year rotation, but prefer to clear new forest if it is within reach rather than to clear the dense brush, more than two meters tall, on the fallow land formerly used.

On account of the poverty of the country and other conditions it seemed impossible at the time when Jeannelle wrote to improve the forest, but conservation of what remained could at least be undertaken by strict prohibition of burning; then, as colonization progressed rational forestry could be undertaken.

At the southern boundary of Tamatave province the forest was about forty kilometers from the coast and its eastern edge followed along at about that distance parallel to the shore, except for the irregularities at intersection of the line with rivers. On the west the forest ended abruptly at the grazing land of the central plateau. The various reasons for the persistence of forest islets away from the main body of the forest are discussed and all of the detached areas are shown on the map. It would be interesting indeed to have a new and comparable map for the same three provinces, for if possible there should be some use made of the unexpectedly detailed observations made under the stimulus of General Gallieni's able administration, which have certainly not been considered by all of the botanists who have written on the subject of forest destruction by man in Madagascar. One gets the impression very strongly that the remnant still surviving of the east-coast forest belt is not only the unique extensive area of rain forest in Madagascar, but that it is the only one that there has been for hundreds of years although it undoubtedly extended at the time of human occupancy across what is now the mostly cleared coastal plain to the Indian Ocean.

Jeannelle and others make it clear that this particular type of forest was not subject to forest fires and would never have been destroyed or even damaged by fire alone. If fires had a different and destructive effect on the forests of the plateau and the west coast, it must have been because they were forests of a very different type, not, in the main, evergreen rain forest but rather seasonally deciduous-leaved forest, with spaced trees separated by grass and shrubs, such a forest type, in fact, as that which is transformed by fire into parkland savannah and then into prairie on the north of the great African equatorial forest. The devastating effect of fire on the flora of Madagascar has been enormous, but the outlines of pre-human plant

geography can still be made out from the vestiges. The evidence is plain that there was no uniform forest type throughout Madagascar when man appeared on the scene, as Lavauden, for example, would seem to believe.

Jensen, Ad. E. (1954) Das Gada-System der Konso und die Altersklassen-Systeme der Niloten. *Ethnos*, Vol. XIX, Nos. 1-4, pp. 1-23, 7 figs. Stockholm: Statens Etnografiska Museum.

Although it has no reference to shifting agriculture, an article by A. E. Jensen deals with a surviving north-east group in Ethiopia with remnants of ancient megalithic culture and having a remarkable development of terrace agriculture, which is not widely prevalent in Africa. The fine pictures showing it are figs. 1 & 2. The almost complete supplanting of shifting by permanent agriculture by a primitive people in Africa indicates a means by which agricultural productivity of some parts of Africa might be maintained and stabilized without drawing further upon the limited resources of original forest.

Jervis, Roy N. (1953) A botanist's glimpse of the Gran Piedra region of Cuba. *Asa Gray Bulletin*, N. S., Vol. II, pp. 43-50.

The devastation of Cuba, begun long ago by primitive man has continued ever since, at first by colonists and slaves and finally under auspices that should have been more enlightened until at last little more remains to be destroyed. There are a few difficultly accessible forests in the mountains of Oriente Province, which Roy N. Jervis has undertaken to study before it is too late, and if possible to interest the Cuban Government in measures of conservation. The following paragraphs give the best glimpse that is available of the situation in the last part of Cuba, where the last remnants of primary forest occur, although even there little remains to be saved from the burning:

(p. 45) "The southwest section of Guantánamo Valley is dry, in fact, so dry throughout most of the year that sugar cane which grows so luxuriantly in most of the northern part of the valley gives way to cattle ranches. The herds of cattle, the windmills, and the long stretches of grasslands resemble areas in cattle country of the United States except that the feathery heads of the Royal Palm, *Roystonea regia* (H.B.K.) Cook, occasionally dot the landscape and the Flamboyant, *Delonix regia*, brightens almost every dooryard with its masses of brilliant red flowers. Two other trees are characteristic of the cattle land. The umbrella-

like legume, Samanea saman (Jacq.) Merrill, with thick short trunk and low spreading branches and the much more common elm-like Guazuma tomentosa H.B.K. provide shade for the cattle. The rough fruit of the "guasima", a member of the Sterculiaceae, is eaten readily by livestock and though not as good shade for the cattle as the Samanea, the "guasima" is usually left standing in the pastures."

. . . . "As I left the cattle country I began to follow the Rio Liguana which curves southward in a semicircle and then into the hills of the Sierra de Canada. . . .

(p. 46) "To a casual observer there was no road. Instead, a small stream, still the Rio Liguana although here called the Casimba rushed across bed rock, around gravel bars and through mud, and allowed mere man to use the same path as a highway. . . .

(p. 48) ". . . .The woodcutter rode along with me as far as his 'bohio' with its surrounding tiny banana and sweet-potato patch, and then I continued to climb from the valley. About a thousand feet higher the road became much better and wound through the mountains of desolate cut-over wasteland.

"Many years ago all the area was covered with a rich mixed forest. But about 1900, under the impetus of the United States occupation of Cuba, most of the finest hardwoods were removed. Then later the remaining hardwoods were cut out. The demand for charcoal for cooking and heating caused the remaining large trees to go. Just before World War I, Dr. Ekman collected Pinus cubensis and Podocarpus in the nearby hills, but today the charcoal burners have removed even the larger scrub. Fires periodically rage through the region and burn off what man has not been able to destroy. There are reputedly some stands of pine still remaining in the Gran Piedra area, but Brother Marie-Victorin could not find them in 1940 nor could I in 1951. (Later, Senor Pedro Canas, President of the Humboldt Group in Santiago, told me that as recently as 1949 there were good stands of pine on Gran Piedra, but lumbering and fire had removed anything that was at all accessible.)"

Johnston, H. H. (1884) *The River Congo, from its Mouth to Bólóbó, with a general Description of the Natural History and Anthropology of its Western Basin with two etchings, and over seventy other illustrations and three maps of the Congo Third edition.* London: Sampson Low, Marston, Searle, and Rivington.

Johnston's first volume on the Congo (1884, pp.13, 14, 15) is notable for containing a pioneer vegetational map of the

western part of tropical region south of the Equator. His vegetational belts from north to south along the coast are: (1) dense forest, which, westward of 15° E. he shows as not extending as far south as the mouth of the Congo, (2) savannah with oil palms, (3) savannah, (4) scanty vegetation, and (5) desert. He crossed all of these vegetational areas except the last, for he landed (Oct. 1882) at Loanda, in the zone of "scanty vegetation", and travelled northward to Ambriz, Kinsembo, and Musséra. Here, he wrote:

"The country round this settlement is much like Kisembo in character. The same coarse grass, sparsely scattered bushes, and euphorbias; but here the rich vegetation of the interior is only three miles from the coast and . . . gradually approaching the sea, until at Cabeça da Cobra the last traces of desert influence will vanish and a tropical wealth of flora reassert its sway"

"From Sierra Leone to the river Ogowé along the coast the one prevailing landscape is that of endless forest. This is, in fact, part of the forest region. . . . But when the mouth of the Ogowé is passed, the forest begins to retreat from the coast (except where it follows the courses of rivers) and is gradually succeeded by more open savannah scenery, so characteristic of the major part of Africa, and so happily described by older travellers as 'park-like', a designation which its open grassy spaces and formal groups of shady trees amply justify. . . . But a little to the south of the Congo embouchure the park-like scenery in its turn begins to retire from the sea, somewhere about Cabeça da Cobra and there follows a much uglier region of sparse vegetation and less abundant rainfall where scarcely anything but euphorbias, baobabs, and aloes are growing, and where there is often less than two months' rain in the year. This harsh country continues along the coast for some distance until about the 13th parallel, where it in turn trends off towards the interior and absolute desert takes its place and continues uninterrupted as far as the Orange River. In a journey from Mossâmedes to the river Cumène, in 15°-16° S. latitude, you may successively pass through these three last phases of scenery, and after crossing an absolute desert, enter a region of sparse vegetation, and finally arrive at the beautiful undulating country of scattered forest and grassy plains which only reaches the sea as far north as the Congo mouth. . . . The sandy wastes between Mossâmedes and the Orange River grow little but the strange Welwitschia mirabilis and a few stunted Bauhinias; in the succeeding region the euphorbias and aloes are the principal occupants of the soil, with an occasional baobab, mimosa, or fig. In the park-like country the forest trees are too numerous and varied to catalogue. . . . This is the most typical region of Africa, and it is the country of the large game animals. The rhinoceroses, zebras, giraffes and many antelopes never enter the forest belt that clothes so much of Western Africa. . . ."

It was in this type of country, on the way to Yellálá Falls, the greatest falls of the Congo, near Vivi, that Johnston (p. 74) made notes on grassland and fire, as follows:

"We looked right across a wide expanse of rolling grassy down and winding valleys, at a colossal mass of rising ground, surmounted by a fringe of dark trees, where lay the distant village of Yellálá. . . . A grand view for space and aerial effect it was, and one, moreover, singularly characteristic. . . . All alike, hills and valleys were clothed with waving yellow-green grass, the monotony only broken by the intrusive blocks of quartz. Save in one or two sheltered valleys, where a few pitiful oil-palms clustered, not a tree was to be seen; and the little gnarled bushes here and there to be found were almost covered with the tall, feathery grass that was emphatically the king of the country.

"It was with great relief that we left this country of grass and rocks behind us and entered the village of Kai, which was embosomed in rich vegetation. Here we paused to drink more palm wine, for the thirst engendered by the terrible scramble over loose stones and through the rasping grass was overpowering. . . . The rich and rank vegetation that surrounds the neatly built houses is most amazing compared with the barrenness outside. . . . It is the first and only time that I remember to have seen this Dracaena (D. Sapochinowski) on the Congo, and it seems curious to find it preserved thus in a village perhaps the real solution of the fact, as also of the presence of large trees and luxuriant vegetation round the villages, is that all the uninhabited country is periodically set on fire by the natives and that only in those places which the bush fires do not reach can rich vegetation and forest trees exist. It is evident -- and indeed the fact has struck Stanley, Schweinfurth, and most observant African travellers -- that the grass fires must largely affect the 'phytography' of Africa".

Of the remainder of the trip to the falls and subsequent travel in the "cataract" country he told of deep ravines with thick forest and interminable grass lands between which (p. 99) "The grass is tall, sometimes eight and nine feet high. When it is dry it cuts you like a razor".

Later, of the vegetation near Lutete, he said:

(p. 142)"A great stretch of valley, filled with rich forest, with a sounding stream that is seen flashing through the trees, is bounded by boldly shaped hills, between each of which lesser valleys lie, that seem, as it were, tributaries of the great one, some of them mere crevasses in the mountains, but each with its tiny stream, its cascades, and its velvety woods. Occasionally, especially near Lutete, patches are cleared in the valleys. . . . The rounded hills that encircle these luxuriant valleys are covered with strong coarse grasses of various sorts, of which the

flower stalks often attain the height of fifteen feet, and with gnarled and stunted trees . . . spread in a sparse manner over the hill-side. . . . The difference in richness of vegetation. . . . between hills and valleys is not due so much to the relative abundance of moisture as to the prevailing grass fires in the dry season. These sweep over the hills at times, destroying all the finer trees, so that only these stunted shrubs and the rank grass spring up from their roots anew and flourish for a season. Therefore it is that around the villages whose plantations are protected from the ravages of the flames . . . rich forest invariably exists, and their presence may be infallibly detected in this country by the groups of fine trees and patches of purple forest growing isolated on the many hill-tops. Again, in all shut-in valleys and river courses, where the fires are choked, there vegetation of the most wonderful character riots in all the wild luxuriance of its unchecked growth."

Johnston (p. 307) concluded that the continuous equatorial forest occurred wherever ample rainfall was more or less continuous. He said:

"The reason this forest belt does not extend more fully over Africa is that, where there is a continuous dry season of four, five, or six months, there is time for the long grass to become thoroughly tindered by the sun, and the natives can then more easily set going the great bush fires in which they delight, which clear the ground for their plantations, and at the same time sweep the forest from the hills. In the equatorial regions of perpetual moisture this is impossible, and so the forest country . . . continues to represent a condition of things which probably existed more widely before the advent of man, or, rather, before . . . man first began . . . to take the law into his own hands."

Johnston, Sir Harry (1906) *Liberia*. 2 vols. London: Hutchinson & Co. Vol. I. XX viii + 520 pp., 12 col. pl., 208 figs., 19 maps. Vol. II, pp. xvi + (521-1183), 16 col. pls., figs. (209-426), 3 maps.

By the fact that some of the African Pygmy tribes had, down to the time he wrote, no knowledge of how to make fire, Sir Harry Johnston was led to speculate on the beginning of the use of fire by the Negroes. He wrote (p. 894 of his work on Liberia):

"They may have only known the effects of fire through the lightning constantly setting the bush aflame in the tornado season. After the bush fires thus caused they would have revelled in the taste of roasted meat by devouring the flesh of rats, snakes, lizards, birds, and big beasts scorched or grilled by the flames

that had come down from heaven. The present writer has so frequently witnessed the ignition of the African bush by flashes of lightning that he can well realize how the Negro may have even been led into the use of fire by keeping alive and feeding the remains of a conflagration. . . ."

It would have been very helpful if Johnston had been more specific, and cited definite instances, with details, for much search of the literature has revealed great vagueness about the natural origin of tropical bush and grass fires. It seems, however, that definite observations have recently been recorded in late years for natural fires in the Belgian Congo, and there are positive records of grass fires started by lightning in the Everglades region of Florida.

Regarding primitive agriculture by the indigenous tribes of Liberia: Johnston wrote (pp. 1000, 1002):

"Native agriculture in the coast regions is simple and perhaps somewhat degenerate. Most of the field work is done by women among the Kru peoples on or near the coast, because so many of the men go to sea for their livelihood as sailors or fishermen. Farther inland the people of all tribes are decidedly agricultural in their tastes, though they do not rise above the simple Negro methods, and have no idea of manuring (except by wood ashes) or of the rotation of crops.

"When a new plantation is required, the men often aid one another in turn, voluntarily. The month of January or February is chosen for the purpose on account of the relative drought, the bush and trees are cut down, left for a short time to dry, and then burnt. The unconsumed logs are dragged aside as much as possible, and the women (or youths) set to work to hoe up the soil and mix with the clods the ashes of the burnt vegetation. The ground is then ready for sowing when the new rains fall in March or April.

"The native agricultural implements are few and simple. They are the ordinary African hoe (wood or iron), a machet or long swordlike knife with a broad blade (nowadays imported from Europe), a small narrow axe, a billhook for lopping branches, a pointed stick for digging, and a few knives. All attempts to introduce the plow (or even the spade) have failed. The soil is too hard, there are too many tree stumps or roots for either implement to be conveniently applied to Liberian agriculture. The natives take readily to the use of the saw and adze, to the sickle and even to the scythe; but the plow and spade -- those most inappropriate emblems on the shield of Liberia -- will long remain strangers to its agriculture."

Johnston has excellent pictures of the crude clearing for rice planting and the mixed crop of rice and cassava at harvest time. (See pp. 985 and 987.) He enumerates the chief

crops as rice (3 kinds; one, maybe native, known as manikoro has a small grain "with a blackish husk"), manioc, yams, and Guinea corn or sorghum. Many subsidiary crops are mentioned, and the curious fact that the majority of the long-established ones came from Asia and the later ones, such as manioc, from America.

As for the effect of agriculture on the forest, Johnston indicated (p. 521) that the forest was better preserved in Liberia than elsewhere. His observations on the abrupt transition from forest to savannah are interesting, as indicating intrusion of savannah into former forest as a result of fire and cultivation (although he does not definitely say so) and his correlation of the vegetation belts with rainfall indicate that, if we consider fire as to some extent a "natural" factor, the savannah is in part a climax formation, at least to the north of the "park land" which doubtless represents, in large part, former forest, cleared by man and controlled by fire.

Joustra, M. (1926) *Batakspiegel*. Tweede, vermeerderde druk. Uitgaven van het Bataksch Instituut, No. 21. Leiden: S. C. Van Doesburgh.

The extensive literature on the Batak lands of Sumatra, north of the equator and south of Gajoland, has been digested and classified by Joustra. He himself is the leading authority on the Karo, regarding whose agriculture he gives (pp. 306-309) first-hand information.

The dependence of the Batak of the highlands is more largely upon permanent irrigated-land sawah agriculture than upon dry-land (djoema-juma) cultivation, but the ratio of land used in the two ways depended upon the availability of water for irrigation and upon the proximity of forest. The plateau is cut by deep ravines and the bottoms of these are utilized for sawah culture. (The level plateau itself has long been deforested and presents many miles of lalang grass on which the water buffaloes and other stock graze.) In the lowland toward the Deli tobacco land there the forest persisted longer, and there djoema cultivation dominated, and the population was correspondingly more sparse and scattered.

The making of the djoema was ngerabi in Karo; the completed field djoema rabin. The processes, in order, were (1) the chopping of brush (ngerandang), (2) the felling of most trees, for some were only trimmed (nabahi), (3) the chopping off of the lower branches of the unfelled trees (noehtoehi), (4) the chopping off of the tops (nombeng), (5) the burning (noeloech), the heaping up of the incompletely burned debris, and (6) the final burning (matoeri). All this was men's work. The planting (merdang) and

subsequent work may be done by women also. It consists in punching holes in the ground with a planting stick (perlebeng) into which the seeds are dropped (ngenahi). After the seeds germinate, hoeing, weeding, thinning, transplanting the thinnings, and scaring away the birds and beasts.

It is curious that the use of heavy wooden crowbars by a row of women for turning a furrow in the tough grassland is not mentioned by Joustra, although the reviewer has seen it done himself (1927) and it was described by one of the earliest European visitors to Karoland, von Brenner (1894).

Junghuhn, Franz (1847) Die Battaländer auf Sumatra. Im Auftrage Sr. Excellenz des General-Gouverneurs von Niederländisch-Indien Hr. P. Merkus in den Jahren 1840 und 1841 untersucht und beschrieben. . . . Aus den holländischen Original übersetzt vom Verfasser. Erster Teil. Chorographie. Zweiter Theil. Völkerkunde. Berlin: G. Reimer. viii + 300pp., 1 pl., 9 maps; X + [ii] + 388 pp., 9 pl.

Junghuhn's most admirable work on the Batak lands of Sumatra has at least in the German edition certain peculiarities of spelling, such as the substitution of k for g and the doubling of letters which do not indicate doubling in pronunciation. These are so obviously merely the author's or translator's idiosyncrasies of spelling, that they have been uniformly changed to more realistic spelling by the present reviewer of Junghuhn's observations on shifting agriculture, grassland, and fire. Junghuhn has so many references to fire and to travelling through an alternation of fresh clearings and grasslands derived from clearings, that not all of the instances need be cited, but the general impression is that at the time of his pioneer explorations much of the Bataklands had already been reduced from primary forest to grassland or various stages of "wilderness".

Not far from Tapanuli Bay on the west coast Junghuhn described the vicinity of Bio-bio as follows (I, p. 88):

The sites of three deserted villages, recognizable by wildling fruit trees, as well as the smooth and treeless east and south mountain slopes indicated a former greater extent of cultivation. The rest house, which had been built near the new path, was on a cleared elevation overgrown with alang-alang grass (Imperata). The mention of "parkot" palm which to Junghuhn indicated an old village site would puzzle a reader until he transformed it into bargot (bagot in other dialects) -- namely, the sugar-palm, Arenga. (The p's for "b" and k's for "g" should put the reader on his guard about some of the place names.

The author mentions the contrast in a view of the landscape between the light green of ladangs (cultivated clearings) and grasslands in contrast with the dark green of solid forest and the little groves and single trees that dotted the grassland.

Describing another locality in the same general region Junghuhn remarked (p. 102) on the grass fires. The few inhabitants were accustomed to lighting the lalang grass, and then the fires and smoke dominated everything and the noise of the conflagration resembled that of a wind-storm in the forest.

Before turning from the region of lower Tapanuli to another, Junghuhn had some remarks to make about the grasslands. He had estimated that in this particular area, the flat land had 14 square miles of cultivation, 14 square miles of grassland (lalang) and 86 square miles of forest, but of course not all of the latter was primary forest. Much must have been secondary. Of the mountain land 14 square miles were cultivated, 16 square miles were grassland, and 187 square miles were forest. In an area near the place southeast of Siboga which he calls Tapollong [Dabolon?] there were a good many little lalang prairies scattered about in the forest. The path traversed no less than nine such fields of grass varying in size from 500 feet across to three-fourths of a geographic mile. Near Tobing the path cut about ten. The majority were sharply delimited by the surrounding forest and overgrown with one species almost exclusively, namely the lalang grass for which he proposed the new name Imperata Allang, intermixed with species of the fern genus Pteris. Such grass areas, covered with lalang about three feet high had the appearance of open lakes with high dark shores or of grass oases in a forest wilderness. Among the trees in the surrounding forest were colossal camphor trees, standing high above all others, some of them 200 feet tall.

Junghuhn regarded the forest-encircled lalang fields as for the most part produced by the hand of man, and indicated that some of them were demonstrably old village sites, but still he thought that they presented problems that had not been satisfactorily explained.

The next district which Junghuhn examined was Upper Angkola. Here the flat land had no remaining forest at all; it was all cultivated (a fourth) or clad with lalang (three-fourths). The mountain land, however, had approximately two and a half times as much forest as cultivated land and grassland together. From a mountain height west of Tobing to the northwest of Angkola, from which this greatly modified district could be seen, Junghuhn described the panorama. To the west there were forested mountain ridges; between which one caught a few glimpses of Tapanuli Bay. There were similar forested mountains to the southwest and south. Toward the east the forest was broken by openings, and one could look far back to the south of east over the smooth gentle mountain slopes into the beautiful Angkola Valley. Being like a flat meadow among the mountains, a lonely lalang wilderness, with no

villages, and only little flecks of forest scattered about, a plain shimmering with the light green of the lalang grass which also covered the enclosing mountains.

Junghuhn's visit, it must be remembered, followed the devastating "Padri wars", which took place in the 1830's and early 1840's, when fanatical Muhamadans from the south (Rau) set out to pillage the adjacent Batak lands and either to convert the pagan Batak to Islam or exterminate them. The objective of the "Padris" was mostly piratical, for their bands were intent upon murder and destruction. The homeloving and relatively peaceful cannibal Batak took refuge in such places as could be defended, and left their ancient village sites to destruction by terrible and bloodthirsty invaders who assumed the sanction of Islam to spread their "true faith" by fire and sword! So much of the desolation of the southern Batak lands in Junghuhn's time did not represent a normal condition, except as interdistrict warfare is normal to semicivilized society.

That the forest as seen from afar was not empty of clearings has already been indicated by Junghuhn's description of the little prairie islets traversed by the path to Tobing. This district, he said, was mostly of brush wilderness, secondary growth in which there were only small scattered ladangs (cultivated dry fields) but a great extent of lalang grass, throughout which many bits of forest survived. The wilderness consisted in part of thickets of ginger allies (Amomum, etc.) as high as ten or fifteen feet, through which one had to chop a way. (Such dense growths of Zingiberaceae are characteristic of deserted clearings.)

Now to turn to another district, at the Toba boundary near the southern foot of Mount Kadjorang, Junghuhn found only isolated bits of forest, little oases scattered about in the grassland, some of which were old village groves as indicated by abandoned fruit trees gone wild, and the encircling bamboo thicket. For each district Junghuhn gave an estimate of the relative amount of culture land, grass wilderness, and forest.

Of course the cultivation of wet rice fields, permanently cultivated, became the chief agricultural activity of the sedentary Batak in the more densely populated districts of the heart land for they were deeply attached to the solidly constructed and beautifully carved houses of their ancient villages. When the forest had been destroyed some of the people remained, carrying on sawah agriculture, but others went away from the mother villages to found forest colonies and to begin the cycle anew.

Junghuhn (Vol.II, p. 191) described the ladangs of the southwestern Batak lands as typically clearings surrounded by forest, fertilized only by the ashes of the felled trees, used in the first year for a crop of upland rice and then for maize, with the same crops repeated the second year. Then the land

would lie fallow for a short period, during which it would become occupied within a year or two by lalang and "kлага" [galaga] grass the latter as much as 10 or 12 feet tall. In June and July the dry grass would be burned off. In it tigers would have settled, and elephants would have fed. The smoke ascending from the fires, like vapor from a newly erupted volcano, would ascend and spread far and wide; the roar would be heard for miles if there was a fresh wind. At night the fires looked like glowing lava streams wandering from place to place. By day smoke covered the land for miles with a reddish gray or brownish cloud. The inflammability of the reed-like galaga often placed travellers in peril, if a path traversed a grassy mountain side, for the wind might sweep the flames and a black cloud of ashes so rapidly up the slope that escape would not be easy.

Junghuhn said that the ashes of burned-over "wilderness" provided enough fertilization for renewed cultivation, but he did not tell clearly how a crop could be obtained after only a short fallow during which woody plants had not yet supplanted grass. He did speak of cultivating the land with wooden hoes, but that was in connection with newly cleared land. He said that in a new clearing small trees and brush were burned, just as galaga fields were, but that big trunks were left to rot, and the ashes were worked into the soil with wooden hoes. This might have included uprooting the clumps of galaga grass, for in Karoland, farther north, the Batak actually turned the refractory lalang sod with digging sticks to make gardens in choice and accessible spots, as von Brenner and later visitors observed, and the more southern Batak may have done the same, although the reutilization of grassland could not have been, as Junghuhn thought it was, less difficult than clearing more primary forest. One suspects that in troubled times the people did not dare to venture too far from their permanent villages, and so resorted to more laborious forms of cultivation than ordinary ladang cultivation.

Junghuhn, Franz (1852-1854) Java: seine Gestalt, Pflanzendecke und innere Bauart. . . . Nach der zweiten, verbesserten Auflage des Holländischen Originals in's Deutsche übertragen von J. K. Hasskarl. Leipzig: Arnoldische Buchhandlung. Vol. I, 484 pp.; Vol. II, 964 pp.; Vol. III, 316 pp.: illust., many charts and maps.

In mapping the altitudinal zones of vegetation in Java, Junghuhn was perplexed by the boundary changes which had come about because of human disturbance of natural conditions. The population of Java was making unprecedented growth and deforestation was going on faster than the lands despoiled for shifting agriculture were being taken into permanent cultivation. He remarked that a fertile well watered tropical region might be expected to recover rapidly after clearing while the population was small and the pressure upon land was correspondingly small,

but that vegetational boundaries in Java seemed to be changing without prospect of recovery. The change was from forest to desolate wastes of grassland.

This was possibly, he thought, because the climate was actually becoming drier and hotter as deforestation progressed. This change could be modified, Junghuhn suggested, by protecting mountain forests which regulated stream flow. So he recommended forbidding the clearing of land that was not suitable for growing irrigated rice or other useful crops on a continuing basis. As matters were going, the alang-alang (Imperata Koenigii) was extending its bounds almost without altitudinal limitations.

Junghuhn said (p. 153) that he had grounds for believing that alang-alang grass was originally confined to sterile, dry, unproductive soils and especially to hard ferruginous places. In Java the prevalence of this grass over stretches of miles or even day's marches in the region above 2000 feet was a sure sign of the hand of man. The grass wastes were formerly forest, destroyed for temporary dry rice fields, which had been abandoned. He was reminded, by the rapid increase of such waste grassland in Java, of the conditions that he had observed in the Batak lands of Sumatra where the land had come to desolation and, fearful uniformity far and wide, because of the pale-green lalang (alang-alang) covering plateaus, mountains and valleys.

To emphasize the changes in Java he cited several examples, mostly of destruction of forest, but also a couple showing the possibility of its renewal. When Fr. van Boekhold ascended the north side of Goenoeng (Mt.) Merbabu in 1785 the path led through shady forest, which so closed in the view that he had to use a compass to keep his direction. In the half century intervening down to 1836, when Junghuhn followed in his footsteps, alang-alang had replaced the forest and had ascended to the highest zone, that of Festuca nubigena and a few other Alpine grasses. After 50 years there was just alang-alang grass with a few scattered bushes.

The neighboring taller mountains Goenveng Sendoro and Goenoeng Sumbing were in the same state of devastation as G. Merbabu. The high primary forest of Junghuhn's third altitudinal zone had entirely disappeared. Even where nothing could be grown following deforestation, the remaining trees had been chopped for fire-wood. The alang-alang, following clearing up to the summit, had crowded out the proper flora of the more delicate grasses, Festuca nubigena and species of Poa.

When Leschenault de la Tour travelled in the east of Java in 1805, the northern flat from the foot of the mountains to the sea was an unbroken forest, which was traversed by a foot-path only. From Panarukan to Sumber waru there was hardly a

habitation. In 1844, after 39 years, Junghuhn made the same trip, and then nearly the whole flat was occupied by sawahs. Between these were groves of fruit trees and cocopalms, sheltering hundreds of little villages and huts.

When Junghuhn in 1839 first went to the plateau of Iēngalengan, at 4000 to 4500 feet elevation, south of Bandung, there was an unbroken high forest through which never the slightest ray of sunlight shone. In 1847 the forest had been felled, but this was not for shifting cultivation but for coffee cultivation. In place of the forest were 15 million coffee trees and 750,000 dadap trees. Two herbaceous weeds, of the composite family, Ageratum conyzoides and Bidens leucantha covered the ground, and it was a mystery to Junghuhn where so many seeds had come from to seed the area and how they had got there. On the basis of counts of the number on a measured area, he estimated that the destroyed forest with its rich and rare plants had made room for 8,700 million individuals of just these two ground-covering weeds.

Examples of restoration of forest could also be cited.

In Java are found sites of ancient centers of population, depopulated, which have reverted to forest and have again been cleared, after the lapse of centuries, for human occupation. Junghuhn gave as an example the plateau of Diēng, where a great city with temples and other stone buildings was built about 1300 A.D. In the early years of colonial Java the site was covered by enormous trees, many of them rooted in the walls of the ruins. A new population, fleeing the ravages of war, cleared the forest again in 1828 and occupied themselves with growing tobacco and cabbages.

The last center of the Siva cult in Java, Banju wangi, was still flourishing in 1597 when Cornelis Houtman's ships anchored at a place supposedly near Pampang Bay. The king lived at the old site in true Indian pomp. The outlying country was covered with sawahs. As a result of internal warfare and consequent spoliation and starvation, possibly disease, the population dwindled and the forest took over. Of course it had a good start from the shade trees and other useful trees which were there to produce seed. In place of a great city surrounded by culture land, a forest with at least a superficial resemblance of primary forest sprang up, which remained until Junghuhn's time but was soon due to go under the axe again because of population pressure.

It is too much to be expected, perhaps, that any great areas of natural vegetation on soils suitable for permanent agriculture can be withheld from depredation where population is dense, but we should learn from Junghuhn what happens when unrestrained human nature has its way. Everything is spoiled without any lasting benefit. There should be restriction of destruction for the benefit of future generations. Better it is for fewer people to lead a better life than for the earth's productivity to be crowded to the limit of a mere subsistence, and it is just as certain that tropical lands can be devastated as temperate.

Keller, C. (1901) Madagascar, Mauritius and the other East-African Islands. London: Swan Sonnenschein & Co., 1901. 242 pp., 64 figs. & plates, 3 maps.

There is much material pertinent to our subject in this work. Extracts follow which contrast the eastern strip of rain forest with the central and western forests of quite different character.

An observation from the eastern forest of Madagascar (p. 36) is interesting not only as a description of the east coast rain forest but also in connection with the restoration of humus to forest soils partially through the agency of termites, and its destruction by fire:

"The underwood is scanty, so that it is possible to pass with tolerable facility between the gigantic columns, twined round with their numberless lianas. The only impediments are the fallen trunks of the trees which have not been able to hold their ground under the burden of age, or which have fallen victims to the devastating cyclones. But these corpses of the forest are cleared away by Nature in an incredibly short time. Millions of voracious ants and termites change the timber into fine dust, which, with the decaying masses of leaves, forms a fertile mould."

This mould was of course destroyed by fire together with felled forest when clearings were made by axe and fire for shifting agriculture.

Keller continued: (pp. 37-39) "Many valuable kinds of timber are found in these regions [eastern forest belt],-- rosewood, palisander, and occasionally ebony. Unfortunately the natives treat these treasures of nature very carelessly; they simply burn down extensive tracts of wood to obtain arable land. This is especially the case in the north, where the forest comes down to the neighborhood of the sea. When journeying along the coast to Antongil Bay and Volhemar, I saw the sky reddened, night after night, as the enormous conflagrations pursued their work of destruction without interruption."

The forests of the northern end of the island, according to other observers as well as Keller, were not immune to fire, for they formed a dry transition to the western coast belt as well as to the mostly dry central plateau. The northernmost forest could be damaged or entirely destroyed by fire.

"When we pass the belt of forest and reach the high land of the interior, the character of the vegetation becomes quite different. It is true that in some of the numerous glens a luxuriant tropical vegetation is still to be found, but as a whole the interior is treeless. Grass land predominates, and cattle are very numerous in some localities, owing to the

extensive tracts of meadow land. . . . Where the land is well cultivated, as among the Hova and Betsileo tribes, rice, in its boundless paddy fields, forms a conspicuous feature of the vegetation.

(p. 122) "The western side, [of Madagascar] inhabited by the Sakalava, is of small fertility. . . . The soil suits cattle-raising better than agriculture, and this industry has been carried on very extensively by the Sakalava of Menabé, because this district has abundance of fertile meadow land. In the south of the island there is a prevalence of miserable steppe land. The extreme north too is a wretched district, and I was astonished to find in the environs of Diego Suarez, which were described to me as a veritable paradise, nothing but a miserable desert."

Diego Suarez is at the dry northern tip of the island.

"In the character of the Flora we can recognize a connection with Africa in many points. There grows here, for example, a near relation of the dum palm (Hyphaene madagascariensis), called Satrana by the natives. In this western region appear also many species of the baobab or monkey-bread tree, which are distinguished as Adansonia digitata, A. madagascariensis, A. Grandidieri, and A. Za. In the south grows the Didierea, a genus placed by Baillon among the Sapindaceae; it has a cactus-like shape and is 12 feet high. . . ."

The application of the English term "meadow" to the Madagascar grass-land seems to be a peculiarity of translation, but the writer has not seen a German edition of Keller's book. The expression "meadow-land" is used where one would expect "grazing land" or pasture. The local evolution of the morphologically anomalous genera Adansonia and Didierea proves, of course, that semi-arid land with vegetation like that of the Sudan and other districts of Africa north of the Sahara has existed during a long period of geological time in Madagascar, and that although man's shockingly destructive activities have greatly modified the flora they have not obliterated wholly the evidence that in the most general outlines the phytogeography of Madagascar in the pre-human era was essentially the same as now. The eastern forest belt has retreated from the coast westward and from the central bushland and prairie eastward. Much grassy bushland has lost the bushes and given way to grassland. Some grassland has doubtless become practically desert. Some stream-margin forests and hill-top forests have been wiped out. Introduced cosmopolites have gained ground vastly at the expense of the formerly much more diversified and botanically unique endemic flora. That the whole prairie area, which has been estimated as 80% of the area of Madagascar, has been created during the occupancy of man, at the expense of forest, is hardly credible. It can only be conceivably true by including bush-land, grassy thorn scrub, and park-like "savanna" land as "forest". How false an impression might be given by stating the situation in too broad and simple terms is as obvious (to the reviewer) for Madagascar as for semiarid central Africa,

when all the available evidence is considered. Highly specialized species of savana and prairie plants adapted to semi-arid and grass-land habitats certainly did not evolve in forest, and it is quite impossible to believe that appropriate habitats have not existed since back in the Tertiary period, and presumably longer.

That the equatorial rain forest of equatorial Africa has its true counterpart in Madagascar only in the forest belt of the declivity from the central plateau to the eastern coastal plain, and that this has probably been true throughout the period of human occupation, is the conclusion that grows on one after reading the earlier and mostly neglected travel records.

(p. 122) ". . . the Central Upland, with its soil of reddish löss is bare of woods and moderately fertile; but here the Hova, by dint of industry and perseverance, have reclaimed the numerous valleys and dells of the undulating country and have laid out boundless rice-fields, the keeping up of which has been aided by the irrigation canals. . . They construct special terraces on the slopes of the valleys and sow the rice in the dry season. Artificial irrigation is then produced by collecting together the neighboring streams. On many of the hills as many as a hundred green terraces planted with rice may be met with. When the [nursery-grown] rice plants are from 6 to 8 inches high they are taken out of the earth and planted in the paddy fields by the women slaves. This is done very quickly, but the magnitude of the industry may be estimated if we consider that, according to Sibree's account, westward from Antananarivo there extends a splendid rice plain 22 miles long and 10 broad. 'When the rice is fresh-planted or when it is nearly ripe in autumn, it presents a glorious sight; the villages and the low red hills of clay rise like islands out of green waves or out of a sea of gold.'

Keller (p. 123) contrasts the wet rice cultivation on irrigated terraces, as carried on by the Hova, with the simpler type of permanent or semi-permanent wet rice cultivation that merely took advantage of the seasonal fluctuation of water level in swamps or marshes. He said: "A few tribes proceed in a somewhat more primitive manner, as instead of hoe or plough they make use of oxen, which have to work the wet fields with their feet; the rice is then simply sown broadcast. The Hova, and still more the Betsileo, proceed with much more care, believing that rice never prospers well unless it is transplanted."

Among miscellaneous observations by Keller, one indicates the importance of taboo which in his time was still efficacious enough to secure the preservation of isolated central or western groves which were avoided as the supposed home of powerful spirits. It refers, of course, to isolated patches of forest in the extreme north, center and west of Madagascar.

(pp. 84, 85) "An important part of the natives is played by Fady, in which there is not much difficulty in recognizing the taboo of the Polynesian peoples, with but slight alteration. Fady signifies inviolable, not to be assailed, sacred, but also at the same time unlucky, and thus plants, animals and all kinds of other objects become subject to Fady-laws. . . . A portion of the forest which has been spared by a forest fire is denoted as fady. It is forbidden to cut down wood there or even to gather herbs."

Another of Keller's observations is interesting in connection with the quick clearing away of dead wood in the forest of eastern Madagascar. He (p. 36) said: "Wherever, in some small clearing, a dead trunk has remained standing, the termites or white ants climb up it into the projecting branches and . . . make their black ball-shaped nests of three feet in diameter." Again (pp. 55, 56) he said:

"The wiziga (Cremastogaster Ranavalonis Forel) has a bad name for ferocity among the natives. It constructs large black nests in the woods. In the economy of Nature it plays an important part, as it aids in the formation of soil by reducing to pulp the fallen trunks of palms and barringtonias as well as of other trees. This useful work, which is rapidly performed, is shared in by other species. . . ."

It would appear from this and other observations that wood-destroying fungi must play a secondary rôle in tropical rain forest, for the termites are more expeditious in reducing wood to soil.

Kestell-Cornish, R. K. (1887) A Short Cruise on the north-western Coast of Madagascar. Postscript. Antananarivo Annual and Madagascar Magazine, No. 3, Christmas, 1877, pp. 17-26. Antananarivo: Press of the London Missionary Society.

Regarding the reported break in continuity of the forest belt at the northwest, there is contemporary evidence from Bishop R. K. Kestell-Cornish. He traversed Madagascar from the Sihànaka country to Anorontsanga by a route previously untravelled by Europeans and described his route as follows:

"On the third day after leaving the [Lake] Alaotra we entered the éfitra (uninhabited country which is well wooded and very beautiful.) We crossed it in three days. This plain land seemed to me to be a continuation of the great Ankay plain. Our last day was occupied in crossing a spur of the fine Ambiniving range, which is the eastern escarpment of the central plateau of Madagascar in this district. This range bears the inner belt of forest corresponding with that crossed at Ankèramadinika (in the road from the Capital to Tamatave) and at this point of our route throws a timber-laden spur to the east, which we found was a watershed. . . ."

"There seemed to be no continuous belt of forest on the great western plain, like what is crossed at Alamazaotra and all along the eastern side of the island, but there is abundance of wood. I wish I could give the result of more scientific observations, but these, I regret to say, were beyond my power."

Kloss, C. Boden (1903) In the Andamans and Nicobars. New York: E. P. Dutton & Co. London: John Murray. xvi + 374 pp., illust.

C. Boden Kloss's book has especially interesting hints (which should be followed up) regarding serpentine areas in the moist tropics which may possibly, because of their over-supply of magnesium and deficiency of calcium, be natural grasslands. The total area concerned is of course small, and the matter is one of scientific rather than great practical interest, but further investigation would nevertheless be very desirable, for it might bring to light strains of forage grasses of unusual adaptability to unusual habitats. Kar Nicobar is the northern island of the Nicobar group. At the chief place, Mūs, where the people lived in houses scattered about among thickets of fruit-trees and fenced-in gardens, we have, it would seem, an example of a population of whom it might more appropriately be said that they depended upon gardens and horticulture rather than farms and farming. The village was described as not unlike an old and well-established Malay kampong. . . . Boden Kloss said (p. 49):

"The houses stand in groups, on open sandy ground, and interspersed with them are plantations (ya) of bananas, melons, and sweet potatoes--protected from the numerous roving pigs by zigzag fences of rails piled horizontally between double posts--and clumps of fruit trees of many varieties--coconut, orange, lime, shaddock, soursop, jack champada, tamarind and papaya." (Note the identity of ya for forest clearing with the yah component of Burmese toungyah. See Ferrars, 1875, for the Burmese use of the word yah, for "clearing".)

(p. 64) "Kar Nicobar has a foundation of serpentine . . . on which rest thick clay beds and layers of sandstone, exposed in parts, and in some places overlaid by upheaved coral banks sandy alluvium which was deposited before upheaval, with an additional layer of vegetable debris. . . . With the exception of an indigenous coco-palm zone, the beach forest, and irregular strips of inland forests the whole island appears to be covered with stretches of coarse lallang grass, dotted with tall screw-pines (Pandanus melleri), bearing the large globular fruit that supplies the inhabitants with their staple food; or with the natives' plantations of coconuts, betel, plantains, and yams. The nature of the forests depends entirely on the character of the soil and on the composition of the underlying rock."

After leaving Kar Nicobar, Kloss, a companion of the owner on the schooner of Dr. William Louis Abbot, who was on a collecting expedition for the U. S. National Museum, passed on to the island of Teressa. He wrote (p. 66):

"All the way until the center is reached, the island, 500 feet high, rises in almost precipitous cliffs of serpentine, with deep water at their feet, while the principal vegetation consists of thickets of pandanus in the gullies, and here and there, in spite of the rocky ground, patches of luxuriant forest . . . Tilanchong [Kar Nicobar] . . . is everywhere covered with jungle except in the north."

Next they visited Trinkat and Kamorta.

(p. 72) "The island of Kamorta lies some 12 miles to the south, the adjacent part rising in low grass-covered hills, with occasional trees dotted about: along the coast runs a fringe of vegetation and coconut trees, while in the center . . . it is more thickly covered with forest."

(p. 97) "The country around the settlement is very undulating, and covered with long grass growing on a sterile clay."

(p. 98) "The other shores [of Kamorta, near Dring Harbor, on the west] are partially formed by small cliffs, with a thin fringe of jungle, bounding grassy hills and downs."

(p. 73) "Trinkat is a low flat island . . . which . . . consists mainly of open undulating grassy land. . . . From the interior the scene was very beautiful; rolling grass downs were dotted with numerous dwarf pandanus trees (*P. furcatus*) amongst which the cattle . . . moved slowly. (The cattle were an experimental introduction by the government.)

(p. 90) "Nankauri is a heart-shaped island. . . . The bed rock consists of serpentinous magnesian, which is exposed in places. . . . The clay beds are similar to those which cover most of the northern islands, and contain silica, alumina, magnesia, and iron, but usually no lime, except in the form of gypsum, found in crevices. . . . About one-third of the island is covered with grass: a belt of forest runs all around the coast, but in the interior is restricted to the valleys and more sheltered slopes.

(p. 98) "The western . . . side of Kamorta consists of low broken hills with pointed summits looking like volcanic cones-- a grassy country, varied by occasional small patches of forest. . . ."

(p. 101) "Kamorta . . . is of the same geological structure as Nankauri, but is covered with far less forest, and its extensive grassy downs are dotted with patches of scrub, bracken, and pandani."

(p. 103) "The island of Bompoka is high, with a central tableland and is covered with forest and grass.

"Seen from a distance, Teressa looks like two islands, for it is elevated at either end: the northern part is covered with forest; the southern end is all grass-land, save for a fringe of scrub and large coco-palm groves along the coast."

(p. 104) "Teressa rises in the north to nearly 900 feet. The bed rock is serpentine. . . . The soil of the grass-lands is of an igneous clay formation--magnesian clay, formed by disintegration of the plutonic rocks. Overlying it in many places are the beds of coral, and to these two formations the grassy downs of the islands are confined--lallang [grass] with occasional screw pines, a bracken-like fern (*Gleichenia dichotoma*), delicate ground orchids, and various scrubby plants (*Kydia Calycina*), which point to the occurrence of annual fires. The transition from grass-land to high forest, which appears on the sandstone, is very sudden."

(p. 105) "The geological formation and the vegetation [of Bompoka] are similar to those of Teressa. The inhabitants have good plantations of fruit-trees--panaya, plantains, and limes, neatly fenced to keep out the pigs."

In 1847, in the whole of the Nicobars, Boden Kloss tells us, Père Barbe found rice grown only at Kar Nicobar, possible evidence of local Malay immigration. That the presence of serpentine, with localized deficiency of lime, may have had much to do with the presence of an edaphic grass-land climax vegetation on the islands mentioned seems very probable to the reviewer. Boden Kloss said (p. 109):

"With Kachal, we returned again to the tropical island of common type in these seas, for it is entirely jungle-covered, with no traces of grass-land visible.

"On account of their geological structure, the Nicobars fall botanically into two divisions--the northern islands, including perhaps Nankauri, are largely covered with grass, with coco palms and pandani growing in the interior, while the southern group, consisting of Kachal, with Great and Little Nicobar, are entirely forest covered."

Since the climatic conditions would determine forest for all, it is suspected by the reviewer that the grass-lands of the northern Nicobars may be the tropical equivalent of serpentine barrens, although fire may well be another factor in maintaining them. In view of the controversial status of humid tropical grasslands it would be worth while to find out. That there is a very peculiar edaphic factor to be reckoned with is indicated by Boden Kloss's statement that on Nankauri portions of the clay cliffs exposed to the sun become covered with a fine efflorescence of Epsom salt

(magnesium sulphate). There is no reason whatever why an equivalent of our well known northern serpentine barrens should not exist in the tropics.

Kluge, Fr. W. (1829) *Hannonos Periplous. Hannonis Navigatio. Textum critice recognovit et adnotatione illustravit D. Fr. Guil. Kluge. Lipsiae: sumptibus Guil. Nauckii.*

Kluge (1829) who edited and annotated the text of Hanno's *Periplus*, called attention to Malte-Brun's suggestion that the "torrents of fire" were mere phantasms, phenomena caused by volcanic heat. He also had a note on the Greek word (gorillas) which he thought must mean "Orang-Outang", which was of course quite impossible, since the latter lives only in Sumatra and Borneo. He also said that the Mandingo called big simians *Toorallas* and that this word might have been changed to *Gorillas* very easily by change of a T to (capital) Gamma. "Haec opinionem imprimis Mandingi, Nigrorum gens, amplectuntur, qui has simias *Toorallas* vocant. Ingeniosa est Hugii conjectura, hoc nomen idem esse ac *Gorillas*, quum nihil est facilius in scripura permutari possit [this of course, if the words were written in Greek]."

Koch-Grünberg, Theodore (1906) *Bericht über seine Reisen am oberen Rio Negro und Yapurá in den Jahren 1903-1905. Zeitschr. d. Gesellsch. f. Erdkunde zu Berlin, 1906, no. 2, pp. 80-101, figs. 7-18.*

In 1904 Koch-Grünberg visited Indians on the upper *Uaupés* River whose contact with trade goods had been only slight, but they already had European axes and cotton goods. They were quite ready to trade away the disused stone axes that their fathers had handed down to them.

At *Cuduiary* the *Kobeua* Indians told him of great savannas and gigantic "stone houses", which he determined to see. Five days' journey upstream, through forest with numerous inhabitants, he came to the headwaters of the *Cuduiarity*, a creek streaming under overarching trees and at length reached the savanna, occupying a high plateau. This was undoubtedly natural, and would seem, from the description (pp. 91, 92) of the sparse, stunted vegetation to be underdrained by limestone caves, for the "stone houses" turned out to be the chambers of a great cave.

This observation is of much value in coming to a conclusion about whether natural as opposed to man-made prairies exist in the moist tropics. In an underdrained limestone country where ground-water is likely to be drawn off by underground streams through

caves, there is no reason at all why there should not be edaphic prairies surrounded by tall forest. If there were a dry season, its effect would be greatly intensified by a constant deficiency of soil water.

Koch-Grünberg, Theodor (1910) *Zwei Jahre unter den Indianern: Reisen in Nordwest-Brasilien 1903/1905*. 2 vols. Stuttgart: Strecker u. Schroeder. 1909-1910. 22 pl., 3 maps, 3 tab.

To the north of the equator there seem to be few descriptions of transition from the Amazonian forest to extensive campos, as distinguished from riverside clearings of the sort that revert to forest when human occupation ceases. One such description, by the anthropologist Koch-Grünberg (II, p. 139) deals with the campos that begin on the Rio Cuduiary at about 70° W and 1° 30" N. These, however, appear to be caused by geologic and climatic factors and to have nothing to do with human agency. Nevertheless their interest is more than casual from the standpoint of human agency in the production of isolated prairie openings, because he speaks of seeing a natural opening in the forest, during two years travel from Manaus on the Amazon to the upper reaches of the Rios Negro and Yapurá, as a unique event. He wrote that the path to the campos led through high forest, succeeded by a narrow strip of open forest (catanga), and then the broad campo lay before them. "A remarkable sight," he continued, "for one who had seen only dense primary forest for long months. A sparse vegetation of a sort never seen by me before led an impoverished existence in the clefts of the rock. With low, sickly-grown trees, stunted shrubs, candelabra-branched tree-lilies bearing clusters of hard leaves, here and there a solitary flower . . . it is no savannah, but a very open scrub steppe, to be likened with the "campo cerrado" of the high plateau of Matto Grosso, with its depauperate vegetation, even though the floristic aspect is here entirely different from there."

Koch-Grünberg, Theodor (1923) *Zwei Jahre bei den Indianern Nordwest-Brasiliens* Stuttgart: Strecker und Schroeder 416 pp., 12 pl., 56 figs., map.

Koch-Grünberg's popular book on his travels from 1903 to 1905 in northwestern Brazil has an unlocalized general account of forest clearings which may be assumed to apply to all of the Indian groups that he visited up near the Colombian border. They planted chiefly manioc and had little

maize. Their clearings were prepared by weakening a large number of trees in the planned direction of fall or an especially large one, which was then felled and carried down with it all the others, which were often tied together by woody vines. It has often been wondered how primitive people before they possessed iron tools were able to accomplish so much clearing, but there are records from various places that advantage was taken of the falling of a key tree to bring down several or many others. (The writer observed this in Sumatra, and it has been noted elsewhere. See Ferdinand Denis (1823) for an account for French Guiana.) The sketches of Koch-Grünberg's book have no legends in the text but are properly localized in the list of figures, where we learn that the one reproduced here (fig.) shows a communal house (maloka) of the Makuna Indians on the Rio Apaporis situated in a clearing for manioc, surrounded by pupunya palms. Logs and stumps that escaped burning are shown. The destruction of Indian culture during the rubber boom early in the century wiped away such scenes as this. The house is of an architectural type similar to some that developed in the East Indies, but differing in not having an elevated floor on posts. At first sight the scene is strikingly but only superficially similar to some on the East Coast of Sumatra (compare fig.), or, as Whiffen (1915) points out, to some in New Guinea. The pupunya palm (Guilielma speciosa) has a golden yellow fruit which was used by the Indian women to prepare various drinks. (It is found as a planted tree, of uncertain origin, in Panama.)

Fig.—. Manioc field prepared by clearing and burning of forest, with communal house (maloka) of the Makuna Indians, upper Apaporis River, northwestern Brazil, near the Colombian boundary.

Koelz, Walter (n.d.) Letters from India. Unpublished: (to appear in the *Asa Gray Bulletin*, Ann Arbor, Michigan).

Dr. Koelz lived in Assam and other parts of India during the early years of Indian independence and was able to observe the rapidly accelerated destruction of forest in all the Assam mountains of the Lushai, Naga, Khasi, Mikir, and other districts. It was also going on in adjacent Bhutan.

In the Eastern Ghats and everywhere in the Central Provinces the destruction was rapid outside of the reserved areas, but in the tribal Central Provinces even the reserve forest was being burnt over during the annual burning, primarily with a view to improving the grazing.

The letters when they appear will show what devastation has come about, with release of control, to much of the scattered and isolated hilltop forests that have been the sole refuge for the last vestiges of the indigenous flora and fauna. The destruction has been final and complete in some localities. With the loss of the last islets of hill-top vegetation the associated forest-dwelling animals have necessarily disappeared.

Krige, Eileen (1931) *Agricultural Ceremonies and Practices of the Balobedu*. *Bantu Studies: a Journal devoted to the Scientific Study of Bantu, Hottentot, and Bushmen*, Vol. V, No. 3, pp. 207-239. Johannesburg, Univ. Witwatersrand Press, Sept., 1931.

An interesting account of the preservation of sacred forests by a Bantu tribe of the northern Transvaal is given by Eileen Krige. She states (p. 210):

"It is the custom of the Balobedu never to cut wood or chop down trees growing near burial places, and it is this custom that makes it a criminal offence to cut wood in the forest of Daja, the sacred spot where the oldest chiefs lie buried. It was near Daja that the Balobedu chiefs settled when they first came into the country, . . . Daja is important for another reason, for it is related that the badima of the Basioka, the first inhabitants of the country, are there too, and it may be that there is some idea of propitiating these old lords of the land, whose descendants have all died out. Seale and his descendants in the royal line were buried at Moholwe, a place quite near the present head kraal and it is at Moholwe that the sacred komana drums are kept. No wood may be cut there. The bush round the present head kraal may also not be cut, though there are no graves there."

The sacred forest was the scene of annual ceremonies which were the most important the people had, being concerned with rainmaking, choice and protection of crops, etc. The sacred ruler did not participate in these but might play a most important part for she was not allowed to grow old. Her life was bound up with vegetation and the fertility of the crops. So she eventually, before growing old, was to drink the poison called ketaba so that the agricultural life of the country, bound up with her life, might not decline. She sat upon a sacred drum (rangoedi) which was supposed to be renewed before the great ceremonies (komana) with the skin of one of her chief councillors. This feature of the ceremonies was disapproved by the Government, and the councillors were inclined to think they agreed with the Government, so the old ceremonies were falling into disuse! They had had the excellent effect in the old days in aiding conservation to some slight extent.

Kuhnholz-Lordat, G. (1939) *La Terre Incendiée: Essai d'Agronomie Comparée*. Nîmes: Editions de la Maison Carrée, Ateliers Brugier. pp. xi + 362 .

Kuhnholz-Lordat has summarized much literature on the effect of fire on vegetation throughout the world, especially that pertaining to France, but his comments and bibliography are also particularly useful for literature on French colonies in Africa and Asia, and for the Belgian Congo as well.

He emphasizes the importance of the plants which he groups together as pyrophytes, fire plants, namely, those which survive fires and those which spring up quickly by seeding following the practice of felling forest and burning the debris. Such fires he terms "precultural", but a better term in English would seem to be "preagricultural". If followed by permanent pasturage or cropping of the land, subsequent intentional burning he terms "cultural", but we shall substitute pastoral or agricultural, as may be appropriate.

Regarding pyrophytes, Kuhnholz-Lordat quotes an old Provencal proverb:

"Quau me coupo me doublo;
 Quau me brulo me fumo."
 (Whoever cuts me doubles me;
 Whoever burns me fertilizes me.)

Anciently recognized as a special group of plants, he classifies them as (a) pyrophytes by passive resistance, and (b) as pyrophytes with vegetative reaction to fire. The former are such thick barked or otherwise well protected species as (to take examples from the tropics) we find in the tapia of Madagascar, and the dao or yao of Cambodia, and Indochina. These succumb after repeated exposure to fire but survive fire a few times.

The pyrophytes that have a vegetative reaction to fire are many. One is the Hyphaene Shatan (literally, Hyphaene of the Devil) which branches below ground. Its growing points escape fire damage and give rise to a palm savannah (the "savane à satramira"). There are similar palm savannahs in many parts of the world, extending as far into the subtropics as palms do, and the one which reaches the Mediterranean is characterized by the dwarf fan palm Chamaerops.

Corresponding to this are the "palm scrubs" of the southeastern United States. Passing over other plant families, for mention in connection with particular types of savannah and prairie, one family generally provides the most characteristic components of burned-over areas, namely the grass family. Producing abundance of wind-borne seeds, and forming large deep-rooted perennial clumps or continuous turf, certain grasses are prairie formers above all other plants.

Kuhnholz-Lourdat's discussion of Bantu agriculture and its reported effect in certain regions in restoring grassland to forest is referred to under Vanderyst (1924).

Kurz, Sulpice (1875) Preliminary Report on the Forest and other Vegetation of Pegu. C. B. Lewis, Baptist Mission Press. 97 + cxxxviii + 95 + xxiv + 1 (with 2 pl.) + 34 pp., illust., 2 maps.

Kurz's interesting observations may be presented in large part as extracts.

(p. 19) Influence of Jungle Fires. "Jungle-fires are happily not often the object of consideration with a botanist, but here in Burma they are so regular and so extensive as to become a powerful prohibitive factor in vegetation. During the hot season here a botanist has to collect his flowers enveloped in smoke and surrounded by fires in all directions.

"The full influence of jungle-fires will only duly be appreciated after the authorities shall have succeeded in suppressing these destructive agencies, at least so far, that they cease to be the rule and become only exceptions. Against the fire-raising propensities of Barmans and Karens, the most energetic action of Government will hardly succeed, and it will be very difficult to prevent these people from setting fire to their toungyas, to which jungle-fires must be chiefly attributed.

"The jungle-fires may be divided into superficial and destructive ones; the former affecting only the low growth the latter often destroying also trees and other woody plants.

"Superficial jungle-fires are annual ones, occurring more or less regularly every hot season, sometimes twice over, and burning down the fallen leaves and the dried up grasses and herbs. Old half-rotten but dry logs are often consumed, healthy ones are rarely more than scorched by the fires. Sometimes, but very rarely, the fires enter the outskirts of the evergreen forests, burning up the dry fallen leaves, but doing little damage beyond scorching the undergrowth.

"The destructive jungle fires do not occur annually but periodically. They set in after the bamboo has come into flower. It is well known that most of the bamboo species, which often form such a dense undergrowth in the Burmese forests, flower rarely; and that when a species gets into flower, all or nearly all individuals of the same locality flower simultaneously although the same species in other localities does not. Those few that do not flower the same year, do so usually the following year, a confirmation of the presumption that they are nothing but stragglers of the same stock. After flowering and fruiting they die off. However, the dying off is not rapid, but slow, sometimes taking two to three years. The spikelets protrude, one behind the other, in such profusion that it is no wonder that the plants become exhausted. It is then, when the bamboo dies off and has become dry enough, that the destructive jungle-fires commence.

"However, the savannah fires, really fearful in certain respects, may occur annually. They shew us what an amount of heat trees can resist, for although the bark is scorched and often enough burnt to coal, and the foliage totally scorched, they recover again perfectly during the ensuing rainy season.

The flames seldom envelope the whole lower part of the crown, especially if the grasses consist of Saccharum procerum and Phragmites."

Kurz (p. 22) presented an interesting map of the phytogeography of India and southeastern Asia illustrating the fact that northern India from the mouths of the Indus to the juncture of the Ganges and the Brahmaputra to the foothills of the Himalayas was an alluvial plain with a secondary flora of mostly wide-ranging species. He said:

(p. 21) "Between Hindostan, the Himalayas and Eastern India a dead aluvial plain extends (on the bed of an ancient sea) known as the Gangetic and Indus plains. . . It is botanically a neutral ground, at present almost destitute of indigenous forests except along the sea-coast, and to the botanist a dreary field for explorations. So poor is its Flora, that the whole of these alluvial plains number not above 1300-1400 species, and even Lower Bengal cannot boast of more than 900-1000 really indigenous plants, amongst which agrarian, swamp and aquatic plants and grasses predominate."

This plain marks the northern edge of the truly tropical part of India, and it is probably no exaggeration to say that almost the whole landscape is man-made, and that little can ever be known about what its original flora may have been when it was a forested region.

The eastern Indian flora begins at the eastern edge of the Gangetic plain and merges into the Burmese, Siamese, Indo-chinese, and Malayan floras, all rich and with distinctive components. In all of the regions east of the Ganges there has been vast destruction by fire and primitive agriculture, but some of the original vegetation persists.

Kurz said that of the effect of man in the delta of the Ganges: ". . . any one who would draw up a description of the Flora of the Gangetic Delta as it now presents itself, would produce a picture quite different to what really existed when cultivating had not yet advanced so far in Bengal; for the alluvial plains of lower Bengal have been at some time exactly what the Irrawadi valley is now, [i.e., was in 1875]. . . . There have been extensive savannahs and savannah-forests gradually passing into lower mixed forests towards the base of the Himalayas, Behar and Khasyah-hills, and as gradually running into savannahs and tidal jungles towards the sea coast."

Kurz called attention to the prevalence of arid-land vegetation along the Irrawadi north of 18° 15' (Myanung) and definitely believed that there existed natural (it would nowadays be distinguished as either climatic or edaphic) savannah, as distinguished from man-made. There is no reason to doubt this, for the "Prome" zone of the Irrawadi was too dry for dense forest, and open forest would surely occur, which in the Prome area was found by Kurz to be characterized

by a species allied to teak (Tectonia Hamiltonii), Acacia leucophloea, etc. In lower wet country he also believed that there were natural savannahs and grasslands. Many would question this, and would believe that he failed to recognize as such the later stages of land repeatedly cleared for agriculture.

It was pioneer ecologist Kurz, (pp. 26, 57, 58) who made the first careful studies of the clearings and village groves of Burma and who is probably to be credited with the more modern adaptations of toungya agriculture for reforestation.

He distinguished "lately cultivated lands" as "lower agrarian lands", turning into pastures after harvesting, and "upper cultivated lands or toungyas, turning after desertion into poonzohs and jungles". Useful perennial plants and trees were sometimes planted in a toungya, such as mulberry, planted by the Karens for silk-worm food, and near the houses all sorts of trees were planted, producing village groves that would last indefinitely. Often, however, a toungya was merely temporary. Kurz said:

"The trees that have been felled and burnt previous to the formation of such toungyas are usually not completely burnt, but many of these logs, seriously damaged and scorched by fire, are scattered on the ground. The stumps of the felled trees are also seen sticking out everywhere, and often throw out numerous shoots that grow up again into trees.

"After the harvest has been brought in, these toungyas are left to themselves for the next 8 to 12 years, by which time they become, as a rule, converted again into young forests. These are then considered by the Karens to have become "strong" enough to yield a sufficient amount of alkalies, etc., for another routine of hill rice culture. They are seldom kept under cultivation for a second year, and then no rice is cultivated, but only cotton, mulberry, and such like, along with the usual culinary vegetables.

"After such toungyas are completely abandoned they are called toungyas poonzoh, or briefly poonzoh, deserted toungyas."

Eventually, he says:

"The whole poonzoh becomes covered by certain weeds that have got the supremacy over the others. . . Such is the case especially in the level tracts, but in hilly parts coarse grasses spring up which supersede all other herbaceous growth, and these are chiefly Thysanolaena acarifera, Saccharum spontaneum, Androscepiæ gigantea, and Poix heteroclita. Bamboos appear only when in the surrounding forest tracts the bamboos flower and fruit at the time when such toungyas become

deserted. . . Another reason why bamboos do not overgrow such deserted clearings in the first year that they are left to themselves, may be that the Karens avoid as much as possible planting rice in localities where bamboos are expected to come into flower. The true reason for this practice is, I think, because wandering rats increase in jungles containing fruiting bamboos to such an extent, that it is known that whole toungyas have had to be given up to these voracious creatures."

Kurz (p. 72) said that for the practical purposes of forestry a distinction might be made between toungyas (also called merely ya) on level ground, which was so rare in Pegu as to be destined for arable crops anyway, and those on hilly land, much of which was incapable of supporting a considerable population anyway, and should remain forested. He likewise thought that a distinction should be made between the toungya or deserted toungya (poonzoh) on land which had been evergreen forest, and that which had been deciduous forest. On the former he suggested growing rubber, and mentioned that *Hevea* grew well in the Botanic Garden at Buitenzorg in Java and that seeds might be obtained from there. If this had been done, it might have made a vast change in the present economic pattern of southeastern Asia! He also wanted to try *Ficus laccifera* of the Andamans and certain woody climbers indigenous to Burmah. He also advocated tests of mahogany, and the rasamala of the Malays (*Altingia excelsa*) as being hardly inferior to teak, and a variety of other valuable trees.

It was quite natural that he should see possibilities of extended silk production, for which the Karens already planted mulberry in the toungyas, and he enthusiastically proposed rational use of the cleared forest by a rational succession of crops which would end in reforestation. To quote:

"The damp toungyas are, after desertion, more or less regularly overgrown with *Boehmeria*, *Sponia* and other members of the nettle tribe, thus preparing the necessary shade for the other evergreens which spring up between them. Of this natural course, advantage might be taken, and instead of the *Urticaceae* already named, the rhea plant might first be grown, which would perform the same services as the evergreens before mentioned and would at the same time give a handsome outturn. The damp valleys of the Pegu Yomeh, and more especially those of Martaban, are well adapted for the cultivation of rhea, and it is difficult to understand why this plant has not yet been cultivated there. . . . In similar places in the Martaban the Chinese green dye (*Rhamnus chlorophorus*) might advantageously be introduced."

Kurz (p. 73) thought the deforested areas of the Martaban hills suitable for tea, and suggested that if the acari, wingless insects that caused great destruction in Bengal tea gardens, should appear, a trial should be made of preventing their movements by interplanting with hemp (*Cannabis sativa*), an aromatic repellent

(but one not likely to be approved nowadays for general cultivation, since it is too widely known to be a dangerous narcotic). He said: "This is not a new idea, but is often resorted to in Germany for similar contingencies."

Turning to the second kind of hill toungyas, those on land from which deciduous forest had been cleared, Kurz (p. 73) said of the areas in the Martaban hills east of the Sittang river:

"The destruction of forests going on there is simply alarming, and can only be explained by assuming that there is no control over permits for cutting toungyas. The yield of rice crops in the Pegu Yomah is said to be from 60 to 80 fold. I can rely but little on Karen information, but, in the second year, it is said the return is only 1/2 to 1/3 of that amount, and for this reason the ya is abandoned after the first year."

Referring to loss of valuable fertilizing ashes by erosion on steep slopes after chopping and burning, Kurz said (p. 74):

"The loss of the valuable ashes that are carried down these slopes at the beginning of the rains cannot be over-rated at two-thirds of the whole quantity obtained by the burning of the ya, and to comprehend this more clearly, it must be remembered that the thunder-storms and showers, at the commencement of the monsoon, are very heavy." . . .

". . . As it is, a Tai [clanship] of less than 100 families cuts down yearly for its support a quantity of timber quite sufficient in tonnage to build a first class man-of-war, and if the whole Karen population of Burma be taken into account, the timber consumed by them (of course taken quantitatively and not qualitatively) would represent in tonnage the whole English fleet. All the trees which are cut down, and which are the natural pumps of crude vegetable nourishment from the depths of the substrata, have to grow again, in order to give another crop to these people. But I fear, with regard to the Christian Karens in Martaban, that the natural reproduction of the forests is by no means proportionate to their annual destruction. (Compare my journal of 12th March 1868 where it is stated that some 36 square miles of teak-forests have disappeared since Dr. Brandis' sketch map of Martaban was published in 1861.) Toungya cultivation in this country will always remain a question of vital importance not only to the forester but also to the public generally, and the destruction of forests caused by such a ruinous system must sooner or later become a matter for serious consideration. . . . As long as these unsettled tribes are left to themselves, the consequences of such a system were not so conspicuous on account of the continuous warfare in which they were engaged, which necessarily thinned the population, and thus counterpoised the evil; in present peaceful times, however, matters assume

a different aspect, and it cannot be said that toungya cultivation is the result of idle habits on the part of the people, for harder work than this can scarcely be imagined. It is an innate hereditary custom suited to the migratory propensities of the people, against which the only modus operandi will be the suaviter in modo et fortiter in re.

"It would really be a boon if the missionaries, who have so much influence with the Karens (at least with the Christian portion) would take it upon themselves to teach these people the blessings of a more rational agriculture; for I believe that the various topics which even the simplest culture involves are more suitable for the advancement of civilization amongst the people, than instruction in mathematics, geography and the like."

Kurz (p. 75) was especially concerned with the false deductions that he believed the foresters had drawn about the natural reproduction of teak, the chief and almost only tree that the government seemed really concerned about. So his proposal for making use of toungyas in forestry, which resulted in what has now achieved great notoriety (except that originated with a systematic botanist who was a really notable pioneer ecologist) in Africa, as the toungya system) is largely pointed to the growing of teak. So, quoting Kurz again at considerable length, we shall present the idea of the "toungya system" as he originally proposed it:

". . . I shall attempt to show how good might be derived from evil, and how such deserted toungyas might be utilized for forest purposes. The right of cutting toungyas in forest districts is, I suppose, subject to the permission of the forest officer of the district. Hence, if the conditions for a subsequent occupation of the ground were favorable for the raising of timber plantations, they would readily, it is believed, be accepted by the parties interested, and a good deal of expense in felling trees and preparing the ground for a plantation would be saved. Such toungyas would be only suitable for leaf-shedders but not (in the greater number of cases) for evergreens [i.e., broad-leaved non-deciduous trees]. It has been ascertained that teak does not spring up very freely in toungyas, and it is supposed therefore that toungyas are not generally favorable for the dissemination of teak. The causes of this are apparently the following:

- (1) Karens usually avoid cutting toungyas in localities where bamboo fruits or begins to fruit, for they know very well that rats would be attracted and would destroy the crops.
- (2) As a consequence of this, coarse grasses, etc., spring up instead of bamboo seedlings, necessarily suppressing, to a greater or lesser degree, the growth of teak and other trees.
- (3) Toungyas are not allowed to be cut in localities where teak is abundant, and therefore the supply of seed that is carried

to them by winds after they are deserted is necessarily small or only nominal.

"On the other hand, we know of teak:

- (1) That its seedlings come up freely where bamboos have flowered and died off.
- (2) That teak attains its greatest perfection in size and growth where Tinwa and Kyattounwa are largest. In fact, the growth of these two bamboos may be considered an infallible criterion for the growth and size, not only of teak, but also of many other leaf-shedding trees, which elongate their stems in proportion to the average height of these bamboos.
- (3) That teak and other leaf-shedders, without bamboo undergrowth, remain small-sized with short stems, and, if grown on deep alluvium or on impermeable substrata, often become deformed.

"From the above facts, we may, with a certain degree of probability, conclude that the present system of planting teak in Pegu is not in conformity with the natural requirements of the tree, and will by no means realize the expectations which foresters may entertain."

[The First Planting Plan for a Deserted Toungya]

Kurz's suggestion for a particular toungya which was to be planted to teak, on the particular soil that was most suitable was presented (p. 76) as follows:

"To return now to the poonzohs or deserted toungyas, we must keep in mind that hardly any advantage can really be derived from them except when they are occupied immediately after desertion. It is then that measures can be taken to prevent the springing up of coarse grasses and weeds, which are so injurious to the free development of tree growth. The natural course would seem to be to sow bamboo seeds and teak together. . . . If shade is actually required. . . . I would suggest for the present castor oil and papaya trees (and the Chinese tallow-tree?); I can for the present note only these few trees as suitable for permeable sandstone formations. . . . The above mentioned trees will, however, keep out wild sugar cane and other coarse light-loving grasses, while weak soft grasses and herbs will spring up, and will have rather a beneficial effect, because they will remain green the greater part of the hot season, and will thus be less subject to jungle fires."

Kurz proposed that in the first rainy season teak, castor-oil and papaya seeds should be grown together, followed in the second rainy season by properly spaced planting of bamboo seeds. In subsequent rainy seasons there would be elimination

of castor-oil and papaya plants in accordance with the growth of the teak and bamboo. Around the edge he would have a plantain hedge with succulent-leaved *Bryophyllum* for protection against jungle fires. The sketch which he presented conformed to his idea that "regular planting out of the trees is preferable to simply sowing them, as every tree receives by such a process the same amount of space, shade, etc. . . . The squares are here taken at 5 feet at each side; castor-oil trees are nearest the teak seedlings, while the bamboo clumps, after removal of the castor-oil trees, will be at distances of nearly 15 feet; giving a total of 440 teak-trees per acre."

Such was Kurz's conception of the toungya system, which, needless to say, has come to show very many aspects. The germ of the idea was his, however, and it grew out of his feeling that without doing away with the primitive agriculture of the natives, it might be turned into permanent forestry. In order to have positive information about the ecological requirements of various trees he proposed a rather elaborate system of collecting timber samples from many localities, habitats, and plant associations, of timber testing for strength, etc., of soil requirements, of botanical collections, of study of native names and uses of wild plants. He acknowledged indebtedness in his studies to Dr. Brandis, Inspector-General of Forests and to Captain W. J. Seaton, Conservator of Forests in Burma and other English foresters, who were probably those who made the first practical use of his ideas, to officers of the Geological Survey, to Dr. G. King, Superintendent of the Botanical Gardens, and to his "venerable old friend, the Rev. Dr. F. Mason in Tonghoo, himself active in the Burmese Flora, and the author of a book on the natural productions of Burmah, who has always been a kind and untiring guide to me."

La Farge, Oliver (1927) "Observations of the Indians of the San Martin Pajapan Region", and "The Coatzacoalcos Basin," Chapters IV and IV bis, pp. 49-92; "Pines", (Chapter XI) pp. 329-243; "The Ocosingo Valley", Chapter XII, pp. 245-257; and "The northern Tzeltal Tribes", Chapter XV, pp. 325-375, in Blom, Frans, and La Farge, Oliver, Tribes and Temples: a Record of the Expedition to Middle America conducted by the Tulane University of Louisiana in 1925. 2 vols. New Orleans: The Tulane University of Louisiana. [vi] + v + 1-238 pp.; pl. I-VI, figs. 1-194, maps I-IV; [iv] + iv + pp. 239-536 + [xvi] pl. VII, figs. 195-374, map V.

In this anonymous work of scientific travel the non-archeological parts are to be attributed to Oliver La Farge and the archeological to Frans Blom. The region traversed included southeastern Vera Cruz, for which area there is a quotation from Villa-Señor y Sanchez (Teatro Americano, 1746) indicating the use of planting sticks in the primitive shifting agriculture at the time of the conquest, which use, La Farge states, has persisted down to our own time. Quotations follow:

(p. 49) "The San Martin Pajapan area between Lake Catemaco and the coast is occupied almost exclusively by Indians speaking Nahuatl and Popoluca. . . . The lower parts are covered with thick jungle; the higher, whether from clearing or through a change in soil, are open grass and oak country. . . . The Spaniards regarded it as part of the province of Coatzacoalcos. . . . Early descriptions of the area are meagre . . . until 1746. . . . In that year Villa-Señor y Sanchez published his book . . . and . . . gives some idea of the fertility and general state of the district [which] we quote here. . . .

" 'The town of Acayuca (Acayucan) is . . . warm and humid and the land so fertile that it gives four crops of corn a year; and, as this has no outlet to other jurisdictions, this same abundance of crop is the cause of the Indians being very little energetic in working, because to make their fields, they have only to cut the bush and make holes in the ground with pointed sticks, and they do the same with beans, without using plow or any other implement of cultivation.' "

La Farge himself says (p. 60):

"The rich soil of the jungle sections is ordinarily used for farming, in preference to that of the more open, grass and oak country. It is possible, indeed, that the open land is produced by partial exhaustion of the soil due to 'bonanza' methods of farming. Abandoned fields that we saw were growing up in grass and small, thick second growth.

"The jungle is cut and the dead wood burned on the field, after such wood as may be useful is carried off. On the whole, the clearing here is neatly done, the fields being fairly free of rubbish. The soil is prepared with a digging stick, only the top

soil being disturbed. There is no plowing. Old machete blades are used for weeding. Corn is the staple crop, and to it the larger part of every field is given over. With it are planted beans, melons, papaya, pineapples, and sweet potatoes. Gourd trees are cultivated, and a bush with a red fruit called in Spanish ajon, used for flavoring meats."

In view of the usual clearing of forest land for agriculture, as contrasted with the very difficult preparation of grassland, it may be rather safely assumed that prairies or savannahs containing extensive archeological remains are in this region to be considered as having been originally forest, which was cleared and transformed into grassland by human occupation. So J. J. Williams's report of 1852 on the Isthmus of Tehuantepec, quoted by La Farge (p. 77) is of much interest. The latter author translated from the Spanish edition as follows, about the mounds scattered over the savannahs around San José del Carmen:

"The number and variety of mounds found near San José render it a place of considerable interest. These are scattered over various points, and generally composed of chalky earth, alternated by various colored clay, beneath which are fragments of ancient vessels. In examining some of these mounds, several copper hatchets and other antiquities have been discovered."

It was not far from here that the Spanish conquerors traded worthless beads for 600 copper hatchets, thinking they were getting gold!

The most northern extent of the Mexican state of Chiapas is like a peninsula reaching up into Tabasco. In this extension live the Bachajon Indians. La Farge described the country as follows (p. 239):

"Our trail wound through low bush and second growth. Here and there on hills were islands of high forest, but the level ground formerly under cultivation was now covered with an impenetrable network of low bushes and thorny brambles.

"Indian agriculture is very simple. Towards the end of the dry season the Indian selects a place in the forest for his corn field, and makes an extensive clearing. All trees and branches are cut in small pieces, and left to dry in the baking sun. When thoroughly dry, they set fire to them, and in a short while the ground is clear, . . . as clean as a floor.

"Then the Indian plants his corn in holes made with a wooden digging stick. . . . The ground is never broken and no fertilizer is used. This method is very wasteful. Three to four plantings can be made in the same clearing, after which the soil is burnt out and exhausted. Then a new place must be found for the field.

"In this way great tracts become waste land. Today the population is scarce, and the damage is therefore comparatively small; but before the Conquest the population must have been much greater, judging by the many and large ruined cities."

La Farge (p. 240) has an interesting comment on soil exhaustion as one of the probable reasons for the migration of the Maya of the Old Empire region in Guatemala to the northward during the seventh century.

Proceeding southward through the Indian country towards Bachajon the Tulane party crossed one mountain ridge after another. Then:

(p. 241) "The vegetation changed to low oak-like bush over ground covered with fern-like moss and pretty, wild iris. As we rode downward to the next valley new mountain ranges appeared before us and we could see the pine country at a distance. There is no transition from tropical vegetation to pine forest. Change in soil is probably the reason for change in vegetation. The tropical forest grows on black humus soil and the pine country is underlain by a red sandstone which weathers into a heavy red clay. The contact of this sandstone with the limestone country, on which leaf-trees grow, lies about an hour's ride north of the village of Bachajon.

"The pine country is very hilly; the trees are scattered over a carpet of vivid green grass cut by the strong red line of the soil of the trail like a scar."

Further confirmation of the general thesis that shifting cultivation is at the expense of forest is furnished in La Farge's chapter on the Tzeltal tribes, to which the Bachajon and Ocosingo Indians belong. They speak the Tzeltal language, somewhat closely related to Maya, and "today live the life that their humble forebears did five hundred years ago. La Farge wrote (p. 326):

"The Bachajon live on the threshold of the pine country. Their farms may be found hidden away in the thick jungle land of mahogany and palms, through which their little hidden trails lead to houses tucked away out of sight of alien travelers. . . . The capital Bachajon Village, is among the pines. There, periodically, the Spaniards used to round them up, that they might be more easily policed, and for the benefit of the church established there."

Concluding this summary of La Farge's notes bearing on shifting agriculture in southern Mexico, one must call attention to his discovery of various localities in Chiapas and adjoining states where there is evidence, in the form of terraces, of agriculture by irrigation. He also reported one Indian community still using irrigated terraces.

Lafort, Capitaine De Mananjary à Fianarantsoa. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. I, No. 5, pp. 223-234, chart of route. Tananarivi: Imprimerie Officielle. 31 May 1897.

From a botanical standpoint one of the best of the reports of traverses by detachments of the French army in Madagascar is that of Captain Lafort (1897) describing the country between Fianarantsoa in the Betsileo country about 200 km. south of Antananarivo to the east coast at Mananjary, which is at about 21° 20'S and 46°E. The very instructive chart shows not only elevation of the route above the sea, but also the slight amount of forest that remained even in 1896.

Leaving Fianarantsoa on the plateau he found the country to be completely denuded until he had passed through the hills at the edge of the plateau and commenced the descent from about 1300 m. down to a lower terrace at about 800 m. This interval he found to be a dense belt of forest about 10 kilometers wide. At the level of the 800 m. terrace below the forest belt and to the eastward the country was again deforested to its edge except for somewhat high hills on its eastern border with wooded summits. At Sarahanony or Safodrano there was a final forest of some considerable extent, but after passing the boundary of the Tanala country the hills were covered with brush except for islets of woods, chiefly the travellers' palm (Rovanala, in the banana family) and bamboo.

Lafort stated that the Safodrano forest was only a remnant of the formerly continuous grand forest of which the edge had been gradually pushed back by fires lit by the natives.

Laird, J. L. On Coomrie Cultivation. Indian Forester, Vol. I, no. 1, pp. 11-16. July 1875. Calcutta, 1876.

The system of dry-land grain cultivation called coomrie [i.e., kumari], as practiced in Bedi (Bidi taluk of Begaum, India) was described by Laird 80 years ago as extending to other parts of India and as being perhaps no different from the usual and most primitive type of shifting agriculture elsewhere. He proposed that a regular cycle of agricultural use and forest regeneration should be based upon it. This would consist in coppicing all unreserved trees of a tract, burning the leaves, branches and other litter, and spreading the ashes over the soil, which would thereby be sufficiently fertilized so that two or three crops could be raised. The process would then be repeated on other fractions in a regular rotation. Except for preservation of reserved mother trees for seeding, which would presumably be accomplished by controlled burning, there would be no difference

from the "coomrie" procedure of the natives, during the first cycle. As soon, however, as the whole area had been used for khuski (dry-land grain) cultivation, if the oldest fallow section had not produced good enough new woody vegetation to be of any value for cutting, the fallow part of the cycle could be lengthened as much as necessary for the production of useful trees. In fact, Laird himself gives the impression that coomrie could be modified from simple shifting agriculture to a system of silviculture which would allow agricultural operations for a year or longer when each block of forest was cut.

Actually, he proposed (1) eventual lengthening of the cycle to 30 or 50 years, or more, long enough to get useful timber, (2) clean cutting of the section to be used for agriculture, (3) burning of only the non-useful debris. He believed, apparently, that there would be enough enrichment of the soil from branches, leaves, etc., so that all useful timber could be taken off the land as a crop.

Laird defined as "coomrie districts" those in which the capital available for cultivating the soil is so small, the waste land so extensive, and the people so poor, that Government thinks it necessary to allow coomrie. He goes on to say (p. 13):

"The fact of land having once been coomried is in itself no criterion that the land is now absolutely coomrie land; indeed, if it were, all tracts now under cultivation would now constitute coomrie districts."

His plan was not very dissimilar to the one advocated in Burma by Brandis and Kurz, and which has become known as the toungya system, since it was to be based upon the clearings for shifting agriculture which in Burma are known as toungya, or ya.

Lamb, A.F.A. (1942) The Kurmis of Northern Nigeria. Farm and Forest or Land Use and Rural Planning in West Africa. Vol. III, no. 4, pp. 187-192. Nov. 1942.

Lamb described the isolated patches of high forest scattered across the hilly country from the Jos Plateau to Minna. This, and similar areas found in Benin and the north of Ondo Province, with magnificent trees, go by the Hausa name kurmi, a forest or wooded ravine. Such forests are nearly always small and located near a permanent village at the edge of a stream. Protected from fire, they were places of refuge in the old days from the raiding Fulani, who came on horseback and would not enter forest for fear of the tsetse fly. The villages and the kumis were protected by earthworks, and a deep ditch surrounding

a wall; the villages of Gurusu and Fuka by a double circle, which the Mende defended, Lamb says, with bow and arrow. No fire was allowed to pass beyond the inner wall and no trees were cut as far as the outer wall, but beyond farming had greatly reduced the fertility of a broad circle of land around the kurmi. Lamb said:

"An aerial photograph of Gurusu kurmi would look like a target with the kurmi as the dark green bull, the denuded area as the pale green inner, and the untouched savanna woodland, broken here and there by farms, as the rest of the target. It is many years since the denuded strip has been farmed, but it has not recovered its woodland vegetation,

"After the advent of British rule, however, the greatest enemy of villagers was no longer the raiding Fulani but the tsetse within these high forest patches. Sleeping sickness is very prevalent and many of the villages have been persuaded to move out to the denuded area outside the kurmis,"

Lamb said that the villages of Kafin, Fuka and Gurusu had so many people that the kurmi of each was cleared of understorey for firewood and house poles, leaving the sacred iroko and also the male, prized for the oil obtained from its fruits. The remaining forest of Fuka and Gurusu was tall, beautiful, and valuable. That of Kafin had more tall species and a dense undergrowth which had grown up in the fifteen years since the village had been moved away from the kurmi into the open.

Lamb found that the farther inland the locality and the higher the elevation, the less favorable it was for kurmis. The soil had to be sufficiently retentive of moisture not to become too dry during the dry season, or else the area had to be near stream level. Of course there was correlation with rainfall. Kaduna with a rainfall of 52.5 inches had one kurmi near the source of a stream, Kafanchan and Zonkwa with 70 inches had a landscape dotted with kurmis,

Lamb guessed that by the end of the second world war all of the usable timber within eight miles of the two railroads would have been cut. He was particularly interested in the natural reproduction of iroko (*Chlorophora excelsa*) which was abundant following one ground fire to destroy competing undergrowth, if protection from fire followed thereafter.

Lancaster, P. C. (1943) Iroko-producing Areas of Owerri Province. Farm and Forest, or Land Use and Rural Planning in West Africa, Vol. IV, no. 2, pp. 76-77, June 1943.

P. C. Lancaster, commenting on findings of W. B. Collins and of A.F.A. Lamb (1942) and of J. Smith regarding the disappearance of the valuable iroko tree (chlorophora excelsa) in Nigeria said that the deforestation situation for Owerri Province was similar to that in Western Ashanti, i.e., bad.

Owerri Province had some iroko in three divisions, Ohoada, Owerri, and Okigwi. In all three, he wrote,

"The mature trees are being felled and the younger age classes hardly exist at all, as almost all the dry land has been farmed or is at any rate honey-combed with farms and apparently has been for some time. . . . The land varies from a small amount of Mangrove swamp and swamp forests to the south of Ahoada, to savannah forest and open grass land in the north of Okigwi. The bulk of it must originally have contained good rain forest but most of it has been farmed and only small patches of forest and individual trees are left."

Of Okigwi district he said:

"Except at the headwaters of the Imo River and along its banks there are practically no areas of forest. In the comparatively flat areas to the west of the Imo River are found the stands of Iroko. The vegetation varies from pure farmland to small patches of good Iroko forest round the villages."

Lancaster concluded:

"The whole issue is primarily a political one. It may be that Government will decide that land suitable for farming cannot be spared for forestry . . . but it is certain that if land is not spared there will soon be no Iroko and the question is sufficiently serious to merit very careful consideration."

Lange, Algot (1914) *The Lower Amazon*. New York and London: G. P. Putnam's Sons.

An interesting account of Para by Algot Lange furnishes many bits of information about clearings, prairies and deforestation on the lower Amazon. At the village of Cachoeira on the Arary River, within the influence of the tide, he observed:

(p. 278) "It is truly a prairie village. . . . Behind and all around the forest is gone and instead I see only here and there, straggling, twisted trees scattered over a prairie said to extend some ninety miles, clear to the ocean. . . . The main variations, from anything I have seen before while on the Amazon, are the open, unobstructed prairies with little groves

of trees and shrubbery sticking up like islands in a green sea. These "islands" are called in the local language *tesos* and represent the only places of refuge for cattle, when, during the wet season, almost the entire island is submerged to a depth of several feet."

These prairies were used for herding cattle and are undoubtedly natural, not man made. The description of them suggests similarity to the Florida Everglades.

On the upper reaches of the Moju River Lange visited Indians of Tupi linguistic stock. Landing at a temporary river-side shelter he followed a well-defined path into the forest and discovered a new clearing. This was about 300 miles from Para, and here he met his first Indians. This clearing had been made with steel axes brought to the place by his companions the year before. A few miles further up the river he visited an established clearing where, he found,

"Until last year the work of felling trees had been performed with diorite axes, shaped from the stones found in the rapids, but after the visit of the rubber workers the Indians acquired through their hunters a few good steel axes of good make, and they were quite expert in handling them. . .

"The diorite axe is a clumsy tool . . . all of almost the same size . . . the average weight is two and a half to three pounds not counting the handle. . . . Only one hand is used in manipulating the diorite axe and with no apparent intention of chipping sections out . . . at the base of the tree. Instead, the fibres are crushed and broken by the blunt edge. After a rough cavity has been made . . . a fire is built in the cavity and allowed to burn for some time when the cutting commences again. Chopping and burning, alternately, fells the tree."

These Indians called themselves Araranndeūara.

Lavauden, L. (1931) *Le déboisement et la végétation de Madagascar*. Rev. Bot. applic. et Agric. colon., No. 122, pp. 817-824. (Seen only in abstract; reference not verified.)

P. de la Bathie was the first to emphasize the enormous effect of man on the vegetation of Madagascar. But it is possible to go farther than he did and affirm the primitive unity of the forest of Madagascar. We can say that the composition of the deciduous forest of the west is due to the denudation of the central region, and that, at the time when the island was forest-covered, it was of uniform aspect, composed chiefly of evergreen species, corresponding with the present forest of the eastern part.

The present reviewer can hardly agree, if the statement in the paragraph above actually represents Lavauden's views, that his conclusion can be accepted. It fails to take into consideration that a long time, probably extending back into the Tertiary, would have been required for the evolution of the endemic xerophytic flora of much of semiarid Madagascar. There would have been no such flora if there had been no appropriate habitat for it.

Lindman, C. A. M. (1900) Vegetationen i Rio Grande do Sul (Sydbrasilien). Stockholm: Nordin & Josephson. 239 p., 69 fig., 2 maps.

Lindman, C. A. M. A Vegetação no Rio Grande do Sul (Brasil Austral). . . Tradução portuguesa por Alberto Löfgren. Porto Alegre: Typographia da "Livreria Universal" de Echenique Irmãos & Cia. 1906. 356 p., 69 fig., 2 maps.

Although the Brazilian state of Rio Grande do Sul is entirely extratropical, the flora and ecological relations of its campos and forests are largely the same as farther north, in the tropics, and further south, in Uruguay and Argentina. Since one of the most ardent investigators of the plant geography of Brasil, Lindman, based his work on that state, it is necessary to refer to him in any discussion of the limits of campo and the matta. On the basis of floristic comparison he stated that the campo of the populous southern states was a primitive plant formation. This was contrary to the belief of some of the earlier investigators who had held that the campos of Rio de Janeiro, Minas Geraes and S. Paulo resulted from the destruction of forest. Lindman agreed that a campos of certain characteristics might be so derived, but denied that these were generally so, or that they were typical. In general, he minimized the importance of fire as a determining agent in the delimitation of campo and forest. In his view the great campos were unquestionably natural, and others were most likely outliers.

Livingstone, David and Charles (1866) Narrative of an Expedition to the Zambesi and its Tributaries; and of the Discovery of the Lakes Shirwa and Nyassa, 1858-1864. New York: Harper and Brothers.

The glimpses of African vegetation and agriculture in Livingstone's works are often very informative, and the best way to present them is by direct quotation.

(pp.21-23) "The first twenty miles of the Kongone [branch of the Zambesi at the mouth] are inclosed in mangrove jungle. . . . The mangroves . . . are succeeded by vast level plains of rich dark soil covered with gigantic grasses, so tall that they tower over one's head and render hunting impossible. Beginning in July, the grass is burned off every year after it has become dry. These fires prevent the growth of any great amount of timber, as only a few trees . . . such as the Borassus palm and lignum-vitae can live through the sea of fire which annually roars across the plains. . . . The whole of the fertile region extending from the Kongone Canal to beyond Mazaro, some eighty miles in length and fifty in breadth, is admirably suited for the growth of sugar-cane. . . ."

(p. 25) [Forty miles up the Zambesi] "The weather was delightful. . . . Large columns of smoke rose daily from different points of the horizon, showing that the natives were burning off the immense crops of tall grass, here a nuisance, however valuable elsewhere."

(p. 30) For sixty or seventy miles before reaching Mazaro the scenery is tame and uninteresting. On either hand is a dreary uninhabited expanse of the same level grassy plains, with only a few trees to relieve the painful monotony.

(pp. 101-103) "Beyond Morambala the Shire comes winding through an extensive marsh. For many miles to the north a broad sea of fresh green grass extends, and is so level that it might be used for taking the meridian altitude of the sun. . . . After steaming through a portion of this marsh [The Elephant Marsh], we came to a broad belt of palm and other trees, crossing the fine plain on the right bank. . . . The Makololo having set fire to the grass where they were cutting wood, a solitary buffalo rushed out of the conflagration. . . . Many gardens of maize, pumpkins, and tobacco fringed the marshy banks as we went on. They belong to natives of the hills who come down in the dry season and raise a crop on parts at other times flooded.

"As we ascended, we passed a deep stream about thirty yards wide, flowing in from a body of open water several miles broad. . . . The lagoon itself is called Nyanja ea Motope (Lake of Mud). It is also named Nyanja Pangono (Little Lake) while the Elephant Marsh goes by the name of Nyanja Mukulu (Great Lake). It is evident from the shore-line still to be observed on the adjacent hills that in ancient times these were really lakes and the traditional names thus preserved are only another evidence of the general desiccation which Africa has undergone."

(p.109) "The Ruo (16° 31'S.) is said to have its source in the Milanje Mountains, and flows to the S.W., to join the Shire some distance above Tingane's. A short way beyond the Rue lies the Elephant Marsh, or Nyanja Mukulu, which is frequented by

vast herds of these animals. We believe that we counted eight hundred elephants in sight at once."

(p. 112)"At the northeastern end of the marsh and about three miles from the river, commences a great forest of palm-trees (Borassus Aethiopium). It extends many miles, and at one point comes close to the river. . . . The Mountain range, which rises close behind the palms, is generally a cheerful green, and has many trees, with patches of a lighter tint among them, as if spots of land had once been cultivated."

Livingstone's "lighter patches" were undoubtedly, as he interpreted them, the overgrown clearings of shifting cultivation. On a plateau west of the Milanje Mountains, sloping down on the northeastern border to Lake Shirwa, he visited the Manganja people and saw their agriculture, which he described as follows, (pp. 122-123):

"The Manganja are an industrious race; and, in addition to working in iron, cotton, and basket making, they cultivate the soil extensively. . . . When a new piece of woodland is to be cleared, they proceed exactly as farmers do in America. The trees are cut down with their little axes of soft native iron; trunks and branches are piled up and burnt, and the ashes spread on the soil. The corn is planted among the standing stumps which are left to rot. If grass land is to be brought under cultivation, as much tall grass as the laborer can conveniently lay hold of is collected together and tied into a knot. He then strikes his hoe round the tufts to sever the roots, and, leaving all standing, proceeds until the whole ground assumes the appearance of a field covered with little shocks of corn in harvest. A short time before the rains begin these grass shocks are collected in small heaps, covered with earth, and burnt, the ashes and burnt soil being used to fertilize the ground. Large crops of the mapira or Egyptian dura (Holcus sorghum) are raised, with millet, beans, and ground-nuts; also patches of yams, rice, pumpkins, cucumbers, cassava, sweet potatoes, tobacco and hemp, or bang (Cannabis sativa). Maize is grown all the year round. Cotton is cultivated at almost every village."

Livingstone's observations on the mode of clearing grass-land are unique, and those on burning soil with the grass are similar to a couple of other reports in the literature on Africa and India. Needless to say, if burning the vegetation on a clearing would release salts of immediate fertilizer value, so would burning out part of the soil humus, and however undesirable such a practice might prove to be in the long run, the immediate effect would doubtless be favorable to the first cultivated crop. Certainly the agricultural procedures of the Manganja were most interesting. There are all too few indications of how primitive people may have met the need for regeneration of garden land from grass land. The tying up of grass into compact conical shocks would doubtless kill the inside stems and the reserve

strength of the rhizomes might then have been exhausted in sending shoots up into the dark and compact mass. Cutting of the outer roots of each 'shock' would likewise weaken the clump. This is certainly one of the most interesting agricultural observations to be found in African travel literature."

Livingstone found one tribe of the Zambesi, namely, the Batoka, highly superior in various respects to their neighbors, especially in their regard for trees, which they planted in orchards. He wrote (pp. 248,249):

"The Batoka had attained somewhat civilized ideas in planting and protecting various fruit and oil-seed yielding trees of the country. No other tribe either plants or abstains from cutting down fruit trees, but here [table-land of Mataba, from Tabachen to Moachemba, which is 21 miles of latitude from the Victoria Falls', a desolated unpopulated land of utterly deserted Batoka villages, from which the people were driven by invaders] we saw some which had been planted in regular rows, and the trunks of which were quite two feet in diameter."

(p. 251) "In traveling from the Kafue to the Zungwe we frequently passed several [Batoka] villages in the course of a days march. . . . For hours together we marched through unbroken fields of mapira, or native corn, of great width; but one can give no idea of the extent of land under the hoe as compared with any European country."

Near Motunta in country from which Batoka had been driven Livingstone found (p. 264) that:

"Fruit-trees and gigantic wild fig-trees, and circles of stones on which corn safes were placed, point out where the villages once stood. . . . Two days march from the Batoka village nearest the highlands we met some hunters who were burning the dry grass, in order to attract the game by the fresh vegetation which speedily springs up afterwards. The grass, as already remarked, is excellent for cattle."

Livingstone (pp. 468-469) gives the following account of hunting as conducted by the Nyamatolo people of the Rovuma River:

"Hunting the Senze (Aulacodus Swindernianus), an animal the size of a large cat but in shape more like a pig, was the chief business of men and boys as we passed the reedy banks and low islands. They set fire to a mass of reeds, and, armed with sticks, spears, bows and arrows, stand in groups guarding the outlets through which the scared Senze may run from the approaching flames. Dark, dense volumes of impenetrable smoke now roll over on the lee side of the islet and shroud the hunters. At times, vast sheets of lurid flames bursting forth, roaring, crackling and exploding, leap wildly far above the tall reeds. Out rush the terrified animals, and amid the smoke are seen the excited hunters dancing about with frantic gesticulations

and hurling stick, spear and arrow at their burned-out victims."

Livingstone visited the Manganja country again after most of their villages had been depopulated by Negro and Arab raiders who supplied the Portuguese slave traders at Quillimane. There were many dead floating down stream and the country was full of the stench of rotting corpses, thousands of the people had been slaughtered or carried away as slaves, huts contained mouldering skeletons, and the gardens had been taken over by wild animals. A neighboring tribe, the Ajawa, agents of the Portuguese officials at Quillimane, had committed the atrocities and had left only a few of the Manganja, but were in turn now being preyed upon by the Azitu.

(p. 494) "Very large numbers of turtle doves feasted undisturbed on the tall-stalked mapira (Sorghum) ears and we easily secured plenty of fine fat Guinea-fowls, now allowed to feed leisurely in the deserted gardens. The reason assigned for all this listless improvidence was, 'There are no women to grind the corn; all are dead'. The cotton-patches in all cases seemed to have been so well cared for and kept so free of weeds formerly, that, though now untended, but few weeds had sprung up; and the bushes were thus preserved in the annual grass burning."

Livingston wrote that as a result of slave-raiding:

(p. 517) "A very large portion of the land had once been under cultivation, but it was now abandoned to buffaloes and elephants."

(p. 519) "A very great deal of native corn had been cultivated here, and we saw buffaloes feeding in the deserted gardens, and some women who ran away very much faster than the beasts did."

(p. 522) "Our course was shaped towards the N. W. and we traversed a large fertile tract of rich soil extensively cultivated, but dotted with many gigantic thorny acacias which had proved too large for the little axes of the cultivators."

Finally came a still unravaged stretch of which Livingstone wrote (p. 523):

"The cultivation was very extensive and naturally drew our thoughts to the agriculture of the Africans. On one part of this plain the people had fields of maize, the plants of which towered far above our heads. A succession of holes three feet deep and four wide had been made in a sandy dell, through which flowed a perennial stream. The maize sown in the bottom of these holes had the benefit of the moisture, which percolated from the stream through the sand; and the result was a flourishing crop at a time of year when all the rest of the country was parched and dusty. On our counting the grains in one large cob or ear of maize it was found to contain 360 and as one stalk has at times two or three cobs, it may be said to yield three or four hundred-fold.

"While advantage is taken of the moist stratum in these holes during the dry season, grain, beans and pumpkins, which are cultivated only in the rainy time of the year, are planted on ridges a foot high, allowing the superabundant moisture to run off. Another way in which the natives show their skill in agriculture is by collecting all the weeds and grass into heaps, covering them with soil, and then setting fire to them. They burn slowly, and much of the smoke is retained in the overlying soil. The mounds, thus formed, when sown upon, yield abundantly. The only instrument of husbandry here is the short-handled hoe. . .

"In illustration of the manner in which the native knowledge of agriculture strikes an honest intelligent observer, it may be mentioned that the first time good Bishop Mackenzie beheld how well the fields of the Manganja were cultivated on the hills, he remarked to Dr. Livingstone, then his fellow-traveller, 'When telling the people in England what were my objects in going out to Africa, I stated that, among other things, I meant to teach these people agriculture, but I now see that they know far more about it than I do'. . . ."

"In two days march we counted twenty-four cotton patches, each at least one fourth of an acre in extent. One was 240 paces broad. All as before observed, had been kept so clear of weeds, that the fires passed by the cotton bushes in the regular grass-burnings without touching them.

"Men and women were seen carrying their grain from villages toward the stockades. . . . Then one dead body lay in our path with a wound in the back; then another, and another, lying in the postures assumed in mortal agony, which no painter can reproduce."

At about 12° 40'S., 33 E. near Chinanga village where the people were Babisa and Manganja, on the way to Mosapo, Livingstone encountered an interesting type of agriculture which we may possibly recognize (by the pollarding and lopping of branches); an incomplete description of the chitemene system, although he did not observe it sufficiently in all details so that we may be sure. He said (p. 572):

"We passed several clearings, each a mile or more square, in which all the trees had been cut down and the stumps left only two or three feet high. The felled wood was gathered into heaps, about fifty yards long by thirty broad, and, when dry, was burned. The ashes were spread on these cleared spots, and a species of millet, called Maere, was raised, of which the natives seemed very fond, though to our stomachs the meal was as indigestible as so much coarse sand. On one side of these cleared spaces the hunters set large strong nets made of beobab bark, into which they drive the game. . . ."

Three days later:

(p. 574) "On the 5th of October we came to the Bua . . . the country generally is undulating, and covered with scraggy trees, many of which seemed pollarded, from having been cut down to make clearings for hunting. Everywhere we came upon people in their gardens, busily preparing for the approaching rains. The men were up in the trees, lopping off the branches, to prevent the shade injuring the crops below, or were clearing away the shoots from stumps formerly cut. Sometimes a woman is seen hoeing alone, or she has a couple of boys collecting the weeds and grass into bundles to be burned. . . . About the end of the hot dry season they make holes about the gardens, and sow maize in them, and water it until the rains begin. This palm gives the maize and pumpkins a start in the race toward harvest. The consequence is that the owner has fresh green maize to eat some six weeks after the commencement of the regular showers."

Descending from the plateau on the west to the level of Lake Nyassa, Livingstone said (p. 579):

"The district into which we descended was still called Bango, and a fine stream, named Furisa, flowed through it into the Lake. Here the people had large fields of maize in ear, which had been raised in holes, in the dry season, by the aid of the water that percolates from the Furisa through the sand."

Livingstone, David (1875) *The last Journals of David Livingstone in Central Africa, from eighteen hundred and sixty-five to his Death, continued by a Narrative by Horace Waller, . . . Chicago: Jansen, McClurg, & Co. 541 pp., 21 plates, 25 figs., 2 maps.*

There are brief references in the literature to the effect of warfare on vegetation, but chiefly from the standpoint of inter-tribal wars and raids causing destruction of forest or bush by fire, leading to the subsequent establishment of grassland. It is undoubtedly true, however, that warfare and slave-raiding sometimes resulted in devastated cultivated land being abandoned, and then, if climatic conditions were right, being reoccupied by forest or at least by woody "jungle" vegetation. Possibly the best record of this is to be found in Livingstone's very instructive diary of his journey from the coast in the southeast of what is now Tanganyika southward to the Ruvuma River (the boundary with Mozambique) and westward along that river (mostly on the southern, now Portuguese, side) to Lake Nyasa.

Livingstone kept a day-by-day diary of his last journey across Africa which contains notes on the vegetation that are rather closely localized. It would be interesting for someone to follow his exact route nearly a hundred years later and write descriptions of present conditions. In fact, if a serious attempt

were to be made to appraise the changes of vegetation and possibilities of climatic change during the European colonial period, it would be in order to visit and redescribe every precise locality for which any early traveller left a tolerably good description of the type of agriculture and the wild land.

Some of the information could doubtless be assembled by correspondence with officials, missionaries, and others, using a questionnaire.

Much would have to be obtained by travel.

The following notes refer to places on various routes which are shown in red on the map entitled "Forest Plateau of Africa", compiled to include Livingstone's earlier explorations which began in 1851, mapped by himself, and the later ones from the posthumous publication of his journals.

His traverse began at Mikindany Bay, 25 miles northwest of the mouth of the Rovuma River. From this point he travelled to the southward toward the river. The starting point (Pemba) had red soil "covered over with dense tropical vegetation, in which the baobab is conspicuous." Now we may quote:

(p. 29) "Went about south from Kindany . . . in a valley, with well-wooded heights on each side, but the grass towered over our heads."

South of Nyañgedi he entered such dense jungle that the path had to be opened out by cutters to get the pack animals (camels and buffaloes) through.

"Every now and then we emerged on open spaces where the Makondé have cleared gardens for sorghum, maize and cassava."

(p.30) "At Tandahara . . . the soil is very fertile. . . . Very heavy crops of maize and sorghum are raised, and the cassava bushes are seven feet in height. The bamboos are cleared off, then **spread over the space to be** cultivated, and burned to serve as manure. . . ."

"On starting we found the jungle so dense that the people thought 'there was no cutting it': it continued upward of three miles. The trees were not large, but so closely planted together that a great deal of labor was required to widen and heighten the path: where bamboos prevail they have starved out the woody trees. The reason why the trees are not large is because all the spaces we passed over were formerly garden ground before the Makondé had been thinned by the slave-trade. As soon as a garden is deserted, a thick crop of trees of the same sorts as those formerly cut down springs up, and here the process of woody trees starving out their fellows and occupying the land without dense scrub below, has not had time

to work itself out. Many are mere poles, and so intertwined with climbers as to present the appearance of a ships ropes and cables shaken in among them, and many have woody stems as thick as an eleven-inch hawser. . . . We employed about ten jolly young Makondé to deal with these prehistoric plants . . . for they are accustomed to clearing spaces for gardens."

From the rather high land to which his caravan had ascended Livingstone (p. 32) "now began to descend the northern slope down to the Rovuma, and a glimpse could occasionally be had of the country; it seemed covered [13 Apr.] with dark green forest, but the undulations occasionally looked like hills. More frequently our vision was circumscribed to a few yards until our merry woodcutters made for us the pleasant scene of a long vista fit for camels to pass."

After reaching the Rovuma they turned westward, crossing spur after spur of wooded highland where they had to cut jungle for the laden camels and buffaloes to pass. Livingstone's curious caravan of camels and buffaloes in country where such beasts of burden were unknown was to see if they would not be able to pass through the tsetse fly country in which other pack animals quickly succumbed to disease.

(p. 33) "We came perpetually on gardens, and remarked that rice was sown among the other grain; there must be a good deal of moisture at other times to admit of this succeeding; at present [16 Apr.] the crops were suffering for want of rain. We could purchase plenty of rice. . . ."

Progressing westward there was gradually more open country both on the plateau level above the valley and below. In the valley floor drying pools were brackish. "A good deal of salt is made by lixiviation of the soil and evaporating by fire."

After passing the end of the flanking range north of the Rovuma they came to a region of different geological structure in which gneiss and syenite replaced sandstone.

(p. 42) "With the change in geological structure we get a different vegetation. Instead of the laurel-leaved trees of various kinds, we have African ebonies, acacias, and mimosae; the grass is shorter and more sparse, and we can move along without woodcutting."

The caravan was here opposite a hill on the south called "Simba" where the population was of the Mabiba tribe. The sepoy from India were spoiling the tsetse experiment by unspeakable abuse of the animals. Livingstone commented on their general worthlessness, cruelty and filthiness, and concluded:

"Sepoy are a mistake."

Passing into the dry region where water and food were hard to get, Livingstone said:

(p. 44) "Rushes, which plagued us nearer the coast, are not observed now; the grass is all crisp and yellow; many of the plants are dead, and leaves are fallen off the trees as if winter had begun. The ground is covered with open forest, with here and there thick jungle on the banks of the streams."

Below the confluence of the Loendi Livingston crossed to the south side of the Rovuma, into what is now Mozambique.

At Lamba, somewhat westward on the banks of the Rovuma, Livingstone wrote (p. 51):

"The country is covered with open forest, with patches of cultivation everywhere, but all dried up at present and withered. . . ."

From this point the country was partly open except for scattered trees, seldom over 30 feet tall, a peculiar grass-like plant that wasn't a grass, and a tussock grass. Livingstone gives no evidence that there had been excessive or even much clearing for cultivation, or any grazing, so it seems at least possible that here part of the country may have been natural grassland or savannah. Later, in open-forest country farther west, at some 800 feet above the sea, Livingstone wrote:

(p. 60) "The people all cultivate maize near the Rovuma, and on islands where moisture helps them. . . ."

"Immense quantities of wood are cut down, collected in heaps, and burned to manure the land, but this does not prevent the country having the appearance of forest."

This observation affords just a hint that the maize cultivators may have practised an agricultural system similar to the chitemene system of central Africa, but unfortunately the statement is too vague to enable the reader to be sure that the wood was not burned on the same land where it was cut, rather than on land already in agricultural use. If the country were left "looking like forest" it would rather strongly indicate that branches were lopped off to get the wood for burning, without destroying the trees, and that the wood was burned to fertilize established gardens or clearings elsewhere, which would be exactly the chitemene system.

Livingstone's observation is only a clue, however, which it would be interesting to follow up even now, to determine the geographical boundaries of the chitemene system, a step toward permanent land use that was doubtless indigenous and that might be used as the basis for an improved land-management system, with permanent agriculture and forestry side by side.

It would not seem so possible that we have a reference here to the chitemene system of cultivation if it were not that the land moist enough for maize was on islands of limited extent and presumable limited areas along the shore, whereas wood for ash fertilization was unlimited in quantity on adjoining drier land which would produce any amount of wood but not maize. The conditions would seem ideal for the development of permanent utilization of the good maize land.

Much of the country that Livingstone passed through showed retrogression of cultivation because of intertribal slave-raiding and pillage. Dead slaves murdered because they could not keep up with their Arab buyers were a common sight along the paths. Chiefs were selling so many of their own people to the Arabs, who in turn sold them to the Portuguese or shipped them to the Arabian coast, that whole villages were being depopulated and the land was reverting to jungle. Livingstone reported the following conversation with chief Chenjewala:

(p. 64) "'It would be better if you kept your people and cultivated more largely', said I. 'Oh, Machemba sends his men and robs our gardens after we have cultivated', was the reply. . . . I told them that they would soon have none to sell; their country was becoming jungle and all who did not die in the road would be making gardens for Arabs at Kilwa and elsewhere."

After encountering marauding parties, and starving people, Livingstone said:

"We passed village after village, and gardens all deserted. We were now between two contending parties. We slept at one garden; and as we were told by Chenjewala's people to take what we liked, and my men had no food, we gleaned what congo-beans, bean-leaves and sorghum stalks we could -- poor fare enough, but all we could get."

Then they came to richer country, with deeper soil and many large acacia trees, where there were convenient maize grounds on the islands in the river. The next observation about gardens strikes one as perhaps a reference to ordinary unmodified shifting agriculture rather than to a system like chitemene.

(p. 66) "As we approach Mtarika's place, the country becomes more mountainous, and the land sloping for a mile down to the south bank of the Rovuma supports a large population. Some were making new gardens by cutting down trees and piling the branches for burning; others had stored up large quantities of grain and were moving to a new location. . . . On asking why people were seen tied to trees to die as we had seen them, they gave the usual answer, that the Arabs tie them thus, and leave them to perish, because they are vexed, when the slaves can walk no farther, that they have lost their money by them. The path is almost strewn with slave sticks."

(p. 67) ". . . . all the chiefs and people in our route to the Lake are Waiyau, or Waiiau [pronounced, the editor said, [Y-you]]. On the southern slope down to the river there are many oozing springs and damp spots where rice has been sown and reaped. The adjacent land has yielded large crops of sorghum, congo-beans, and pumpkins."

(p. 68) "A short march brought us to Mtarika's new place. . . . The population is immense; they are making new gardens and the land is laid out by straight lines about a foot broad, cut with the hoe. One goes miles without getting beyond the marked or surveyed fields."

Being now (5 July) in country where the people were so well supplied with trade goods by the Arab slavers that they could not trade food for cloth or beads, Livingstone turned away to the southward from the rich forested land on the south of the Rovuma.

He wrote (p. 69) that at first:

"Upland vegetation prevails; trees are dotted here and there among bushes five feet high."

The next day he reported:

"Hard travelling through a depopulated country. The trees are about the size of hop-poles, with abundance of tall grass. . . . A dead body lay in a hut by the way-side; the poor thing had begun to make a garden by the stream. . . . A couple of days later, with his own party in a state of starvation, Livingstone was met by Sef Rupia, head chief of a great slave caravan of eleven parties with eight hundred or a thousand slaves and sixty or seventy Arab traders. He had heard of Livingstone's distress, and, inconsistently, almost ludicrously, came charitably to his rescue of his antagonist with gifts of an ox for slaughter, a bag of flour, and some cooked meat, - "all of which were extremely welcome!" Sef turned back and accompanied Livingstone to Mataka's village. Here there were a thousand houses: "the mountains were pleasantly green and had many trees, which the people were incessantly cutting down."

Approaching Mataka's, it was clear to Livingstone that the country had all been cultivated at some past time and then abandoned. He wrote:

(p. 76) "An immense tract of country lies uninhabited. To the northeast of Moembe we have at least fifty miles of as fine land as can be seen anywhere, still bearing all the marks of having once supported a prodigious iron-smelting and grain-growing population. The clay pipes which are put on the nozzles of their bellows and inserted into the furnace are met with everywhere, often vitrified. Then the ridges on which they

planted maize, beans, cassava, and sorghum, and which they find necessary to drain off the too-abundant moisture of the rains, still remain unlevelled to attest the industry of the former inhabitants; the soil being clayey, resists for a long time the influence of the weather. These ridges are very regular, for in crossing the old fields, as the path often compels us to do, one foot treads regularly on the ridge, and the other in the hollow, for a considerable distance. Pieces of broken pots, with their rims ornamented with very good imitations of basket-work, attest that the lady potters of old followed the example given them by their still more ancient mothers.

". . . .No want of water has here acted to drive the people away, as has been the case farther south. It is a perpetual succession of ridge and valley, with a running stream or oozing bog, where ridge is separated from ridge: the ridges become steeper and narrower as we approach Mataka's."

As Livingstone came nearer Lake Nyasa he encountered a great slave party, and another made a long detour to avoid him. Much of the land which was now unpopulated gave evidence of former occupation in the form of abundant bits of pottery, but there were no stone implements. The old inhabitants seemed to have stepped directly from the use of wood to iron. He wrote (p. 82): Marks of smiths are very abundant, and some furnaces are still standing. Much cultivation must formerly have been where now all is jungle. . . . Certain it is, from the pots-herds strewed over the country, and the still remaining ridges on which beans, sorghum, maize, and cassava were planted, that the departed population was prodigious. The Waiyau, who are now in the country, came from the other side of the Rovuma, and they probably supplanted the Manganja, an operation which we see going on at the present day."

After he arrived at the eastern shore of Lake Nyasa, Livingstone was on more familiar territory. He travelled southward and even in this rich and favored region found evidence of depopulation. He wrote (p. 89):

"We passed very many sites of old villages, which are easily known by the tree euphorbia planted round an umbelliferous one, and the sacred fig. . . . Here the destruction is quite recent, and has been brought about by some who entertained us very hospitably on the Misinjé, before we came to the confluence. The woman chief Ulenjelenjé, or Njelenjé, bore a part in it for the support of Arab caravans."

So end the observations in what is now barely within the limits of Mozambique.

The points where Livingstone made his observations may be traced on the map of his route. After leaving the territory now Portuguese at the south end of Lake Nyasa he went in a zigzag

course northwestwardly to Lake Tanganyika through present Nyasaland and Northern Rhodesia.

At the plateau level (about 4000 ft.) above the southern end of the lake at about the middle of Nyasaland he described the land as follows:

(p. 109) "The country is very fine, lying in long slopes, with mountains rising all around, from two thousand to three thousand feet above this upland. They are mostly jagged and rough; the long slopes are nearly denuded of trees, and the patches of cultivation are so large and often squarish in form, that but little imagination is requisite to transform the whole into the cultivated fields of England; but no hedgerows exist. The trees are in clumps on the tops of the ridges, or at the villages, or at the places of sepulture.

. . . .The soil is rich, but the grass is only excessively rank in spots; in general it is short. A kind of trenching of the ground is resorted to; they hoe deep and draw it well to themselves; this exposes the other earth to the hoe. The soil is burned too; the grass and weeds are placed in flat heaps, and soil placed over them; the burning is slow and most of the products of combustion are retained to fatten the field; in this way the people raise large crops. . . . No wild animals seem to be in the country, and indeed the population is so large they would have very unsettled times of it."

The process of hoeing the ground and burning the dug sod, not merely the grass above ground, and the large amount in cultivation shows that here at the place called Tamiala there was an indigenous agriculture without long jungle fallow and without irrigation, marking a very considerable modification of the usual unirrigated land shifting cultivation. The people were identified by Livingstone as Maravi or Manganja.

Soon after leaving Tamiala Livingstone noticed a striking example of a tree preserved in a sacred grove which seemed to have been exterminated elsewhere.

(p. 111) "On resting by a dark sepulchral grove, a tree attracted the attention, as nowhere else seen: it is called Bokonto, and said to bear eatable fruit. Many fine flowers were just bursting into full blossom. After about four hours march we put up at Chitimba. . . ."

The next tribe to the west were Kanthunda, or climbers, whose villages were clustered at the base of several squarish mountains, and who kept their granaries on top, to be out of the reach of marauders. Livingstone said:

(p. 113) "Each village has a clump of trees around it: this is partly for shade and partly for privacy, from motives of decency. .

The rest of the country, where not cultivated, is covered with grass, the seed-stalks about knee-deep. It is gently undulating, lying in low waves, stretching north-east and south-west. . . . All the people are engaged at present in making mounds six or eight feet square, and from two to three feet high. The sods in places not before hoed are separated from the soil beneath and collected into flattened heaps, the grass undermost; when dried, fire is applied and slow combustion goes on; most of the products of the burning being retained in the ground, much of the soil is incinerated. The final preparation is effected by the men digging up the subsoil round the mound, passing each hoe-ful into the left hand, where it pulverizes, and is then thrown on to the heap. It is thus virgin soil on the top of the ashes and burned ground of the original heap, very clear of weeds. At present many mounds have beans and maize about four inches high. Holes, a foot in diameter and a few inches deep, are made irregularly over the surface of the mound, and about eight or ten grains put into each: these are watered by hand and calabash, and kept growing till the rains set in, when a very early crop is secured."

Before leaving the region of the Kanthunda Livingstone remarked (p. 116) of village groves:

"In passing along we came to a village embowered in fine trees. . . ." Coming to the village of the paramount chief Chisumpi, "I saw that his village was one of squalid misery, the only fine things about it being the lofty trees in which it lay. . . . In passing the sepulchral grove of Chisumpi our guide remarked: 'Chisumpi's forefathers sleep there'. . . . The trees in these groves and around many of the villages are very large, and show what the country would become if depopulated."

In other words Livingstone thought this particular area would naturally have been forest except for human occupation. One presumes that the grass lands were burned over in this district but it was not until the explorer reached the watershed between the lake and the Loangwa River that he actually mentioned grass fires. He mentioned the immense length of time that iron smelting must have gone on here and the depletion of trees for charcoal to supply the furnaces, of which fragments, transformed into brick by the heat, are strewn everywhere, with slag.

After entering what became Northern Rhodesia, Livingstone wrote (p. 129):

"On leaving Silubi's village, we went to a range of hills, and after passing through found that we had a comparatively level country on the north: it would be called a well-wooded country if we looked at it only from a distance. It is formed into long ridges, all green and wooded; but clumps of large trees, where villages have been, or are still situated, show that the sylvan foliage around and over the whole country is that of mere hop-poles."

The whole of this upland region might be called woody, if we bear in mind that where the population is dense, and has been long undisturbed, the trees are cut down to the size of low bush. Large districts are kept to about the size of hop-poles, growing on pollards three or four feet from the ground, by charcoal burners, who in all instances are smiths too."

At Malambwe, about 12°S., 32°E., the inhabitants were Babisa, a comparatively lowly tribe, who were subject to frequent devastating raids by the Mazitu (Zulus) who ravaged the country far and wide for slaves and other plunder. Their agriculture was therefore a peculiar form of shifting cultivation, described by Livingstone (p. 140) as follows:

"We remain a day at Malambwe, but get nothing save a little maëre [Eleusine coracana] which grates in the teeth and in the stomach. To prevent the Mazitu starving them, they cultivate small round patches placed at wide intervals in the forest, with which the country is covered. The spot, some ten yards or a little more in diameter, is manured with ashes and planted with this millet and pumpkins, in order that, should Mazitu come, they may be unable to carry off the pumpkins, or gather the millet, the seed of which is very small."

Still in the same region, at Motuna's village, Livingstone wrote (p. 143):

"A very high mountain called Chikokwé appeared west-south-west from this village; the people who live on it are called Matumba; this part is named Lokumbi; but whatever the name, all the people are Babisa, the dependents of the Babemba, reduced by their own slaving habits to a miserable jungly state. They feed much on wild fruits, roots, and leaves; and yet are generally plump. They use a wooden hoe for sowing their maëre. It is a sort of V-shaped implement, made from a branch with another springing out it, about an inch in diameter at the sharp point, and with it they claw the soil after scattering the seed. About a dozen young men were so employed in the usual small patches as we passed in the morning."

It is interesting that Livingstone encountered mostly secondary vegetation in 1867 in this region of Northern Rhodesia east and northeast of Lake Bangweolo between the several headwater streams of the Chambeze River, which flows into the east end of that lake. He said (p. 175):

"What we understand by primeval forest is but seldom seen in the interior here, though the country can not be described otherwise than as generally covered with interminable forests. Insects kill or dwarf some trees, and men maim others for the sake of the bark-cloth; elephants break down a great number, and it is only here and there that gigantic specimens are seen; they may be expected in shut-in valleys among mountains, but, on the whole, the trees are scraggy, and the varieties not great."

Loeb, Edwin M. (1928) Mentawai Social Organization. *American Anthropologist*, Vol. XXX, No. 3, pp. 408-433. July-Sept., 1928.

Loeb studied the ethnology of North Paget Island in the Mentawai group west of Sumatra. He considered that the Mentawai natives were culturally, compared with other Malayan peoples, "at the bottom of the ladder. Due to their isolation, the waves of early Hindu and later Mohammedan influence left them untouched." Yet he accepts as a fact a record found by Karny (1925) indicating that in 1621 Sibernt Island was uninhabited. This is certainly much to be doubted.

The largest type of Mentawai house is the uma, which is the communal house of the "expanded family", whose lesser family units live in lesser houses called "lalep". The uma is a social center, and the true social unit, for a village may contain more than one uma, each with its own portion of the land and its own religious and political adherents.

In the opinion of the present writer the Mentawai uma or great house with its outlying territory and lesser family houses is genetically related to the Malay rumah (house) on the one hand and to the Batak djuma, a forest clearing, on the other.

Loeb (p. 409) was critical of Maass's book and said: "Little is known of the Mentawai Islands with the exception of the Pagehs. A not over reliable book was written on Si Pora, viz., Alfred Maass's 'Bei lebenswürdigen Wilden'. . . ." He was also critical of Kruyt, for in discussing terms of cousinship the latter spoke of patogan ama and patogan ina, whereas Loeb wrote pa-togat-ama and pa-togat-ina. So Loeb wrote:

"The orthography of Kruyt defies translation". As a matter of fact the pa is a true formative and should therefore not be hyphenated. Ama (father) and ina (mother) are not formatives. Final at may or may not replace original Malayan an. So Kruyt's orthography would seem to be better than Loeb's!

Löfgren, Alberto (1898) Ensaio para uma Distribuição dos Vegetaes nos diversos Grupos Floristicos no Estado de São Paulo. Boletim da Comissão Geographica e Geologica de São Paulo. No. 11. 2a Edição. São Paulo: (Typographia . . . Vanorden & Cia.) 50p.

Löfgren (1898) has presented an interesting diagram showing two lines of transition from the primaeval forests of São Paulo to campo. The first starts with what Martius called the forest of the Dryades, namely the virgin tall forest (matta virgem). This is the type of forest which, if destroyed, is

never reproduced directly and of which the later successional stages are unknown. Rather, it is replaced in what may be an early stage of regeneration by secondary forest of quite different composition. Such virgin forest occurs in the coastal mountains, humid hilly areas, and along large streams. If completely destroyed by felling and burning or by human occupation, and if secondary forest is not allowed to develop, it becomes campo sujo, which is never identical with campo limpo or natural prairie.

The second line of vegetational transition leads from such natural forest types as those called caatanduva, cerradão and caapao, passes to caatinga, to cerrado or campo cerrado, and then to campo lindo, or natural prairie. The transition may be purely from natural causes, or may be accelerated by man. Such primary forests as those that show every transition to natural campo are those of the high plateaus (Planaltos), of drier areas, and of forests directly adjoining natural prairie. In such forests many species resist fire, at least once and possibly many times, so that a residue of the association remains which may be enriched later until the original condition is more or less restored. They are mostly interior forests, forming "islands" caapões or ilhas de campo away from the main streams, and they belong to Martius's Oreades. They include the plant formations called cerradões.

Lord, T. (1900) The Early History of Imerina based upon a Native Account. Antananarivo Annual and Madagascar Magazine. No. 24, pp. 451-475. Christmas, 1900 (Part IV of Vol. VI). Antananarivo: Press of the London Missionary Society.

This article is based upon a mass of papers left by a Malagasy named Raombàna. When a young man Raombàna was a member of a mission sent by Radama I to England, where he lived two or three years. As an introduction to his memoirs, begun in 1853, he prefixed a traditional history of Imèrina from the earliest times. It refers (p. 451) to a sacred grove at the traditionally most ancient site of habitation, about 30 miles east of Ifanangoavana, as follows:

"I have been twice at Ifanangoavana, and there are still to be seen there the remains of a town. These remains consist principally of the stone pavements that surrounded the houses. In the centre of the town there is a huge rock on which Andrian-amponga and his chief men used to sit basking in the sun and playing the game of fanórona. Ifanangoavana is a somewhat elevated place and completely surrounded with trees. It is now (1853) held so sacred that no person, of whatever rank, dare break any of the trees and use them as fuel, for it is supposed

that if any person dares to do so, death will instantly come upon him for having infringed on the rights of the holy ground or tany masina. King Andrianamponga died about 500 years ago."

There is a tradition of a king named Ralambo who was the first to discover that beef was good to eat. The story (p. 453) goes as follows:

"One day, as Ralambo, accompanied by two slaves, was strolling about . . . the long grass by some means caught fire. The flames spread so rapidly that several oxen grazing near, unable to make their escape, were burnt to death. . . . By threats and cajolery he at length induced his trembling and wretched followers to cut some slices from the roasted carcasses and eat them." So began the eating of cattle!

Another legend (p. 453) concerns the more extensive forest of the old days. It follows:

"The founding of Antananarivo is attributed to Andrianjaka, the son of Ralambo. . . . Andrianjaka one day climbed to the top of the Andringitra hill, from which elevated position his eye was caught by the commanding eminence on which Antananarivo now stands. Selecting fourteen of his followers he sent them forthwith to examine the hill and report upon its suitability for settlement. The party found the hill covered with a dense wood. Making their way through this, they reached the summit of the hill, where they came upon a clearing in which were a few wretched huts. These, they concluded, were dwellings of the miserable remnant of the Vazimba tribe that had been driven from Alasora by the chief Andriamanelo. . . . The party did not come across a single person. . . ." The Vazimba took fright and went to live with the Sakalava, so that their village was open to the Hova for resettlement, "thus relieving Andrianjaka of the necessity of resorting to force and bloodshed."

Low, Hugh (1848) Sarawak; its Inhabitants and Productions: being Notes during a Residence in that Country with His Excellency Mr. Brooke. London: Richard Bentley Publisher in Ordinary to her Majesty. xxiv + 416pp., illust.

An early description of shifting agriculture in Sarawak is that which was given by Hugh Low, who was Colonial Secretary at Labuan and a very competent observer. Some of his notes follow:

(p. 225) "In July and August the Dyak, having previously fixed upon a spot convenient for a farm, begins the labour of felling the forests; in this he is assisted by the females of his family,

who clear away the brushwood; slaves and male children fell the larger trees.

(p. 226) "Having felled as much forest as he thinks sufficient for his purpose, which -- considering the only instrument they employ is the 'billong,' or small chopper of the Malays -- is accomplished with astonishing quickness, the fallen giants of the jungle are allowed to remain prostrate, until a succession of dry days has so parched them, that, being set on fire in several places on the windward side of the field when a fresh breeze is blowing, the whole is, in a few hours, consumed with a flame, and smoke, and crackling noise, which, at a distance, is awfully beautiful, and the sublime appearance of which, when many farms are thus burning together, can scarcely be conceived: the heavy dark cloud which hangs over the country, caused by the smoke, for many miles previously to the ascent of the flames, has frequently been mistaken for one of the thunder clouds which are seen to gather, of this solid and black appearance, only in tropical countries. So great is the resemblance, that persons accustomed to the appearance have frequently remained undeceived, until a gust of wind carried the bright flames high above the intervening jungle, and displayed to the spectator a scene of the most majestic beauty, which certainly equals, and probably surpasses, the burning of the grass on the plains of North America.

(p. 227) "When the fire has exhausted itself, and the ground is again cool, which, from the frequency of rain, is soon the case, the Dyaks collect, from the black and charred trunks of the trees, the smaller ones suited to the purpose, and commence making their 'pagar,' or fence, for the protection of the future crop against the inroads of the deer and wild hogs, which would soon injure and destroy it.

(p. 227) "In parts of the country more populous than others, it frequently happens that the Dyaks have not, in their territory, old jungle; or it is at such a distance from their houses, that the labour of carrying the produce to them would be very oppressive in a country where the services of no domestic animal are available for this purpose. Such situations are not so laborious to prepare, but being destitute of that rich layer of vegetable mould, and the fertilizing properties of the burnt wood, are not nearly so productive.

(p. 228) "The burning being finished, and the pagar made, though this latter operation is frequently delayed until the seed has sprung up, no other preparation of the ground is deemed necessary. The plough, and other instruments for turning up the soil, the inventions of nations more advanced in the art, are to them unknown; but if the former were introduced, it would be useless in many places, as the sides of steep hills are frequently chosen for the farm; and, in all cases, it would be unavailable while the natives continued to leave their fields after but one year's

cultivation, as the labour of removing the trunks of the large trees, which are now allowed to decay in the field, fertilizing it as they crumble into earth, would not be compensated by the produce of the ground they occupy, if the field were not cultivated for a succession of seasons.

"The padi seed, which is saved with the greatest care from the choicest of the preceding season, is planted in holes, made by a blunt-pointed stick, at the distance of from fifteen to eighteen inches apart every way. Three or four seeds are dropped into each hole by the women and children, who cover them by scraping a little earth or ashes over them with their feet."

As for gardening and permanent land-use by horticulture, as contrasted with agriculture, Low observed (p. 233):

"Besides the farms above described, the Dyaks have small gardens, usually the property of women, in which they plant vegetables of different kinds, principally the 'trong', brenjal of the East, and egg-plant of Europe, sugar-cane, plantains, yams, sweet potatoes, chilies, etc."

They also had plantings of plantains and bananas of several kinds, sugar-cane, and groves of fruit trees around their villages. They enriched the jungle by planting fruit trees.

Lundell, Cyrus Longworth (1937) *The Vegetation of Petén. With an Appendix: Studies of Mexican and Central American Plants -- I.* Washington: Carnegie Institution of Washington. ix + 244 pp., 3 figs., 39 pl. (incl. charts & maps).

The Petén region of northern Guatemala is of extraordinary interest because it was the site of the Maya Old Empire. Dated stelae and monuments enable the approximate length of time to be determined since the ancient Maya cities were abandoned. This time has sufficed for the development of a climax type of forest to develop at the old sites, where conical forest-clad hills turn out to be pyramids surmounted by temples or altars. In the Petén area there are open savannahs which may have been open since the land was cleared for cultivation, and that may have been much longer ago than the abandonment of the temples.

Lundell gave attention in the Yucatan Peninsula in general to the effect of seasonal drought in determining the aspect of vegetation and concluded:

(p. 7,8) "Cycles of dry years and occasional extremely dry seasons are of far greater importance in interpreting the vegetation and its distribution than any average of rainfall conditions. Inasmuch

as the Köppen system of climatic classification is based on average conditions, many differences may be expected within the tropics between the climatic boundaries and the vegetational boundaries. Biotic and edaphic factors must be given due consideration in determining the natural vegetation boundaries. Artificial and temporary boundaries are now evident in the tropics over great areas as a result of disturbances by man. . . . The climate of most of the peninsula borders on the savanna-forest transition. The greater part of Northern Yucatan (Lundell, 1934b, fig. 1) is covered with thickets, probably a result of man's influence. Continued rotation from acahual to milpa for hundreds of years accompanied by fire destruction may account for the vegetation of today. Were it not for the fact that the shallow calcareous soils favor a vigorous growth of non-grasses, the northern region would likely have been reduced to savanna country centuries ago. It is probable that all of the State of Yucatan, excepting possibly the small strip along the northwest coast, would revert to dry forest of the nature to be encountered now on the eastern coast and in the Southern Campeche phytogeographical division (Lundell, 1934b) if left undisturbed."

It is believed that the end of the period during which the Maya Old Empire flourished was when there was a general exodus of the population to an area further north, but there was probably never complete depopulation. Lundell says (p. 9):

"Although conclusive evidence is not at hand, it is supposed that the population in Northern Petén and elsewhere in Petén had declined drastically by A. D. 1000, and most of the land had been abandoned permanently. Scattered settlements probably continued to exist in the area. I see no reasons to back the opinion that the land was utterly forsaken even though the cultural centers shifted elsewhere, chiefly northward. According to Maya chronicles, the Itza tribe returned to the Lake Petén area in the fifteenth century and built Tayasal, the stronghold which was not conquered until 1696. Cortes in 1525 and the Spaniards who visited the region after him all report the existence of villages (see Means, 1917).

"In Northern Petén, at least in northeastern Petén, there are stone ruins of a city or ceremonial center for every 25 square miles of the uplands, in addition to innumerable scattered house mounds. In view of this fact, it is certain that all or the greater part of the forest was felled in one period or another during the occupation of the sites.

"In considering the vegetation, three points stand out: (1) that the greater part of the upland forest of the area was felled for agricultural purposes; (2) that the population probably had sufficiently declined by A. D. 1000 so that the greater part of the area was permanently abandoned; and (3) that scattered settlements probably have been present since the time of the Old Empire."

The composition of the present ancient climatic climax forest is believed to have been greatly influenced in composition by the useful trees which were retained in clearing forest or planted at house or village sites by the ancient Maya. This would account for the prevalence amid the ruins of two forest associations, the ramonal, and the zapotal.

(p. 10). "The ramon tree, Brosimum alicastrum, appears on Maya ruins in dense groves, giving the climax association known as the ramonal (Plate 3). Today in the peninsula ramon trees are planted and protected for a twofold purpose: the leaves and small twigs are used for forage and the fruit for food. The ancient Maya certainly planted the tree also, but for food only. The sweet pulp of the fruit is eaten raw, and the hard starchy seed is ground, giving a black flour (Thompson, 1930, p. 185).

"From the fact that the ramon trees dominate on the ancient sites, we may assume that the dominance is due to an initial advantage accruing to the species through its presence in large numbers when the places were abandoned. The trees are today important to some of the Maya as a supplementary source of food; that they were of much greater importance to the ancient Maya is a logical conclusion. The tree is probably a relic of ancient horticulture."

(p. 11) "Achras zapota undoubtedly was present in the upland forest areas during all the period of Maya occupancy. We may assume, therefore, that some trees were spared when clearings were made, thus giving them an advantage over the other vegetation when the areas were abandoned. This practise of leaving certain valuable species when the forest is felled is found among the bush Maya of today and the Batak of Sumatra (Bartlett, 1935b, p. 16).

"Zapote wood was used by the Maya for lintels and beams. It is extremely hard, durable, and fine-grained. The tree is a source of gum and a delicious fragrant fruit. With only honey as a source of sweets, fruits such as those of the zapote were undoubtedly prized by the Maya. Today the trees are occasionally planted in the villages for fruit.

"In view of these facts, it is probable that the ancient Maya planted the species and also spared it in making clearings. Therefore, when the land was abandoned, these advantages gave it a position which it has maintained."

Lundell's observations on the shifting cultivation (milpa agriculture) of the Maya are very interesting, and the differing effect of repeated clearing and burning especially so, since he found a distinct difference in the conditions which led in the Petén to prairie or savannah, but in northern Yucatan to thorn bush. He wrote (pp. 11, 12):

"In the Yucatan Peninsula the Maya use the milpa system exclusively for growing maize and beans, the two staple food crops. Beginning as early as November and continuing as late as March, brush is felled. The smaller trees, shrubs, lianas, herbs, and the smaller branches of the large trees are cut up, piled on the larger wood, and allowed to dry. Late in April, or May, toward the end of the dry season, the brush is burned. Where green tree trunks and larger limbs are present, these remain unburned, but they are not a major hindrance in this type of agriculture (Plates 4 and 5).

"When high climax forest is felled for making milpas, the Indians spare some large trees of such valuable sorts as the zapote, ramon, and thatch palms. When a clearing is made in a corozal, some of the corozo palms as well as large trees are left standing. However, in somewhat densely populated areas, as in Northern Yucatan, very few, if any, of the old forest trees survive the successive clearings and subsequent fires.

"The rains begin sometimes late in April, but more often in May, at which time corn is planted in holes made with sharp-pointed sticks. During the growing season the large weeds may be pulled up or cut several times, this being the extent of cultivation. Beans, squashes, and gourds are planted along with the maize.

"The crop of the milpa is best the first year, the second the yield of corn diminishes, and in the third year the area is abandoned and another site chosen and cleared. The same cycle is repeated over and over.

"In addition to the milpas some Maya may have a semi-permanent and a permanent plot for other crops, the first located in or near the milpa, the latter in enclosures around the huts. . . . The plot near the milpa generally contains perennial herbs such as the banana, plantain, macal, and in addition, sweet potatoes, peppers, and tomatoes.

"The village enclosures contain such trees as the aguacate, daimito, guayabo, cacao, and coffee. . . . The herbaceous plants include the chayote, papayo, banana, plantain, tomato, sweet potato, and peppers. Ornamental and medicinal shrubs and herbs are very prominent. If cotton is raised, it is generally planted in the dooryard."

(p. 15,16) "In summarizing the history of the modification of the vegetation in Northern Petén, the following points stand out: (1) The greater part of the upland forest of Northern Petén was probably felled during the Old Empire period of the Maya; (2) the Old Empire declined, and the population had so greatly decreased by about A. D. 1000 that much of the uplands was practically abandoned, thus leaving a period of from 800 to 900 years for the climatic climax forest to reach its present state;

(3) trees such as the zapote and ramon were doubtlessly protected and planted by the Maya, and hence gained an advantage over the other vegetation when the uplands were abandoned; (4) the destructive milpa system of today possibly existed in its present form over a large part of the area; (5) the careless burning of brush coupled with occasional extremely dry seasons has often led to considerable fire destruction; (6) long-continued milpa agriculture and fire destruction have so changed conditions in some localities that savannas exist even though not particularly favored by the climate and soils; and (7) during the last four decades, chicle exploitation and mahogany logging operations have left a culled climax forest. In some areas both species have been largely eliminated."

Regarding specific savannas, Lundell observed (pp. 43,44,45):

"In Northern Petén near Lake Petén exist several well-drained upland areas which are characterized by savanna vegetation. . . . The rendzina soils without exception are reddish calcareous clays of no greater depth than in the climax forest. Through continued occupation as inhabited sites, or by milpa rotation and subsequent fire destruction, the retrogression of the vegetation to the present state has resulted. I am convinced that the savanna vegetation in the Northern Petén savannas is maintained in the present condition by fire, and that forest would completely reclaim them if fires were controlled. Even in spite of fires, it is evident that forest growth of fire-resistant species is encroaching on the areas. At Kantetul scrub growth has almost completely overrun the savanna. . . .

"The savanna at Kantetul . . . covers the site of an old Maya city. The retrogression of the vegetation there may have been the result of long-continued occupation followed by fire destruction since abandonment. Until recently the site has been used as a station and potrero by chicle operators. Kantetul lies in a valley near an arroyo so that the red clay soils are somewhat deeper than on the hills, and may have favored grassy growth.

"Since abandonment by chicle contractors, the place has been largely free from disturbance. Although somewhat extensive open areas are said to have been present a few years ago, when I visited the ruins in May 1933 the site was entirely overgrown by scrubby species. . . . Forest probably will reclaim the area rapidly. The species overrunning the savanna are present in other Northern Petén savannas as scattered trees and marginal growth. That these pioneer invading species will be replaced eventually by mesophytic species is a foregone conclusion.

"There are other small savannas . . . in the uplands around Lake Petén. The existence of these savannas on the rendzina soils of the region is very interesting, for their presence indicates that long-continued human occupation of the land, coupled probably with fire destruction, results in savanna conditions even in humid limy areas which naturally support forest vegetation."

Logan, J. R. (1849) Five days in Naning. Journ. Indian Archipelago and Eastern Asia, No. I, pp. 24-41. Singapore, Jan. 1849. Second day, No. V, pp. 278-287, May 1849. Third day, No. VII, pp. 402-412, July 1849. Fourth and Fifth days, No. VIII, pp. 489-493, August 1849.

This diary includes an early account of the agriculture of Naning, the district which in the old days was immediately adjacent to Malacca, and of Rambau, the next beyond. Logan's journal is especially interesting to the reviewer because of the allusions to the rice grown in the unirrigated clearings as paddi uma or forest clearing rice, uma being here the word for a "clearing". He travelled along an inhabited elevation called Chirána Puteh on which the sugar palm ("gomuti, ijo, or kabong") was intermingled with the coconuts. The path paralleled a ridge called Bukit Payong (umbrella hill) of which he said (p. 33):

"The sides were mostly covered with low jungle, showing that paddi umah had been extensively cultivated. . . . Presently the scene changed. We emerged from the jungle and stood on the margin of a broad undulating tract of paddi umah, covered with the trunks and larger branches of trees which had been felled." (p. 34)

Proceeding the second day, Logan passed in succession secondary forest and grass plain which was undoubtedly of agricultural origin. He said that after crossing the broad surface of Jalatang the next hill likewise was of slight elevation. He said (p. 280):

"Towards the northern side of the elevation the jungle retires on both sides, leaving an open green covered with the common short and scanty grass and dotted with shrubs. These greens, which indicate the vicinity of villages, are very agreeable."

The extent of country transformed into prairie was great.

(p.283) "On climbing to the top of the grassy slope, a striking view was obtained of the country in front. On the east and stretching away to the south east, a broad and perfectly level plain of rice lay beneath the eye, and through it the Sungai Tampin took its course. [This would have been flood plain sawah rice.] The undulating ground beyond, which was thickly covered with coconuts, fruit trees and cottages, bounded it with its irregular margin, presenting in its wavy outlines and frequent advancing prominences. the precise appearance of the indented shores of a lake or inlet of the sea. . . . A Naning Malay . . . used the word tanjong . . . capes. . . . One of the largest of these (Tanjong Rimau, Tiger Point) was covered with gomuti trees [sugar palm, Arenga]. . . . (p. 285) A . . . dry prominence in the middle of a flat is called pulo or island. . . .

(p.404) Near Malacca Pinda, Logan visited a settlement of Běsisi, one of the aboriginal tribes who were racially very similar to the Malays of the country. Their place was approached entirely through secondary growth, and the path was nearly overgrown.

"We continued to press along it, and after walking some distance the brushwood began to be intermixed with plantains in a half-wild state; pineapples were soon added, but the thicket made by these with the plantains and strong lalang was more dense than that of the brushwood. Extricating ourselves at length from this deserted garden, we stood on the margin of a recently felled forest and at the foot of the steep face of Panchur. The trees and branches lay all around so as to render our further progress very difficult. Plantains, klede, and a few papayas were planted in the open spots amongst them."

It will be noted that Logan makes no mention that the felled forest had been burned, and obviously it could not be without destroying the plants that were already being grown. One wishes that there had been a positive statement that fire had or had not been employed!

Lunet de Lajonquiere, E. (1906) *Ethnographie du Tonkin Septentrional* redigée sur l'ordre de M. P. Beau . . . d'après les Etudes des Administrateurs civils et militaires des Provinces septentrionales. Paris: Ernest Leroux. 379pp., 20 pl., charts, map.

In the north of Tonkin all of the many allied groups that go by the general Chinese name of "Man" ("barbarians") were considered by Lunet de Lajonquiere (1906) to be non-Chinese who inhabit the southern boundaries of China, of Annamite affinity. In the north their agriculture is almost exclusively of the slash and burn type, which is called rai throughout the peninsula, but they have some terrace cultivation of irrigated rice. Only two or three crops are harvested before the fertilizing effect of the ashes wears off, and then new land is cleared. The crops are maize, upland rice, millet, tobacco, cotton, beans, and a few other plants. When all the land surrounding a village becomes exhausted, the village itself is moved to unoccupied land with new summits to be denuded. The Mau groups use the hoe and other agricultural instruments similar to those of the Annamites of the Delta.

Maass, Alfred (1902) Bei liebens-würdigen Wilden. Ein Beitrag zur Kenntnis der Mentawai-Insulaner. . . . Berlin: Wilhelm Süsserott. [viii]+ 256 pp., illust., map.

The description of agriculture in the Mentawai Islands by Maass is exceptional in that there is no mention of fire in clearing the land. He says (p. 150) that when the natives make a taro field in the primary forest they first cut the small trees which are set aside, and planting is done at once. Holes are punched in the moist earth with planting sticks into which little plants are dropped and left to take root without any covering of the roots. Nature takes care of that. Later the garden is enlarged and more light let in by chopping bigger trees. The trunks remain where they fall, and only the branches are chopped off and removed, for they are more in the way than the logs. Bananas are planted in the same way, and also Alocasia macrosrhiza, which Maass calls bira-bira, but that is the Malay name. (His companion Morris (1900) recorded the Mentawai name as bio.) Coconuts are also planted, so that a single clearing provides a succession of crops. Sugar cane might be planted in both the taro plantation or among the bananas.

The Mentawai Islanders had different names for their new plantings, depending upon whether the chief planting was Colocasia (gátá), Alocasia, (bio), banana (bago), etc., these names being the word moná followed by the name of the plant. After the plantings were old, and discontinued or about to be, another series of names was used, these also derived from the names of the plants. These words are all constructed similarly. Thus, from bio, pubioat, the prefix pu denoting a function and at (or kat) being locative, the equivalent of Malay and Batak an. (The phonetic equivalence is shown by such pairs of words ending respectively in t or p as duriat (Ment.) and durian (Mal.), the well known tropical fruit; ubat (Ment.) and uban (Mal.) gray or white-haired; padat (Ment.) and pandan (Mal.) Pandanus; tolat (Ment.) and tulan (Mal.), bone; urat (Ment.) udjan (Mal.) rain; tabat (Ment.) and tamban (Mal.), a little fish; The point is further proved by the existence of various pairs of words of identical meaning in Mentawai, such as agbanan and agbanat, for mango. The basic word for homestead, uma, applies in the Mentawai Islands to the great house of the chief, and is therefore the equivalent of the Malay cognate rumah, whereas it has come to apply in other languages to a clearing, as in Batak djoema (juma).

It is curious that various authors have discussed Mentawai social organization without realizing that uma means house, and the people of an uma pertain to the same household even if scattered about in smaller houses because of crowding or for convenience in agricultural labor. (See Wallace, 1951, for the references.)

Maass, Alfred (1910) *Durch Zentral-Sumatra*. Berlin: Wilhelm Susserott. xxxi + 851 pp., 223 figs, 26 pl., map.

Maass (pp. 296-307) gives an account of agriculture among the Minangkabau Malay of Sumatra, which probably advanced to permanent cropping of wet rice fields, and to permanent village gardens many centuries ago but still retains the ladang system of shifting agriculture as a secondary resource. As he describes the ladang system of the Kuantan region it is used so frequently in a regular rotation of cropping and brush fallow that it can hardly be called shifting agriculture with the degree of opprobrium that has come to be attached to the expression. The rotation is rapid enough to utilize the same plot every six or eight years. Like all Malayan peoples, the Minangkabau gather jungle produce, and it is a safe assumption that some of it has resulted from purposeful enrichment of waste land or from relics of old garden plantings persisting at abandoned village or house sites. Maass does not, however, indicate that this is true. The tools employed in agriculture range from the plow and hoe (tjangkua' [Mal. tjangkol]) which are chiefly used in wet rice fields (sawah) to the chopping knife (tadjak), hatchet (balu'ang [Mal. b'ellung]) and planting stick (tugal [Mal. tunggal]) which are used to prepare the ladang. To these is worthy of being added the ornamentally carved planting stick (tugal [Mal. tunggal]) which, in this ancient culture, is obviously no longer a work-a-day thing to be improvised when needed and then discarded, but, on the contrary, a prized possession. The two examples of the tugal figured by Maass have carving resembling that on the posts of graves farther north which may possibly have some symbolic significance.

Maass gives a long list of the cultivated plants of the house gardens, the sawah and the ladang, and says that aside from ashes derived from burning the forest or brush on fallow land the only fertilizer used for any crop is buffalo manure used for tobacco, which is grown in a little specially fenced inclosure where buffaloes have been kept, and where the seedlings are transplanted into prepared holes in which a mixture of buffalo manure and ashes has been placed. The transplanted seedlings are shaded by mango leaves until they have become established and are again manured when a foot high. This is a unique record of systematic, intentional manuring for Malay ladang agriculture, but the tobacco planting is a special and isolated one, apart from the ordinary ladang, and the unusual treatment accorded it may indicate European influence.

A rice ladang is planted only once, for a new one is prepared every year, and six or eight plots are used in rotation. In the period of rotation a type of secondary forest (balukar) becomes established which is sufficiently developed so that the ashes from burning will fertilize the soil for a crop. The system is therefore a bush-fallow system and not the irregular type of shifting agriculture that is practised by less sedentary populations. The Minangkabau Malay are famous for elaborately carved ornamentation of substantially built houses, and only at a

considerable distance from a center of population would there be opportunity to cut old forest for ladang agriculture.

Harvesting around Taluk was done in rotation by community help, and the remuneration of the helpers was the harvest feast. There were ceremonies at the sacred burial place of an ancestral chief of the present village elders.

In the vicinity of Taluk in the Kuantan region the forested land was classified as rimba (primary forest), balukar (former ladang, not yet ready to clear again), and sasó (Mal. sasap, land with traces of former habitation and cultivation). Mass frequently speaks of marching alternately through forest and alang-alang (lalang; Imperata exaltata) plains, so obviously (as nearly everywhere in Samatra) much of the land had degenerated from forest to grassland through ladang agriculture and fire.

Macdonald, K. R. The Devastation of Africa by Fire. Farm and Forest or Land Use and Rural Planning in West Africa. Vol. V no. 2, pp. 73-75. June 1944.

K. R. Macdonald wrote that in West Africa especially Nigeria: "The spectacle of the raging bush-fire is so commonplace, and is normally regarded by the average European and African as something so inevitable in and inseparable from African life, that it rarely calls for any comment." He discussed the usual reasons for setting grass and bush fires, especially the firing for temporary improvement of grazing and for driving game in hunting. The use of fire in hunting Macdonald condemned as indefensible from any point of view.

In precolonial days slave raiding and intertribal warfare were both carried on with the aid of fire, as we know from the accounts of many writers, and the nomadic Fulani are often mentioned in connection with such usages.

Of Nigeria specifically, Macdonald said:

"It is probable that Fulani herdsmen are amongst the greatest offenders in the matter of bush burning. Together with their herds of cattle they rarely remain for any length of time in one place, and as they move on from one grazing area to another, they leave a trail of fire devastation behind them. . . . The solution of this particular problem is fraught with difficulties because of the arrogant independence and nomadic habits of the Fulani, but we cannot go on shelving the issue, and legislation will have to be introduced to cope with it."

Macdonald emphasized the difficulty of getting native cooperation in combating the fire peril, and concluded with what a cynical commentator called impassioned oratory, as follows:

"European and African must cooperate, and, if success is to be quickly achieved, nothing short of the drive, enthusiasm, and fanaticism of a Jihad must be employed. . . . Africans! What kind of heritage do you mean to hand over to your children and their descendants? A country blasted by fire? Are you content to stand idly by and fiddle while Africa burns?"

The answer to this burst of rhetoric, the commentator opined, was undoubtedly "yes", for the African was not disposed to worry about what anyone in the far future might think of him. But, if he were assured that they would sometime invoke curses upon him, that would be a different matter! Superstition could be more appealed to more effectively than reason or philanthropy, and (if the conscience of the anti-fire propagandist permitted) curses and the threat of curses could be a potent argument.

Macdonald (1944) called attention to ceremonial firing in Nigeria, a most interesting ritualistic first firing of the land connected with a post-harvest hunt which has become in the course of time one of the ceremonial events of the harvest celebration. As a religious observance, it is entirely different in motivation from a practical hunt. Macdonald says:

"This practice must not, however, be confused with that which obtains amongst the Birom tribe of Plateau Province, and, possibly, certain other pagan tribes, where hunting is incidental or secondary to the main ceremonial, in which the actual setting of fire is of primary importance. Little is known of the origin of these ceremonies, and the 'Tsafi' chiefs or 'priests' . . . do not volunteer much in the way of information. However, the 'Tsafi' areas or groves, which may or may not contain trees, and in which no metal implement may be used, are well known and the ceremonial firings are, in the main, connected with the commencement of seasonal farming activities and the consumption of large quantities of beer at the end of the harvest. It is not suggested that the burning of 'Tsafi' sites should be forbidden, but it should be made clear to those responsible that precautions must be taken to ensure that fire does not extend beyond the limits of such areas."

McElderry, J. C. K. (1942) A Forest Reservation Survey in Pategi Emirate. Farm and Forest, or Land Use and Rural Planning in West Africa. Vol. III no. 1, pp. 23-27, March 1942. Ibadan, Nigeria.

(p. 24) "There are still relics of what was probably quite extensive fringing forest along the Niger and to a lesser extent along the Kampe. . . In the Niger valley it seems probable that the clearing took place many years ago. . . The relics of fringing forest are probably decreasing steadily with new clearings for rice cultivation and the effects of annual bush fires. . . The savannah woodland varies of course with the soil. . . . Fire does more damage than anything else to the woodland. The fires often occur very late in the season and kill or badly damage large trees and destroy regeneration. After such fires all the new shoots and leaves are burnt, even on tall trees. These fires are lit chiefly for hunting but also to make it easier to get about the bush to collect forest produce such as palm fronds."

Mackay, J. H. (1936) Problems of Ecology in Nigeria. Empire Forestry Journal 15, No. 2, pp. 190-200. 1936.

Mackay uses the term savannah to designate what Shantz called high-grass low-tree savannah. In the southwestern part of Nigeria about 92% of the area was savannah and farmland, about 8% high mixed forest, mostly secondary, although relics of primary forest remain. He was unable to distinguish clearly between high mixed forest and rain forest. The remaining relics of virgin forest are found mostly on small scattered hills and remain because they are juju, i.e., sacred to the spirits of the hills. There are also vestiges along streams. The two kinds of situations are two extremes and give a good idea of what the forest of the intermediate situation might have been. As for the hillside forests, particular kinds of trees are not sacred, but the hills themselves. A strong "juju" was attached to them, and therefore the farmers left them alone.

Mackay says of savannah:

(p. 192) "Savannah is nearly a climax type of forest in the extreme north and farther south only persists as long as annual burning goes on. But for the annual burning it would revert to high forest in a comparatively short time, but the annual burning may to all intents and purposes be considered to be as inevitable as the seasons, either inside or outside reserves, except over small areas."

Mackay informs us that moister areas of less intense fires revert to high forest by way of an intermediate open woodland. Under favorable conditions, judging from observations of hunters and others, the advance of tall forest into savannah may progress at the rate of a hundred yards in ten or fifteen years. This is what usually takes place in the forest reserves, and is the opposite of invasion of tall forest by savannah, which takes place wherever there is farming. He says:

(p. 191) "From the relics of forest that remain it is apparent that almost the entire area under consideration would have a form of Mixed Deciduous Forest as its climatic climax but for the interference of man." The cycle of cultivation and fallow has become shorter with increase of population, return of clearings to forest is more and more imperfect, the soil becomes impoverished, grasses invade in increasing abundance, annual burning ensues, only fire-resistant trees persist, and savannah has replaced tall forest.

McMahon A. R. (1876) The Karens of the Golden Chersonese. London: Harrison. vii + 424 pp., plates, map.

McMahon wrote of a visit to Karen villages of Burma near the mission headquarters in Toungoo, about 200 miles or so north-east of Rangoon. The site chosen for Cinchona trials was Bawgalay. From here the route traversed in visiting the villages as far as Mondinegyee "wound along ridges little differing in the vegetable clothing, being for the most part through "toungyas" or hill clearings, more or less deserted and partially overgrown with bamboos or elephant grass." He gives no hint of enrichment of these toungya by special planting before abandonment except to remark on "three hamlets pleasantly situated half way up a ridge, at an elevation of about 2,200 feet above the sea, in the middle of very beautiful areca gardens, famed all over Burmah for the excellent nuts they produce". These gardens must of course have had their origin in clearings first made for annual crops and then enriched with the betel-nut palm, exactly as the groves of useful and ornamental perennial plants have developed at village sites, originally forest clearings, in Malaya and Indonesia. Another Karen village visited by McMahon was Plomado, "situated on an eminence in a valley surrounded by hills, with very fine areca and other gardens in its vicinity."

(p. 239) Passing Plomado McMahon's party reached a region where there was virgin forest, and then again, he said: "We now came on toung-yas or hill clearings, differing in character from those met with in our second and third day's marches. In them we noticed several species of wild tea and cinnamon trees, and . . . two kinds of raspberries. . ."

(p. 258) Elsewhere he spoke of the Paku Karens "the first tribe met with after crossing the river Sittang at Toungoo who devote themselves assiduously to the culture of oranges, citrons, and limes, as well as to the breeding of pigs for the market."

(p. 278) Layto, a relatively new Karen village northeast of Toungoo was described as follows:

"The Karens have built a neat chapel and schoolhouse for the missionaries, which like the houses the inhabitants

live in, are of the most temporary description, for, owing to the system of cultivation that obtains on these hills, the ground is not worked for more than three years and is afterwards allowed to lie fallow for five or six years more. The people are, therefore, compelled to move their dwellings in order to be near their fields, and cannot afford to build substantial structures. The fathers [of the Italian Mission] hope in time to improve this wasteful habit of husbandry. . ."

Here we certainly have no intimation that the planting of *toungyas* with useful perennials, orchard plants or valuable timber trees was a regular practice in Burma, or that the "*toungya* system" was in general different from shifting cultivation anywhere else.

(p. 403) McMahon described the country of the Red Karens, which he called "Karennee" mostly at second-hand, quoting O'Riley, who visited it in 1856-57 and again in 1863-64, and Mason, who arrived there in 1859.

(p. 401) "Karennee, or the country inhabited by the Kayas, or Red Karens, consists for the most part of an extensive plateau, elevated about 3,000 feet above the sea, and lying between the parallels of 18° to 20° N. Lat. and 97° to 99° E. long., with an area of about 7,200 square miles."

(p. 403) "The surface of the country shows that it has been occupied for many generations, for not a vestige of the primeval forest remains. . ."

Marche, Alfred (1887) *Luçon et Palaouan: six années de Voyage aux Philippines*. Paris: Hachette et Cie vi + 406 pp., illust., 2 maps.

The French anthropologist Marche (1887) visited various parts of the Philippines and made passing remarks on the deforestation which had resulted from shifting cultivation. For some of the islands there is little additional information. He visited the Calamianes, for example, in search of skeletal material from old pagan burial sites. His account of Palawan (1887, p. 335) makes one of the few mentions of bamboo fires. These are important from the standpoint of vegetational change when they occur on occasions of mass fruiting of bamboo. The greater areas of relatively pure bamboo thicket or forest in the Philippines are as definitely stages in revegetation following clearing as are the great plains of cogon grass. Bamboos, however, flower gregariously and at long intervals. Having flowered and fruited simultaneously, the plants die and dry up while the seeds are being dispersed. There is a subsequent stand of bamboo from seedlings if the latter are not destroyed by fire, which may happen if the dead and highly inflammable dry thickets are ignited.

Crossing the narrowest part of the island of Palawan near its center, on the way from Tapul to the Bay of Ulugan, Marche's party was endangered by a bamboo fire which sounded like a fusillade as they were traversing the single range of hills covered with bamboo thicket which there forms the backbone of the island. The noise like gun-fire was caused by the explosion of the hollow nodes when they ignited. Descriptions of bamboo fires are not too easily found, because their occurrence is irregular and relatively infrequent, but it appears from Marche's account that he may have considered them to be annual events. Possibly some types of bamboo thicket can be burned off in the dry season without killing the clumps clear to the base, and that they may regenerate by sprouting before reaching the age of simultaneous fruiting and death. Some of the Philippine botanists should make some conclusive observations on this point.

Marcuse, Walter D. (1914) *Through Western Madagascar in Quest of the Golden Bean*. London: Hurst & Blackett, Ltd. 318 pp., 47 pl., map.

The English traveller Marcuse although somewhat of a naturalist, exhibited the strange disregard for conservation which so many Europeans in the tropics display. He said:

(p. 267) "The Malagasies regularly burn the forest to provide suitable clearings for pasturing their cattle, and the initial burning takes place in the dry season, when the resinous vegetation burns like tinder, the only surviving trees being the Sacoa (Sclerocarya caffra), which are extraordinarily resistant to the ravages of the bush fires. After the next rains, a rich and luscious pasturage springs up on these savannah-like wastes, which form ideal feeding-grounds for both wild and domestic cattle. On first seeing these tracts of cleared country I was at once reminded of the rich grazing-lands of southern Brazil..

"The French colonists have made a great point of the need for legislation to prevent the Malagasies from burning the forest for . . . providing . . . clearings, and they have based their agitation upon the resulting destruction of wild rubber vines. Though strongly deprecating the absolutely ruthless destruction of forest areas, which has created sandy deserts in many other parts of the world, I venture to oppose the colonial point of view, for scientifically cultivated plantation rubber is gradually making the exploitation of wild vine rubber an unprofitable undertaking. On the other hand, the rise in prices of hides and the large demand for carcasses by the Majunga canning establishments have combined to make cattle-raising far more important than rubber-vine tapping in north-western Madagascar."

Marcuse found that among the Bara of northwest Madagascar it was impossible to get an ox for beef without bargaining for a week. The cattle were less important economically than as cult objects and evidence of wealth and prestige. He said:

(p. 99) "The situation was all the more galling for we were within sight of vast herds of cattle, fat and sleek and worshipped, thousands of which would have been remorselessly slain in an idle sacrifice had a native chieftain died."

Elsewhere Marcuse (p. 263) remarked of the Sakalava that there was nothing in the world that this warlike native loved better than his herds, and the only difficulty in the way of trade was to induce him to part with them, for he looked upon them with some of the veneration of the Indian for his Zebu. Perhaps one of the most striking of all the features of the west coast was the extent of beautiful grazing lands (capable of sustaining thousands upon thousands of animals) without a living human being for miles. "In the Menabé province alone, I should say there were some twenty thousand head of wild cattle, and this is a very low estimate of their numbers."

Marcuse was one of the few who took note of the wasteful exploitation of the almost extinct rubber-yielding *Euphorbia intisy*.

(p. 151) "As we made our way up the burning slopes of the "Table" Mountain, on towards the pass leading to the valley of the Onihaly River, I noticed numbers of the gum-yielding euphorbia called Intisy. This peculiar specimen of the botanical world attains a height of twenty to thirty feet, and is absolutely innocent of a single vestige of leaf. . . . If an incision is made in the trunk close to the roots, a gummy latex exudes which hardens on exposure to the air, and when worked by the natives into balls, forms a valuable rubber with the trade-name of niggers. Unfortunately, the wasteful methods of collectors have destroyed thousands of this plant, so that the export of the special rubber obtained therefrom has declined from nearly 500 tons per annum in the early nineties to about 50 tons at the present day."

Marloth, R. (1924) Notes on the question of veld burning. S. African Journ. Sci. XXI, pp. 342-345.

Marloth contributed to a symposium of the South African Association for the Advancement of Science held at Bloemfontein in 1923 on the subject of whether the vegetation of South Africa showed any definite signs of deterioration to a drier aspect, and to a following symposium on veld burning in 1924 at Cape Town. He reported that practically all observers agreed that large areas had changed their aspect. He said:

"While no positive proof has been produced so far that the annual rainfall has decreased during the last 50 or 100

years, it is generally recognized that the vegetation of large areas of the country has deteriorated. . . One of the principal causes . . . is the practice of setting fire to the bush and grass. . .

"Centuries ago, before white colonists required the hills and slopes for grazing purposes these parts [of the southwest of South Africa] were covered with thick evergreen scrub, termed maquis by botanists. This maquis consisted of many hundreds of shrublets, shrubs and small trees. . . Between the shrubs the ground was entirely occupied by perennial herbaceous plants. . . . Now all this is changed. Only here and there, in specially fortunate nooks and corners, sheltered by rocky surroundings or on spots protected for special reasons like the burial place of the ancestors of a farmer, one may find the original shrubby vegetation or even trees as relics of the past, but such nature monuments are few and far between, and represent only an infinitesimal fraction of the hundreds of square miles of luxuriant maquis which have been devoured by the flames during a century or two of its reckless burning. . .

Marloth deplored the impoverishment of the botanically unique Cape flora, and commented:

"There are hundreds of species of plants in our herbaria which had been found by the older collectors. . . . more than one hundred years ago, and have not been seen again since. At the rate at which veld burning in the mountains is still being carried on, even in remote mountain valleys and on distant heights, many more such species will suffer the same fate--a sad prospect for the lover of nature and friend of the country.

Marsden, William (1783) *The History of Sumatra, containing an Account . . . of the Native Inhabitants, with a Description of the Natural Productions . . .* London: Printed for the Author. viii + 375 + [vi] pp., .map..

William Marden, while "Secretary to the President and Council of Fort Marlborough" (the British establishment on the western coast of south Sumatra at Bencoolen) wrote an account of the ladang agriculture there in which he pointed out the scarcity of accessible forest in some districts even when he was there. His description is one of the first and best for Sumatra, and likewise so well expresses the feelings of one who is shocked by the wastefulness of shifting agriculture that it may be quoted in large part:

(P. 61) "I shall speak first of the cultivation of the Laddang [i.e., ladang] or upland paddee. This is sown, as is obvious from the name, in high grounds, and almost universally on the

site of old woods, on account of the superior richness of the soil; the continual fall and rotting of the leaves, forming there a bed of vegetable mould, which the open plains cannot afford, being exhausted by the powerful action of the sun's rays and the constant production of a rank grass, called lallang [i.e., lalang or alang-alang]. When this lallang, with which the eastern islands are for the most part covered, is kept under by frequent mowing, or the grazing of cattle, its room is supplied with grass of a different texture. Many suppose that the same identical species of grass undergoes this alteration, as no fresh seeds are sown, and the change uniformly takes place. But this is an evident mistake, as the generic characters of the two are essentially different. . . . The former [Imperata] which grows to a height of five feet, is remarkable for the whiteness and softness of the down, which is its blossom, and the other for the sharpness of its bearded seeds. . . . Le Poivre, in his Travels of a Philosopher, describes the plains of Madagascar and Java as covered with a long grass, which he calls Fatak, and which, from the analogy of the countries in other respects, I should suppose to be the lallang; but he praises it as affording excellent pasturage; whereas on Sumatra it is reckoned the worst, and except when very young, it is not edible by the largest cattle; for which reason the carters and drovers constantly set fire to that which grows on the plains by the roadside, that the young shoots which afterwards spring up may supply food to their beasts. . . .

"On account of the fertility which it occasions, the natives do not look upon the abundance of wood in their country as an inconvenience, but the contrary. In few parts of the island do they ever sow grain on land that has been long cleared, and there, more from necessity than choice. I have heard a prince of the country complain of a settlement made by some strangers in the inland part of his dominions, whom he should be under an obligation to expell from thence, to prevent the waste of his old woods. This seemed a superfluous act of precaution in an island which strikes the eye as one general, impervious, and inexhaustible forest. . . . The quickness of vegetation precludes all possibility of clearing a country so thinly inhabited. Ground where paddee has been planted, will, in a single month after the harvest, afford full shelter for a tiger."

Marsden fully realized, however, the difference between a weedy growth that would shelter a tiger and the magnificent ancient primary forest of which he lamented the destruction. He goes on to say (p. 62):

"Being regardless of the timber, they do not fell the tree near the ground, where the stem is thick, but erect a stage and begin to hew, or chop, rather, at the height of ten or twelve feet, where the dimensions are smaller, till it is sufficiently weakened to admit of their pulling it down with rattans, in place of ropes, made fast to the branches.

And thus, by slow degrees, the whole is laid low. I could never behold this devastation without a strong sentiment of regret. Perhaps the prejudices of a classical education taught me to respect those aged trees, as the habitation or material frame of an order of sylvan dieties, who were now deprived of existence, by the sacrilegious hand of a rude, undistinguishing savage. But without having recourse to superstition, it is not difficult to account for such fellings, on the sight of a venerable wood, old as the soil it stood on, and beautiful beyond what pencil can describe, for the temporary use of the space it occupied. It appears a violation of nature, in the exercise of a too arbitrary right. . . . Trees whose amazing bulk, height, and streightness would excite the admiration of a traveller, compared to which the masts of men of war are diminutive, fall in the general ruin. The branches are lopped off, and when the continuance of the dry weather has rendered them sufficiently arid, they are set fire to, and the country is, for the space of a month, in a general blaze, till the whole is consumed. The expiring wood, beneficent to it's ungrateful destroyer, fertilizes for his use, by it's ashes and their salts, the earth from which it sprung, and which it so long adorned."

(p. 64) "When the periodical rains begin to fall . . . they proceed to sow the grain. Ploughs are rarely used, and only in the open plains, when cultivated, in countries where the old woods are comparatively scarce. In the grounds I am describing, the stumps of the trees would utterly preclude the possibility of working them. The husbandman enters the plantation; as it is usual to call the paddee field; with a sharp stake in each hand, and with these makes small holes on either side of him, at equal distances, as he proceeds. Another person follows him with the seed, of which he drops a few grains into each hole; leaving it to accident, or the winds and rain, to cover it."

Marsden has a description also of the permanent rice culture in the irrigated terraces or diked overflow lands (for which he gives the local name at Bencoolen as sawoor, which in standard Malay is sawah). He then proceeds (p. 66) to the following account of plough cultivation which he observed only in a small district south of Bencoolen on the west coast, well toward the southern end of the island:

"In the country of Manna, a progress in the art of cultivation is discovered, superior to what appears in almost any other part of the island; among the Battas [Batak] perhaps alone excepted. Here the traveller may observe pieces of land, in size from five to fifteen acres, regularly ploughed and harrowed. I shall endeavor to account for this difference. Manna is much the most populous district to the southward, with the smallest extent of sea coast. The pepper plantations and laddangs together have in great measure exhausted the old woods, in the accessible parts of the country, and the inhabitants are therein deprived of a source of fertility which nature formerly supplied. . . .

(p. 68) . . . Notwithstanding the received opinion of the fertility of the Malay islands, countenanced by the authority of Le Poivre and other celebrated writers . . . I cannot help saying that I think the soil of Sumatra is in general rather sterile than rich. It is almost every where a stiff, red clay, burned nearly to the state of a brick, where it is exposed to the influence of the sun. The small proportion of the whole, which is cultivated, is either ground from which old woods have been recently cleared, whose leaves had formed a bed of vegetable earth some inches deep, or else swamps into which the scanty mould of the neighboring hills has been washed by the annual torrents of rain, in consequence of their low situation. . . . But these are partial and unsatisfactory proofs of fertility. . . . Although in Manna they have got into the practice of tilling the ground. . . . it must be observed that this is still new land, though not just cleared for the purpose, and the same spot is doubtless not worked a second time till it has lain fallow. . . . Every person at first sight, and on a superficial view of the Malay countries, pronounces them the favorites of nature where she has lavished all her bounties with a profusion unknown in other regions, and laments the infatuation of the people, who neglect to cultivate the finest soil in the world. But I have scarcely known one, who after a few years residence, has not entirely altered his opinion."

Martin, E. F. Native Agriculture. Land Tenure in the Northern Province; pp. 38-53 in Tothill (1940), q. v.

Marshall, R. C. (1934) The Physiography and Vegetation of Trinidad and Tobago. Oxford Forestry Memoirs, No. 17. Oxford: Clarendon Press. 111+56 pp., 32 figs.

The early Carib population of Trinidad and Tobago initiated the primitive type of cultivation which has been maintained there by newer populations on a similar cultural level, from Africa and India. The better lands which were originally occupied by tropical rain forest have been largely taken over by permanent agricultural level but there is some secondary forest which consists of fewer species mostly of rather quick-growing, lightwooded trees of weedy propensity. The latter is seldom left long enough to pass into a later successional stage but is more often cut for charcoal production and a new agricultural sequence. The latter starts with clearing, burning of the debris left after utilization of part of the wood for making charcoal, and then the growing of a crop of maize, pigeon-peas, cassava, etc. Then, Marshall states (p. 39):

"Then, as the soil deteriorates the crop is neglected and finally abandoned. The area is invaded by grass and certain second-growth species, and often reaches a state of dynamic equilibrium as a disordered tangle of grass, vines shrubs, second-growth species, etc. On occasion, however, a 'deflected' succession may occur, resulting in a type of vegetation sufficiently stable to merit the term 'deflected climax' being applied to it."

The four types of deflection to which Marshall refers must all be considered in connection with the effect of fire on tropical vegetation, but one is especially interesting, namely, his "Orchard type", which is a plant association consisting of small stunted "orchard-like" trees dotted about in a grassy savannah. The gnarled and twisted trees are only 20 to 30 feet high, and chiefly of two species, Curatella americana and Byrsonima crassifolia. It is characteristic of this type of vegetation that the transition from it to rain forest is abrupt. If, as the writer believes, it is analogous with similar savannah in British Honduras, there is likely to be an edaphic factor in its maintenance, for Marshall says the soil of such savannah is always rather poor. He considers that the orchard type of vegetation in Trinidad and Tobago has originated from the continual destruction of second growth and subsequent invasion of grass, which has been maintained, he suggests, by the agency of fire. It seems to the reviewer that very similar land in British Honduras has never been used agriculturally, but was originally grassy enough to be burned over in aid of hunting clear up to the edge of tall forest, on better soil. Repeated burnings would lead to elimination of woody plants (except for "pyrophytes"), maintenance of savannah or prairie, and establishment of an abrupt boundary of prairie against the forest, providing the boundary between good and poor soil was sharp. It would follow that the savannah or prairie in its original state was not rain forest but semi-deciduous forest bounding rain forest, the former fire-resistant, the latter not, the former not transformable into savannah or prairie by fire alone, but only by clearing followed by fire, the latter transformable by fire alone.

As to the possibility of savannah reverting to primary forest Marshall appears to have had grave doubts. He said (p. 49) that the "orchard type" plant association might be sufficiently stable to be termed a climax. The conditions maintaining it he said "may include repeated fires, pasturage, human agency, etc., and it is on such lines that the occurrence of the orchard type, etc., can best be explained. . . . "There is often a tendency to imagine that if the land is left to look after itself, the original vegetation will reestablish itself. Possibly it may, after the lapse of centuries--but it is not certain. Early writings of the Spaniards, three or four hundred years ago, refer to the 'natural savannahs' (= orchard type) on the hills at the back of St. Joseph. These 'natural savannahs' still exist today. In the case of the orchard type of vegetation

recurrent fires and the dense growth of grass appear to be the imposed conditions which have kept this type in existence for several centuries."

Marshall's other "deflected climax units" of the rain forest appear to be such. The patches of bracken fern to which he refers have their exact counterparts in the clearings made by Indians in the Amazonian forest. The other two are a cocorite (Maximiliane caribaea) palm forest probably replacing cultivation on abandoned land, with many counterparts, and certain small areas of another type of dicotyledonous forest which were also apparently under cultivation.

Martius, C. F. P. Flora Brasiliensis. Enumeratio Plantarum in Brasilia hactenus detectarum. . . . Argumentum Fasciculorum I-XL. Lipsiae apud Frid. Fleischer in Comm. . 1840-1865. .

This introductory part of the vast work of Martius consists of a series of plates with explanations, which, together with the lives and travels of the botanists, indexes, etc., published just a century later, makes up Vol. I of the monumental "Flora Brasiliensis", nominally in 15 folio volumes but ordinarily bound in about 40. Martius gives (col. LXIII-LXX) an excellent disquisition on the primitive agricultural practices which had gone far in the Province of Rio de Janeiro to bring about destruction of the magnificent coastal belt of rain forest that extended originally from below the Tropic of Capricorn through that Province, to about 11° S. (Province of Bahia). The European immigrants had, from the earliest days of colonization, killed, driven away, or amalgamated with the Indian population, but had adopted their primitive agricultural practices with rapidly accelerated destructiveness because the Indians had not had metal tools, and could only couple with fire the relatively puny effect of their stone implements. Martius dealt with conditions as he knew them over a century ago (1817-1820). His comments on primitive agriculture were introduced in connection with a picture of cut-over and burned land at S. João Marcos, Prov. Rio de Janeiro, but deal especially with the Province of San Sebastian. His observations on fire (col. LXXVI-LXXVII) are introduced in explanation of a plate illustrating the nocturnal spectacle of a prairie (campo) fire in the western part of the Province of Minas.

The demoniacal destruction by the hand of man and by iron of the virgin forest (mato virgem), leaving nothing that could be of any use, aroused his utmost resentment at man's failure to act in the light of reason, at his ignorance and greed in consigning to flames what it had taken nature ages to produce in order to grow one or a few crops amid the ruins. He called attention to the great size of the ancient trees

with their spreading buttresses, and said that the chopping sometimes had to be done 10 or 15 feet above the ground in order to be able to cut through the cylindrical part of the trunk.

In the burning, the great stumps and logs were often not consumed, but remained to rot away in the course of years, after the clearing (roca) had been used for three or four years. It then grew up to second-growth (Caa-apoera, corrupted to capoera) which, Martius indicated, was a very different plant formation. After eight to twelve years this would be a dense growth of slender trees in which the characteristic forms of the primary forest would be lacking, especially those noble genera of slow growth excelling in density, strength, weight, and beautiful color.

Not infrequently the colonist would return to this second growth in a dry season, and clear the roca again for planting crops, but during a shorter period than before. Then it would again be abandoned, and again grow up to capoera, less diversified than before. Rotation at intervals of six to thirty or more years, with progressive deterioration of the woody plants, often finally resulted as first indicated by St. Hilaire, a final state of being covered with molasses grass (Tristegis glutinosa; capim melado or gordura), indicating soil of the least value. This irrational system of agriculture resulted sometimes in a ground cover of ferns, as useless as bracken. At the boundaries of campo or prairie where tree growth was poor at best and the soil sterile forest degenerated most quickly to brush and then to campo with stunted bushes.

Martius called attention to laws protecting some of the "noble" woods that dated back to the Portuguese colonial period, especially those which were especially important for naval timber or dyewood. Not for many kinds, however, were there any legal restraints for destruction, even if there were laws in behalf of a few "madeiras reais" ("royal woods") or "páos de lei" ("law trees"). The chief was the dyewood called "brasil" (from which the country got its name) or Pernambuco wood.

In general, the ignorant despoiler of the land, called by the high-sounding title Fazendeiro (Spanish, haciendero; English, land proprietor) merely followed ancient tradition without being restrained by the limitation of lack of tools or of labor, since there were both impressed Indians and imported black slaves to do the work. He knew, as Indian predecessors had known, the capacities of different soils and cleared the best first. These superior soils were known as massapé, being black and loamy, and plants characteristic of such soils would of course be the first to become rare or perhaps extinct. Others were the white clay soils of the coastal region called apicu, good for growing sugarcane, salao, lateritic red clays, and dry, sandy soils called "areisco".

Aside from the use of fire for agricultural clearings in Brazil, which were always at the expense of forest, and the best forest first, fire was generally used to improve grazing

land. This Martius considered an objectionable practice from the standpoint of impoverishment of the flora. It eliminated species that had no organs of vegetative propagation safely protected beneath the soil or that were not otherwise fire resistant. Some crippled trees and shrubs might survive fires, but the majority of trees did not, and annuals did not. Successive fires would eliminate trees that had only been crippled before. In the long run, after repeated burnings, the prairie would have mostly a few perennial species, namely, those capable of renewed growth from below the ground level. All the most desirable trees would vanish and also the annual herbs.

Martius added that travellers through these burning wastes often see clouds of smoke, black by day, and by night scintillating flames sweeping the campos, terrible to see, and such a spectacle as that which led the way through the desert for the children of Israel--a cloud by day and a pillar of fire by night (Exod. C. XIII, v. 21). I have not seen that this interpretation of the biblical passage has been accepted by other writers, but it seems quite reasonable and remarkably consistent with the other reference to grass fires in antiquity, namely that in the Periplus of Hanno.

Mason, Francis (1860) *Burmah, its People and Natural Productions, or Notes on the Nations, Fauna, Flora, and Minerals of Tenasserim, Pegu and Burmah*. . . Rangoon: Thos. Stowe Ranney. 913 pp.

When Europeans (including the American Missionaries) first gave critical scientific attention to Burma, kingdoms had arisen and fallen through long centuries of interracial war, and their cities had been laid waste. The occupation of the fertile plains by wet rice culture was too far in the past for its history to be known, for Pegu had become a land of paddy. In the hills, however, the lands of marginal economic value still demonstrated the age-long process of destruction of primaeval forest by chopping and fire for primitive shifting agriculture. In Burma, however, Europeans were more impressed than they had been in the East Indies and elsewhere by the transition from shifting agriculture to permanent utilization of forest clearings by planting them with perennial and woody useful plants.

The matter is worthy of much more field study and historical delving than has been done, but it would appear that permanent land use came about by an evolutionary process that began with occupation of a temporary clearing by an equally temporary house. As clearing of land progressed and more labor was required to secure building materials, houses were more prized, and settlements became more stable. House and village sites came to be planted with useful trees and

shrubs, and so came into existence permanent village groves, merging into orchards and other permanently planted areas, including even areas planted with trees useful for house timbers.

Most of the land changed in aspect without record, for such everyday matters would not form part of serious history, although allusion would be expected in folk tales and legend.

British and American observers found that in what is now Burma the clearing for temporary agriculture was called (with variant spellings) taungya, and that it showed interesting transitions to permanent utilization which came about by the planting of useful woody plants in the clearings. If, when the time came for the land to be utilized again by clean clearing after lying fallow for some years, the trees had become too valuable to be destroyed, the tree growth would be spared and would continue, probably, to be improved by selective elimination of otherwise useless "weedy" trees for firewood, and the interplanting of new trees belonging to the tree garden.

British foresters seized upon the traditional habit of transforming the taungya into groves to promote reforestation. The word taungya itself seemed to enchant them, and so there came to be, in British tropical colonial forestry, a conception of reforestation by native cooperation which is called the taungya system. We read about it as being introduced or advocated clear across equatorial Africa. Whether it might not as well have been called the juma or uma system from observations in Sumatra or the ladang system from observation anywhere in Malayan lands is quite beside the point. It is undoubtedly true, that primitive tropical agriculture begins with forest clearings, and that wherever there is sufficient density of population materials for building become scarcer, houses come to be more valued, establishment of villages takes place, shifting agriculture is pushed into peripheral lands, and the lands nearer the centers of population go into somewhat permanent utilization, for groves of useful trees and for growing of crops by irrigation, the chief being the growing of rice in naturally wet lands or by artificial impounding of seasonal water in such diked fields as the Malayan sawah.

Some tropical peoples have been much more wasteful of natural resources of forest and soil than others. Some have hardly progressed beyond maximum wastefulness and have destroyed by chopping and fire the utility of enormous areas for themselves and others on the same cultural level. Others, in localities more favored by nature, have progressed all the way to permanent land utilization, and the majority have been perhaps somewhere in between. So far as pre-European agricultural practices are concerned, all stages may be seen or have been recorded in the countries of southeastern Asia. So far as indigenous agriculture is concerned, the same is true of tropical America, but a system of permanent land utilization never developed successfully in many places, for only Peru can be definitely pointed out. Africa

may have been more backward, perhaps, than America but even the dark continent had permanent terrace cultivation, most notably in Ethiopia.

Nothing about human cultural history is simple except before it is investigated. It is easy enough to make broad generalizations about anything on the basis of superficial observation, and primitive agriculture is no exception. The more it is studied the more varied it seems, but eventually one comes to admit that superficial observation often led to correct conclusions. Certainly it cannot be denied that the primitive shifting agriculture of the tropics, conducted by chopping and fire, by the growing of a few or even a single subsistence crop, followed by abandonment of the land to repeated bush and grass fires, has resulted in appalling destruction of natural resources and profound changes in the face of the earth. Likewise it is clear that the initial stages of European colonial enterprise have often, if not generally been equally destructive. The higher technical resources of colonizing peoples have indeed enabled them to make some progress in the utilization of lands previously devastated by more primitive man, but civilized man is often willing to be as destructive and ruthless an exploiter as his less sophisticated brethren.

In Burma the hill districts, inhabited by non-Burmans, gave early observers the clearest view of primitive conditions. The American missionary Mason gives us much information about the peoples called, from the color of their dress, "White Karen", or the Sgau tribes, inhabitants of the region "from Mergui in latitude 12° N. to Prom and Toungoo in nearly lat. 19° N." He wrote (pp. 77, 78):

"When the population is sparse, as in the Tenasserim Provinces, a Sgau cares as little to be the proprietor of the land on which he erects his booth as a bird does to own the tree on which it builds its nest. . . About January . . . he finds a place that pleases him, he digs up a small portion of the earth and prays: 'Now I will hew here, I will clear here . . . if it will come to nothing, if there will be no produce . . . when I return tonight let me have bad dreams; but if not, let me have pleasant dreams.' He then returns home with a little of the earth, and puts it under his pillow at night. Should the omens be unfavorable, he repeats the search until he finds earth to pillow on that is accompanied by pleasant dreams."

There follow the exorcism of evil spirits from the chosen place, the felling, the burning of the debris in April, and the building of a house. Then:

(p. 79) "In May, so soon as the rains have softened the ground, and it has been imbued with the lye from the ashes of the timber that has been burnt upon it, the paddy is planted, as Indian corn is in America. A hole is made in the earth with a sharp pointed bamboo, and a few seeds dropped into it."

Mason tells of interplanting with many other crop plants but not with trees, except for an allusion to Symmes who had written half a century earlier of Tougoo: "The country produces the best betel-nut in the empire," to which Mason adds, "but nearly the whole of it is derived from the Karen gardens in the south-east portion of the province."

Matheson, J. K., and Bovill, E. W. (1950) *East African Agriculture: a short Survey of the Agriculture of Kenya, Uganda, Tanganyika, and Zanzibar, and of its principal Products.* London; New York; Toronto: Oxford University Press.

This excellent book gives a comprehensive idea of the problems that have arisen during the transition of a large tropical area (a million square miles) from primitive agriculture to a state of continuous crop productivity under colonial administration and scientific direction of agriculture. These problems have arisen (1) from the release of restraints on human reproductivity through suppression of slave-raiding and intertribal warfare, leading in turn to a much greater need for agricultural production just to keep up with basic subsistence, (2) from the taking of land by white colonists for more or less Europeanized types of continuing land usage without corresponding development of education in and practice of soil conservation, and (3) from the tendency of the detribalized and semi-Europeanized people to demand, largely superfluous import goods which are not compensated for by their own productivity except during good times, so that they have no reserves to tide them over bad times, and have to be supported as parasites, a drag on the total economy.

It seems a curious anomaly that in spite of a redundant population living from hand to mouth and depending upon charity in bad seasons, there should have been always a dearth of labor for the European planters. This was because the laborer would work only long enough to set himself up as a cattle owner with his savings when he returned to his home village after a few years. The ownership of stock conferred social prestige but the animals were often a mere symbol of wealth, used for almost only one purpose, the purchase of brides. The pastoral peoples rarely used live stock for food except to bleed them for drinking the blood, and sometimes to milk them. Milk, however, was often completely disregarded as a food for human beings, being looked upon with aversion by many agricultural tribes.

The reading of such a book as Matheson and Bovill's, especially if one reads largely between the lines, leads to the conviction that the primary need of the world is education along the lines of birth control, and that unless population can be kept within bounds there is disadvantage rather than advantage in increased agricultural production. If scientific agriculture merely leads to maintaining an ever increasing population at a

bare subsistence level, with disproportionate drain on irreplaceable natural resources and no compensating higher average cultural level for many, or even with cultural retrogression for most, then it seems a disadvantage to change the social and agricultural customs of the past. Great, unwieldy, indolent, uncooperative, semi-Europeanized populations, too lazy to maintain or improve their status except through dependence on the colonial system, which, if overthrown, will sooner or later, leave the natives to their own devices, to fight out a modus vivendi among themselves. The experiment of bringing about unrestricted native population growth without the development of corresponding capacity for intelligent utilization of resources and independent productivity is likely to prove a costly one, but it is hard to see how political self-determination could result in anything but retrogression for naturally unprogressive tropical groups who have been and should continue to be under colonial management, for their own good.

Matheson and Bovill express great confidence in some of the Africans becoming, eventually, able to hold their own in industry with Europeans. They say (pp. 42, 43):

"The complacent attitude of the Imperial Government towards the African constitutes one of the gravest dangers to the future of the people. The idea that the bulk of the population should be left to work out their own salvation in their primitive ways and that thousands of able-bodied men should be allowed to idle away their time in native reserves and on European- and Indian- owned farms and estates. Given the labour they need so badly, these estates could be quickly brought into full productivity and be capable of adequately feeding all their employees. By this means, a minority at least of the Africans would be assured of food and a decent living.

"The African himself must play his part in the development of these territories. He must be taught and educated to realize that the progress of his country will depend primarily upon him. Plans and finance will be of little real value unless he is prepared to work, and work hard, whether it be for himself or for an employer. For work he must if East Africa is to take its rightful place amongst the great countries of the world."

The Matheson and Bovill volume has signed contributions by several authors. Bovill discusses the ethnic classification of the people. Most of the population is predominantly Bantu, with varying degrees of admixture with Hamitic and Arabic peoples from the northeast. There is gradation, from tribe to tribe, from comparatively pure Hamite to comparatively pure Bantu. The Nandi and Masai of Kenya are related to the Hamites, as are also the Baganda. The latter, according to Bovill, (p. 11) "owe to their Hamitic ancestry the qualities which enabled them to evolve advanced social and political systems before the British occupation." . . . "The pastoral [Hamitic] strain is pronounced in the Bahima of Ankole in

Uganda, who have become the aristocratic, cattle-owning, ruling class, with the Bahera as their artisans and villeins" [formerly their slaves]. The Hamites were essentially pastoral people, and nomads, who, spreading from the north-east, preyed upon and enslaved the dominantly agricultural Bantu with whom they came in contact, but also mixed with them racially, until greatly mixed populations were produced. Bovill says (pp. 11, 12):

"The principal neighbours of the Masai, and those on whom they traditionally preyed, are the Wakikuyu and the Wakamba, one of the largest tribes in East Africa. The Wakikuyu cultivate the soil, and keep large herds of cattle and goats, which they regard as their wealth. They have also developed as traders. They are greedy for education and have advanced political aspirations. The Wakamba are predominantly pastoral, and the overstocking of their grazing grounds and the consequent erosion of the soil together present one of the gravest problems confronting Kenya to-day. A notable group of Bantu agriculturists are the Wachagga of Kilimanjara, with a remarkable system of irrigation, who, like the Baganda and the Wakikuyu, have been quick to assimilate certain aspects of European civilization and to develop political aspirations.

"Close behind them in development are the Kavirondo of the Nyanza Province of Kenya, divided into two groups, the Nilotic and the Bantu. The former--the Jalu, for instance--seem to be related with the Nilotes of Uganda, the Lango and the Acholi and others. These are a Hamitic group whose centre is in the Sudan, and are essentially pastoral, cattle being in many cases more important than wives. The Jalu in many ways are more akin to the tribes of Uganda than those of Kenya. The Bantu Kavirondo are agriculturists and prosperous.

"The two most populous tribes in Tanganyika are the Sukuma of Mwanza and the Nyamwezi of Tabora. Together they form a fifth of the entire population of the Territory. Both are predominantly agriculturists. The next most populous tribe are the Wagogo of Dodoma, who are pastoralists and notably Hamitic in appearance.

The seaboard of Kenya and Tanganyika is the home of the Swahili, a people who are found in scattered groups along the coast and in the islands of Zanzibar and Pemba. Nominally Bantu, both Swahili-speaking near-Arabs and pure Bantus may claim to belong to this group. They are in a sense an historical people, for they formed the constituent elements of the Zang or Zeng Empire of the twelfth century A.D. They are Moslems and depend for a living on agriculture and trade.

In the discussion of native labor Matheson and Bovill say (p. 35):

"Today, with so many natives removed far beyond the short reach of tribal discipline--itself greatly weakened by the spread of western ideas--and knowing no restraint other than the sanctions

imposed by the penal code, the opportunities for advancement now being so freely offered them are being almost entirely wasted for lack of discipline and character training, the two greatest needs of the East African native.

"Much has already been said to the discredit of the native. But there is another side to the picture. So far European rule has tended to stimulate the growth of the population rather than to raise its standard of living. The greatest dangers to the natural growth of the population--intertribal war, famine, and disastrous epidemics--have largely disappeared as the result of British administration. But comparatively little progress has yet been made in ridding the native of hook-worm, sleeping sickness, spirillum fever, malaria, and venereal disease, with which a great proportion of the population is infected. Moreover, his standard of living is, generally speaking, of so low an order that his diet, even when satisfying to his hunger, is not sufficiently varied to ensure his well-being, with the result that he passes the greater part of his life handicapped by nutritional deficiencies.

". . . . When in 1942 rubber production became one of the most pressing needs of the Allies, the difficult task of reviving the defunct Tanganyika rubber industry was greatly aggravated by lack of labour. The only important local tribe who had surplus males were the Wagogo, a cattle tribe of the Central Province of Tanganyika whom no one would employ because they were such bad workers. The need for labour for rubber was so desperate that it was decided, contrary to general advice, to try the Wagogo. As a result of the great care which was taken to satisfy their particular needs, this despised tribe eventually became the backbone of rubber production, to which they contributed many thousands of skilled tappers who showed an enthusiasm and aptitude for work such as had seldom before been seen in East Africa. This striking example of what 'native welfare' can achieve is described in greater detail elsewhere in this volume."

The chapter on native agriculture in Zanzibar, by Fergus Wilson, have been reviewed under his name.

Maugham-Brown, H. (1943) The Sei Bush Belts of Sierra Leone. Farm and Forest, or Land Use and Rural Planning in West Africa. Vol. IV, No. 1, pp. 8-9. Feb., 1943.

It is pleasant to find an occasional indication of some slight comprehension of the need for conservation on the part of native Africans. H. Maugham-Brown () tells us that the Mendes of Sierra Leone have recently quite enthusiastically approved one plan for forest reserves which is in accord with one of their traditions. He says (p. 8):

"The Mendes have long recognized the principle of bush preservation, and by an old native law farmers were required to leave a fringe of high bush alongside paths and rivers when 'brushing' their farms: the strips so left were known as salei or sei bush. These strips were usually narrow, seldom more than 50 feet wide, and the land hunger of recent years has caused a progressive narrowing until in many parts they have disappeared. This recognized practice has been adopted for the purpose of forest reservation and Sei Bush belts may be defined as reserved strips of productive protective forest by the side of a path, road, river, or railway: the resurrected strips are normally 200 feet on either side of the track. These belts have the advantage that they develop a network of forest growth throughout the country. . . . The chief disadvantage is, of course, the great length of boundary per unit area of forest. . . . Native Administration forestry started in 1941 and from the first the popularity of the Sei Bush system proved itself. In the Bo District, where the scheme was introduced in seven chiefdoms, we now have well over a hundred miles of belts. . . . In the Moyamba District there has also been development . . . so that the total length of Sei Bush belts is now in the neighborhood of 150 miles: not a vast area of forest, perhaps, but of inestimable value from the fact that the initial steps have been taken with the approval and cooperation of the people. It is the start of their education to a forest and land sense. . . ."

Mer, Auguste (1885) *Mémoire sur le Périples d'Hannon*. Paris: Librairie Académique Didier, Emile Perrin, Librairie-Editeur. 156 pp., map.

Captain Auguste Mer (1885) who had had long experience on the west coast of Africa believed that Hanno's "Periplus" was nearly a matter-of-fact relation of an actual voyage which reached the island of Fernando-Po, south of the Niger delta and just north of the equator; also that the three apes which were called gorillae were killed here, and skinned so that trophies could be taken back to Carthage to be hung in the temple for the populace to view. Then the mountain of fire, Théon Ochêma, would have been the peak of Camaraôs, 500 meters higher than Tereriffe. Captain Mer explains the streams of fire as lava flows, whereas Falconer had accepted the explanation that they were brush and bamboo fires, extending downward along ravines to the sea. The Carthaginian colony, according to Captain Mer, was not near Cape Blanc, but was at Gorée. Hanno's "Lixus" was the Senegal River, the rivers that he explored were the Gambia and the Géba, where he saw the hippopotamuses and crocodiles, his high mountainous coast becomes the Cape of Palmes, his islands (one of which inclosed a lake) were those of the Bénin or Niger delta, and the island of the "gorillas" was his farthest south, Fernando Po.

Merrill, Elmer D. (1926) An Enumeration of Philippine Flowering Plants. Vol. IV. Manila: Bureau of Printing. 515 pp., 6 maps. "General Ecology of Philippine Plants and Animals," pp. 56-71. "Bibliography of Philippine Botany," pp. 155-239.

The introductory material to the "Enumeration of Philippine Plants" attained such length that it was removed by its author, Merrill (1926) from its originally intended place at the beginning of the work and put in Vol. IV with the indexes. It gives the best and most authoritative view of Philippine vegetation that we have. The paragraphs that are quoted below are pertinent to our subject of primitive agriculture and fire:

(pp. 58, 59) "It is practically certain that before the advent of man in the Philippines most of the country was covered with unbroken forest of one type or another, from sea level to the tops of the highest mountains. Open areas may have existed in the regions now occupied by the pine forests at and above an altitude of 1,000 meters and, of course, certain open areas existed along the margins of streams in swamps, flood plains of rivers, certain types of beaches along the seacoast, and in regions where the arborescent vegetation had been temporarily destroyed by natural causes such as volcanic eruptions. However, such types of vegetation as the enormous areas of grass-covered slopes and plains and the open cultivated areas, now prominent features in the landscape, did not originally exist; so that the general aspect of many localities must have been very different from what it is today and from what has been the condition within historic times. Considering the fact that approximately two-thirds of the entire land area of the Archipelago consist of cultivated areas, open grassland, thickets, and second-growth forests, and that all of these types of vegetation are due directly or indirectly to the presence of man, some idea may be obtained of the profound changes that have been wrought in the vegetation of the country in past centuries."

(pp. 59-61) "The first agricultural method employed in the Archipelago whether by the aboriginal Negritos or by the later Malay invaders was certainly the cañgin system, which is still very extensively practiced in the Archipelago. This primitive system of agriculture consists simply in clearing a selected area by felling the trees, burning the debris, and raising some crop on the area thus cleared. Such a clearing, in general practice, is utilized but one or two years, rarely longer; it is abandoned as soon as coarse grasses, weeds, shrubs, etc., commence to gain ascendancy over the cultivated plants. With only the most primitive agricultural instruments, the agriculturist devoting himself to the cañgin system today, as in past centuries, finds himself unable to cope with the luxuriant vegetation. In keeping a cleared area open for agricultural purposes he finds it much easier to fell and burn the trees on a new area than to combat the encroachment of weeds, coarse grasses such as cogon (Imperata) with deep-seated perennial rhizomes, and the bamboos of the genus Schizostachyum. Certain advantages are gained

in clearing new areas, especially that of securing a virgin soil, but this feature is in many cases doubtless a secondary consideration. A clearing once abandoned may, depending on local conditions, revert to a forested condition through a succession of coarse annual weeds, shrubs, and various quick-growing trees, a second-growth forest soon occupying the clearing; or it may become covered with coarse grasses, especially cogon, or sometimes other species in such genera as Saccharum, Rottboellia, and Themeda; or it may become occupied by gregarious bamboo forests, the species in this case being representatives of the genus Schizostachyum.

"If the abandoned clearing become reforested, it is only a question of time when it will again be cleared for cultivation by the caingin system. Very frequently, however, the clearing becomes covered with coarse grasses, and when this occurs the chances are that the area will not become reforested. Each year grass fires are purposely started, either to improve agricultural conditions or to make the country more easily traversed. Thus, most of the grass-covered areas in the Philippines are burned each dry season, and grass fires of enormous extent are prevalent throughout the Archipelago when conditions are favorable. These fires prevent the reproduction of forest by killing young trees and seedlings which may have become established among the coarse grasses; in fact, all plants other than the coarse grasses and those provided with deep-seated perennial rhizomes are thus annually destroyed. As the grass-covered areas become more extended, the fires often gradually push back the edges of the forest by the destruction of the young and mature trees along the borders of clearings. As the ultimate result, in many hilly areas in the Philippines, the continuous slopes are covered with grasses, and the forest persists only in the ravines where the land is generally not suitable for cultivation.

"Forest fires as such are practically unknown in the Philippines, except in certain limited areas, especially those characterized by the presence of the pine tree. The average high humidity, the rapid decay of fallen leaves and branches or their destruction by termites, and the nature of the undergrowth militate against forest fires. To assume that forest fires caused ravages in the Philippines in previous times it would be necessary to postulate radically different climatic conditions, and any great difference in this respect, especially lower humidity, is exceedingly unlikely. Forest fires as a factor in the establishment of open grass-covered areas can hence be ignored."

Métraux, Alfred (1943) Le caractère de la conquête jésuitique. *Acta Americana*, Vol. I, No. 1, pp. 69-82, Jan-March, 1943. Mexico City and Los Angeles, Calif: Inter-American Society of Anthropology and Geography.

Métraux calls attention to the use of fire to supplement chopping with their ineffective stone axes by the Guarani tribes in early days

of the Jesuit conquest of Paraguay. Coming down to recent times, Métraux says that the Tsirakua Indians of the northern Chaco attack travellers and colonists with the sole objective of getting iron tools. He believes that the Jesuits were able to make their amazing conquest of Peru because of their control over the marvelous gift of iron. The missionaries certainly exploited iron in the prosecution of their work. There are several places in Rondon's records of exploration from Matto Grosso to the Amazon from which we learn that gifts of hatchets or axes were made to remote groups of the Nambaquari who were still in the stone age. By primitive man in the Americas, until long after European conquest, nothing was more highly valued than a sharp metal blade. Not only Rondon's records but many others give evidence that primitive man's attack on the forest was made much more effective by getting steel tools, and that if European colonists adopted Indian methods of agriculture, there was likewise a reciprocal influence, for the Indians adopted European tools. Both influences hastened forest devastation.

Michel, Lieut. (1897) Excursion dans la province de Andévorante. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. II, No. 8, pp. 113-117; No. 9, pp. 467-471. Tananarive: Imprimerie Officielle. Aug. & Nov. 1897.

In the coastal province of Andévorante, Lieut. Michel (1897) found that the coast was forested in part, but that forest alternated with herbaceous vegetation a meter tall. There were areas in which both forest and grassland were replaced by brush. To prepare the brush land for rice cultivation the bushes were chopped in the early days of September, allowed to dry, and burned. Then the clearings had to be fenced with bamboo to keep the cattle out. If a patch of manioc was to be planted it was fenced and cattle were bedded down in it nights in order to manure the soil. In this way magnificent patches of manioc were grown. He said that the small herds of cattle that found excellent pasturage in the brush land could have been multiplied by twenty without fear of overgrazing. Michel passed to the southward of one piece of magnificent forest which he considered to be isolated, but his map shows that he did not know how far it extended to the north. It was actually the southern end of the more eastern of two forest belts, separated by the cleared valley of the River, described by other travellers who had gone by a northern route from the coast westward to the capital as lying between two parallel forest belts. We may assume, from Lieut. Michel's enthusiasm over this piece of original forest that other forested patches which he saw nearer the coast were merely secondary growth.

In the second installment of his article Michel said of the region from Vatomandry to Beforona, that the inhabitants preferred forest land for their dry rice cultivation and that

they had cut and burned in the year 1897 portions of two remaining forest areas. Practically all of the forest had been destroyed in the region Fasina-Mangabe-Amboditavolo. He recommended strong penalties to stop what he characterized as a barbarous and deplorable practice.

Miller, Leo (1918) In the Wilds of South America. Six years of Exploration in Colombia Venezuela, British Guiana, Peru, Bolivia, Argentina, Paraguay, and Brazil. New York: Charles Scribner's Sons..

The author of this book on South America collected birds and mammals for the American Museum of Natural History and often made observations on the distribution of forest, grasslands and agricultural clearings in the course of his travels.

His experiences in Colombia were very interesting as pointing out a region to the southward of Cali that should have the most careful ecological study from the standpoint of whether or not it is natural edaphic grassland of volcanic initiation. This was the region of lomas, which in this particular place are great barren hills. The approach to the lomas and the lomas themselves were described by Miller as follows:

(p. 18) "We left Cali at noon, May 13, well provided with riding and pack animals, and half-breed arrieros, and started on the well-beaten trail that leads toward the south.

At first there was no appreciable change in the valley, but by degrees the stretches of absolutely level-appearing land increased in size; instead of extensive cultivated areas there were pastures of large size, covered with a luxuriant growth of grass. Thousands of head of cattle were sprinkled over the velvety turf. We rode an hour through one of these ranches just before reaching the river Jamundi."

The next day:

(p. 19) "We rounded Mount Saint Ignacio early in the morning, and shortly after had our first view of the volcano Purace; we were to learn more of this mountain in the not distant future. Soon after, the lomas or great barren hills appeared; they form a kind of connecting-link between the Coast and Central Ranges. These gently rounded mounds are bare except for a kind of worthless, wiry grass that in some unaccountable way draws enough sustenance from the red-clay soil to maintain its meagre growth. These hills gradually increase in height, but the ascent is by such slow degrees that one is scarcely conscious of any rise at all. There are few houses, and the small number of inhabitants seem to be as sallow and lifeless as the hills themselves."

(p. 20) ". . . . In perfect accord with our expectations, there was little bird life on the cheerless lomas."

The next night was spent at Morales, at an elevation of 5900 ft.

(pp. 22, 23) "With the first faint glow of light in the east the banks of vapor became dissipated and gradually disappeared. Peak after peak reared its head above the ocean of snowy whiteness. First of all was Purace, the hoary monarch that dominates the southern part of the Cordillera Central and spreads terror through the land with threats and warnings similar to those we had just experienced. This great volcano has been active for untold ages. A huge column of smoke and vapor ascends continually straight into the clouds, and this, reflecting the light of the rising sun, makes a magnificent picture. Occasionally at night the eternal fires within the gaping crater may be seen tinting the low-hanging clouds and the snow that crowns the summit, fourteen thousand five hundred feet high, with rosy red. All about, the great barren lomas are strewn with black boulders, some of immense size, that serve to remind the wayfarer of the cataclysms of bygone ages. Everywhere they dot the hillsides and tower above the trail that winds among them."

It is to be assumed that much of the Colombian grassland up to relatively high altitudes has been derived from clearings made at first by the Indians and then in old Spanish days. There are grasslands of artificial origin and palm savannahs up to the belt of mountain forest which lies below the paramos. This is the situation, for example on the headwaters of the Quindio River, west of the Nevado del Tolima. Miller wrote (p. 55):

"September 12 found us wending our way along the Quindio River toward its headwaters. The valley floor is covered with grass that is kept close-cropped by cattle and horses. Low shrubbery grows along the river-bank; the stream--not over one hundred feet wide--is clear and swift and the icy water rushes over a boulder-strewn bed. A scattered growth of tall palms dots the entire valley and extends up the mountainsides to an elevation of about nine thousand five hundred feet.

"The lower slopes were barren, having but recently been burned over; fire was still raging in a number of places and the hissing and popping of burning vegetation could be heard frequently with distinctness. Tall, smouldering stumps were clustered here and there like blackened chimneys from the tops of which wisps and columns of smoke ascended into a hazy sky. The pungent odor of burning green plants was at times almost suffocating.

"Forest begins at nine thousand five hundred feet. It is at first somewhat open and reminded us of Laguneta. The

rich mould of the forest floor was very deep and caused us much anxiety lest some of the pack-animals be lost, for they sank into it to a great depth, and there was constant danger of their floundering and pitching headlong down the mountainside....

"Toward evening we reached a native hut--the second since leaving the valley. The elevation of the place was ten thousand five hundred feet. A large clearing in which white clover grew abundantly surrounded the house. The inhabitants also had other clearings farther down, where they planted corn and wheat."

The forest below the paramos was magnificent, and above that were the paramos, open land of bogs, ponds and rocks, uninhabited and wild.

Miller visited the country at the edge of the great Amazonian forest east of the Andes. Here there were a few clearings but they were too small and scattered to threaten the extent of the forest.

Of the region of Medellin, Miller wrote (p. 111):

"Our first expedition was to a point in the mountains southeast of the city, known as Santa Elena, and only a few hours' ride on mules from Medellin. After crossing the ridge we found ourselves on a high, wild plateau, which had at one time been covered with forest; but the trees had been felled on the greater part of the area, and only small, scattered patches of woods were left untouched. There are numerous little huts in this upland country, and at one of these we decided to remain for as long a time as the country proved a profitable collecting ground.

"On account of the great change in the flora, occasioned by deforestation, a corresponding change had taken place in the bird life. But little remained of the subtropical fauna we had expected to find; however, there were black thrushes, several species of tanagers, toucans, trogons, and motmots, besides many commoner species."

A second expedition from Medellin took them 5 days to the northeastward, to Peque. Quoting again (pp. 123, 124):

"Some of the country surrounding Peque once doubtless bore a light forest growth, with heavier forest in the ravines; but by far the greater part is naturally barren or covered with brush thickets. I was told that at the time of the Spanish invasion forty thousand Indians inhabited the region, and as the several mountain streams supply an abundance of water, and the soil responds fairly well to cultivation, there seems to be no reason why it should not have supported an extensive population; at the present time only a few hundred people are left, the others having gone to swell the ranks of victims exacted by the lust of the conquerors.

"The forested zone, beginning at eight thousand feet on the ridge we had just traversed, gradually extends its limits downward as one goes farther north, until at Peque it reached as low as five thousand feet in the deeper and well-watered ravines; and, as previously stated, at Puerto Valdivia it reaches the very edge of the Cauca."

Miller worked in Venezuela and has an interesting note on Maquiritare Indian clearings and cultivation along the Cunucunuma River west of Duida. The clearing or cunuco of the Maquiritare chief was called Yacaré. Here (to quote from pp. 173, 174):

"Surrounding the great, conical house was a small patch of yucas and pineapple-plants, walled in on all sides by the interminable forest. The edge of the roof came down to within five feet of the ground, and there were eight fireplaces, equal distances apart, showing that eight families occupied the dwelling. A perfect network of poles and beams supported the ragged grass and palm-leaf canopy, and from these various articles were suspended: Drums, made of sections of hollow tree-trunks and covered with the skin of a red howling monkey on one side and of a peccary on the other; long tubular baskets of wickerwork used to express the poisonous juice of the yuca root in making mandioca; blow-guns ten feet long, hammocks, and fishing-tackle. Everything was immaculately clean and well arranged. On one side two small rooms had been built of adobe, one for the chief, and the other for storing baskets of mandioca, each of which held about a hundred pounds.

"A walk around the edge of the clearing disclosed an obscure trail which zigzagged and wound through the forest about a mile and then opened into an immense plantation, which we estimated contained not less than a hundred acres. The trees had been cut down and burned, and yucas neatly planted in hills stretched to the very edge of the clearing. Through the centre ran lanes of plantain and banana plants, bordered by rows of pineapples, sugar-cane, and cashews. The ground was carefully cultivated, and there were no weeds; the stalks of uprooted plants had been piled around the edge of the field forming a thick fence. The reason for maintaining such large plantations is that the women make a good deal of mandioca to sell to the traders for cloth, matches, perfume, and trinkets. The men clear the ground; the women plant and care for the crops."

In Brazil Miller was a member of the Rondon-Roosevelt Expedition. His observations on the grass marshes of the upper Paraguay is interesting but is not dissimilar from the descriptions by the other two whose works are here reviewed.

Milne, Mrs. Leslie. The Home of an Eastern Clan. A Study of the Palaungs of the Shan States. Oxford (Clarendon Press) 1924. viii 428 pp., 20 pl.

Mrs. Leslie Milne had her first experience with the Falaungs of Upper Burma in 1906 and subsequently wrote extensively about them. Their primitive shifting agriculture had become transformed in part into the permanent use of the clearings for tea as a result of their belief that tea would grow better on land which had borne a crop of upland rice than it would on freshly cleared soil. They also had terraces for wet rice cultivation. Her diary of 1911 (1924, p. 8 & seq.) mentions tea gardens between Pang-nim and Mōng-ngaw, but also "clearings probably made for the sloping paddy fields of the hills, but now in the process of reverting to jungle . . . covered with the tall grass . . . very much used for thatching. . . . We skirted long, terraced rice-fields. . . . At times I rode over the summits of hills . . . while far below were miles and miles of uncultivated forest. Sometimes we passed through grasses so tall that they almost met overhead as they swayed in the wind." [These probably indicated sites of deserted clearings.] . . .

(p. 224) "Palaungs recognize the fact that the introduction of tea to their country is comparatively modern, and there are few ceremonies connected with . . . tea. But when the hill-slopes are to be cultivated for the sowing of paddy, offerings are made to many of the local spirits. . . . When the trees and bushes have been cut down, or pulled up, and thrown into heaps, they are left to dry and are afterwards burnt, the ashes being scattered over the field. . . ."

(p. 226) "Tea plantations are generally made on ground that has already been cleared for paddy; indeed paddy is for the most part the first crop on the land, because Palaungs believe that the tea trees will grow stronger after a crop of paddy, than on land that has simply been reclaimed from the jungle. When the paddy has been reaped and taken away, a small piece of land is prepared as a nursery. . . . When the young trees in the nursery are three or four years old, they are pulled up for transplantation. . . . If the land is good, the trees are planted twelve feet or more apart; if the ground is poor, they are set only three or four feet from each other. . . . The tea gardens at a high elevation . . . are kept well hoed . . . but the soil in the lower gardens, where the heat is great, is liable to crack; there only the large bushes are removed, grass and ferns being left. It is not easy to keep the earth in exactly the right condition; the tea ground is so steep that if the soil is too well hoed, the heavy rain washes the earth down into the valley below, baring the roots of the tea trees. No terracing of the land is attempted."

This account of modification of shifting toward permanent agriculture by planting a shrub or tree crop even if not for timber certainly suggests the toungya silvicultural system of lower Burma which has become so well known, but of which the origin seems not entirely clear, unless the present writer correctly ascribes it to Kurz. Certainly native practices could not have given more than a suggestion of the system, for this account of Mrs. Milne's is one of the best, and late enough so that if the development of the system by British forestry had shown any reflection in native shifting agriculture, it should have been apparent by 1911.

Miquel, F. A. W. (1862) Sumatra, seine Pflanzenwelt und deren erzeugnisse. Amsterdam: C. G. van der Post. Utrecht: C. van der Post Jr., Leipzig: Fried. Fleisher. 656 pp., 4 pl.

Miquel (pp. 32-33) felt that Junghuhn had exaggerated the extent of lalang areas in Sumatra, perhaps because they were more obvious in the north of the island than in the south. He said that on various uplands one of the dominant physiognomic vegetational aspects was lalang field. Imperata arundinacea, three to four feet high, reproducing abundantly by its hairy windblown spikelets, was ready at hand to possess areas denuded of forest or abandoned by cultivation. Although the alang grass in Java occurred chiefly at 3000 to 4000 feet, it came down to 700 or 800 feet in Sumatra and, according to Junghuhn had extended its distribution greatly in historical time. As the lalang fields increased, the productivity of the land decreased, and "without doubt" Miquel said, the water resources of the island also decreased.

Where this grass is once master, a natural forest does not readily reestablish itself because the thick clumps of the lalang do not afford a proper place for germination. Still, Miquel thought, Junghuhn's high estimate of the extent of the alang fields on Sumatra was excessive and based upon superficial estimate, probably because Imperata seemed to intrude less into the alluvial plains of the south and east than in the north.

Other observers besides Junghuhn, however, have mentioned the great extent of lalang in South Sumatra (e.g., Forbes, q.v.).

Modigliani, Elio (1890) Un Viaggio a Nias. Milano: Fratelli Treves, Editori. xvi + 724 pp., 195 figs., 26 pl., 4 maps.

Modigliani's description (p. 590, seq.) of shifting cultivation on Nias uses the Malay word ladang for the forest clearing, and the procedure might be almost anywhere in Sumatra. Having found an auspicious place, the makers of the ladang cut herbs and bushes in December, which operation is called mombala. From two to four weeks later follows the molowi, in which the debris is piled up and burned. Each successive operation is accompanied by symbolic prohibitions from doing various things. Finally the clearing, fertilized by the ashes, is planted in February or March, the men punching the holes for the seeds and the women sowing. Appropriate invocations for the success of the planting are pronounced, and the owner has a little family celebration to which others are invited. At harvest there is another party at which there are invited guests.

The terms for house and cultivated clearing which we have been concerned in tracing (uma, djuma, luma, etc.),

are represented in Nias by omo, a house of assembly or a solitary house in a plantation dependant upon a village. It therefore corresponds to Malay rumah and refers to the house rather than to the clearing. The usage seems to indicate the evolution of the clan house in the village from the isolated outlying house which might be far enough away to form the nucleus of another colonial village.

Mohnike, Otto (1883) Blicke auf das Pflanzen- und Thierleben in der Niederländischen Malaienländern. Münster: Aschendorffsche Buchhandlung. 324 pp., 18 pl.

Mohnike supposedly on the ground of his personal observations (which, as described seem in large part like a reflection of those of Junghuhn) said (p. 124) that the alang-alang grass of ill repute (Imperata arundinacea) gave a characteristic physiognomy to the places where it grew. It occurred especially in Java, Sumatra and Timor, more seldom in the Moluccas, and practically not at all, he said, in Borneo. Often covering stretches of many square miles, its abundance was causally closely connected with the extent to which the forests that in ancient times covered all islands of the archipelago had been destroyed. Originally he conceived the alang-alang to have been at home on steep declivities at 2000 to 5000 feet elevation, and to have spread into the lowlands following human activities, among which he gave warfare a high place. Lands formerly cultivated but abandoned became vast stretches of alang-alang which flowered in October and November, and then had a monotonous white-gray shimmer that gave rise to melancholy reflections on how the hand of man could transform beautiful luxuriance into permanent wastes. Mohnike ascribed the desolation of the Sumatran grasslands chiefly to war, and the spread of alang-alang in Java to the ravages of the dense population on every bit of woodland for fire-wood. Desolate grassland was extending largely in central Java just where the population was densest. In the central residency Kedu, which he described as a paradise, the whole surface except some mountain sides, and the four volcanoes at the boundary, namely the Merbabu and Merapi on the east and the Sindoro and Sumbing on the west, were occupied by alang-alang up to 7000 feet. He noted that there were evidences that the Merbabu had been thickly forested until 1785. These mountain forests at the time of his observations, had disappeared without giving place to permanent cultivation. (Almost a paraphrase of Junghuhn's Javan observations!)

Mohnike believed that deforestation and desiccation of the soil were so closely related in this region that either could hasten the other.

His observations on Sumatra were made in 1862. In that year he crossed the island from Palembang to Benkulen. This was a region that had formerly been largely in permanent cultivation

with wet rice fields (sawah) and fruitful village groves, but for ten years had been the scene of war between the natives and the Netherlands Government. Overgrown with alang-alang grass in that short time, or at any rate in thirty or forty years, the plateau was for the most part an unvaried expanse of useless grassland. Climbing a hill near Lahat he was able to survey the landscape from an elevation four hundred feet above the general level a great grass plain with here and there an island of bush. Far to the south he could see the distant boundary of tall forest, westward the grass stretched toward 10,000-foot Mt. Dempo. On the plain was a herd of certainly more than a hundred and fifty elephants. His Malay companion assured him that ten years before the scene was of villages, rice fields, and fruit gardens. Accompanying Imperata were other grasses of similar habits, especially "glaga" (Saccharum spontaneum L.). It seems curious that Mohnike had nothing to say about fire as a factor in the transformation of cultivated land to alang-alang prairie, but "war" may be taken to imply fire.

Montano, J. (1886) Voyage aux Philippines et en Malaisie. Paris: Hachette et Cie. 351 pp., illust., map.

Dr. J. Montano visited the Mantra district of the interior of Malacca in 1897 and reported (p. 16) that there was little cultivation. The Mantras lived partly by hunting. For their miserable agriculture they merely cut down the trees near their houses and fired the debris when it was still half green, so that only leaves, small branches, and vines were burned. The inextricable medley of larger trunks and branches was left. With pointed sticks the Mantra planted in the ashes a little rice, yams (ubi manis or sweet yam, thought by Montano to be Dioscorea but possibly Ipomoea Batatas or sweet potato), and manioc.

Old clearings encountered in the forest presented great obstacles to travel, for the great trunks criss-crossing each other were difficult to climb over. (p. 23).

In the region of Davao at the base of Mt. Apo, Montano (see p. 234) had an encounter with wild carabaos descended from the domesticated ones in an area of grassland which may have been natural, and free of forest because of seasonal fluctuation in water level. In traversing a large prairie surrounded by forest he shot an aigrette at the border of a lake bordered by grass. The shot aroused a herd of carabaos which would doubtless have killed his party if the forest border had not been close enough to afford refuge. This incidental mention of such semi-submerged land coincides with observations of the reviewer in the vicinity of Cotabato where there is much marshland covered with tall grass which may at some time have been utilized for wet rice culture but which, lying fallow, certainly

gives the impression of being a natural plant community uninfluenced by human agency.

Montano (pp. 62-65) visited the Bikol province of Albay in 1879 at a time when most of the area was state land and forested but rapid sales of land were being made for the establishment of abaca (Manila hemp) plantations. The conservator of forests (ayudante de montes) was attempting to prevent any clearing on land for which a concession had not been granted, for he reported that the improvident Bikols devastated beautiful forests of valuable trees in order to plant rice for only a single season. Requests for concessions were numerous, and were released at prices varying from 3 francs 60 to 7 fr. 20 a hectare, which at the value of the franc at the time (for Montano, writing for French readers, gave the equivalent of Spanish values in French money) would have meant an average rate of an American dollar per hectare, reminiscent of the free or almost free land policy in America at the same period, when the greater part of the eastern American forest had already been destroyed or was rapidly being so, with no regard for the future.

Morris, Max (1900) *Die Mentawai-Sprache*. Berlin: Verlag von Conrad Skopnik. viii + 356 pp.

Max Morris was not an entirely independent observer since he accompanied Maass to the Mentawai Islands in 1897 (they visited Si Kobo) but being concerned primarily with the language he confirms abundantly that the primary meaning of uma is a large communal house. Several anthropologists have thought that it meant clan, but if so, clan is used in the sense of a household group or the descendants of such a group, for Morris gives Mentawai expressions such as uma n-abak, "house of the boat", i.e., boathouse which indicates that the uma is the house itself rather than the people in it or related to it.

Morris's Mentawai texts do not deal much with agriculture, but brief allusions to the subject mention clearing and planting forest without reference to burning.

Loeb's aspersions on Maass lend importance to this work of Morris, with its many items of ethnological importance.

Mooney, H. F. (1942) A Sketch of the Flora of the Bailadila Range in Bastar State. *Indian Forest Records*, n. s., Botany, Vol. III, No. 7, pp. ii + [197-253], illust., 2 maps.

The district described by Mooney is very difficult of access. It lies between 18° 30' and 19° 5' N.; 81° 10' and 81° 15' E., in the Central Provinces, touching Hyderabad on

the south and the Eastern Godavari district of Madras, extending some 45 miles, south of the Indravati River. Seldom visited, this land of the "Bison-horn Gonds" is one in which there had never been effective regulation of shifting cultivation or of fire. It lies for the greater part within the boundaries of the Bailadila Forest Reserve. The following quotations deal with shifting cultivation and fire:

(pp. 201, 202) "That the higher valleys were at one time inhabited and the upper slopes subjected to shifting cultivation is quite clear; but there is no certainty regarding the date when the hills were abandoned, except that it was some time prior to 1910 when the range was constituted a reserved forest. Shifting cultivation, known locally under the forms of marhan and penda, was undoubtedly practised on the slopes of these hills and even on the crest of the range itself, probably within the past fifty or sixty years, by the "bison-horn" Madia Gonds, who inhabit the surrounding country. Evidence of this is fairly conclusive and, although some time has elapsed since the slopes were cleared, the fact cannot be overlooked that even this remote spot was inhabited until comparatively recently, and that in consequence the vegetation is not entirely unaffected by settlement and the destructive hand of Man. Having exhausted the accumulated fertility of the soil (which was probably not great on this rocky wind-swept mountain) the upper slopes and valleys were abandoned. Exposure and erosion have played their part in degrading the vegetation, the shallow soil being insufficient to support tree growth over much of the area; and this subclimax is maintained, if it is not in fact suffering further degradation, by the annual conflagrations that sweep across the range in the dry season. These fires successfully inhibit any seral progression towards closed forest on the grassy slopes rendered treeless by penda in the past. The grass and bracken, which have replaced the forest, are burnt year after year. A few veteran trees with charred trunks and gnarled branches, which alone remain to testify to the past, stand as a memorial to the dead.

"If one seeks the original or what may have been the climax vegetation, one must search in the deeper ravines that have escaped the axe, and where the flora and humidity are such that fire rarely, if ever, penetrates their recesses. It is none-the-less noticeable that numbers of plants are annually killed off along the periphery of the evergreen belt, thus gradually restricting this interesting type, which might even disappear in time. A few copses occur on the slopes, preferring, on the whole, the eastern aspects; and the Galli valley is still, generally speaking, well-wooded. These woods are, however, afflicted by the annual burn and are composed, for the most part, of fire-hardy species. It seems to me beyond doubt that the climax type of vegetation in the high-level valleys is evergreen and that progression to closed forest would follow protection from fire."

Mooney considers that the climax vegetation must have been closed forest of the Terminalia-Xylia type, still barely existing as a few relict caps on mountain tops. He says (p. 209):

" It has been all but exterminated by cultivation and fire; and the subclimax condition is due to the latter factor aggravated by lack of soil. This has resulted in a grassland type of proclimax. But grassland is probably nowhere the climatic climax vegetation in these parts; and the conclusion that I reach is that there will be progression. No matter how slow, soil-forming processes are at work; and, if the fire factor is eliminated, conditions will in due course be built up, which will ultimately permit of a return of the climax type of vegetation. I therefore class this community as a proclimax in spite of its comparatively static appearance."

Of the largely denuded central valley slopes, with Dillenia and Phoenix humilis scattered in grass and bracken, he says:

"There is little doubt that the open grassy condition of these slopes is due to past shifting cultivation. Extremely characteristic is Phoenix humilis, which is very abundant everywhere; and bracken is gregarious in sheltered depressions, becoming increasingly frequent toward the valley bottom.

" Shifting cultivation in the first instance destroyed the forest; repeated cultivation and exposure have removed the soil; and subsequently annual fires have kept the vegetation in that degraded or subclimax condition in which we now find it. With continued fire protection, it is not unreasonable to assume that the moister type would again take possession of the lower slopes and that it might ultimately regain its supremacy at the higher levels, wherever a vestige of soil covering remains."

Moss, Chas. Fredk (1876) Over Swamp, Moor, and Mountain: being the Journal of a Visit to Antongodrahoja, and home by Ambatondrazaka. The Antananarivo Annual and Madagascar Magazine. Revised and Re-edited by the Rev. J. Sibree, F. R. G. S., and Rev. R. Baron, F. L. S. . . . A Reprint of the first Four Numbers. Antananarivo (London Missionary Society) 1885 Number 2, pp. 131-149. Christmas, 1876.

This is one of the publications that are so numerous for Madagascar giving evidence about the aspects of vegetation at definite places and along definite paths. They provide, as a whole, much information for phytogeographic mapping and for appraising the changes that have taken place during the period since the French occupation.

This particular account of travel indicates how readily Europeans fell into the devil-may-care attitude that grass and bush fires might be set anywhere at any time, quite as a matter of course. Quotations follow.

(p. 132) "On the evening of our stay here ["Antanantsara, 20 miles north by east of the Capital"] we had an instance of the great extent to which the grass-burnings are carried on among the wild hills and moorlands of Madagascar. The night being clear, and the moon in its first quarter, we counted nearly twenty large fires in different directions. Some of them, distinctly visible, were on the lofty slopes of Ankaratra, fifty miles away."

(p. 136) "To guide our luggage bearers, who had fallen considerably in the rear, we set fire to the long grass, which soon made a glorious blaze . . . and then groped our way into . . . Ambàkorèny."

(p. 139) "Rather more than eight hours' riding over these high moors, blackened with recent grass fires brought us to . . . [Marofòza]."

(p. 144) "In pity for our poor luggage bearers, who were toiling along a mile or two behind, I set fire to the long grass to serve as a beacon for them. Bye and bye a magnificent glare lit up the horizon, and by its light our poor fellows were guided to our stopping place." [Antsàmpandrano]

This was the day before reaching the Sihanaka country proper. Moss and his party concluded the journey through country at least in part beautifully wooded with "stately forest trees" festooned with creepers.

Mouhot, Henri (1864) *Travels in the Central Parts of Indo-China (Siam), Cambodia, and Laos, during the years 1858, 1859, and 1860.* 2 vols. London: John Murray. 303 + 301 pp., illust., map.

Mouhot, the famous explorer of Angkor Vat, lived three months among the Stièns (Stièngs) at Brèlum, (108° E., 12° N.) and described their agriculture (1864, I, pp. 244-246) as follows:

"They cultivate rice, maize, tobacco, various kinds of vegetables, and fruit-trees, such as bananas, mangoes, and oranges. Every person of any substance possesses several slaves, and a field, always at some distance from the village, and very carefully attended to. In these fields, in little huts raised on piles, the Stièns pass the whole of the rainy season, during which they can neither hunt nor fish, both on account of the inclement weather and the leeches, the immense numbers of which, as in the forests of Siam, make them a perfect pest.

"Their manner of preparing a rice-field is very different from the way in which our agriculturists set about matters. As soon as the first rains begin to fall, the Stiên chooses his ground, and busies himself in clearing it. This would be a laborious task for a European; but he, with his hatchet with cane handle, has in a few days cut down a thicket of bamboos 100 to 150 metres square. If he meets with any tree too large for him to manage, he leaves it standing. After a few days, when the canes are a little dry, he sets fire to them, and the field is soon cleared. As for the roots, he cares little about them, as no digging is required; on this virgin soil everything grows with little labour. There only remains to sow the seed, and for this purpose he takes two long bamboos, which he lays in a line on the ground; then, with a stick in each hand, he makes on each side of this line holes about an inch or an inch and a half deep at short distances. The man's work is now finished, and that of the woman begins: stooping down, she follows the line traced by her husband, and from a basket carried at her left side takes a handful of rice, of which she throws a few grains into each hole with great rapidity, and at the same time so dexterously that it is rare for any to fall outside. In a few hours the task is finished, for here there is no need of harrow or plough; kind Nature will soon send some violent showers, which, washing the soil over the holes, will cover the seeds."

Mouhot has no notes on ordinary grasslands resulting from the shifting agriculture of the Stiéngs, but several observers in southeastern Asia have considered the bamboo forest as generally a secondary vegetation. If so, the clearing observed by Mouhot represented land already at least once cleared.

Nano, José F. Kaingin Laws and penalties in the Philippines. Phil. Journ. Forestry II, No. 2, pp. 87-92. 1939.

"Illegal kaingin has been going on in the Philippines from time immemorial and untold forest wealth has been turned to ashes. . . The kaingin is a nomadic method of cultivation very common in tropical countries. It consists of clearing a forest tract, burning the trees and other forest growth and planting crops. . . After a harvest or two, when the returns begin to dwindle, which is inevitable because the land is essentially non-agricultural, the kaingineros move to another forest area and repeat the process. . . For the last ten years alone, 28,933 hectares of forest land in the Islands had been illegally converted into kaingin. To this vast area must be added kaingins in out-of-the-way places that have escaped detection. . . The vast open waste which the Government is reforesting at present at great expense is the result of kaingin, and it is high time that we make our kaingin laws affect the remedies so sorely needed."

Laws regarding kaingin were promulgated in Spanish time in 1867, 1874, and 1882. They were revised by the Americans in 1900, and again in 1901. This law read in part "The making of so-called 'kaingins' or clearings on public land by felling or burning trees is hereby prohibited."

Then, in 1904, action was taken to make the penalties lighter. In 1917 and again in 1926 the penalties of violation were made still lighter.

"Observation hitherto had shown that the kaingin-making rampant everywhere in the public forests was largely due to this growing leniency of the law. Kaingineros take the penalties very lightly and as a matter of course. A kainginero in one instance upon being advised that a criminal complaint had been filed against him . . . for destruction of public forest, dressed up, took his mat, blanket and two-day outfit and started for the court. Arrived there, he pleaded guilty, knowing full well that he only had to serve the few days imprisonment. Upon his release he went back not only to continue occupying his kaingin but to enlarge it further. . .

It is a paradox that while we are busy reclaiming these waste lands, . . . we are allowing, through our puny laws, more destruction to take place in our forests . . . giving rise to the very conditions we are attempting to remedy with expensive reforestation measures."

While this article was in press the National Assembly approved a more stringent law.

The New Kaingin Law. [Commonwealth Act No. 447] An Act to further amend section twenty-seven hundred and fifty-one of the Administrative Code, as amended by Act numbered thirty-three

hundred and fourteen. Phil. Journ. Forestry Vol. II No. 4, pp. 393-394. 1939.

Netto, L. (1865) Remarques sur la destruction des plantes indigènes au Brésil et sur les moyens de les en préserver. Bull. soc. bot. France, V^e ser. Bot. IV, 10 Feb. 1865, p. 70.

On the ravages of the "pre-cultural" fires and on stations of refuge of the species of *Eriocaulon* of the burned-over campos. This genus of plants is highly developed in the great campos and must have had a long evolutionary history in a prairie habitat.

Netto, L. (1866) Additions a la flore bresilienne; voyage botanique dans la province bresilienne de Minas Geraes. Ann. Sci. Nat. 5^e ser. Bot V, p. 158-201.

Netto listed the plants characteristic of the "queimados", pastoral burned-over lands of Brazil. He said (p. 180) that during the dry season when they were just beginning to burn over the campos, the air was filled with smoke giving a sinister color to the scene by the light of day and obscuring the sky which had been so bright a month before. The herders assured him that unburned campos were the last to become covered with verdure and did not generally display the same splendor of vegetation as those that were burned every year. Of this they were so convinced that they enforced the burning-over of as much land as they could.

Nilles, J. (1943) Natives of the Bismarck Mountains, New Guinea. Oceania, Vol. XIV, No. 2, pp. 104-123. Melbourne (Australian Nat. Res. Counc.) Dec. 1943.

Nilles describes the gardening operations of three tribes in the Chimbu valley, belonging to the Kuman or Arawa group. The Kuman area is one of the most densely populated parts of New Guinea.

Nieuwenhuis, A. W. (1904; 1907) *Quer durch Borneo. Ergebnisse seiner Reisen in den Jahren 1894, 1896-97, und 1898-1900. . . .* Erster Teil. Leiden: E. J. Brill: 1904 xv + 493 + [1] pp., 97 pl., 2 maps; Zweiter Teil. xiii + 557 + [1], 91 pl. 1907.

On the Kapuas River in Borneo the signs of habitation began above Semtau in the form of deserted clearings (ladang) of Malays and Dyaks, and afforded Nieuwenhuis an opportunity to observe the height (10-15 ft.) to which the brush had grown in the two years since he had been there before. Further up the people were Dyaks who had such stem names as Uma Acing and Uma Pagong. The term Uma denotes house in Kayan Dyak, just as in the Mentawai Islands, and the second word the particular house from which a group is descended. There is a special term luma which would seem, if the reviewer's interpretation is correct, to correspond with Batak juma (djoema). Nieuwenhuis records it (I. p. 157) in connection with his description of the luma lali, or tabooed field, a special miniature field where the chief carried out certain rituals that were intended to secure an abundant rice crop. All the operations of rice growing were ceremonially carried out there, all of which had symbolical significance. To be noted is the same word, lali, for taboo, which Forbes encountered in Timor.

Nieuwenhuis (II, p. 38) made the interesting observation that alang-alang grass (Imperata) was much less abundant on the upper Mahakam River than it usually was elsewhere. The Bahau people here were able to use a shorter rotation of cropping and bush fallow than was ordinary, and made less extensive inroads on virgin forest, which, however, had practically vanished near the villages. Like the Malays, the Bahau were contenting themselves with cutting young woody growth, which quickly crowded out the alang-alang. The procedures and ceremonies of preparing the luma (field) did not differ greatly among the Bahau from those of the Kayan, and there were many prohibitions or lali, such as refraining from rice cutting during certain periods. (See II, p. 122.) One of the customs was for reciters to occupy night after night singing or reciting (dajung) legends (II, p. 131).

Nieuwenhuis has much not only about lali but also about pemali, a system of restrictions commonly found in Malayan countries, which prevents agriculture, house building and almost all other activities at what might be the proper time or place because the omens were not right. The omens from flying birds and other quite capricious phenomena often stood in the way of rational procedure. Pemali, it would seem, was quite different from lali. Pemali might prevent things from being done that were essential, whereas lali proscribed certain activities or things while other essential things were in process of being done.

One of the great obstacles that shifting agriculture imposed upon the cultural progress of the less sedentary Dayak groups was that so much energy went into the moving of whole communities when the accessible lands had become exhausted by too

many rotations of clearing and planting. That meant a new start of housebuilding, etc., every few years, which was destructive of a steadily growing material culture such as that attained in regions of permanent cultivation. (See II, p. 461.)

Nieuwenhuis had an opportunity to observe primitive agriculture among the coastal Malay of Borneo as well as among the Dayak of the interior. Among the Malays of the Sultanate of Sambas and Matan, he observed (see II, p. 491) the clearing, burning and planting new fields. After the burning of the felled forest he said that there was no preparation whatever of the soil for rice. The seed was sown in holes prepared by jabbing the ash-covered surface with a sharp-pointed planting stick. For planting sugar-cane, however, little hills were thrown up. New fields was cleared after two years, and left in bush fallow five or six years.

Nuñez Cabeça de Vaca, Alvar The Narrative of . . . translated by Buckingham Smith. Washington: [privately published] 1851.

According to Buckingham Smith's translation of the "Naufregio" of Nuñez Cabeza de Vaca the Indians of Florida killed deer by surrounding them with fires. Likewise he tells of burning the grazing lands of "cattle" so as to drive them to graze where they wished them to go. The "cattle" must have been bison. He said that he saw them three times and had eaten their meat, that they had short horns like the cattle of Morocco with the hair very long and floccy. The translator suggests that his author generalized from subsequent experience in reporting that they came as far as Florida "from the north, and ranged over a plain of four hundred leagues, where the people lived upon them and scatter a vast many skins throughout the country."

Oliver, S. P. (1863) Madagascar and the Malagasy. With Sketches in the Provinces of Tamatave, Betanimena, and Ankova. London: Day and Son. n. d. [1863?]

Lieut. Oliver, a member of the British delegation to the coronation of Radama II, in 1861, described the vegetation of the route from Tamatave to Antananarivo, the capital. Extracts from his diary (1863?) follow:

(p. 13) "On leaving Tamatave we travelled along the coast in a south west half west direction. Our course lay over a flat plain, the soil sandy, but covered with grass, there being a great quantity of dark vegetable matter mixed with the sand. . . After travelling two or three miles . . . the country became more wooded and park-like; short crisp turf made the plain like an English lawn, and on each side of the road, about half a mile off, were very good groups and topes of timber. . . The ground within that distance had been cleared on account of the numerous herds of cattle that came from the interior for sale at Tamatave."

(p. 16) "After leaving Trano Maro, . . . the trees look more healthy and there is an absence of those blanched, gaunt, dead trunks of trees which are so remarkable a feature of the country between Trano Maro and Hivondro River. The white ants seem to be responsible for this; all along the coast multitudes of their nests are to be seen up in the trees, the sides of which are covered with their tracks; the trees themselves are very soon destroyed by them. . . The thickets became closer, but the path still continued as broad as an English highway and covered with beautiful turf. . . Turning out of the forest at Tanyfotsy, and crossing a small stream we came once more upon the seashore."

Travelling along parallel to the shore the next day and passed through "woods" along Erangy lake until at Takalampona they took to the sea-shore, going south, with "groves" on the right. Now, he wrote, (p. 19) "The line of sand-bank between the sea and lake became gradually narrower and lower, and presently disappeared altogether, so that we were . . . forced to cross at a ferry."

On the other side was a village, and then "a lovely grassy glade surrounded by an amphitheatre of lofty timber. Here they plunged into a narrow-path through dense forest where there were lemurs. At their stopping place for the night they met a young botanist named Magee, collecting orchids and ferns for Messrs. Veitch in England.

The interesting point of this journey along the sea is the substantial information that in this stretch there was still original forest along the sea. The next day, still following the coast, Oliver made no notes on the wild vegetation and the party reached Andevorante, described by other and later writers. This was 60 miles south of Tamatave, and the place from which they

turned inland, travelling up-river by boat. Oliver and Meller "a first-rate botanist" were in the same boat and they paddled slowly, "stopping every minute for fresh specimens."

Soon taking to land travel by palanquin ("filanzan"--the Malagasy word is a cognate of the Persian) they saw no more trees of filao (Casuarina equisetifolia) which had been common along the coast. Between the "downs", bare of vegetation were swamps and marshes where the streams were full of fallen decayed trunks of rofia (raphia palm), ravenale (the famous travellers' palm), etc. The next three days of travel were notable for ethnological instead of botanical observations, and brought them to Beforona. The day after leaving there they found themselves "engulphed in a vast forest where the bearers attracted lemurs by imitating their cries.

(p. 30) "Besides innumerable large timber trees, their vast limbs covered with litmus, lichens, orchids, creeping ferns, and parasites, palms of numerous varieties shot up to a tremendous height. . . . Here, in a humid atmosphere and under a tropical sun, the spontaneous growth and decay of vegetation has proceeded without interruption for centuries, presenting scenes unsurpassed in the world. The next day; "The trees were, if anything, larger even than yesterday." Towards evening "the thick forest trees became less and less, the clearings more numerous; and at last, after a slight ascent, we saw a wide, open, prairie country before us." This was the cultivated valley of the River Mangoro.

(p. 40) Ascending the other side of the valley they found themselves in the second belt of forest, where they crossed the watershed and the precipitous valley of the Mandraka river, which flows to the west. Then, ascending for the last time, they "came into open country, undulating, with bare downs, and were now in the country of the Hovas." From the first village, Ankerá Madinika, the country was "an assemblage of bare and barren downs, with hardly a tree or trace of natural vegetation. . . . but now and then the eye is surprised and refreshed by the rich bright green of the rice-fields in the valleys below. . . . and every available inch of ground is subject to cultivation of the best description. . . . Cultivation increased as we drew near to the capital. The sides of the hills were diversified by large patches of burnt grass, which is periodically set on fire. . . . The idea is to promote the growth of fresh young grass for their cattle by destroying the old dry grass before the rains set in.

Parker, H. (1910) Village Folk-tales of Ceylon. 3 vols. London: Luzac and Co. vii + 396; viii + 466; viii + 479 pp.

H. Parker, a former irrigation officer in Ceylon, gives a vivid picture of primitive shifting cultivation in that country, where the clearings are called chēna. His own observations are in the Introduction to his "Village Folk-tales of Ceylon" (1910) and are supported by numerous references to chēna cultivation in the stories themselves. First we may quote Parker himself (vol. 1, pp. 1-4):

"When the forest and jungle of north-central or north-western Ceylon is viewed from the upper part of a hill of considerable height, it has the appearance of a dark green sea, across which, if there be any wind, waves closely resembling those of the ocean roll along in parallel lines as the swaying tree tops bend under the gusts of the breeze. . . No houses are to be seen nor sounds heard, and the visible country appears to be an uninhabited silent wilderness of vegetation. .

"We leave the dusty main roads and follow a winding village path. . . not such a path as was constantly encountered thirty or more years ago, on which the overhanging thorny bushes often made it necessary to bend low or run the risk of having one's clothes torn, but a track flanked with grass, having the bushes completely cleared away for a width of twelve feet. . . Shut out from the cooling breath of the wind we have on each side only closely interlaced jungle, a tangled growth, consisting chiefly of leafy thorns and creepers from ten to fifteen feet high, interspersed at varying intervals with a few large trees. This is the wild growth that has sprung up on the sites of abandoned chēnas or jungle clearings, and will be cut down again for them from five to seven years afterwards.

"An occasional recent example of such a clearing may be passed, having a few large surviving scorched trees and several smaller ones, interspersed among the growing crop of green millet. . .

"In such clearings are cultivated chiefly millet of different sorts, or edible grasses, sesame, and a small pulse called mun; while in the richer soil around some scattered conical brown anthills are planted maize, pumpkins, or red chillies, and a few small cucumbers called kaekiri. . . .

"Then, if one be lucky, comes a tract of the original forest that has escaped the chēna clearer's destructive bill-hook and fires. . . This is the home of the Elephant. . . . Another patch of the chēna jungle succeeds the forest, and then the patch reaches one end of the embankment of a village tank or reservoir, a shallow sheet of water varying in size from two or three acres to more than a hundred. . . Here all is peace: an uneventful calm has survived the changes of perhaps two thousand years, and that may be unaltered in another two

thousand. One may wonder if the fevered life of the present western civilization will last as long, or will have burnt itself out, and been swept away like that of the dead civilizations that preceded it."

Parker describes the temporary shack erected for the watchers of the chēna, the permanent village near the tank with its perennially used wet rice fields, buffalo paddocks, and permanent gardens or plantings of useful trees. The village had advanced to a higher agricultural level than shifting agriculture but retained the chēna system as well, which, as Parker describes it, is not merely nomadic, but a regular system of cropping for a short period, followed by a long fallow with young secondary forest or brush.

Following the clearing and planting of a forest or jungle clearing, Parker says:

(pp. 17-19, vol. 1) "It is a holiday season for the villages, during which they can devote themselves to the congenial occupation of contemplating the growth of the rice and the millet crop; but it was preceded by much hard work in the rice field and the chēna. The felling of the thorny jungle at the chēna, the lopping and burning of the bushes, the clearing and hoeing of the ground, and the construction of the surrounding fence, were carried on continuously under a scorching sun from morning to night, until the work was completed shortly before the first light showers enabled the seed to be sown, after a further clearing of the weeds that had sprung up over the ground. . . .

"When the chēna crop is ripe, the wives of the owners collect a number of friends and relatives, and proceed with them to the place, each carrying a light sack or two, and a diminutive sickle. With this they cut off the heads of millet, storing them in the sacks; the straw is left as useless. . . . This work is looked upon as recreation and is carried on amid a large amount of chatter and banter and the singing of songs by first one and then another, each verse being repeated by the whole party.

"At noon and in the evening the bags full of millet are carried to the houses of the owners of the crop. Meals are provided for the whole party by them and no payment is made for the work."

The custom of living at the chēna only temporarily, otherwise at the permanent village, is indicated by a story of two friends who spent their time in the village, but realized that it was improper not to be at work. So they resolved to cut a chēna.

"Having spoken thus, the two persons went to the chēna jungle, and there being no watch-hut there, built one; and taking supplies week by week, began to chop down the bushes. . . .

Having chopped down the jungle, and burnt it, and sown the chēna, the millet plants grew to a large size."

The story was that the watch house burned down, one of the men died in the fire, and the other ran away for fear of being accused of having killed his companion.

Another story (vol. II, p. 109) is about a suit occasioned by sparks from a burning chēna igniting a load of oily rags on a horse's back, and burning the horse to death, but only after the horse had dashed into a citronella garden and burned it up.

Patullo, M. L. (1942) The Communal Forest Area Scheme. Farm and Forest or Land Use and Rural Planning in West Africa. Vol. III, no. 3, pp. 112-116. August 1942.

The Nigerian native is basically opposed to conservation of natural resources and to establishment of forest reserves. M. L. Patullo wrote:

"Such reserves restrict his farming and hunting and the collection of firewood and other forest produce. Altogether he thinks the establishment of forest reserves a pretty poor idea. If he is a northerner and not accustomed to argue with those in authority he will probably conclude that it is the will of Allah and make the best of it. In other parts . . . he will very probably succeed in having the proposed reserve shelved indefinitely while he continues to cut down the best of the forest to make new farms. Impassioned harangues about his duty to posterity fall on deaf ears as he is much more interested in his own comfort and prosperity than in that of generations yet unborn. . . Moreover, the very word 'reserve' stinks in the nostrils of large sections of the population."

In spite of this attitude toward the ordinary type of forest reserves, it has been possible to argue the natives into establishing little village reserves, especially in areas where there is great deficiency of firewood. By the end of 1940, one hundred and seven village reserve areas had been established with a total area of about 84 square miles, distributed through seven of the twelve northern provinces.

In the southern provinces the idea of communal forests can be extended to cover the idea of saving as nuclei the vestiges of high forest that still exist outside the forest zone proper. Otherwise these will soon disappear.

Pendleton, Robert L. (1933) Cogonals and Reforestation with Leucaena glauca. Lingnam Sci. Journ. Vol. 12, no. 4. pp. 555-560, pl. 34-41. Octo. 1933.

Pendleton pointed out that the artificial grass lands of the Philippines, the cogonales, so named from cogon, the name in Tagalog and other languages of grasses or the genus Imperata, result from the type of forest clearing for primitive agriculture that has been followed so long and so widely that much of the land of the Philippines has been unproductive except for limited grazing. "Kaingin" agriculture, to use the Tagalog term, is the system, according to Pendleton, that must have devastated the barren hills of southwestern Kwangtung Province, the only Chinese Province that is strictly tropical, although other parts are nearly so and similar in present flora. The devastation of South China, Pendleton surmises, followed a period during which the modern desolate grassy mountains had been used for annual crops or more probably for Cunninghamia forest. The successful regeneration of such lands in the Philippines by broadcasting seed of Leucaena glauca (ipil-ipil) in the cogon indicates that the same procedure might be successful in the tropical parts of China.

Perez, Angel (1902) Igorrotes. Estudio geográfico y etnográfico sobre algunos Distritos del Norte de Luzon. Contiene, además, la Obra, copias de las Memorias inéditas sobre los Igorrotes de Ilocos Norte, Benguet y parte central, y la estadística general de los infieles. Por el R. P. Fr. Angel Perez de la Orden de S. Agustín. Con un prólogo de D. José Ma. Romero Salas. Tomo Primero. Manila: Imp. de "El Mercantil". 1902 [Jan. 1903] xxvi + 420 pp., 7 pl.

The excessively rare book of Padre Angel Perez is remarkable in many respects but it is significant in the present connection that he was one of the few missionary geographers who recognized that the grass plains (cogonales) were an artificial plant association. He said (p. 111) that at ranchería Ululin (a non-Christian settlement on the left side of the Abra River eight kilometers from Cervantes, Ilocos Sur.) there was unforested grass land with the place names "montes del Dalican" and "lomas de Cayus". Perez asked if the former name was reminiscent of the many fires that had no doubt denuded the hills. Dalican, he said, signified the portable stove of the Filipinos, or a cooking place in general, and "Cayus" he held to be (a Spanish plural) from the usual word for tree (cayo; General Malayan kayu; the use of the Spanish plural is understandable). He pointed out that in certain places there were remnants of the ancient forest vegetation, from which it was easy to deduce that the region had formerly been forest. The reduction of the trees to ashes had suggested the place name Dalican.

"Hills of Trees" (Lomas de Cayus) may be supposed to have been once an appropriate name, and to have remained after the destruction of the forest. It is from Perez that we learn of the pagan sacred groves that in his time still existed in Ilocos Sur. At Besao, about 29 or 30 km. northwest of Cervantes, Perez tells us that there was a twin-peaked steep hill, at a distance of only 800 meters from the quarters of the Civil Guard, that invited a visit because of the capricious form and symmetry. So in October 1889 he determined to go, being ignorant of the local significance of the two high summits. He was accompanied by four Igorrotes to clear a trail and the captain of the guard. (It turned out that there was a regular path by which they might have ascended, but the guides were reluctant to go and unwilling to show it). After a difficult climb they arrived at the summit and saw the sacred gateway at the end of the regular path. There were fire-places, which led them to believe that they had reached the dwelling place of the local gods. The symmetrically placed stones, the ashes and charred fire-brands indicated altars. So they asked the Igorrotes what it all meant, but were told that the guides did not know the latter, "being ashamed to confess their ridiculous religion or fearing that we would laugh at them."

They descended easily by the beaten trail. The Captain, determined to make the Igorrotes confess that the hill was sacred to their gods, said that he was going to burn it over by setting fire to the thicket at the base of the sharp ascent. The guides implored him not to do so, out of consideration for their livelihood, for the fire might spread and destroy the settlement. Since their argument did not convince him, the captain set the fire and they moved to a distance from which they could watch the immense blaze. At once, as though from nowhere, the whole population, men and women, swarmed up with chopping knives to cut down and clear away the brush in the path of the fire, and then, with green branches beat out the flames before they reached the hill tops. The Padre said that nothing would have stopped the conflagration from reaching the sacrificial places if it had only been January (the dry season), instead of October! The "savages" were much annoyed, but were placated by spirituous if not spiritual ministrations.

One wonders if Dalican may not once have been a sacred fire-place, and therefore a grove which remained such after surrounding land was cleared. This interpretation of the significance of the place name would lead to the same conclusion that Perez reached, about the region having been formerly forested.

Perrier de la Bathie, H. (1917) Au sujet des tourbières de Marotampona. Bull. de l'Acad. Malgache. Nouv. Ser. Vol. I, 1914, pp. 137-138. Tananarive: Imprimerie Officielle.

Perrier de la Bathie (1917) was the first to have clear ideas about the relatively recent destruction of forest vegetation over much of Madagascar. He reported at a session of the Académie Malgache in 1914 on an alluvial deposit of plant debris which had been found in a swampy depression traversed by the Andrantsay river near Marotampona, on the way from Betafo to Antsirabe. These two places, close together at about 44° 45' E. and 19° 45' S., - southwest of Antananarivo, are as nearly as possible at the center of the largest area which a map of Gallieni (1908, Pl. 58) showed to be completely denuded, and there was no place nearer than 100 kilometers where the ten identified central forest species were still living or might be. The deposit actually contained many more species of the same ecological affinity, with bones of the extinct gigantic bird *Aepyornis* and also *Hippopotamus*. The plant debris was very abundant and fairly well preserved, but had been deposited after water transport. Perrier de la Bathie concluded that at the time of deposition the upper basin of the Andrantsay was still forested, that the forest flora resembled that which was then found 70 kilometers east of Antsirabe, that the subfossil bones appeared in the deposits at the same level with charcoal, which indicated the advent of man, the destruction of the forest - and a now extinct fauna were contemporaneous, and that the date could not have been less than three centuries before. It would be a matter of great botanical and zoological interest to collect material anew from the deposit for actual dating by the carbon-14 method.

Perrier de la Bathie, H. (1927) Le Tsaratanana, l'Ankaratra et l'Andringitra. Mém. de l'Acad. Malgache, Fasc. III. Tananarive: G. Pitot et Cie., 71 pp. (Appendice II. Historique de la destruction de la végétation de la cime de Tsaratanana et ses conséquences, pp. 26-28.)

The ideas of Perrier de la Bathie (1927) on the recent extinction of much of the old flora of Madagascar were partly developed through observations that he made on three isolated mountains of the central region in 1912. These, the chief elevations of Madagascar, were Tsaratanana in the north, Ankaratra at the middle, and Andringitra in the south. Each was remarkable for having endemics that were completely localized as well as others with a wider but remarkably disjunct distribution.

Viewed from the north or east the most remarkable thing about Mt. Tsaritanana would be the advanced state of denudation, for forest existed only in the ravines. From the south, however,

seen from the plateau of Mrangaka, the upper region was an enormous forested mass with three peaks, the central being the highest, and the whole, with its spongy coating of vegetation, a marvellous regulator of humidity, and the source of many streams. Below 1000 m., burned over and denuded, the lower aspect was in violent contrast with the upper.

The vegetation even of the summit is far from being undisturbed by man. At the base the repeated grass fires of the natives had gradually eroded the edge of the forest, but it was there damp enough to protect the upper slopes, where the vegetation was of a more combustible nature,— Perrier de la Bathie says as easily ignited as a torch. The natives, however, never went near it, at least with fire, and it remained for the first French visitors to burn off the north-east slope. In 1899 the protective belt still extended all around the mountain. Captains Meunier and Rodez then attempted the ascent, but were turned back by wind and rain. On the return their "porters" (Why the porters?) are supposed to have started the fire that swept all the way to the summit. In the following year Captain Violland saw and photographed the carbonized vestiges of the fire near the summit, with young brush and grasses of the sort that follow fire. M. Lemoine later Professor of Geology at "the Museum" made three ascents during the dry season in 1903 and started numerous fires because he enjoyed the spectacle. Lemoine's lyric description of the fires is quoted by Perrier de la Bathie from the "Journal officiel" of 20 April 1904. (Alas, that such a fool should not have been incinerated in one of his own fires!) He wrote that all the region was illuminated by a magnificent intentional fire ("feu d'artifice") forming an unforgettable spectacle. All three of his expeditions were toward the northeast, now the most denuded peak.

When Perrier de la Bathie made his ascent in 1912, with every precaution against the calamities caused by his predecessors, he found that Lemoine had destroyed almost all the virgin vegetation of the main central peak and the eastern peak, and that the fire had descended on the north slope to about 2400 m. elevation. At about 2600 m., however, he was able to find a few rare vestiges of the ancient silva amid the carbonized trunks which had miraculously escaped destruction. The western slopes were then intact.

Lack of supplies made it necessary for him to defer exploration of the west flank until later. Then the war and other circumstances prevented him from renewing his explorations, this time from the west, an approach which would have enabled him in 1912, to study to continuous virgin vegetation from 1000 m. altitude to the summit. He spent two months (Dec. 1922 to Feb. 1923) on the lower slopes and was then forced to discontinue. Resuming in April and May, 1924, he had the bitter

disappointment, when he reached an elevation of 2200 m., to find that all the vegetation from there to the summit had been burned off several years before. Moreover, the little vestiges on the southeast, which he had located in 1912, had been burned, as well as all of the forest on the west and northwest. It was learned that this vandalism had been caused by the "porters" (!!) of an engineer, M. de Girancourt, six or seven years ago.

Perrier de la Bathie concluded that the survival until our time of the virgin vegetation of Tsaratanana proved, contrary to what some wished to believe, that in a state of nature, lightning did not start the brush and grass fires. In thirty years of sojourn in Madagascar he had known of one fire caused by lightning. When they occurred it was at the season when the winds would not spread the fire and the young growth was least combustible. For Madagascar to have been devastated as it has been, one must look to an incessantly recurring cause, which is the travelling native with torch in hand, as one sees him all the time in plains and mountains. (He might have added, "travelling foreigners.") To botanists the evidence is indisputable that the Madagascar prairie is recent and of human origin.

As for the Ankaratra massif which rises in the middle of the central plateau, it was already despoiled in the time of Perrier de la Bathie, but he was able to find a record that prior to 1777 it was still wooded. (He refers to the voyage of V. Mayeur (1777, p. 25). He mentions the smooth and rounded relief of this mountain mass, the lack of ravines which might have served as refuges where bits of the flora would escape conflagration, and the location in the midst of a dense population inveterately addicted to burning over the country every dry season. Almost nothing remained to be discovered of what must have been a rich autochthonous vegetation with as large a proportion of distinctive species as Tsaratanana.

About the same had to be recorded of Mt. Andringitra in the south. Despite deep sculpturing and traversed by crevasses, fire had long since found its way everywhere and the vegetation of the summit had hardly anything but the common grasses. The progress could be followed from the centers of human occupation, from which pure prairie extended farthest into savoka, the native name for a dense growth of *Philippia* thicket. The immediate vegetation to follow destruction of virgin montane vegetation is savoka, and savoka loses ground every dry season from the grass fires that rage upward from the lower slopes.

Phillips, John (1930a) Some important vegetation communities in the Central Province of Tanganyika Territory (formerly German East Africa). A preliminary account. Journ. Ecology, Vol. XVIII, No. 2, pp. 193-234. August 1930.

John Phillips supplemented his own observations on the ecology of Tanganyika by a review of the German literature on this former German colony, with references which included several publications that have not been available to the present reviewer. He concluded that there are in the Central Province only two plant formations (as defined by Clements) namely, the deciduous scrub (locally called mchaka), and the subtropical evergreen forest. The present grasslands or mbuga, he viewed as successional and not climax vegetation. These mbuga areas are of course viewed as having been created by man's activities. They are "periodically moist alluvial sunklands", and seem at first sight to be a third great plant formation. In view of the difficulty in finding credible evidence that lightning sets prairie fires and thus maintains such areas as grassland, the conclusions of Richardson regarding Florida (1955) should be considered as having a possible bearing on the following statement (p. 200):

"As lightning is often suggested as the cause of extensive fires within the vegetation communities, it is of interest to record that German data taken over a number of years show that while there are frequent occurrences of forked lightning during the moist season when vegetation is kindled with difficulty, there are very few occurrences during the dry."

Of course Phillips **recognizes the existence of small** pioneer grasslands of temporary status on new alluvial deposits, but these pass into a shrub or shrub and tree stage which is still grassy, and then, he says:

(p. 204) "Owing to annual or biennial fires the aerial portions of the grass are destroyed, the shrubs and trees mentioned being deprived of their younger wood, burned back to their rootstocks, and even killed. Provided these shrubs and trees during their earlier years escape the fires, they can withstand severe conflagrations at later stages. They often assume a stunted orchard-tree habit (Zwetchenbaumtypus: Busse, 1908) produced by the killing of the apical buds and the consequent development of the laterals.

Without reviewing the details of succession in different sorts of cleared areas, one may pass to what Phillips says of grazed or cleared areas in general (p. 229, 230):

"Within the Central Province it is estimated that there are today about 30,000 square kilometers of country deprived on a grand scale of their original vegetation, besides thousands of square kilometers made up by small clearings."

Dealing with the up-and-down-hill cultivating which the natives do instead of following the contours, and the excessive grazing, destructive erosion is taking place at a truly alarming rate. As for fire:

(p. 231) "There are few portions of the Central Province, other than that covered by climax Deciduous Scrub, the Grewia-Prosopis Scrub, Subtropical Evergreen Scrub and Forest, that are not fired annually either intentionally or by accident. As in other regions of Africa, fire has become one of the most important features of the year as regards both plant and animal life. . . . It may be permissible to list a few of the more important results wrought by fire: (a) Destruction of aerial portions of the ground flora together with leaf-litter cast by trees and shrubs; this prevents the production of organic matter in the soil. (b) Frequent destruction of regeneration of tree and shrub species, or frequent burning-back of the aerial parts of sapling-stage regeneration. (c) Stimulation of the superficial roots of trees and shrubs, resulting in the production of abundant root suckers. (d) Frequently inhibition of the better, more nutritious, less xerophytic grasses, with concomitant favouring of the more xerophytic, less nutritious species: (e) According to species, gradual destruction of trees and shrubs, with ultimate production of open grassland where formerly existed woodland. In the opinion of Busse (1908), Gradmann (1916, p. 503), Jaeger (1911, p. 53) and Obst (1923, pp. 177, 186) much of the open grassland simulating a climax community must have been produced in this way. (f) The production of stunted, orchard-like shrubs and trees. . . . (g) Destruction of Forest, with consequent increase in the extent of Open Woodland or Woodland. (h) Exodus of certain game during the fire and for a short period thereafter.

"The subject of control of fire and its rational use has such direct bearing upon the whole economy of Tropical and Sub-tropical Africa that the attention it demands should be procrastinated no longer."

Phillips, John F. V. (1930b) Fire: its influence on biotic communities and physical factors in South and East Africa. South African Journal of Science, Vol. XXVII, No. pp. 352-367. Johannesburg, Nov. 1930.

The ecologist Phillips (1930) when he wrote in charge of research on tsetse and sleeping-sickness in Tanganyika, felt that in spite of much publicity about the evils attending the burning over of land in Africa, there had been too little scientific experimentation that had direct bearing on the many problems, and that it would be useful to review some of the more interesting publications on the subject. As might be expected

because of his close concern with the tsetse problem he may have had a natural and pardonable bias in favor of open land for he said:

(p. 364) "I have already touched upon the seeming utility of controlled firing in the Tsetse-fly problem, the degree of utility depending upon climatic, soil, and vegetational conditions. I feel it desirable to urge the need of our carefully considering all regional circumstances in the light of scientific experience, before we definitely decry the practice of firing. Possibly I may be criticized for this statement, but in making it I consider I have but done my duty. Controlled firing is a useful and oftentimes necessary agent in veld management and in Tsetse-fly control."

Phillips wrote:

(p. 364) "Volkens (1897:266), Wissman (1888) and Reichard, who travelled in East Africa, considered that fire did little harm: Reichard (p. 46) went so far as to say it was one of the benefits of the year. Sweinfurth (1874), Pechuel-Loesche (1887), Bornhart (1900) and almost all South African writers find no merit whatever in the firing of vegetation. The Drought Investigation Commission (1926) for example, "unequivocally states that veld burning is contrary to the interests of the country as well as the principles of all veld and soil conservation. . . ."

On the other hand, Busse (1908), Bews (1918; 1929:347) and Staples (1926) realize that controlled firing of grassland has its useful features. With this view I am in cordial agreement. . . Thus, in regions where the development is toward either scrub or forest, valuable grazing would be lost were firing withheld completely. . . ."

✓ (p. 363) "In the Savannas of East Africa the proportion of direct sunlight is much decreased during the months May to October, for during these months the skies are for appreciable periods overcast by dim palls of smoke from the great fires that sweep the country from end to end. . . Brown (1887) records a fire in the Southwestern Cape that caused a smoke pall, 120 miles long by 7 to 8 miles wide, to hang over the country for some days."

(p. 352) "According to Busse (1908) extensive firing of vegetation took place in East and Central Africa during the times of Hanno the Carthaginian. Sim (1907:43) in an interesting chapter on forest destruction records that Vasco Da Gama, in 1497, on account of the smoke pall discernible from the sea, called the 'Cape Terra de fume'. It appears that firing was practised by the Hottentots, for Kolbe (1727) states that it was from these that the Europeans learned. At all events the various Placaats . . . of the Dutch East India Company at the Cape

threatened punishment to those who fired grass. The last . . . Placaat went so far as to prescribe scourging for the first offense and death as the penalty for the second. The Forest and Herbage Act of 1859 of the Cape of Good Hope laid down relatively heavy penalties, for example, a fine not exceeding 100, or imprisonment. . . ."

(p. 355) "Busse (1908), Jaeger (1911) and Obst (1923) believe that much of the open grassland of East Africa, simulating a climax community, has been produced by fire, a view to which Bews (1927:111) appears to subscribe. Henkel (1928:41) describes the persistent killing of young woody growth in "savannah forest" by fires. . . Busse (1908), Siebenlist (1914) and others tell of extensive [forest] depletion in former German East Africa. . . Hutchins (1909) and Troup (1922) record . . . the heavy toll taken by fire in Kenya Colony. . .

"My own views, based on the study of soil profiles, the identification of charred . . . wood . . . from the soil and . . . observation of the existing vegetation, are that fire has . . . enormously reduced the area of climax forest and very greatly reduced that of the higher successional stages. . . ."

(p. 357) "Manuscript reports by C. Harison in the Records of the Forest Dept., S. Africa, quoted by J.F.V. Phillips (p. 359) state that the great fire of February, 1869, which devastated thousands of acres of forest between George and Humansdorp is said to have covered a total length of 400 miles and a width ranging from 15 to 150 miles. . ." There are some interesting references to the killing of elephant and buffalo, bushbuck and other animals in the George-Humansdorp region during the great fire of February, 1869."

(p. 361) Phillips (1930) referred to his earlier findings vaguely, but seems to have found that the difference between day and night temperatures at the surface of the soil might be twice as great on burned as on unburned grassland. The difference was ascribed to the greater absorption of heat by the black surface.

Phillips, John (1931) The biotic community. Journ. Ecol., Vol. XIX, No. 1, pp. 1-24. Feb. 1931.

Phillips, referring to the Knysna forest of South Africa wrote:

(p. 13) "Europeans have drawn upon the timbers of the forests since 1812, and for many years in a selective manner, the result being that today the proportion of semi-mature, mature, and over-mature individuals of certain valuable timber species

to that of less-required or useless species is much smaller than formerly. Furthermore, through reckless felling and firing in the earlier days, man has not only diminished the actual extent of the forests but produced marked changes within them. He has set train to innumerable examples of secondary successions - successions in which there are not only marked changes in the plant stages but also "in the animals."

He points out that to a large extent the large native herbivorous animals had been replaced by domestic cattle. Only one small herd of elephants remained where the country had formerly supported many thousands of these animals, and the formerly abundant buffalo had been exterminated completely. The Knysna forest was of the evergreen subtemperate-subtropical type and extralimital from our restricted geographical standpoint. Phillips also discussed the Tanganyika forest of East tropical Africa, much less modified from primitive conditions. Here also man is one of the more profoundly effective ecological determinants, as indicated by the following quotation:

(p. 16) "Man through the ages has played a mighty part, not so much through the practices of agriculture . . . but through the agency of the annual grass fires. Indeed these universal fires have become a definite feature of the dry season; apart from their checking influences upon the young of animals, they have succeeded in holding in check certain stages of the successions - thus the *Berlinia-Brachystegia* Woodlands of the Central Plateau, undoubtedly are inhibited from developing to the scrub climax by the annual or biennial fires."

Phillips with his colleagues Nash and Jackson were largely occupied with a study of tripanosomiasis in man and beast, carried by the tsetse fly. They therefore studied the habitat distribution, breeding, and flight habits of tsetse and were able to establish two chief correlations: (1) that animal concentration around water in the dry season greatly increases tsetse population, i. e., forms "fly centers", and (2) that flies, especially females, emerge from closed types of vegetation to open glades chiefly to feed. They therefore concluded:

(p. 18) "From these two instances of correlation between game and fly, we see that the keynote is in reality the vegetation type; vegetation type presents particular features favourable or the reverse to game, and the fly associates itself with the vegetation type and thus with the game. . .

"Man comes into the biotic community at times: for example, he is driven by advancing human or cattle trypanosomiasis from his villages, with the result that vegetation rapidly develops upon his gardens and grazing areas, game advances, and with it the fly. On the other hand, he may be living within a vegetation-cleared area sufficiently large

to inhibit the advance of fly, but may be prevented from grazing his increasing stock in the adjacent woodland, on account of the presence therein of tsetse. The outcome is overgrazing with concomitant sheet and gulley erosion, a process that sets train to new stages in plant and animal successions. Finally he may remove vegetation, drive out the game, and thus upset the equilibria for the existence of tsetse. . . .

"In the biotic community I should include not only the higher plants and all forms of animal life - including man himself - but would also give place to those apparently insignificant but in reality influential organisms, the cryptogams. My inclusion of man doubtless will call for much criticism - so to anticipate such I would remind you that despite the ability of man to upset . . . the development of a community, it is more than he can do to alter fundamentally the trend of these. . . ."

Pierre, Gilbert (1897) De Soanirana a Antenina. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. II no. 8, pp. 128-136, map. Tananarive (Imprimerie Officielle) Aug. 1897.

G. Pierre (1897) gave an excellent account, illustrated by a map which did not, however, show forest boundaries, of the east coast region of Madagascar northward from about 17° 40' S. (the region of Lake Alaotra) to about 15° 40' S. His notes therefore supplement and extend those of Baron and others.

Pierre's native bearers did not wish to take him where he wanted to go, and seem to have conspired to wear him out by useless zig-zag travel, but his notes were on that account perhaps all the more valuable. At the village of Ambavala they entered a wet forest in which the sun's rays never reached the patch. The whole region traversed was absolutely mountainous and swampy. Forest was widespread and reached to the coast, but the natives destroyed a great deal of it each year for rice planting. The vicinity of Antenina was completely and densely forested. The chief cultivation of varied crops was near the coast. Clearings in the more dense forest inland had only rice and sugar cane.

Pierre considered that the Grande Forest began at Ambodirafia, where there were extended swamp forests of the rafia palm. Then came the dense upland forest. The lowland swamps were in general too deep for wet rice cultivation.

Pillans, N. S. Destruction of indigenous vegetation by burning on the Cape Peninsula. South African Journ. Sci. XXI, pp. 348-350. Johannesburg, 1924.

Pillans (1924) read a paper at the South African symposium on veld burning in which he repeated, with application to a different area, many of the same things that Marloth had said. Quotations follow:

"Farmers usually instruct their herders to start fires as soon as the plants will burn. These employees, . . . take every opportunity of destroying the vegetation. So it is that day after day . . . fires may be seen gradually devastating large areas, even entire mountains. . . On the Cape Peninsula, the acreage of tall shrub-formation and forest has been greatly reduced by the ravages of fires. Formerly every ravine was clothed with one or other of these formations, and most mountain streams were bordered with belts of shrubs or trees. At present most streams, when they do flow, take their course between bare or but sparsely covered banks where the charred stumps of trees are continually being reduced . . . by . . . fires. . . ."

Pillans concludes:

"On privately owned lands there cannot be expected a change from the present habit of indiscriminate firing. . . The lead in preserving the veld from fires should be taken by those bodies who administer public lands. . . "

Pittier, H. Consideraciones acerca de la Destrucion de los Bosques e Incendio de las Sabanas. Boletin de la Sociedad Venezolana de Ciencias Naturales. Vol. III, no. 26, pp. 291-302. Caracas, 1936.

Pittier (1936) who was one of the keenest of observers and widely experienced in tropical America, wrote that he had nowhere seen so deplorable a state of destruction of forest and sterilization of the soil as in the central valleys of Venezuela. The vandalism of axe and fire was proceeding so rapidly that unless there was imposition of controls he could predict that in a few generations the entire country would be an unproductive semidesert.

The chief contributing causes were (1) the agricultural system called "conuco", one of the worst inheritances from the aborigines, (2) the annual burning of the savanas, and (3) the freely ranging goats.

The "conuco" system is the same as the "milpa" system of Mexico and Central America - cutting and burning originally for

the temporary subsistence fields of the Indians, and extended later for the large-scale sugar-cane plantations of Europeans, followed in later time by great clearings for bananas and coffee. In addition to the burning of irreplaceable forest resources, the superficial humus has been burned, the exposed soil has been carried away by erosion, lakes and waterways have been silted up, the land has been gullied, and dangerous intermittent torrential runoff follows rains.

The burning of the savanas is a custom that has the sanction of long-standing, and is justified by herders on the ground that it improves pasturage and kills the young of the ticks, - the garrapatas, which are a veritable plague. Pittier pointed out that the tick nuisance was actually increased by the fires.

The freely ranging goats render reforestation of devastated forest impossible. The goats were defended by some as the poor man's cattle, but Pittier stated vigorously that they were one of the greatest of evils and enemies of mankind. He pointed out the sad aspect of the valley of Tacagua where goats had ranged freely since 1840. Up to then it is known to have been as beautifully forested as the present valley of Ocumare of la Costa, with gigantic cedros, mahagonis and other tropical trees. There were then perennial streams of clear water. Now, subject to torrential floods, but with the stream-beds usually dry, the deteriorated wastes are over-run by goats, preventing all recovery. Pittier also demanded control of the charcoal burners. We learn from a footnote to his vigorous paper that regulations designed to conserve the forests were immediately put into effect.

Pöch, Rudolf. Wanderungen im Gebiete der Kai (Deutsch-Neuguinea). Mitteilungen aus den Deutschen Schutzgebieten. Vol. XX, pp. 223-231, Taf. XI, Karte XI. Berlin (Ernst Siegfried Mittler u. Sohn, 1907).

Dr. Rudolf Pöch visited the district of the Kai people, inland from Finschhafen, New Guinea, in 1904-1905. He reported (p. 226) the familiar type of shifting agriculture, but the population was not sufficiently dense for great damage to have been done to the forest. Each year a fresh piece of land was used. Taros and yams were most frequently planted, and maize, known by its Malay name jagong was frequent. Bananas were few. Sugar-cane and coconut were not planted, and so the land would quickly have reverted after a single season's use if bamboo had not frequently taken possession of the abandoned field, making an impenetrable growth, so dense as to leave neither room nor light for anything else. The establishment so

commonly seen near the coast of alang-alang grass was not so frequent in the Kai district. The Kai stayed within a certain area but moved their villages about every three years without changing the names of them.

Powell, Wilfred (1883) Wanderings in a Wild Country; or, three years among the Cannibals of New Britain. London: Samson Low, Marston, Searle, and Rivington. viii + 284 pp., illust., map.

In Wilfred Powell's remarkable book on New Britain, an interesting companion work to that of his missionary friend George Brown (the two, helped by friendly natives, carried on a miniature but sanguinary war in New Britain after four teachers of Mr. Brown's missionary had been murdered and eaten) we find some incidental remarks on cultivation. The groves of useful palms, bananas, etc., suggested the practice of horticulture with permanent land occupation rather than shifting cultivation, but the latter, for the growing of root crops, especially taro, existed as well. Powell referred to the extensive grass prairies that occupied much of the country a short distance back from the coast. He described active volcanic action from scores of crowded craters almost at sea level, which would have destroyed much vegetation and opened the country for grass, but still woody vegetation would have taken over unless there had been more frequent grass fires than volcanic activity may be supposed to have caused. Powell indicated that fires were started in grassland as a measure of defense against ambush in warfare and as a preliminary to planting yams. The further preparation of the soil for agriculture was undoubtedly by use of the digging sticks mentioned by George Brown and others.

Curiously enough, however, Powell actually describes one implement as primitive as the digging stick which others merely allude to, apparently thinking it too simple to deserve more than mention. That was the special club, shaped somewhat like a paddle, of very heavy, hard wood, that was used in clearing land of brush before chopping knives or hatchets were common enough to be commonly used except as weapons. The natives of New Britain had elaborate war clubs and stone axes, the former made by laboriously shaping and perforating a hard stone and fitting a wooden handle through the hole. For smashing off the branches of small trees and brush, which could be sun-dried and piled as fuel about large trees that were to be killed by fires at the base, heavy, hard outer wood of the coconut palm or of the Areca palm was fashioned into an oar-like shape. A blow from this would easily smash the branches from most quick-growing and brittle plants. Powell wrote:

(p. 187) "In some places the grass had been burnt in patches to make way for yam planting. All my guides were armed with different weapons . . . and one had a kind of sword made from the outside wood of the cocoa-nut or betel-nut palm, and cut with jagged teeth something like a saw, with which they beat back any stray bushes or grass in the track; one man had a club something the shape of a spade without the shoulders. These I saw many of afterwards: they generally have the end of the handle covered with net-work, sometimes stained with different colours; the broad end is concave, with a half-moon shaped ornament on either side. . . ."

[Randolph, Isham Leighton, Marshall O.; and Perkins, Edmund T.] (1914) Florida Everglades. Report of the Florida Everglades Engineering Commission to the Board of Commissioners of the Everglades Drainage District. . . Washington: 63d Congress. Senate. Document No. 379.

This document is of very great interest in connection with what has happened to the Everglades region as a result of drainage and fire. It deals with one matter that has seldom been considered in connection with tropical soils and that is the production by drainage of normally flooded areas of an organic soil of dried muck or peat. This sort of a soil was common in parts of the drained Everglades. It could burn to a very considerable depth if ignited, especially following drouth, and the record of events of the last three decades (see Richardson, 1955) indicates that this has happened. It is a very different thing from the burning of unhumified vegetable debris and superficial humus which takes place when the surface layer of forest soil is burned off, as is done in the preparation of forest clearings for agriculture by fire. The same thing might happen to muck deposits burned over during seasons of unusual drouth, not preceded by any artificial drainage, and might well explain the observations of Baden-Powell in New Guinea, where he remarked on the extraordinary thickness of ash in certain burned-over marsh or swamp areas. Deep burning of muck or peat might also explain the areas of open water sometimes encountered in swamp areas where they do not appear to represent part of an old drainage channel.

The following brief quotations bear upon organic soils: (p.42) "The virgin muck is a coarsely fibrous substance; after cultivation for several seasons it becomes a fine-grained soil of almost unexampled productivity."

(p. 62-63) There is an estimate that drainage to a depth of 2 to 6 ft. would result in vertical shrinkage of the top foot amounting to 7-8 inches "while the remainder of the column down to the water table will shrink not at all."

Appendix F of the Everglades Commission consists of 21 pictures, some showing "glades", i.e., alternate areas of unwooded swamp and water, "saw-grass" area, and tall cabbage palms along the Caloosahatchee R.: also Seminole Indians and a Seminole house.

Richards, Audry I. (1939) Land, Labour and Diet in Northern Rhodesia: an Economic Study of the Bemba Tribe. Published for the International Institute of African Languages and Cultures. London, New York and Toronto: Oxford University Press. xvi+423 pp., 16 pl., 3 charts.

Of the Bemba (also called Babemba) of Northern Rhodesia, A. I. Richards wrote:

(p. 230) "Now the main aim of the Bemba cultivator is to grow as much millet as possible in any one year, and millet gardens are made by cutting off tree-tops and burning their branches. For this reason, when walking through the bush the Bemba are constantly on the watch for many and high trees. To these natives the whole stretch of land is in a sense one unit. It is all "bush" (mpanga) and all potentially cultivateable. The difference between productive and unproductive soil in their eyes, is the presence or absence of trees. . . Trees are the ultimate source of his food-supply."

(pp. 243, 244) "Cultivated land is divided into (a) mpata, or village mounds, a circular band about 300 yards across round the village, (b) ifitemene (sing. icitemene) the millet gardens which are cut in the bush each year, at first near the village and then farther and farther out until they lie sometimes eight or ten miles away. The word icitemene is derived from kutema (to cut down trees) and is applied to a new millet garden in the course of being cleared and prepared for sowing. Hence Government reports now refer to the 'citemene system' to describe the characteristic Bemba method of clearing the bush. However, the garden, after it has been sown, is known as an ubukula (plur. amakula) and in its second and subsequent years of life, when it is planted with other crops, it is called icifwani (plur. ififwami) and continues under this name until the cultivated land reverts to bush. The average size of an ubukula has been calculated to be about one acre, for which a strip of bush about eight acres is usually cleared, but the gardens, though roughly circular have no fixed size or shape."

Although land is plentiful, and ownership disputes rare, Richards indicates that jurisdictional quarrels are not unknown. Thus in giving testimony before a white magistrate in a case of disputed succession, a chief said: "I know he wanted to claim the stool (i.e., office of chieftainship) because he sent men to cut trees on my land."

Richards described cultivation as falling into the three stages of (1) burning brushwood and branches on the chosen site to destroy weeds and fertilize the soil, (2) alternating crops after the millet was harvested, and (3) hilling up the soil into mounds for growing legumes, maize, kaffir corn, cassava, sweet-potatoes, etc. The Bemba consider their system of cultivation as characteristic and superior. Every year two

or three deaths occur from tree cutting accidents. The peculiar method of tree cutting is their pride and delight. It has developed a traditional ritual.

An effort of the Government to prevent cutting of trees resulted in the growing of almost no millet. It had to be ended in 1907, for the people were in danger of starvation. The cultural emphasis on the value of tree cutting and the religious observances connected with it act as barriers to a change of custom.

Richards very valuable book gives one of the best accounts we have of the agricultural procedures of any primitive people.

Richards, Audrey I. (1948) *Hunger and Work in a Savage Tribe*. Glencoe, Illinois: The Free Press. 238 pp.

Among the Babemba, the largest and most highly organized tribe of North-Eastern Rhodesia, an agricultural and hunting people, Audrey I. Richards (1948) found that agricultural labors were seasonal. There was a general air of excitement when the rains came at the end of the dry season.

(p. 100) "The ground is hard, and cannot be worked at all, and the country is blackened by forest fires. Food is beginning to be short, and the people are listless. The older people sleep a large part of the day, and even the children sit in the shade too tired to play. With the first heavy thunder showers this suspense is broken, and the people shout and sing. In a few days they shoulder their hoes and hurry out to dig the newly softened earth. An African spring is an unforgettable experience to a European who watches a strip of blackened bush burst suddenly, almost in a night time, into vivid green. . . There is, moreover, a real sense of expectancy and interest in the beginning of tree-cutting preparatory to the making of new gardens, and in the burning of the piled branches which serve to fertilize the fields."

It was an earlier publication of Richards (1939) which Gourou (1947, pp. 30-31) cited regarding the interesting agricultural procedure of the Bantu which is called "chitiméné". An area of forest is felled. Then from an area six or eight times as large as the clearing the branches are lopped off of the trees by the men and piled up in the clearing by the women to blanket it to a depth of 60 cm. The competition of the men in tree climbing and chopping results in many accidents, but results in an abundance of fertilizing ashes when the burning is done. Of course the fixed nitrogen is largely lost from the contributory area, and the equilibrium of return to the soil of other fertilizer constituents is disturbed.

Robertson, William B., Jr. (1955) A Survey of the Effects of Fire in Everglades National Park. United States Department of the Interior, National Park Service. Submitted Feb. 15, 1953. Mimeographed. 169+3 pp., 45 photos. [Homestead, Fla., 1955]

Because of the tropical nature of the vegetation of the Everglades National Park in southern Florida and the careful study of fire effects which has been made there by W. B. Robertson, full attention must be given here to his admirable report even though the region dealt with is technically outside of the tropics. Although it directs especial attention to changed conditions which have come about locally through disruption of the natural conditions of drainage the author considers various matters of broad general application. One is the occurrence of natural fires, i.e., those not kindled by man. He writes (p. 11):

"4. Lightning Fires - Up until two years ago or less the answer to the question 'does natural fire occur in South Florida?' would have been 'No.' There was a strong belief that lightning fires did not occur, and in the absence of any direct evidence to the contrary this was generally accepted. One feature of the newspaper coverage of fire in South Florida has been the search for other explanations for fires occurring in remote sections of the glades, which has produced some notable flights of fancy. This assumption that natural lightning fires were too infrequent to be of consequence has hindered understanding of the role of fire in South Florida, as well as planning for fire control. For example, several authors (Small, 1924, 1930; Beard, 1938; Egler, 1952) have considered the present vegetation, accepted the belief that natural fire was rare or absent, and concluded, quite logically with the assumption that a continuous broad-leaved forest must once have existed in south Florida. Egler's comment (op. cit.: 226) is typical. "in short, the vegetation of south Florida during late Pleistocene pre-Indian times may have been a dense evergreen broad-leaved tropical jungle....."

"With the establishment (in 1951) of two fire lookout stations overlooking large sawgrass areas in Everglades National Park it soon became evident that natural fires caused by lightning do occur frequently. Several fires were seen to start from observed lightning strikes in sawgrass and in tree islands of the Everglades. In all, lightning was the reported cause of 12 fires in 1951 and of 11 in 1952 (up to July 1). Some of these fires were extinguished by rain which accompanied the electrical storm, but among them are also some of the major fires in the history of Everglades National Park. Too few data are at hand to permit much to be said about the seasonal occurrence of Everglades lightning fires. But the "dry storms" which set them appear at present to be a phenomenon of the very end of the dry season. Of 23 lightning fires reported to date three occurred in late May, 16 in June, and four in August.

"With the establishment of the present importance of lightning-caused fires it becomes reasonable to assume that they have been a continuing factor throughout the geological existence of South Florida, and that the fire-maintained cover types have been a continuing feature of the South Florida vegetation.

"(A word of caution may be needed here. With proof that lightning fires do occur comes the natural tendency to attribute all unexplained fires to lightning. Such overemphasis will serve the problem of understanding fire in the area as poorly as the earlier reluctance to consider the possibility of lightning fires.)"

Robertson next deals with the problem of the evolution of distinctive endemic species of plants that are peculiar to associations that are maintained as such by fire, that have required geological time extending far back of the period of human occupancy for origin and dispersal. About this he says (pp. 12, 13):

"5. Endemic Plants - One of the characteristics which makes the flora of South Florida so interesting is the group of plant species which have originated in the region. Small's Manual of the Southeastern Flora (1933) shows 103 such species that have evolved in South Florida. These are distributed in 31 plant families and 66 genera and include plants from both tropical and south temperate zones. Almost all of them are herbaceous plants or low shrubs. Examination of the habitats of these species gives us important additional evidence of long ages of natural fire in South Florida. Table 1 shows the distribution of these species according to the vegetation types in which they occur. Notice that well over half are limited to pine forest areas, and in all 70% of the species occur in vegetation types that today are maintained by fire.

"Differentiation of new species requires geographic isolation of populations under new ecological conditions to which they become adjusted through a long period of natural selection. The evolution of low-growing plants of the kind which make up this unique South Floridian group certainly required that their sub-climax habitats remain constant for a long period, and this in turn required recurring natural fire. (Or other natural disturbance, of course, but fire seems the only likely factor). For example, at the present time almost all of the endemic pinewoods species are shaded out by invading hardwoods in pine forest areas that are free of fire for as little as five years. It is quite clear that they could not have evolved if natural fire had been absent, or even of irregular and infrequent occurrence in the region.

	<u>Vegetation Type</u>	<u>No. of Endemic Plant Species</u>
TABLE I: Ecological Distribution of Endemic Plant Species of South Florida	Pineland	58
	Hammock	22
	Everglades	14
	Marshes	
	Other (Strand, Mangrove, Etc.)	9

Their existence as distinct species is inescapable proof of ages of regularly recurring natural fire sufficient to maintain large areas of sub-climax vegetation. It can thus be said with some assurance that the aspect of the vegetation of South Florida probably never differed much from that pictured in the earliest historical accounts."

As for fires kindled by the Indians Robertson quotes the same passage from Alvar Nunez de Vaca () that Small () and Demmon () had also quoted and then (p. 13) comments on a recent publication of Egler () as follows:

"Egler (1952: 226-7) devotes considerable attention to an analysis of the probable effect exerted on South Florida vegetation by aboriginal use of fire. He makes two main points:

- 1 - The sum effect of Indian fires was to modify the continuous "Pre-indian Swamp Forests" creating a mosaic of vegetation types similar to that seen today (i.e. pineland with scattered hardwood hammock, sawgrass prairie with scattered tree islands).
- 2 - Indian fires were likely most frequent early in the dry season, occurring at a time when organic soils and hardwood hammock vegetation were still too wet to burn, and hence caused less destruction than fires later in the dry season.

"In the previous section compelling evidence has been presented to show that natural fires must have been sufficiently frequent in south Florida from the earliest times to maintain large areas of sub-climax vegetation. I do not, therefore, see the need to invoke Indian fires as a major factor in the origin of these fire-maintained types. I agree, however, with Egler's assumptions that Indians were probably free and careless in using fire; that Indian fires were probably frequent; and that they probably tended to occur as early in the dry season as sawgrass would burn.

"Concluding, there is reason to believe that fire incidence in south Florida increased sharply as early Indians became established with the addition of their fire-hunting and escaped fires to the recurring natural fires."

Occupation of south Florida by the white man resulted in an increase of fire and Robertson takes sharp issue with Egler in denying that in south Florida the white man did "with smug righteousness forbid all fires." Quite the contrary, as Robertson says (p. 14), as follows:

"In the Everglades area white man's incendiary activities have beggared those of his dusky brothers. I believe that the frequency of man-caused fires probably increased sharply as whites replaced aborigines in the area. White man in south Florida burned freely for every reason that the Indian did, and for some all his own. Even today with the present finally awakened fire-consciousness ones does not go long in south Florida before hearing of fires set to kill mosquitoes, kill rattlesnakes, clear out the brush, drive out game, create fresh pasture for cattle or deer, etc. Burning to locate 'gator holes in sawgrass areas was a common practice of commercial hide hunters. In a copy of an interview on file at Everglades National Park Headquarters, Mr. Loren Roberts describes the burning of the Ingraham Prairie behind Cape Sable by 'gator hunters about 1902. Add to these frankly incendiary fires those which spread more or less accidentally from farming and lumbering operations on the eastern rim of the glades, and an imposing picture of fire occurrence for the white man's half-century in south Florida is obtained."

Next Robertson takes up the local south-Florida problem that has been created by the burning over of lands which formerly had waterlogged peat soils at the time of seasonal burning, but which, since the establishment of deep drainage of Lake Okechobee directly to the sea by artificial canals instead of by overflow through the Everglades, have been left high and dry.

The hammocks of the Everglades are the slightly elevated areas of dicotyledonous forest surrounded by formerly wet prairie which in part correspond exactly to the forested "islands" which botanists and explorers describe for the transitional region from the marsh-lands of the upper Paraguay River to the great central Mato Grosso pampa. Analogous places occur in other parts of the world. By deep drainage the formerly wet Everglades prairies have had the water table greatly lowered, for there is now an excess of evaporation over annual rainfall amounting to as much as twelve inches, which was formerly made up from the overflow of Lake Okechobee. As a result, the soil of some (but not all) the hammocks is dry enough to take fire when the prairie burns. Then the peat soil burns down almost to the water level, and the whole interior forest vegetation is destroyed, for the roots and bases of the trees are incinerated even if the trunks contain

too much water to burn completely. Utterly destructive in the interior of some hammock, the fire may fail to kill a few trees at the edge, where the soil is nearer the marsh level and does not provide a deep enough layer of dry peat fuel for the fire to kill even though it passes beyond into the deeper dry peat of the interior. On the contrary, Robertson cites instances of other hammocks injured only at the edge and not at all in the interior.

Drainage began to be effective in combination with fire in producing this disastrous destruction of the hammocks about 1918. Robertson says (p. 15):

"Since drainage began to be effective, a pattern of increasingly severe fire has developed. Under present conditions the lower glades may be completely dry for months in dry years, much extending the period of critical fire danger. Previously a sort of balance had existed, with the generally higher water levels acting to restrict both the extent and severity of fires. Dry years with severe fires and much destruction of organic soils and hammock vegetation undoubtedly occurred, but it can be safely assumed that these were rare. Fires under the altered conditions brought about by drainage have been notable in two respects: (1) Destruction of organic soils, which in turn has decreased the water-holding capacity of the glades due to the loss of the peat and marl seal over the highly permeable underlying limestone; (2) widespread destruction of hardwood forest vegetation, both upland hammocks and tree islands."

The results of fire prevention in the Everglades area indicate very strongly that pine forest is there only maintained by fire. Without fire it would be replaced by hammock. So Robertson cannot classify fire except as a "natural" agency. Man has greatly increased its frequency. If he were to eliminate fire entirely the tendency would be for prairie to be transformed into non-coniferous forest. In view of the new drainage system which man has established and which, if maintained, will require continued and successful fire prevention, in order to preserve the organic soils from destruction, it is already clear that some of the most interesting habitats and endemic species are doomed to destruction. Their existence depends upon at least moderate burning-over, which is inconsistent with keeping the organic soil if the water table is to remain permanently low.

Robyns, W. (1936) Contribution à l'étude des formations herbeuses du district forestier central du Congo Belge. Essai de phytogéographie et de phytosociologie. Institut Royal Colonial Belge. Sect. des Sci. Nat. et Med. Memoires in 4^o. V, 1, 154 pp., 3 figs., 2 maps, 13 pl. 1936.

Robyns (1936) distinguished three types of forest in the Belgian Congo, namely, the central forest and the mountain forest, both shady, and the open forests of Haut-Katanga and Haut-Kasai, which he said were not forests, properly speaking, but wooded savannas, dry character. Primarily concerned with the central forest, in which openings or savannas, had been reported, he set himself the problem of finding out how continuous and uniform it really was.

The non-forested plains in the forest interior had been first discovered by Fr. Thonner (1898) in the course of his first visit to the basin of the Mongala, District of Bangala. They aroused the usual discussion as to their origin and significance. Robyns was able to satisfy himself that these savannas were of three types, edaphic (caused by soil relations), climatic, and secondary. The secondary savannas were of small extent, some caused by man and some by elephants. It was interesting that natural savannas actually occurred, some of them on recent alluvial deposits of the sort known locally as "esobe", which are simply new areas that pass into forest, and some on laterite. The latter may have been old or new, and the significance of the areas from a vegetational standpoint is therefore not clear.

Robyns, W. (1938) La forêt équatoriale congolaise est-elle discontinue? Journées d'Agronomie coloniale, 29-30. Jan. 1937. Louvain, Ceuterick, 1938.

Deals with "esobe" (non-woody sand-bar vegetation), edaphic savannas on lateritic soil, in Ubangi, of unknown evolution, climatic savannas at the periphery of the equatorial forest, and secondary savannas populated by ruderal plants and anthropophiles. Discusses the continuity of the Congo forest.

Rondon, Candido Mariano da Silva (1916) Conferencias realizadas pelo Sr. Coronel Candido Mariano da Silva Rondon. . . . referentes a Trabalhos executadas sob sua chefia pela Expedição Científica Roosevelt-Rondon e pela e, Comissão Telegraphica. Comissão de Linhas Estrategicas de Matto Grosso ao Amazonas. Publicação n. 42. Rio de Janeiro, 1916.

Rondon, Candido Mariano da Silva, Lectures delivered by . . . on the Roosevelt-Rondon Scientific Expedition and the Telegraph Line Commission: translated by R. G. Reidy and Ed. Murray. Comissão de Linhas Estrategicas de Matto Grosso ao Amazonas. Publicação n. 43. Rio de Janeiro, 1916.

At the north boundary of the less broken central campos of Matto Grosso, where there were forests only lining the streams, the Rondon-Roosevelt expedition followed the course of the older explorations of 1907-1909 through the sparsely populated country of the Nhambiquara Indians, with forest spreading over more and more of the country as they proceeded. Rondon makes it clear that these Indians cleared forest, thus creating more prairie or campo. Up to 1911 telegraph line extended to the Campos de Comemoração de Floriano beyond the Serra do Norte, and thence they had to proceed toward Campos dos Palmares and Maria Molina. In this region there was more forest than campo, the areas of the latter being limited, but far more convenient for running a telegraph line than to suffer the grave inconvenience of carrying the line "through the woods of the valley of the Rio Tenente Marques de Souza", which Coronel Rondon and his parties were calling the Ananaz in 1911. The campo of Maria Molina was man-made, one of those which were "the outcome of the destruction of large stretches of primitive forests, set on fire by the Nhambiquaras, in preparing the ground for their plantations". So explorations were made by Rondon in 1911 and 1912 to find other campos of the same sort, on the way to Maria Molina, previously reached through forest. He thought that there should be such corresponding to the Indian groups called Nenês, Iáiás, Navaitês, Tagananis, Tautitês, and others "each one occupying its distinct territory". These campos were given the name Campos Indigenas by Rondon, to distinguish them from natural prairies.

Leaving Vilhena on 6 Nov. 1911 he reached the small natural prairie of cerrado () which he named Mangabal, and which had already been made known in 1909. There had been an Indian village there, which had been abandoned and burned. Subsequently he found just the sort of campos indigenas that he sought, interspersed among forest and "entangled overgrowth." He then entered the headwaters-region of what was later to become the Rio Roosevelt. He said: "After crossing the river Ryrineus I found a beautiful "campo indigena" called the Perdiz, whence we could see to the North and to the Northeast, many others, which succeeded one another, without end, out of sight."

Rondon proceeded to Campo de Maria de Molina by a course 50° NW from Mangabal, somewhat over 36 kilometers from his stake at Mangabal, or 18 from Festa da Bandeira, and what he wrote is the best description I have found of the transition into the Amazonian forest from the southward. He said: "In this last stretch the country presented itself to us covered now with entangled overgrowth, now with certain special vegetation intermediary between the former and virgin forests; the Indians called it "Alôri" and we knew it under the name "Lorê", because, in the midst of same, a certain tree is very abundant, the wood of which is very strong and lasting and is so called by the Indians."

Colonel Rondon studied the region in order to find out how far the Campos Indigenas extended and in the course of so doing established friendly contacts with Indian groups about which his lectures give valuable information. As an example of the types of vegetation that he encountered one may quote a traverse as follows: From the station José Bonifacio at Campo de Maria de Molina, more than 83 kilometers from Vilhena, on the right bank of the Carumicharú, or Festa da Bandeira, his party took an Indian trail which first crossed a "jungle" [of tangled secondary woody vegetation] into a forest of Loré. Indian guides soon got ahead . . . on account of the many cipos (lianas) and branches and trunks of trees lying across our path above the height of a man. . . . However . . . a little ahead, we found our [Nhambiquara] host awaiting our arrival with a large quantity of Naru-caguinindê, a refreshing drink much used by the Nhambiquaras, who prepare it with water and the juice of the wild pine-apple, which is very abundant in their country and is cultivated . . . in the numerous clearings in the interior of the woods opened up by fire . . . we had got out of the forest of Loré into a new jungle. . . . From the jungle we passed into another wood not very extensive, covering a small headwater. There we found a few small, open huts which the Nhambiquaras construct in their Ikidás or temporary villages used for hunting purposes. . . . Soon after we got out of the woods into some country where the vegetation was low and scant, and from here into an open campo of Alochitú, the name of the grass which grows in the campos indigenas in the yellow background of which the outline of the big conical huts of the Xicés or Nhambiquara villages could be discerned.

The alternative route for the telegraph line through these campos replaced the much more difficult route in regions where the earlier expedition of 1909 had found only the tall and close-set trees of the virgin forest. The final discovery on the alternative route before it joined that of 1909 was at a point on the Rio Commemoração de Floriano where, "near the waterfall Salto do Paraiso, a beautiful campo was discovered . . . covered with magnificent pasture which was named Parabens." From here little was to be expected except thick and high forests.

The latter, from a somewhat different approach, a short distance to the eastward in the region of headwaters of the affluents of the Amazon, were described by Rondon in quotations from Lieut. Julio Caetano, who explored from the source of the Rio Ikê to Santarem on the Amazon. The Ikê flowed into the Doze de Outubro, which joined the Camaré, and the latter the Juruena, and the last named, the Tapajoz. On the bank of the Ikê he made two canoes from trunks of the cedro, and the portages were so difficult that for the first month he did not average a kilometer a day.

"The Ikê", Caetano said, "flows in the wood for twenty kilometers, where the Campos Indigenas commence to appear, on the right at first. They sometimes depart from, and sometimes approach the banks, scarcely ever meeting the river, and the banks now firm, now marshy, abound with palm trees [of several kinds] . . . according to the nature of the soil. It is poor in rubber trees. . . . The campos indigenas extend down stream and crossing same at nearly 24 kilometers, we come across a 'cerrado' (dense wood) extending out of sight. . . . At 277 kilometers from the point of embarkation the Ikê . . . discharges its waters in the Doze de Outubro, . . . following which, 18 kilometers, is the Rio Camaré. . . Here commence the large forests of the Indians."

It is by no means to be supposed that nearer the Amazon there are no Indian clearings, but, rather, that they more often revert to forest than remain open as clearings. The botanist Frederic Hoehne accompanied an exploration of the course of the Rio Tapajos under the direction of Capt. Manoel Theophilo da Costa Pinherio, who, describing the descent of the Rio Juruena, is quoted by Colonel Rondon as follows: "Every now and then . . . on both banks of the river, we noticed large openings in the woods, which indicated plantations [of the Nhambiqua Indians] to us; landing stages on both sides of the river corresponding to one another; primitive rafts (bundles of burity palm leaves bound together) on which they used to cross from one side of the river to the other. . . ."

In all of Rondon's reports the unqualified term "campo" signifies a natural prairie as opposed to the campos indigenas, which he specifically defines as produced artificially by the Indians clearing the forest. The latter would appear to be chiefly confined to a region near the boundary between forest and prairie, to be more fertile than the largely sterile natural prairie, and to be characterized by the abundance of good forage grasses which hardly occur in the natural prairie.

Rondon, Candido Mariano da Silva, *Historia Natural. Ethnographia. Comissão de Linhas Telegraphicas Estrategicas de Matto Grosso ao Amazonas. Rio de Janeiro, n.d.*

Colonel Rondon () recorded most of what is known of the Indians of the Cerro Parecis. When he visited them in his exploration of Matto Grosso there were only 340 individuals, by actual count or report, belonging to 3 chief divisions, living in twelve communities.

The earliest account of them which Rondon quoted was that of Antonio Pires de Campos of 1723. At that time the Indians were numerous. In one day's march the explorer

traversed ten or twelve settlements, each of ten to thirty round houses. They cultivated manioc (mandioca), maize (milho), sweet potatoes (batatas), and pineapples (ananazes), planted with admirable orderliness. They hunted deer (veados), emus (emas) and many other animals.

The Indios Parecis had their next literary record from Bossi in 1862 and von den Steinen () who visited them in 1884 and again in 1887-88.

Rondon's own pictures show them as living in leaf-thatched houses of almost semicylindrical shape with an obtuse ridge. He found them making much use of wild fruits, and to be great hunters. Game was watched for by lookouts stationed in trees. The hunting was done with the aid of fire. The campo which the game occupied was surrounded by flames and in attempting to escape the animals could be captured or killed with some ease. The explorers adopted the same method to collect certain zoological rarities for museum specimens. Fire was started by the Indians by rubbing two sticks of a certain wood together.

Rondon found the following to be cultivated: Maize (milho), manioc (mandioca), cotton (algodão) and other plants. The men prepared the land, by clearing the forest in May, burning in August. The women planted at the beginning of the rains in September, then weeded and harvested the crops. In general the soils were sandy and poor, so that new places for clearing were frequently sought.

Neighbors of the Parecis Indians were the Nhambiquaras who extended to the extreme north of the state of Matto Grosso.

Rondon, Candido Mariano da Silva (1947) Relatório apresentado á Directorio Geral dos Telegrafos e á Divisao Geral de Engenharia . . . 1º volume: Estudos e Reconhecimentos. Comissão de Linhas Telegraphicas Estrategicas de Matto Grosso ao Amazonas, Rio de Janeiro, n.d.

Ed. 2. ministerio da Agricultura, Conselho Nacional de Proteção aos Indios. Imprensa Nacional, Rio de Janeiro, 1947.

Roosevelt, Theodore (1914) Through the Brazilian Wilderness. New York, 1914.

This work forms a most interesting supplement to the writings of the Rondon Commission. He described the Plan Alto or highland plain of western Brazil in its aspect near

the Sepotuba river as "a great natural pasture, covered with a very open forest of low, twisted trees, bearing a superficial likeness to the cross-timbers of Texas and Oklahoma." But leaving that area, "the first day's march away from the river lay through dense tropical forest."

The next morning they "climbed a steep slope to the edge of the Parecis plateau . . . waterless, shadeless, sandy . . . covered with grass and with a sparse growth of stunted twisted trees, never more than a few feet high. . . . Day after day we rode forward across endless flats of grass and of low scrubby forest, the trees standing far apart and in most places being but little higher than the head of a horseman. . . . The country bore some resemblance to the country west of Redjaf on the White Nile.

At Campos Novos, two days before reaching Vilhena, there was an utterly new kind of country ". . . traversed by several brooks . . . in deep, swampy valleys, occupied by a matted growth of tall tropical forest. Between them the ground rose in bold hills, bare of forest and covered with grass, on which our jaded animals fed eagerly." On the way to Vilhena ". . . the country was like that around Campos Novos and offered a striking contrast to the level, barren, sandy wastes of the chapadão . . . not suited for extensive agriculture. In the deep valleys were magnificent woods. . . . The hillsides were grassy pastures, or else covered with low, open forest."

After Vilhena, having been three days "in endless close-growing forest" in which the animals got scanty pickings, they came to what Rondon called campos indigenas, and which Roosevelt described as "a beautiful open country, where grassy slopes, dotted with occasional trees, came down on either side of a little brook which was one of the headwaters of the Duvida. It was a pleasure to see the mules greedily bury their muzzles in the pasturage." Here they encountered Nhambiquaras, for they were in the forest fringing the campos, the proper home of these Indians.

At Roosevelt's place of embarkation on the Duvida they were at 12° 1' S. and 60° 15' W. Up to this point the prairies with their scattering of Nhambiquaras had continued. The last two days had led across "a hilly country of good pastureland" ranged over by cattle from the Government Ranch at Tres Burity, with densely wooded valleys.

From here they travelled by boat, and Indian clearings, if visible from the river, would have to be near. To 11° 44' S, 60° 18' W, they found artificial clearings "old Indian fields, grown up with coarse fern and studded with the burned skeletons.

On the left bank [of the Duvida] we came to two or three old Indian fields, grown up with coarse fern and studded with the burned skeletons of trees." Although a careful study of

succession would have to be made to prove it, the supposition is that cleared land with a dense cover of ferns would revert to forest and not be transformed, unless very large and kept open by repeated burning into grass land. That there were natural areas from which grass seeds could come is indicated by an observation of the following day, regarding the portage around falls in the river. "At the point where the descent was steepest there were great naked flats of friable sandstone and conglomerate. Over parts of these, where there was a surface of fine sand, there was a growth of coarse grass. . . . This had for long been a station where the Nhambiquaras at intervals built their ephemeral villages and tilled the soil with the rude and destructive cultivation of savages. There were several abandoned old fields, where the dense growth of rank fern hid the tangle of burnt and fallen logs."

This place was close to $11^{\circ} 44'$ S and $60^{\circ} 18'$ W from Greenwich. Beyond this locality, proceeding in general northward, the Indians had made no appreciable modification of the landscape, and unbroken forest followed all the way to the highest points reached by rubber tappers on the larger affluents of the Amazon.

The conclusion to be drawn from the observations of Rondon, Hoehne, Roosevelt and others is that the seasonally well watered prairies of Matto Grosso are natural, and in part very sterile and unsuitable for agriculture or grazing. Modification of the vegetation has come about by extension of the campos at the expense of forest, through human agency, by the use of fire, beginning long centuries prior to European contact by the Indians, and continued in much the same way by the settlers of modern times. The Indians found the soft soil of new forest clearings more suitable to their primitive agriculture than the natural prairie. By repeatedly burning their own old clearings after agriculture was abandoned, they improved grazing for deer and other animals which they hunted, for these areas grew up to nutritious grasses (especially the new growth after burning) instead of sedges and other inedible vegetation. The artificial prairies (campos indigenas) therefore proved most suitable for the needs of new settlers for grazing land, just as they had been best for hunting by the Indians.

From the time of embarking on the "Rio Teodoro" until their emergence on the Madeira the route of the Roosevelt-Rondon party lay between 60° and 61° West Longitude and between 13° and $5^{\circ} 25'$ South Latitude.

We therefore think of human agency and fire as having always tended, in moist tropical Brazil, to extend the prairies, and we must think of the aboriginal Indians of tropical Brazil as having been essentially forest dwellers, not plainsmen.

Roy, Sarat Chandra (1912) *The Mundas and their Country . . .*
 With an Introduction by E. A. Gait . . . Calcutta: Jogendra
 Nath Sarkar at the City Book Society. viii + vii + ii + x +
 546 + lxxxiii pp., illust.

In India much of the land has been so long densely populated that only traces of ancient primitive agriculture survive. Among the Munda of Chota Nagpur, as we learn from the admirable treatise of Sarat Chandra Roy (1912) the land is largely in permanent cultivation even though the poorer soil is allowed a fallow period of one, two, or three years following cropping. The cultivation of fallow land has long been replaced by repeated plowing and pulverizing of the soil instead of clearing and burning, but there is possibly a curious survival of antiquity in that material from the compost pit, perhaps only coarser debris, is burned before being used for fertilizer, thus wasting nitrogen and humus. Cow-dung, however, and other manures such as oil-cake are not burned. Another survival is the sacred grove:

(p. 386) "Although the greater portion of the primeval forest, in clearings of which the Mündā villages were originally established have since disappeared under the axe or under the jārā-fire, many a Mündā village still retains a portion or portions of the original forest to serve as Sarnās or sacred groves. By the 'jara' system, land is prepared for cultivation by burning down portions of jungles. In some Mündāri villages only a small clump of ancient trees now represents the original forest and serves as the village-Sarnā. These Sarnās are the only temples the Mundas know."

For many generations the Mundas have labored unceasingly to terrace their land, not merely that good for wet rice fields, but even dry and sterile upland upon which unirrigated crops are grown. Weeding is scrupulously careful, and weedy grass which might become a nuisance is pulled by hand and taken home to be used as fodder.

"Sabiad", [Pseud.] (1944) Climatic change in West Africa, and its Relation to Erosion Problems and Soil Deterioration. Farm and Forest or Land Use and Rural Planning in West Africa Vol. V No. 4, pp. 186-192. December 1944.

Under the pseudonym "Sabiad" someone wrote a thoughtful article on the effect of long continued climatic change on soil degeneration and the growth of deserts. He said that he wrote as an amateur and that his opinions would be torn to pieces by land-use departments, but he took fully into consideration geological and archeological evidence of climatic change that conservation propagandists were likely to gloss over or not consider at all. Of course he was fully in accord with all that could be done for conservation, but in viewing unalterable geological trends such as those concerned in the "advance of the Sahara" he took a realistic attitude. Regarding climatic change and soil deterioration he said:

"To keep cultivation going in West Africa for another five hundred years, or possibly another five thousand years, may ultimately be of value to the human race. . . . But leaving out of the question our responsibilities towards our possible but far distant descendants, we have our responsibilities to the immediate generation who are to inhabit this part of the world. . . . It is surely necessary therefore to investigate the position at once. It would appear futile to initiate schemes for wells, dispensaries, schools and all the other more solid appurtenances of rural development if, in another twenty or forty years, the population for whom these things were built has already begun to migrate from the area, and if, in another 50 or 100 years, these things are landmarks in a sea of sand. Hailey says: (page 1653) It is not always easy to distinguish between erosion due to the action of man from that occasioned by nature; and some discussions on the subject appear to be directed rather toward convicting man of his sins than to ascertaining how much of the mischief . . . is capable of remedy. Worthington (S. Afr. p. 118) writes 'Whether or not Africa as a whole or in part is undergoing progressive desiccation, one conclusion seems certain; the drought-stricken parts of Africa are in no position to meet a possible prolonged cycle of drier years.'"

Here we see no opposition to conservation measures but merely a disposition to take nature as well as man fully into consideration. Agreeing with Stebbing whom he nevertheless viewed as somewhat of an alarmist, "Sabiad" said that Aubreville was as much an alarmist, despite his skeptical attitude toward Stebbing's concept of the rapidly "advancing Sahara." Aubreville actually believed much as Stebbing did, but wrote more in a spirit of scientific detachment than as a prophet of doom.

"Sabiad" showed that evidence of drying-up of the East African lakes in late years merely continues a geological swing that is indicated by completely extinct lakes and a system of beaches 200 feet above where they are today. He wrote:

"The famous Serengetti plains, 'the home of Africa's sophisticated lions' is such an old lake bed--an old lake which supported on its shores in the past an animal assemblage greater even than that which roams there today. For not only are the remains of Palaeolithic Man, ranging from the crudest pre-Chillean artifacts down to the highly developed weapons of the dawn of the Neolithic to be found but also . . . a huge collection of the ancestors and relatives of the antelopes, sheep, goats, cows and giraffes of today. And . . . man lives through such earth-shaking events, as the formation of the Rift Valley and the formation of volcanoes thousands of feet high; and on top of all this there were periods of great climatic change--change which still continues today. From the wealth of evidence available, there is no contradicting the fact that East Africa is much drier than what it was, and that we are still in a drying stage. It was possible for Dr. Leakey, for example, to prophesy that the 'bottomless' lake Nakuru would dry up in 1939--a prophesy made ten years before the event--which duly came to pass in 1939."

It is to be noted that "Sabiad" was himself with Leakey on an archeological expedition and is not so much of an amateur in such matters as he would have his readers think. Turning from Kenya to Uganda he reviews the conclusions of Wayland (1940), namely, that the growth of natural deserts has accompanied the decline of the ice age, but that climatic deserts have inherent limits beyond which they cannot expand and which they may or may not reach. There is likewise equally inevitably a natural forest area. Between the two are intermediate zones, the rather stable marginal scrub and the more unstable savannah. The climatic desert will remain such no matter what herculean efforts are made. The intermediate zones are in unstable equilibrium and any disturbance by man shifts it toward desert. Marginal land in Nigeria is that with a yearly rainfall of less than thirty inches. In the forest zone man may destroy the capacity of the soil to support his needs, but no matter how badly he treats it, in the long run it will return to climatic forest if left undisturbed through long enough time for nature's slow restorative processes to be concluded.

"Sabiad" concludes, with regard to East Africa:

"We should not indulge in spectacular attempts to reclaim that marginal land which we have lost, but should strain every nerve to consolidate that which we now hold."

For Palestine (out of limits for the present writer's assignment) "Sabiad" calls attention to the unbelievable abundance of artifacts in what is now semi-desert, but was densely populated in Neolithic times. In the Sinai desert he had found old lake beds with a horse tooth, Neolithic remains, and fresh water mollusca. Far distant from the one small water hole which now exists, there was a stone-built village of about the period 600 to 800 A. D.

"The cathedral town of Faironan also existed in what is now a very slightly watered wadi, whilst the large number of anchorites who undoubtedly lived in this area would have needed daily miracles to have existed at all had conditions then, 300 to 600 A. D., been what they are today.

"Dr. Sandford, quoted by Dr. Wayland, says of this area, 'Complete failure of the rainfall seems to have started in Nubia and to have spread along the Nile. The western plains and plateaux probably lost their surface run off in late Middle Neolithic times and thereafter their climatic history may have been very different from the Nile Valley. . . . In Neolithic times . . . crops were raised on ground which is now barren'."

As to North Africa, granary of the world in Roman times, Danham and Barth found Roman remains as far south as 27°, which indicated a considerable population. Man lost his hold on the area now desert largely as a result of the Arab conquest of the Berbers. Sabiad says:

"The Berbers, particularly under Princess Kahrina, in their fight against the Arabs, used the scorched earth policy to such good effect that they, with the help of that hungry ally, the goat, effectively destroyed the value of the area. Man should have been fighting to keep the desert at bay--as he should today in Nigeria--but the destruction of the olive groves, the filling in of the wells, and the deliberate or concomitant destruction of the terraces . . . let in the desert, and the good top-soil, the result of generations of careful farmers, and the inheritance from a wetter era, was allowed to be swept away by storm and wind in a comparatively short time."

As for the Sudan Sabiad says:

"The gravel surfaces of the dune-free areas are also reported to give an abundant harvest of Neolithic artifacts and potsherds to anyone who cares to search. . . Buchanan and Rodd in their journey to Air in the nineteen-twenties recorded villages so recently deserted that a pile of manuscripts was observed in one."

Sabiad then turns again to Nigeria and says:

"There is little doubt . . . that Nigeria is part of the border lands of the Sahara. When climatic conditions allow of the greatest expansion of the desert, Nigeria--or at least most of it--forms part of the desert. When the desert is at its smallest, Nigeria, or at least the northern part, still forms part of the unstable marginal area."

Discussing the absence of Palaeolithic artifacts in Nigeria "Sabiad" mentions the possible exception of one tool found by himself on Santau hill in Dikwa Division. (This seems to indicate that he was Stanhope White?)

Without reference to White's more extravagantly imaginative suggestions for changing the face of the earth (he wrote as an advocate of the Wegener hypothesis of continental drift and thought that an application of atomic energy might shift the continents to more appropriate positions) one may note his advocacy of establishing a large fresh-water lake in the Sahara by piping surplus waters of Europe to the Quattara depression, and his proposals to divert the waters of the Niger to the extinct drainage system of the Chad, and to turn the Benue back to Chad to rejuvenate the Bahr-el-Ghazal. In 1955 the Russians are reported to be thinking of using atomic energy to create a great lake in Siberia, and to divert two great rivers to water central Asia, using atomic energy to do the work.

Sachs, Carl (1879) *Aus den Llanos: Schilderung einer naturwissenschaftlichen Reise nach Venezuela*. Leipzig: Veit & Co.

Sachs contrasts the llanos as described by Humboldt with those of his visit. Viewed from the foot of the range "La Galera" the horizon was no longer that of a sea of grass. That he saw only later from Apure. From La Galera the country appeared generally wooded, with the islands of trees surrounded by grassland. In 30 years' time the herds had been so reduced by the depreciations of civil war and the low price of cattle that trees had seeded and grown freely. The price of cattle had fallen below the price of the hides alone, and the cattle had been slaughtered and skinned. From an estimated $1\frac{1}{2}$ million in Humboldt's time, there had come about an extraordinary reduction.

Whereas in earlier days the seedlings of trees had been destroyed by the grazing animals, they could now develop uninjured in the desolate steppe, and the reforestation would apparently go on until the number of cattle in the llanos had reached somewhere near its former height. Not far from Calabozo toward the Rio Oritucu is Los Tamarindos. The Oritucu flows into the Guárico three miles below Calabozo. Here Sachs went to study the electric eel (*Gymnotus*). Hardly had his party got out of sight of the town than they were enveloped in thick clouds of smoke. A great part of the horizon was alight with flames which appeared through the smoky air in blood-red hues. As soon as the dry season has advanced far enough the grass of the pasture lands is kindled in order to fertilize the forage plants of the coming season. In many accounts of travel the danger of these fires to travellers had been emphasized, but Sachs thought unduly so, unless a traveller were so careless as to go into an area already nearly surrounded by flames.

In these savannahs Sachs found that almost the only woody plants were a wax palm (*Copernicia*) and the notably fire-resistant calabash tree, or chaparro, (*Crescentia Cujute*). Sachs's use of

"savannah" accords with a restricted American concept. Palms are of course characteristic (according to colloquial American English of the southeastern United States) of any land properly called savannah. Without palms such land would usually be called prairie, but phytogeographers have obscured the meaning of the word "savannah" by making it cover almost any dry tract with no trees or only scattered xerophytic ones.

Sampaio, Alberto José de (1945) *Fitogeografia do Brasil*. 3a Ed. revista e aumentada. São Paulo . . . : Companhia Editora Nacional Brasileira. Bibliotheca Pedagogica Brasileira, Ser. 5a, Vol. 35. 372 pp., 38 figs.

Sampaio classified the types of Brazilian vegetation and his book, which reviews the literature on the plant geography of Brazil, must be consulted by those who wish to become acquainted with the numerous and interesting local terms used for plant associations. He divides the campos or prairies into natural and artificial, the latter including (1) those used for pasturage, on which grasses useful for forage are either planted or encouraged, (2) abandoned cultivated land (tapéras) invaded by capim gordura (Melinis minutiflora, the miserably weedy pervasive but useful "molasses grass", of African origin) by sapé (two coarse grasses of the genus *Imperata*) of very restricted forage value, or by samambaia, the ubiquitous bracken (Pteridium aquilinum).

Most of the artificial campos were originally forest and there is no clear line of distinction between them and the natural campos, for the latter, in spite of their vast extent, have become so modified by man that in all Brazil, Sampaio says, it is hard to find virgin campo. Invasion by the weedy plants that accompany man in his wanderings have altered their character almost everywhere.

He mentions the difficulty that has been experienced since the time of Saint-Hilaire in delimiting plant associations or deciding the vegetational sequence at certain borders of the campos. He distinguishes the pantanal of the Upper Paraguay from the campos of the high plateau of Matto Grosso. The former are the great complex of swamps, marshes, and floating aquatic vegetation, with great variation of water level, that extends through the Gran-Chaco to Brazil. The latter has been especially studied by Hoehne () and described by many explorers, such as Rondon () and Roosevelt ().

There are pantanals, riverside marshes, anchored or floating, which border the campos of the island of Marajo, and those of the island of Maranhao. The former extend into pastoral land on which much stock is grazed, including the water buffalo, and which is in a state of regression to forest, which strongly indicates, of

course, that it must have been kept open by fire, and that it was originally forest.

Santos, Domingo de los (1793) Vocabulario de la Lengua Tagala. Reimpresso. [Manila] (Imprenta de D. José Maria Dayot, por Tomas Oliva) 1835. 739 + 118 pp.

The word caingen [kaingin] occurs in the Tagalog dictionary of Fr. Domingo de los Santos (1835) of which the imprimatur is dated 1793. The etymology presents problems, for the word is not General Indonesian and there is an almost identical word in south-eastern Asia rather than farther south in the islands. The words may, of course, be only accidentally similar. Someone who shares the reviewer's enthusiasm for tracing the spread of culture traits by the words connected with them may feel inclined to follow this clue.

Schmieder, Oscar (1929) The Brazilian Culture Hearth. Univ. Calif. Publications in Geography III, No. 3, pp. 159-198, pp. 18-20, 6 maps. Berkeley, 1929.

The narrow coastal plain of Brazil presents the oldest modification of the landscape by European culture, for it was long the only region exploited by the Portuguese. It has been interestingly described in its modern aspect by Schmieder (1929), with references to older literature. When the coast was settled, it was reported by Pedro Vaz de Caminha (1500: printed 1877-78) to be inhabited by six major tribes of Tupi-Guarani Indians, and even as late as the first half of the nineteenth century there were parts of the states of Espírito Santo and Porto Seguro that were held by free Indians who had resisted European colonization. These coast Indians were finally only exterminated or driven into the wilderness (sertão) by the Portuguese about the middle of the century.

Some of the coastal tribes were exterminated soon after colonization. Thus, the Tupinambá, because of wars among their three groups, were gone by the end of the 16th century. They were reported to be great hunters, fishers, and cultivators of the land, but moved about frequently, building new villages every three or four years in order to clear more forest with stone hatchets and fire. Most of the land was covered by the coastal forest (matta costeira of Gouzaga de Campos ()) but there were some campos when the Portuguese settled, and some of these we may presume to have been produced through the felling and burning practiced by the tribes. The more extensive campos were

of periodically inundated type, like some of the land of the Florida everglades, and may have been natural. The great "Campos dos Goaytacases" south of the Rio Parahyba have become sugar land, although in 1815 at the time of the visit of Prince Maximilian (1820) these "campos de varzea" were used only for cattle raising.

Schmiedler, Oscar (1930) The Settlements of the Tzapotec and Mije Indians, State of Oaxaca, Mexico. Univ. Calif., Public. in geography, Vol. IV, pp. viii + 184, 47 pl., 7 figs., 8 maps. Berkeley, 1930.

Schmiedler (1930), in his notable study of the Tzapotec and Mije Indians of Oaxaca, has made one of the most interesting studies of the development of a cultural landscape that we have for tropical America. The Mije agriculturist has some permanently cultivated fields, of small extent, occurring in patches in the rugged country. These are the terrenos de aradura and are highly prized. Too small, in the main, to support a family, the cultivator also makes temporary use of low-grade land. The vegetation is cut down, burned when dry, and the land is planted to corn and beans amid the charred stumps; each field is the property of a single cultivator. Forest land around some of the villages has become scarce, and there are jurisdictional disputes about remaining more distant forest between the different populations.

The Tzapotec of Mitla developed a more complex system of land holding, for a group engaged in making a common clearing, which was then divided into lots. Since any one of the group may have participated with other groups at other places, his small holdings were very scattered. The result was that the Zapotec communities became larger than those of the Mijes and developed a correspondingly higher culture for there was no more incentive to move onto one small holding than onto another. Mije families moved frequently.

A temporary field is a milpa, from or related to the Nahuatl word milli, cultivated field. It formerly remained community property if abandoned but remained private property so long as occupied. The new land laws have changed the customs, so that communal clearing followed by subdivision is no longer practiced. The Indians formerly kept about one square kilometer of fertile land covered with wild vegetation. Since the community feared that the government would appropriate it as permanently unoccupied land it was cleared by communal labor and divided up.

The Mije and Tzapotec territories have a vastly complicated pattern which results from the mosaic of numerous small land holdings which are either cultivated or have been lying fallow for varying lengths of time.

Schnell, Raymond (1950). *La Forêt dense: Introduction a l'Étude botanique de la Région Forestière d'Afrique Occidentale. . .* Publié sous le patronage de l'Institut Français d'Afrique Noire. Paris: Paul Lechevalier. 531 pp., 13 figs., 22 pl.

Schnell has given a very excellent summary of chiefly French literature on West African forest botany. Following Chevalier he divides Africa south of the Sahara into the following zones of vegetation:

- 1) The Sahelian (sahélienne), a steppe region, from Senegal eastward
- 2) The Sudanian (soudanaise), characterized by wooded savana (parkland) from Dakar eastward
- 3) The Guinean (guinéenne), where the wooded savanas are traversed by gallery forest, from the Guinea coast eastward, touching the coast at the Gold Coast, the mouth of the Gambia, and the mouth of the Niger, then cutting the equatorial forest into two parts
- 4) The dense equatorial forest, which has a western Liberian-Guinea-Ivory Coast portion and the eastern Camerun-Congo part, with a fairly smooth boundary from west to east on the north, but very irregularly lobed on the south. The only one of these zones which extends all the way across Africa is the Sahelian, which encounters the Senegambian desert on the east, but turns southward to reach the coast in the Mozambique region. The tropical forest succession of zones to the southward of the tropical equatorial forest is not simply a reverse of these on the north, for desert (the Kalahari) is encountered only on the southwest, and the great area which Chevalier (1911) terms the tropical South African forest replaces thorn-brush land in an immense area.

In Camerun the higher altitudes (1400-1500 m.) are densely inhabited. The past and present inhabitants of the Ivory Coast at similar elevations are numerous, and in French Guiana likewise. In all these areas the vegetation has been greatly modified by man. Fires have devastated much of it clear to the mountain summits, but certain mountain crest forests in the Ivory Coast have been preserved by the natives because they are held sacred to the mountain spirits. They are refuges of the native flora. Bouys (1943) says that the spirit of the mountain Tonkoui was invoked, with sacrifices, to assure good crops, the birth of children, and to prevent illness. Another sacred mountain, Niénokoué was ascended by Chevalier much against the wishes of the natives, who would not go along, for it had a bad reputation as a source of evil and abode of demons. According to tradition it was the abode of the "first inhabitants", perhaps pygmies or a blend of pygmies with tall blacks. Again Schnell (1944) made the ascent in 1942, and found a large area near the summit of dense impenetrable vegetation which might well have been an ancient village site. Since only hunters ascend the devastated summits near

Tonkouï, Aubreville held that they were probably responsible for the degradation of the mountain vegetation by fire. If the aborigines destroyed forest without making permanent use of the land, they must also be given credit for having saved some samples, even if only because of superstition! Traces and vestiges of mountain forest prove that it was formerly of greater extent. Schnell summarizes the situation by saying that the effect of fire does not necessarily prevent extension of the primitive forest. To make an opening provides for extensions of prairie at high-mountain levels. He draws a parallel between the situation here and in Kivu, as described by Humbert.

Regarding laterite crusts, there is no perfect correlation between their distribution and that of savanna, although it is true that the bare or almost bare crusts are not forested. Some of the laterites are "ancient", (within limits of the Quaternary) and may be forested if covered by enough soil. A forest over laterite crust thinly covered by soil is in a state of instability in that conditions do not favor reestablishment after deforestation. A forest may maintain itself in such a situation, as it does at the forest border toward the Sahara, but the equilibrium which permits its continuance is easily disturbed, so that forest is likely not to be regenerated if destroyed. So Schnell accepted the evidence that under some conditions there appeared to be complete natural regeneration of forest of the primary type in West Africa. On the contrary, if forest clearings were in the vicinity of savanas, the vegetational equilibrium was easily disturbed by fire, and prairie succeeded forest. Of the woody species making up the forest, the lianas showed more aggressiveness against grass and sometimes regained land for forest. If fires established grassland in places where there was a laterite hard-pan, veritable "irreversible prairies" were produced. Thus the plateau at the foot of the Nimba Mountains, once mesophytic forest, is now savana and bowal. Absence of a laterite hard-pan and protection from fire led to natural reforestation. Too frequent clearing of the same land and annual fires on fallow land, characteristic of land use by the Malinké peoples, resulted in grassland. The Malinké pushed into the Nimba region from the north, displacing a thinner forest-dwelling population which had allowed longer periods of fallow between crops and more regeneration of forest.

Speculating on the origin of grass and brushland fires, Schnell (p. 96) concluded that the use of fire was probably one of the most ancient modes of hunting. Likewise, fire was used to destroy harmful animals, such as snakes. Setting fires has become, in the course of thousands of years a deeply rooted custom of the Africans. It was observed by the Carthaginian Hanno who travelled down the African west coast to establish a commercial colony several hundred years B. C. (See Falconer.)

Schnell mentions the use of thermal couples by H. Masson to ascertain the temperature attained by the surface soil in being passed over by a grass fire which occupied one minute. The surface temperature was about 700 to 850° C., and at two centimeters below

the surface hardly elevated at all. Many buried seeds and other subterranean parts of plants would survive, but not tree seedlings incapable of sprouting from below the soil surface.

In conclusion, Schnell says that at the northern border of the forest, fires have an effect on vegetation comparable to that of a climatic determiner. He calls attention to the utility of the term used by Tansley and Chipp (1926) "fire climax."

Schuitemaker, J. P. (1950) *Bos en Bosbeheer op Java: samengesteld uit Dienstgegevens in Opdracht van de Hoofdinspekteur, Hoofd van de Dienst van het Boswezen. Insulinde, Serie Handleidingen voor de Kennis van Indonesië, VII.* Groningen & Djakarta: J. B. Wolters.

The importance of forest conservation and control in Java has been admirably covered in a well illustrated popular monograph by Schuitemaker (1950). He says that now, as of old, the greatest menace to the forests is the periodic burning-over. Teak trees have thick bark and can withstand an ordinary grass fire, as can also some of its fire-resistant associates of the dry djatibos (teak forest). It is otherwise with the mountain forest which is largely killed by a ground fire, which likewise destroys the superficial humus and crude humus-building materials. The destruction is largely caused by grassland fires escaping into the forests, which are open enough so that alang-alang is an unwelcome invader. It does not grow in shady forests or those with undergrowth.

Schultze Jena, Leonhard (1914) *Forschungen im Innern der Insel Neuguinea (Bericht des Führers über die wissenschaftlichen Ergebnisse der deutschen Grenzexpedition in das westliche Kaiser-Wilhelmsland 1910).* Ergänzungsheft Nr. 11 der Mittheilungen aus den deutschen Schutzgebieten. Berlin: Ernst Siegfried Mittler und Sohn. V + 100 pp., 20 figs., 55 pl., IX panoramas, map.

Schultze Jena (p. 45) who explored the Sepik River found that for a distance of about 260 kilometers from the village of Imbuando to the neighborhood of Tschessbandai the forest withdrew from the stream on both sides, sometimes too far to be seen, being replaced by a flat plain subject to seasonal inundation and covered by grasses similar to alang-alang (Imperata) but not identified. Here and there were low, isolated little trees and bushes, or there were no visible woody plants at all. In the green expanse there were scattered lakes. Not infrequently green gave way to the dead gray of massive destruction where for long instances fires set by the Papuans had burned the vegetation.

The conflagrations were stopped perhaps by swamps of sago palms, showing smoked and toasted fronds along their borders. In September clouds of smoke, now white, now dark, so obscuring the lower atmosphere that the sun set in a rare violet haze.

[Scott, James George] *The Burman, his Life and Notions*, by Shway Yoe, Subject of the Great Queen. 2 vols. London (Macmillan and Co.) 1882. xvi + 370, viii + 360 pp.

Sir James George Scott (1882, vol. I, pp. 291, 295) in his admirable book published under the pen-name Shway Yoe remarked on the remarkable indolence of the farmers who grew rice in the wet river-valley fields of Burma. He added, however, that it was otherwise in the uplands.

"Finally, there is the laborious *toung-ya* cultivation, where whole hillsides are cleared of trees to produce a crop. This hard work is left to mild aboriginal or other tribes, whom the Burman has long ago bullied out of the fat lowlands. . . .

"If rice cultivation is easy work in the low country, it is very different with the *toung-ya* or hill clearings. Here the dense underwood and forest growth has to be cut down; and the more there is to cut the better the crop, for the soil needs fertilising badly, and all that is cut down is burned. Work is begun about April; everything is felled, bushes and all; and after the fallen logs have dried some time in the sun, the brushwood is heaped up round about them and the whole is set on fire. Some of the logs smoulder for weeks--perhaps till the first rains come. Then the ground is rudely dug up with hoes, and the ashes turned in. . . . The scanty manure provided by the wood ashes is not sufficient to last for another year; and when the crop is secured the party proceeds on to a new settlement, there to repeat the same laborious process. A very ingenious device for lightening the toil is resorted to where there is much heavy timber. Beginning at the bottom they slightly cut the lowest trees on the upper side only, gradually increasing the depth of the notch as they advance up the hill, until at the top of the clearing they cut the trees completely through. These fall on the row immediately below them and by their weight knock it down; and so the felling process is continued down to the bottom. . . . This *toung-ya* system is very wasteful as well as laborious, and annually draws down upon itself the denunciations of the English forest officers. But the hill-tribes who adopt it are too few to support themselves in any other way. They were long ago driven out of the plains by the Burmans and now cling to their old nomadic life with a degree of obstinacy which Government officials, in a variety of ways, have found is not to be tempted by any tale of the present security and plenty of the low country."

The foregoing account was written by a remarkably well informed officer, and there is no hint of the toungya system having developed beyond the primitive aspect that it had when Brandis wrote of it twenty years earlier. Scott does indeed mention the sowing of cotton in the toungyas, but that was quite in accord with the mixed planting for delayed profit that was part of the system of shifting agriculture almost anywhere in south-eastern Asia or the adjoining islands. It was far from the forestry system that was later developed by British officials, which was, however, planned to accord as well as possible with the system of shifting agriculture known as toungya and to take advantage of certain commendable customs of the upland people. Credit, however, must be given to the botanists Kurz, Sir Dietrich Brandis and to their contemporaries and successors in Burman forestry for developing the ideas that are associated in the minds of forestry officials in Africa with "the toungya system."

Shantz, Homer LeRoy, and Marbut, C. F. (1923) The Vegetation and Soils of Africa. American Geographical Society, Research Series No. 13, New York, 1923. (x + 263 pp., 50 figs., 2 pl.)

Shantz, writing on African vegetation, said (p. 6):

"In mapping and classifying vegetation we can deal only with the vegetation as we find it, and it would be unsafe to map what we think will be the ultimate stage of vegetation. Surrounding the tropical rain forest is a great savana (a grassland with trees scattered through). If the destruction of forests by primitive man and by fire could be suspended, the forest would undoubtedly spread out over a much wider area. That the forest would ultimately replace all the grassland is very doubtful; but the grasses, by the aid of fire, which is started by lightning as well as by primitive man, extended over portions that could otherwise have developed forests. This is true wherever forest and grassland come in contact. To map the grassland areas which would become forest if fire were eliminated could not be done without a detailed soil survey or years of experimental planting. It is equally possible that if fire were eliminated as a factor the dry forests would be composed of very different species from those found there at the present time. In the use here employed, the term 'formation' is not based on habitat but vegetation.

"As one passes southward from the equatorial region of high rainfall . . . toward the Namib Desert of Southwest Africa the change from tropical rain forest to absolute desert is as gradual as climatic changes always are where topography is not a decidedly influential factor. Yet the changes are as the following series of formations in the order named . . . : tropical rain forest; high-grass low-tree savana; dry forest; acacia tall grass savana; acacia desert grass savana; desert grass desert

shrub; desert shrub; and desert. All of these changes are gradual and are not marked by topographic boundaries. They are the result of decreasing water supply. Going from the same point up the highlands of East Africa we pass from tropical rain forest to temperate rain forest, mountain grassland, and alpine meadow, here correlated with decreasing temperature due to increase in elevation."

Shantz calls attention to the relatively limited extent of the tropical rain forest of Africa as follows (p. 27):

"This forest is not as extensive as one might suppose. In area it covers only a part of the Belgian Congo and of French Equatorial Africa and the southern part of the Cameroons, and occurs only in relatively small isolated areas between the Cameroons and Liberia, where a relatively large area occurs. There are a few small forests east of the Lake Albert, Lake Edward, Lake Kivu rift valley; but for the most part they are on alluvial soil, in all cases are not of wide extent, and if not exaggerated on the map would be almost lost to the eye."

Shantz (pp. 30, 31) then proceeds to a discussion of native agriculture and, it will be noted, is one of the few writers to describe a longer agricultural cycle than is generally credited to tropical peoples, for it begins with a grain crop, passes to a root crop to the end of the fourth year, as frequently noted, and then to bananas, of which the duration is not given. At any rate, he gives a not unfavorable view of native agriculture, as follows:

"Although primitive man in this forest utilizes the natural products, he is still largely agricultural. In the region about Kindu on the upper Congo River, as in other parts of this great forest, he cuts down all but a few of the larger trees and with the aid of fire and the hoe prepares the soil to receive his crop. On this land he plants bananas, relatively far apart, and also manioc. He then puts in a crop of maize and a little later a crop of upland rice. The maize is harvested just before the rice begins to head. Thus two perennial and two annual crops are grown together. . . . This area will first become a manioc thicket in about three or four years, yielding a constant supply of this most useful food up to the fourth year, when it is dug out. Later the same area will become banana field. It will continue in this condition until replaced by an early stage in the secondary succession, leading to the re-establishment of the primitive forest. Many other crops are grown by the native, among which may be mentioned sweet potatoes, yams, beans, peas, cucurbits, tobacco, sugar cane, eggplant, tomatoes, and many of our vegetable crops. The native seldom relies on a single crop. There are usually many crops grown together, such as the four just mentioned; or manioc, maize, beans, and peanuts; or voandzeia [a peanut-like legume], sweet potatoes, cucurbits, tomatoes, and eggplant are

stuck in almost anywhere; while sugar cane and tobacco occupy small areas often to the exclusion of any other crop."

Shebbeare, E. O. (1932) Sal taungyas in Bengal. Empire Forestry Journ. XI No. 1, pp. 18-33. 1932.

One of the most valuable timbers of northern Bengal is sal (Shorea robusta). When the Forest Department took over the Bengal forests after the Bhutan war of 1867 they had been repeatedly fire-swept, and the scattered patches of sal were islands in a sea of savannah grasses from 6 to 16 feet high. Fire protection was initiated and the first effect on the sal was enormous natural reproduction on areas which had been burned and then protected. Later, as fires came to be less and less frequent, an evergreen undergrowth developed which impeded sal reproduction until it ceased altogether. By 1905 some remedy was obviously necessary and burning was suggested as a remedy. Naturally it was opposed by the older generation of foresters who remembered the old days of devastation by fire.

Down to 1915 no artificial stocking of a sal forest had ever been successful, but experiments had shown that it was possible to plant successfully in grass land. The trial of a drastic new method was therefore decided upon, namely, clean cutting, followed by the old and long-forbidden type of temporary cultivation with the introduction of the modification known in Burma as taungya. When subsistence crops are planted in a new clearing according to this method, seedling trees in widely spaced rows are likewise planted and tended by the cultivators. After cropping the land two or three years it is abandoned. By this time the trees have made a good start. In Bengal the sal seedlings were started in nurseries and transplanted successfully to the cut-over lands. Taungya was successful if the transplants were kept clear of creepers and other competing plants, and so experiments were started in the control of the latter by fire, another reversion to an old and long discredited practice. Shebbeare wrote:

"A few years should show us whether fire is good for sal plantations or not and, if so, what we should burn and when. It must be admitted that our belief in fire is based more on what we feel than on what we know, but the fact remains that aboriginal villagers, who know more than we do, are strongly in favor of burning as tending to reduce the labor of climber-cutting--a matter of some interest to them."

With sal in the taungya plantings there has also been some champ (Michelia champaca). It is not fire resistant, and where the taungya has been planted with sal and champ, fire cannot be allowed.

Shebbeare concluded his article with a reference to Assam:

"In the adjoining sal forests of Assam, where sal reproduction was equally lacking, the problem has been faced, apparently with success, by the use of fire. . . In one of our forests which most closely resembles those of Assam, this method is being tried experimentally over about five square miles. If this proves a success, it is probably that this method will be used in Bengal sal forests on the waterless plateau."

The use of the newly cut-over sal forest as taungya is by contract with villagers who perform certain stipulated duties of planting and care of the tree seedlings in return for use of the land for crops.

Sibree, James (Translator) (1877) Ifanongoavana: the ancient Seat of the Hova Kings. Antananarivo Annual and Madagascar Magazine, No. 3 (Vol. I, Part III) 289-291. Antananarivo (Press of the London Missionary Society) Christmas 1877, reprinted 1885.

In 1876 the traditional ancient seat was a sacred forest and no longer inhabited. Before the Hova, the Vazimba were said to have lived there. A Malagasy account which appeared in the vernacular journal Ny Gazety Malagasy was translated by James Sibree (1877) indicated that the place must have long had the protection accorded to sacred places for the reigning Queen had "forbidden even a stick to be taken away." This might have been necessary if foreign contact had broken the force of ancient tradition.

The place was twenty-seven miles east of Antananarivo and five miles within the inner belt of forest that bounded the Imerina plateau. The Malagasy author described the location of the ancient city, of which certain hearths and hearth stones remained, as well as a surrounding fosse, as being on a mountain with two tops and a saddle between where a stream arose that formed a beautiful water-lily pool at the base. The entire mountain was densely forested and there were caves at the foot, from one of which a stream issued. On one summit was a flat table rock around which were red-flowered trees that had been brought by foreigners from distant countries.

Sibree, J[ames] (1897) The Manners and Customs, Superstitions and Dialect of the Betsimisaraka. Part I. Translated from a Malagasy M. S. The Antananarivo Annual and Madagascar Magazine. No. XXI (Part I of Vol. VI) pp. 67-75. Christmas, 1897. Antananarivo, Press of the London Missionary Society.

Sibree states that this article is a translation of a paper that had been given to him several years before by an intelligent Hova evangelist, who resided on the eastern coast for some time and gained information about the Betsimisaraka that had never been published. These people inhabit the central section of the eastern coast of Madagascar, to the south of the Tankay tribe, to the north of the Taimòro people and "to the east of the great forest which forms the boundary of the Imerina province."

"The country inhabited by most of the people of the three districts is forest, but the eastern portion . . . has much open clearing; while the towns of the two western divisions are none of them farther from the forest than 700 yards. None of the villages are built on hills or high ground, but on level places, or in the valleys, not far from streams, which in some cases run through the village. . . .

"The Betsimisaraka do not live always in one village or homestead, like the people in Imèrina, but change their dwellings every year, going to where there is forest, or where the forest has been removed, and there they form rice-grounds. But they do not go together in numbers, when changing their abode, but one household only at a time, so that the villages and homesteads are quite deserted during spring and summer--the wet season--all being away at the rice-grounds. But when the rains cease, the people begin to remain home and eat the rice from the new crop: but they do not stay at home more than three months, for by that time their rice is consumed, and so they go off to prepare fresh rice-grounds in the forest, or in the clearings.

Sibree, James (1899) *Adventures and Experiences among the South-east Malagasy*. Antananarivo Annual and Madagascar Magazine, No. 23 (Vol. VI, Part III) pp. 311-320. Christmas, 1899.

Sibree, in part of a journal long unpublished, described a tour from the Betsileo Province to the southeast coast, traversing the Tanàla forest. For two hours after leaving Iolomaka they were in the outskirts of the forest, a succession of low hills partially covered with wood; and divided from each other by swampy valleys. Becoming denser, the forest finally consisted of enormous buttressed trees. Descending steeply down the principal gorge, passing cascades and waterfalls, they emerged into "a tremendous hollow or bay, three or four miles across, and more than twice as long, running into the higher level of the country from which we had descended. The hills, or, rather, edges of the upper level, rise steeply all around this great bay, covered with wood to their summits, which are from 2000 to 3000 feet above the valley. Between these bold headlands we could count four or five waterfalls. . . . Between the opening points of this great valley, three or four miles across, could be seen a comparatively level undulating country,

with patches of wood, and the windings of the river Mátitãna. On a green hill to the left (north) side of the valley stood a group of houses, which we were glad to hear was Ivohitrosa."

The interpretation of this description would seem to be that the plateau above the embayment had been originally thin woodland, grading into prairie, probably partly by clearing, that the edge of the steep declivity to the lowland was original forest, and that the lowland had been mostly cleared by slash and burn for cultivation.

Simpson, George Gaylord (1940) Los Indios Kamarakotos (Tribu Caribe de la Guayana Venezolana). Traducción de J. Villanueva-Ucalde. EE. UU. de Venezuela, Revista de Fomento, Año III, Nos. 22-25, Marzo a Junio 1940, pp. 197-660, illust. Caracas: Servicio de Publicaciones.

Simpson (1940) commented on the general custom of burning the savanas throughout the north of Venezuela, in spite of its dangers and damages. He asked if it was possible that this custom could have had any other explanation than that it was an inheritance from the Indians, although the people attempted to justify an essentially traditional act by various sophisms. Simpson himself had observed what he called pyromania among the Kamarakotos, a tribe inhabiting Venezuelan Guiana, who told him that they lit grass fires wherever they went in the dry season for the sheer pleasure of seeing them burn. They resided in the region of Kamarata, a valley to the southward of Auyán-tepui in Venezuelan Guiana.

Smith, Edwin W., and Dale, Andrew Murray, (1920) The Ila-speaking Peoples of Northern Rhodesia. 2 vols. London: Macmillan and Co.

Smith and Dale in their admirable monograph of the Ba-Ila of Northern Rhodesia do not indicate any great deviation from the usual pattern of shifting cultivation except in the method of clearing land. One of the usual crops is maize, which English writers on Africa usually call "mealies" without explanation and the native people have no tradition of a time when they did not have this American plant, introduced by the Portuguese. (One may consult many books before finding out what mealies are!)

About agriculture we find (vol. I, p. 135) that: "The acquaintance of the Ba-ila with the principles of agriculture is very slight. . . . Their present methods are extremely wasteful, both of labour and land. A man desirous of hoeing a garden

selects a piece of land, preferably in the bush, . . . before winter is too far advanced, in order that the hot months before the rains may render the wood combustible, armed with a small hatchet, lops off all the branches of each tree in the field and then piles them carefully around the base. After allowing them to dry for two or three months he sets fire to the heaps, and the ground is free for the wife to commence her labors. The charred stumps of the trees are left standing. While the native is aware of the fertilizing power of the ash, it must be admitted that he utilizes fire as the readiest method of getting rid of the timber.

"When the sweet scent of the violet blossoms of the mufufuma tree fills the air, and the Pleiades are visible in the East after sunset, the wife recognizes that the time has come for her to commence her labors. Assisted by the members of her household she starts to hoe the ground, stacking the grass and rubbish in large heaps until dry enough to burn. . . . As soon as the ground is hoed, it is sown. . . . While the main cereal crop of maize or sorghum is ripening, the family dig fresh plots for beans or potatoes, or for sowing the following year.

"The first year's crops are invariably small, being what they style bukunku, realizing that the soil is not yet weathered and sweetened. The second crop is usually a good one; the third gives warning that another stretch of primeval bush must be attacked and burnt, while the late garden relapses into jungle."

Smith, J. Rich Forest Areas. (1943) Farm and Forest, or Land Use and Rural Planning in West Africa. Vol. IV, No. 1, p. 50. February 1943.

J. Smith, commenting on Lamb's article, referred to the speedy destruction of fine forest areas similar to those of Benin which in 1930 still existed in Kumba Division in the Cameroons. These had been described in the Annual Report of the Forest Administration of Nigeria for 1930 as surprisingly rich in valuable iroko and other fine trees. "When one considers the number of trees which must have been destroyed in clearing it is probable that the quality of the original forest excelled that of the Sapoba areas. It is indeed unfortunate that so rich a forest area cannot be preserved, but there seems no doubt whatever that it will have to give way to cocoa!" This was only too accurate a prediction. Only five years later Smith saw the district, and said:

"Perhaps the richest area of all had been that in the vicinity of Tombel, which, even when I saw it, was just one vast sea of cocoa with a well stocked upper storey consisting almost entirely of the timber species mentioned above [iroko, sapelewood (Entandrophragma), obeche (Triplochiton) and khaya (mahogany)].

In fact the latter were so prevalent that a French timber company found it worth while to lay out thousands of pounds in compensation for cocoa in order to exploit that particular area."

Spottiswoode, H. (1942) Soil Conservation--in Basutoland and in Nigeria. Farm and Forest or Land Use and Rural Planning in West Africa Vol. III no. 3, pp. 109-112. August 1942.

"Nigeria is separated only by time from the very serious state of affairs that would have overtaken Basutoland if vigorous methods had not been adopted. . . For instance, much of the Igbirra country is already seriously degraded, while immediately to the south, Kukuruku, with similar natural characteristics, is still largely unspoiled, thanks to its smaller population; which, before the British occupation was prevented from farming extensively owing to Nupe slave raids."

Stamp, L. Dudley (1925) The Vegetation of Burma from an Ecological Standpoint. Calcutta: Thacker, Spink and Co. vi + 65 pp., 28 pl., 12 figs., map.

Stamp, fifty years later, followed Kurz (1873; 1877) in emphasizing the extraordinarily close correlation in Burma between the distribution of the chief types of vegetation and the underlying geological formation. Many ecologists are blind to geology, which often gives the clue to controlling edaphic factors. Stamp says: "There are places in which may be found, within a stone's throw of one another, typical Monsoon Forests of eng and ingyin; Savannah Forest; Thorn Forest, and Thorn Scrub. This is purely the result of edaphic or soil control."

Stamp refers to official publications of the Indian Forest Service from which interesting ecological facts were gleaned but in so far as they fell into the category of published "working plans" they were apparently never widely distributed for none of the twenty-six cited by him has been available to the reviewer for consultation. Of these publications Stamp in fact says that they "are not accessible to the general public." In all of them, moreover, he says: "There is, unfortunately, practically no information on nonarbooreal vegetation except of those species regarded as pests by the forester." This lack of attention to the non-forest vegetation is to some extent reflected in Stamp's own book, but there are a few allusions to the modification of vegetation by man which are quoted below.

(p. 1) "For some years the writer has been struck by the extraordinary inaccuracy of the 'vegetation maps' published both in atlases and as wall maps. With regard to the maps sometimes it seems that only the exploited areas of forest have been colored as forest, the remainder being uniformly coloured as 'grass or sparsely cultivated' or even under the heterogeneous title 'woodland, grass, and cultivation. . . . The authors seem to have imagined that the evergreen tropical forest must of necessity fringe the coasts and penetrate inland along the main river valleys. Such is, of course, by no means the case."

Discussing the effect of elevation he says (p. 3) after pointing out certain distributional boundaries:

"In addition it may be stated at once that there appears to be no true grassland in Burma below 3000 feet, though large areas of the Shan Plateau above 3000 feet and of the Arakan Yomas are grass-covered. . . . A great deal of the land below 500 feet or even below 1000 feet is cultivated. Of the remainder the whole may be described as forest-covered, but the rainfall determines the range from evergreen rain forests, through monsoon and savannah forests to thorn forests and thorn-scrub or even to semi-desert. It must be noted, however, that the latter is an impoverished type of woodland and not an impoverished grassland. It is an important general principle that both woodland or forest and grassland degenerate to desert with lack of rainfall or other moisture. It is in the area of Burma below 3,000 feet that are found all the forests at present exploited."

This statement about "true" grassland startles one until he reads further and finds that by "true" grassland, Stamp must mean natural climax grassland and not the temporary grasslands that would proceed to become something else if not arrested by some unnatural agency, of which man is the only one. Discussing climate (p. 4) he says:

"It would be difficult to find a country which proves more conclusively the argument of Schimper that woodland does not pass into grassland by decrease of rainfall. He holds that grassland may be maintained by frequent showers too light to penetrate deeply into the ground, whereas forest demands some watering that is sufficient to penetrate deeply. Therefore a monsoon climate with seasonal heavy rainfall, such as that of Burma, will favor forest rather than grass. This argument appears to be invalid for many regions.

Stamp's provisional classification of Burmese vegetation put everything above 3000 ft., that being as close to the mean frost line as could be ascertained, into the category Mountain Vegetation, and everything below into Lowland Vegetation. We may be chiefly concerned with the latter. Although his subdivisions correspond largely with those of Kurz (1873; 1877) there is the essential difference that a number of the vegetational types which Kurz considered to be original or natural were relegated to

the status of successional phases rather than as climax. These belonged to the categories designated as "Savannahs" and "Natural Pastures" by Kurz. Stamp does not consider them as man-made but as stages in the forestation of sand and gravel deposits formed by the floods of the Irrawaddy River. In the grassland phase these are called kaing, the word that is so startlingly like Tagalog kaingin in form and meaning, although doubtless unrelated.

After describing the wet lowland forest types Stamp comes to the "bamboo brakes", which Kurz had called "bamboo jungles", and says (p. 26):

"Bamboo brakes, differing widely in character and aspect cover enormous areas in Burma. The spread of bamboo at the expense of forest has undoubtedly been greatly helped by the hand of man. Land which has been cleared of forest, temporarily cultivated, and then deserted, is often taken possession of by bamboo. Many forest officers are inclined to regard all the areas covered by bamboo brake as having been originally forested, but this is an important assumption and may not be borne out by further study. As A. H. M. Barrington says, 'natural forest in Burma is usually rich in bamboo undergrowth and poor in trees. The most extreme example I know is in the Lemru Valley of North Arakan where one may count, from one side of the valley, the trees growing on the opposite slope'.

"Most types of forest . . . may be replaced by bamboo jungle, and the dominant species are often the same as the dominant bamboos in the neighboring forest. Good teak is often accompanied by kyathaung bamboo, and the presence of bamboo brake of kyathaung is very often indicative of conditions especially suitable for teak although not a single tree may actually be growing."

Stamp then (pp. 27, 28) lists seven types of bamboo brake and indicates a related forest type for some of them. It may be suggested that a dense undergrowth of bamboo might survive (as it does in certain other tropical regions) the clearing and burning of forest, and there might be enough sprouts as neglected "weeds" among the crop plants to carry on the bamboo through a season or so of cultivation. Thus the argument of abundant bamboo undergrowth might present exactly the right condition for the land to be taken over by bamboo jungle in immediate sequence after shifting cultivation. In other words, the evidence of almost pure bamboo jungle being secondary, and man-made, is very strong.

It is a very curious fact that this relatively recent and detailed account of Burmese vegetation does not allude to taungya as a system of shifting cultivation belonging in a sequence with the artificial planting and care of selected trees of value in forestry. To Stamp taungya is merely forest clearing for temporary agriculture. That is all. In Burma the word has no connotation such as foresters in Africa attach to it in their

reference to taungya as if it were in Burma the cultivation of agricultural crops planted between the planted seedlings in the cyclic use of adjoining areas for growing commercial forest and harvesting the timber on successive areas by clear cutting. Doubtless the more optimistic foresters in Burma hoped for the establishment of a beautiful system of forest management based upon the planting of valuable trees in the clearings made for primitive agriculture, but the foresters in Africa thought that Burma had actually developed a "taungya system" of agriculture followed by a long fallow with woody plants in which they didn't just grow as nature might determine but in an orderly manner controlled by man. There are places in Burma and elsewhere, where native habits indicated mental adaptability to a scientific rotation, but the "taungya system" as conceived by its proponents in Africa was in Burma less a "system" of the natives than a pleasant dream of European foresters.

Stamp, L. Dudley (1926) Special Aspects of Vegetation Survey in the Tropics. Chapter XI (pp. 238-258): in Tansley and Chipp (1926) q. v.

Stamp (p. 247) has emphasized the great influence that man has had in changing the vegetation of the earth even where the population is sparse. He wrote (in 1926):

"Away in the hills of the remoter parts of Burma the population drops to less than ten persons to the square mile, and it is possible to travel for days without passing a village. It might, therefore, be tacitly assumed that the natural vegetation is practically untouched by the hand of man. This assumption is one of the two great dangers--we may call it the Scylla--of the ecologist in this country. Over vast areas of these sparsely inhabited regions the vegetation is semi-natural rather than natural. An explanation must be sought in the agricultural practices of the migratory hill tribes. . . . The village cultivators know that forest soil is rich. Each man selects an area of virgin forest and clears it in the easiest way possible--usually by burning, cutting or felling whatever will not burn standing. Evergreen forest is difficult to burn, but once it is set on fire the forest is totally destroyed--that is to say, the species of the evergreen forest are destroyed by fire. Monsoon Forest, on the other hand, benefits from fire--only the ground vegetation burns off and tree growth is greatly benefited. For this reason it is more or less usual to burn off the ground vegetation in Monsoon Forests annually. The cultivator who wishes to clear the ground must often, therefore, resort to felling. In any case the natural forest is totally destroyed and the ground sown with some crop--maize, millet, cotton, etc. After one, two or possibly three years the soil loses its first richness. It is deserted, and the villager

attacks a new area of forest. The cultivator will rarely return to an old cleared patch whilst there is still an accessible area of virgin forest to be attacked.

"Apart from the hill tribes the same practice is in vogue all over Burma, where forest land is available. The appalling wastefulness and destruction of magnificent natural forest may better be imagined than described. In Burma only the timely formation of Government Reserved Forests has saved to the country one of its greatest assets.

"The deserted 'taungyas'--as the cleared areas are called in Burma--return very slowly, if they return at all, to natural forest. More often the areas are permanently invaded by various species of bamboo and, in the hills, bracken. Vast areas of Burma are covered with useless bamboo and bracken brakes which have originated in this way.

"On the other side there is the other danger--the Charybdis-- One often hears it stated that the whole of Burma was formerly forested. Referring only to the Dry Belt of Burma, such a statement automatically relegates all types of thornwood, thorn scrub, and semi-desert to the category of semi-natural vegetation. Some areas may be of this nature, but, bearing in mind the rainfall, as low as 21 inches in some places, the high alkalinity of the soil and other factors, the writer considers it inconceivable that many areas under existing climate conditions ever supported a richer vegetation than they do at present."

Stebbing, E. P. (1922-26) The Forests of India. 3 vols. London: John Lane. 1922, 1923, 1926.

(I, p. 30) The Aryan invaders of India, about 2000 B. C., found dense forest in what seems to have been the region between the Ganges and Jumna Rivers, if the account of the burning of the great Khundava forest in the Mahabharata is to be taken as semihistorical.

In the time of Alexander the Great the conquerors kept real descriptions of the regions that they traversed and the country east of the Jhelam was a densely shaded, well watered, stately forest. The description seems to apply to low country between the Pabbi and Chenab, over which some trees of Dalbergia and Acacia are now scattered. Other areas were then much as when the British entered India, for instance, arid lands west of the Ravi in the Punjab, transformed by the British irrigation system into a productive agricultural land.

Great reduction of forest came about through influx of Central Asian peoples bringing flocks, which led to wide areas of forest being burned to provide pasturage. Then came the Muhomedan incursions, bringing people who regarded the forest as a free gift of Nature, belonging to anybody, just as water did. The displacement of aboriginal people who practiced shifting agriculture spread the practice, which, Stebbing says, is "a pernicious system which is probably as destructive to forests as any other act of man."

The scant history of India is verified by the archeological, for there are numerous vestiges of town and village sites in what is now arid country but must once have been productive.

In 1864, Stebbing states (Vol. II, p. 4):

"The forests over considerable tracts of the country had been cleared. . . . In the wilder parts of the country occupied by the aboriginal tribes the forests were almost unknown, even the existing maps of the country showing them as 'unexplored'. It was surmised that considerable areas in these regions would prove to have been destroyed by the system of shifting agriculture. . . . Throughout large areas unchecked devastation and exploitation still reigned, with its concomitants of firing the forests and unrestricted grazing. . . .

"The recognition of the grave position of the accessible forests which were threatened with total annihilation unless prompt steps were taken to check the abuses to which they were subjected, found expression in the appointment of Brandis in 1864 to act as adviser to the Government of India with the designation of Inspector-General of Forests."

The first general legislation looking towards forest conservation in India was entitled "An Act to give effect to Rules for the management and preservation of Government Forests", dated 24 February 1865. It came (theoretically) into operation 1 May 1865. Stebbing (p. 12) states: "The practices so long in force of firing the forests, grazing, shifting cultivation, and unauthorized hacking and felling were prohibited in reserved forests unless previous sanction had been obtained."

There were immediate clashes of opinion within the Government itself about the desirability of forest conservation. Likewise, local officials were largely in opposition. The Governor of Madras concurred with the Madras Board of Revenue and other officials of his own province in the opinion that the government Forest Act of 1865 should not be applied within his jurisdiction. He wrote (as quoted by Stebbing, Vol. II, p. 17):

"We are of opinion that the introduction of the Forest Act into the Madras Presidency is uncalled for at present and would be inexpedient where nearly all the jungles and forests are within village boundaries and are subject to the

prescriptive rights of the villagers, without causing much popular discontent and serious risk of oppression."

Stebbing commented:

"It will be observed that the Madras Board of Revenue, in spite of sixty years of forest destruction, had not yet been able to appreciate the fundamental basis of forest conservancy: that if an ignorant population failed to realize that their improvident acts would result in totally destroying forest areas and reducing them to barren lands, thus leaving nothing for their successors, it was, at least, the duty of a Government to take such steps as would remove the danger."

Mysore was, however, placed within the operation of the Act. It was then under the management of the Government of India, but was still regarded as a Native State which would ultimately be restored to its chief. Brandis (about 1869) had recommended the formation of village forests, but had been overruled. So the same effect was sought by increasing the area of "jungle" land within the State forests, the term "jungle" being used in its proper Indian sense, applying to dense secondary vegetation of grass, bamboo, shrubs, pioneer trees, etc., instead of old forest.

Stebbing (Vol. II, p. 209) definitely ascribes the so-called "tounya" system to Brandis. He says:

"The idea that a modified system of 'tounya' cultivation could be made use of in advancing the plantation work was due to Brandis. It was not new. In some famous French and other continental forests the system had been practiced many years before . . . , the raising of an arable crop for a year or two on the area from which the trees had been felled, and then in the third year the seed of the crop and that of the teak was sown together. On ripening the former would be cut and removed, leaving a plantation of teak seedlings on the area."

Stebbing (Vol. II, p. 210) goes on to quote a letter of Captain Seaton's, dated 8 September 1870, regarding a visit to the teak plantation at Kyek-pyoo-gan, Burma where the system was having an experimental trial. Seaton wrote:

". . . . almost the entire area cleared for this seasons operations had been planted out with teak seedlings preparations had been made for putting out sweet potatoes by mounding the spaces between the teak plants. . . . This is the first time an attempt at a more elaborate system of cultivation has been attempted in conjunction with teak than that of sesamum and cotton with varying success. It may be that further experience is needed to establish the superiority of this new system; but the experiment promises very satisfactory results."

The first attempt to protect any forest in India from fire was made in 1864 following a tour of the Central Provinces by Brandis and Pearson in 1863. Stebbing says (Vol. II, p. 223):

"That it would be possible to introduce into India the protection of the forests from fire was openly derided by possibly all district Civil Officers and most of the existing Forest Officers. That this attitude was a natural one to take up is easy to realize when the fact is borne in mind that from time immemorial the forests had been burnt annually over larger or smaller areas, either purposely to obtain an early crop of grass with the arrival of the first rains or from sheer carelessness."

The effort on the first two well chosen forest reserves was successful, but an effort to extend it to a third had less happy results, which "was solely due to the hostility of the 'ahirs' in charge of herds of cattle which were brought up from the lowlands to graze in the Mandla uplands. These people wanted to continue to burn the grass for their own purposes."

Stebbing (1937a) was able to write of shifting cultivation in India that whereas it was rife throughout the forests of the greater part of India a century earlier, in 1937 "save in one or two regions", it was extinct. He was unduly optimistic, but the fact remains that the long period of relative law and order that was introduced into India by the British was responsible for maintaining and even in some places improving one of the chief natural resources, the forest.

Stebbing, E. P. (1937a) *The Forests of West Africa and the Sahara*. London and Edinburgh: W. and R. Chambers, Ltd. 1937. 245 pp., ill.

Stebbing (1937a) was greatly opposed to using the word savannah for the type of forest which the French in West Africa called "savana". He found very little that he would term true savannah, and in a note written at Bondoukou before passing from the Ivory Coast into the Gold Coast he said:

(p. 7) "The forests I have seen after leaving the Rain Forest area are true mixed deciduous forests which merge into a badly (but varying in degree) degraded type of the same class. The latter still contains species of the high deciduous forest which once occupied the area." His later comment was that the degraded mixed deciduous forest, far from being savannah, was "fully capable of being reconstituted high forest by the two agencies of closure and fire protection."

Stebbing, E. P. (1937b) The threat of the Sahara. Journ. Roy. African Soc., Extra Supplement. 25 May 1937. 35 pp.

According to Stebbing (p. 3) Duveyrier in 1864 (*Les Touareg du Nord*) recorded information on vegetation and on forests which have now practically disappeared.

Stebbing cites (p. 13) historical records and other evidences to show that within modern times the Sahara has been "on the march", as Captain Fauché (1920) put it with reference to Timbuctoo. The Arabian historian Muhammad Kati ("*Tarikh el-Fettach*") disclosed in his account of a pilgrimage to Mecca made in 1497 by a Gao emperor with a retinue of 800 (including the historian) that the region from Gao into the English Sudan via Agades and Bilma was a fertile country with plenty of water. It is now all desert. As recently as the 18th century north of Tahona Stebbing found records of permanent villages along the line Gao in Gali Agades, still indicated by remains in the sand. By 1934 Stebbing found (p. 14) that the Sahara had reached southward to the town of Ansongo on the Niger on a line due east via Zinder to Lake Chad.

E. W. Bovill (*Caravans of the Old Sahara*) wrote of the salt trade of Agades with Hausa. "A remarkable feature of this trade was the gigantic caravan, . . . which set out from Air every autumn to bring salt from Bilma. . . . As recently as 1908, when it was in its decline, it numbered no less than 20,000 camels." Now the grazing grounds of Air, which made it possible, have disappeared. At the beginning of historical time the great equatorial forest reached to very near Kartoum, which is now in the desert.

Stebbing found himself in agreement with Shaw that man has been an important agent in extending the desert. He said (p. 18):

"This question of desiccation in the past need not be further labored. The more deeply researches are carried out into the former Sahara in its several parts the greater the evidence that man has been to some considerable extent responsible for the present-day boundaries, which, moreover, are expanding southward in our own times. How has this proved possible? It can perhaps be briefly summed up in wars, over-utilization of the soils by primitive methods of agriculture, and extensive grazing and pasturage, and perhaps most important of all, fire. History records that in the internecine warfare . . . fire was used to safeguard a retreat. . . . In certain parts of the Sahara--the afforested parts--crops were raised under the practice known as shifting cultivation, whereby a patch of forest is cut down, burnt, and the ashes used as manure. . . . Fire, annual firing of the areas and of the forest, is often the accompaniment of this type of cultivation. . . . In time the degraded remnants of a formerly rich forest were made over to the herds and flocks . . . and under excessive use the last savannah disappears with the water."

Stebbing (p. 19) quotes Arthur S. Champion (Geol. Journ. Feb. 1937) regarding the Province of Turkana in Kenya, as follows: "The Highlands . . . are well watered with a rainfall of from 20 to 50 inches per annum. . . The vegetation is subtropical and in parts . . . luxuriant. The mountain sides at 6000 feet and above are often clothed in dense forest, with many good timber trees, and at no very distant date were much more extensive than at present. The deplorable deforestation which has taken place recently, due in great part to fire, overstocking, and native methods of cultivation, is exercising a serious influence on the physical condition of the whole region. Even if the actual rainfall has not been appreciably diminished, the retention of moisture, the soil cover, the yield of the springs, and the period of flow in the rivers have all been greatly diminished."

Continuing (p. 20) Stebbing says: "Lake Rudolf, like Lake Chad in West Africa is drying up, or rather the level of the lake is sinking and has been steadily disappearing in the last 35 years, and in the last 5 years at a rate of no less than 1 foot in a year. Mr. Champion writes: "This recession of the waters has left behind vast stretches of fine sand which is now being blown back over the land by an almost constant southeasterly wind, covering a great part of the plain with shifting sand dunes. The drought of 1932-34 so accentuated these conditions that many parts of Turkana which only 5 years ago were passable grazing can only be described now as desert."

Stebbing said (p. 21) of the "savane" of the French literature that much of it does not conform to the English conception of savannah at all, being really degraded mixed deciduous forest. In the north the condition is aggravated by the drier climate, the vicinity of the Sahara, and the large flocks of cattle, sheep, and goats.

(p. 23-24.) "The savannah conditions on the edge of the Sahara are unlike the type-savannah forest in other parts of the world, where the soil may still be covered with grass or other surface vegetation of varying type; with the Sahara extending away to the north for 2,000 miles the soil layers have become gradually overlaid with sand in an ever-thickening carpet. There can be no re-afforestation under these conditions . . . the water supplies commence to become intermittent . . . and finally . . . the savannah forest is . . . accompanied by masses of tussock grass, which gradually degenerate out in the desert to the grass masses alone; these latter, the final stage in deterioration of the soil, being the last stage to disappear. The desert has conquered."

Stebbing (p. 24) gives interesting first hand notes of his own rapid traverse of the country from Northern Nigeria across the Sahara in March and April 1934. The notes were made almost hourly.

He found only small areas of true savannah forest in North Nigeria, around Geidam and on the Katsina frontier. Passing the international boundary into French Niger Colony, the desert

began at Tibiri near Maradi. Thence for 350 miles there were extensive tracts of dry mixed deciduous forest exposed to fire and overgrazing, and with sparse cultivation around each village. Beyond there were still more important areas of cultivation around Dosso and Dogonduchi. At the latter place the desert reappeared. "Much of the mixed deciduous forest is still capable of forming a protective belt of great importance to this French colony and the British region to the south. . . This belt, associated with existing forest of the same type on the British Nigerian side of the boundary, should be capable of forming a valuable barrier to sand drift if the three evils--an improvident system of farming, firing, and overgrazing--were judiciously regulated."

From Niamey the Transsaharienne turns northwest 300 miles to Gao, along the eastern bank of the Niger, through cultivated lands with a fair type of dry deciduous forest to Asongo in the French Sudan. Here the Niger expands into a lake. A line could be drawn eastward to Lake Chad showing the historic advance of the sand southward. Desert conditions begin to appear. Northward to Tabankort from Gao to savannah forest remained much the same, but was more open and the grass tussocks increased. At Rengan true desert was suddenly reached,--dead level and dark colored.

(p. 27.) "It is of importance to realize the final stages in this forest degradation. By the time it has reached open savannah conditions its fodder-producing capacity has decreased. The open savannah forest is then treated by the nomad herdsmen . . . under a rough system of pollarding. . . The flat-topped trees . . . are easily recognizable in the last stages of the savannah forest out in the desert." Finally so weakened for the production of food for the goats that they die, the trees disappear and the final extinction of the savannah forest has taken place. There were still islands of the savannah forest in the desert which seemed to mark the position of old extinct river beds, with ground water not too deep below the surface. Kennedy Shaw had made similar speculations about the Wadi Hawa (latitude 16°) in southern Libya.

(p. 32.) "The . . . Sahara is far from stationary on its southern borders . . . the present method of agricultural livelihood . . . with unchecked . . . firing the countryside annually and methods of pasturage--all tend to assist sand penetration, drying up of water supplies, and dessication."

[Stebbing, E. P., Ed.] (1942) Commission of Research: Africa (and other Tropical Countries). Commission set up to study Deforestation and Erosion in Tropical Countries under the auspices of the Royal African Society. Mimeographed, n. p., n. d. [1942].

Under the auspices of the Royal African Society a conference was held at London in January 1942 on the subject of Destruction resulting from Human Activity. The motif of the conference was announced in the first sentence of the proceedings: "It is man who has largely contributed to the deforestation of tropical regions and to the creation of deserts." A number of recommendations were made by the Commission, which were based upon various considerations. Professor Stebbing stated:

I found that in the north of Nigeria, and towards the east in the French Niger, the Sahara is advancing southwards at a rate of 100 km. a century. A study of the Sahara clearly reveals that this great desert was formerly, to a considerable extent, well watered, that it was certainly covered with fine forests and inhabited by settled tribes. The causes of deforestation were indicated as (1) shifting cultivation, (2) various kinds of wasteful felling, (3) forest fires, and (4) grazing.

Shifting cultivation had become accelerated in destructiveness and the inroads made on the equatorial African forest during the last half century because of the new political stability resulting from European colonization. Cessation of intertribal warfare and raids had increased human population and stock. The demands on the forest resulted in a shorter cycle of shifting agriculture and progressive failure of height, growth, and density of the secondary "bush" that followed abandonment of cropping. High rain forest was replaced at an alarming rate by savanne or "brousse", and the latter had degenerated through the bush fires started for forest clearing, to facilitate hunting, and to improve grazing. In the north of the forested region toward the Sahara the growth when burned no longer provided enough ashes to fertilize the soil for a crop and the land was used only for grazing. It became too poor to support cattle, which were replaced by sheep and then by goats. Eventually even goats could only survive if the "thorn bush" trees were pollarded to feed them, and the end result was desert.

Stebbing had had vast experience in India and Burma. He was therefore fully aware of the value of the Burmese "taungya" system and recommended its adoption in Africa. This system operated by clearing for cultivation areas of forest containing relatively little of value. Rows of valuable forest trees were planted 12 to 15 meters apart through the clearings, and the land between the rows was cropped for about three years. The method requires the maintenance of nurseries.

Governor-General Richard Brunot of Mauritania and Chad stated that the danger from progressive deforestation was extreme and that the populations of Senegal, Sudan, Niger and Chad toward the Sahara were undernourished because the soil on which they live is becoming more and more desert. He recommended the appointment of a Commissioner to get trustworthy information and the official regulation of bush fires.

Count P. de Briey, representing the Belgian Congo, commented on the spreading deforestation of the Congo, chiefly in the east between the Anglo-Egyptian Sudan and Northern Rhodesia, and in a continuous deforested zone stretching through the whole southern part of the Congo, between the 5th and 12th degrees of latitude South including a mountainous region in which erosion may cause great ravages, on the deterioration of the remaining forest in the regions of retreat, and on measures which had been taken to promote conservation. These were the establishment of forest reserves and national parks, the requirement of compulsory replanting work for 60 days each year by the Congo population, the planned re-afforestation of certain important water sheds and other devastated areas, legislation, admittedly ineffective, for the control of bush fires, which were often surreptitiously lit at night, and the actual unavailability of great grassland area for grazing unless burning was permitted. "Old dry grasses," he said, are no good as fodder. . . . Moreover, as it is impossible to mow the vast areas needed to graze African livestock, there is no way except burning. . . . The fellings carried out in the forest by Europeans to make room for their plantations are only a small item compared with the ravages caused by the natives when they shift their crops. . . . The only way of putting an end to shifting cultivation would be to enrich the soil. . . . But the products of native agriculture are of too low a value to allow of buying fertilizers . . . or even of forcing the natives to devote three times the amount of effort to farming. These are problems the importance of which should not be underestimated."

Sir William Hunt said that in the southern provinces of Nigeria forest preservation was "the most unpopular of causes with the natives and the District Officer consciously or subconsciously fights shy of it. . . . All attempts at measuring land in the Southern Provinces meet with the greatest opposition. . . . The extent of the areas subjected to shifting cultivation during the last 10 to 20 years . . . have certainly increased . . . owing to the . . . cessation of tribal warfare and the readiness of the farmer to go further afield. . . . There is no regulation in Nigeria outside the small cultivation on the taungya system in forest reserves . . . a few chiefs are enlightened enough to understand the need for regulation but even they can hardly resist the lure of quick profits from cocoa farms made in virgin bush. . . . In Nigeria (Southern Provinces) the Forestry Department has tried to get 25% of each Province constituted as a forest reserve, protect that 25% rigidly, and let the natives do as they please in the remaining 75%, but I doubt if they have succeeded, even on paper, except perhaps in Benin Province. . . . In Benin the land in theory belongs to the Oba, who happens to be a progressive man. . . . The Oba's policy, however, met with much opposition. . . . The native staff is very venial and in sympathy with the people. . . . Outside the Benin Province I know of only one case where the people of their own free will constituted a forest reserve, and that was in a mangrove swamp."

Mr. G. T. Stanley Clarke, late District Commissioner, Basutoland, said of overstocked farms:

(p. 21.) "The soil is trampled hard and impervious to the rain, but movement of stock kicks up a loose surface. Paths were made everywhere. . . . When the rain fell in torrents it rushed about, having no herbage sufficiently strong to control it. . . . Streams ran down the paths and wore them into furrows, these increased to dongas and the dongas increased to river beds. . . . Large patches of land are now irredeemable and the position gets worse daily. . . . It appears to me that with our European outlook we have attempted to use the soil of Africa to a greater extent than nature intended. . . . The Europeans will undoubtedly resist any attempt at interference, and to cut down the stock of the natives impinges on aspects more religious than mathematical."

Governor Brunot suggested encouragement of natives in establishment of "sacred forests" (bois sacrés).

Count P. de Briey felt that the taungya system would require an impracticable amount of supervision. He remarked: "The native is a born enemy of the forest plant, which he regards as a parasite. If he is compelled to cultivate any, he combats them in any way he can." He thought dense, block afforestation would be more likely to succeed.

Steinen, Karl von den (1886) *Durch Central Brasilien. Expedition zur Erforschung des Schingú in Jahre 1884.* Leipzig: F. A. Brockhaus 372 pp., 77 figs., 16 plates, tables, 3 maps.

Karl von den Steinen was the pioneer explorer of the Xingu River of Brazil, which has its headwaters in the campos of Mato Grosso and flows through the Amazonian forest to the Amazon. His start was made from Cuyabá on the Paraguay River. His first contact was with Bakairí Indians of the Carib stem before reaching the headwaters of the Xingu. Then, in order, he reached the Kustenaú of the Nu stem, the Suya of the Tapuya stem, the Manitsauá of the Tupi stem to the west of the Xingu, and the Karajá to the east.

He tells us that there were deserted Indian clearings along the upper course of the Batovy River, the tributary on which he embarked by canoe for his perilous adventure down the Xingu. The "chapadao" alternated with forest, and when he made side trips away from the river, he himself did as the Indians did and kindled fires in the dry grass, so it would be easier to get back to camp after a short reconnaissance ahead. What he figured (p. 155) as "burning riverbank forest" was actually, according to his description, mostly burning bamboo and grass. There was not much evidence of the presence of Indians except

traces of their canoe portages around the numerous rapids and falls until they were well within the forested region. At first the forest was merely fringing or "gallery" forest but how far that continued there was soon no evidence after they got a little to the northward, for any natural prairie away from the river would be invisible from the river. There were, however, old Indian clearings near the river, overgrown with grass and bamboo in which the explorer started great conflagrations of the "forest", which would have been impossible had it been old primary forest instead of the secondary growth of bamboo and grass.

The annotations of von den Steinen's traverse maps as he proceeded in a generally northward direction down the Xingu reveal much about the vegetation. One of the difficulties of finding out much about man's influence on the great Amazonian forest is that records of travel and scientific exploration have always been so largely confined to the streams. A traveller by canoe on a stream with fringing forest is quite likely not to know what the conditions are away from the stream, and the modern forest-dwelling Indians of the Amazon tributaries conceal the approaches to their clearings from the rivers.

Modern methods of aerial photographic survey show up actual openings, of course, but the irregular boundaries of older stages of forest regeneration are not always easily distinguishable from primary forest. The writer does not know to what extent photographic airplane survey of the actual extent of the Amazonian forest has progressed. There are, however, many small aboriginal tribes in the forest and their aggregate effect through the centuries cannot have been negligible.

Von den Steinen started by boat after travel across the campo and for various stations indicates the latitude and longitude, as well as the general nature of the vegetation and whether there were Indians in evidence or not. Pertinent notes from his maps follow:

Station 1. $54^{\circ} 24' W.$; $13^{\circ} 57' S.$ Stream bordered by forest. This undoubtedly represents extension of forest along the stream as fringing or "gallery" forest, as described for other rivers of the Amazonian region by Rondon, Heyne, Roosevelt and others. The river valley was here of appreciable width, but it diminished as they progressed, and the entry into a narrow rock-walled defile before reaching $13^{\circ} 10' S.$ (between Stations 9 and 10) may possibly represent the greatest extent of natural northward prairie lobes reaching into the forest on the plateau between the rivers, but this is mere conjecture.

Station 2. Bush-forest.

Station 3. Beautiful trees, then a glimpse of chapadao (old clearing).

Station 6. Buriti palms.

Station 9. 13° 37' S. Thick vegetation; then thick woods, and, soon after entering the rocky walled defile, the first evidence of actual Indian occupancy.

Station 11. Traces of Indians, with buritisa (groves of buriti palms indicative of secondary vegetation).

Station 12. 13° 21' S. Buritisa.

Stations 14 and 15. Signs of Indians. Forest Path.

Station 16. 13° 14' S. Palm grove. The first village of the Bakaíri Indians.

Stations 18 and 19. 13° 7' S. Second Bakaíri village.

Station 20. After this, very thin forest.

Station 21. 12° 53' S. Third Bakaíri village, somewhat away from the river.

Station 24. Thin forest.

Stations 26 and 28. Fourth Bakaíri village: clearings.

Station 29. 12° 17' S. Settlement and planted clearings of Kustenu Indians.

Station 30. Buriti and then bacava palms.

Station 31. Beautiful trees.

Station 32. 11° 55' S. Confluence of their Batovy River, which they concluded to be the Tamiatoala, and then shortly with the Ronuro and the Kuliséu, to form the Xingu. A short distance up the Kuliséu River was a village of the Trumai Indians, and farther up there were said to be about twelve tribes on this river and its tributaries. Before reaching the next station they passed a grove of urum palms.

Station 36. 11° 41' S. Confluence with the Suyá missú (River) and village of the Suyá Indians.

There is no use in detailing further than this point the succession of actual village sites, signs of present Indian occupation, or evidence of older clearings in the form of palm groves surrounded by forests. Since the region is one in which palm groves unmixed with dicotyledonous trees are almost certainly to be considered evidence of old agricultural clearings with the plant succession modified by fire, it is obvious that even along the river the "amazonian forest has suffered some inroads upon its integrity. On account of intertribal warfare the more important clearings were ordinarily reached by obscure and devious paths, so vague evidence at the riverside of Indian occupation might

have indicated a settlement of considerable size that was out of sight.

Anyway, the rivers were the highways, and cultivation was at the expense of forest. As for the lobes of prairies (campo) which, between the rivers formed tongue-like extensions from the great central campos, they were soon out of sight as one went northward by river. At first there was fringing forest, which soon became broader, until there was no longer any visible evidence from the river of natural or edaphic prairie. How far it extended as tongues or a succession of prairie "islands" one could not know from the type of survey that was possible in von den Steinen's time. The whole region has now probably been photographed from the air, or enough of it to provide relatively complete information on vegetational boundaries, and it is to be hoped that new phytogeographic maps of the great Amazonian forest will become available.

Stephens, John L. (1841) *Incidents of Travel in Central America, Chiapas, and Yucatan*. 2 vols. New York: Harper and Brothers. viii + 424, x + 474 pp., illust., map.

The famous archeological explorer Stephens made an extensive tour through Central America in 1839 and 1840. He did not correlate his observation of devastating fires with particular agricultural practices and was generally quite vague about the vegetation of the country except that he travelled alternately through great prairies and forests but the fact that he encountered extensive fires twice is an indication of their prevalence and that they must have had a determinative effect on vegetation. The pertinent quotations follow: Following survey lines for the proposed transcontinental canal near Lake Nicaragua, he wrote (Vol. I, p. 403):

"Coming out into the road, the change was beautiful. It was about ten feet wide, straight, and shaded by the noblest trees in the Nicaragua forests. In an hour we reached the boca of the mountain, where Nicolas was waiting with the mules under the shade of a large tree, which threw its branches fifty feet from its trunk, and seemed reared by a beneficent hand for the shelter of a weary traveller. . . Soon we reached another station of Mr. Bailey. Looking back, I saw the two great mountain ranges, standing like giant portals, and could but think what a magnificent spectacle it would be to see a ship, with all its spars and rigging, cross the plain, pass through the great door, and move on to the Pacific. Beyond, the whole plain was on fire; the long grass, scorched by the summer's sun, crackled, flashed, and burned like powder. The road was a sheet of flame, and when the fire had passed the earth was black and hot. We rode some distance on the smoking ground along the line of flame, and finding a favourable place,

spurred the mules through; but part of the luggage took fire, my face and hands were scorched, and my whole body heated.

"Off from the road, on the edge of the woods, and near the River Las Lahas, was another station of Mr. Bailey. From that place the line runs direct over a plain till it strikes the same river near the Lake of Nicaragua. I attempted to follow the lines again, but was prevented by the growth of underwood."

Then, north of Quequetenango in Guatemala, not far south of the boundary of Chiapas, he had a second experience with fire, this one less definitely a grass fire and indicating that on mountain slopes the forest was not immune to invasion and destruction by fire. The trees may have been distant, however, so that there was much combustible grass between them. His description follows (Vol. II, pp. 236-238):

"Passing through the village [of San Andres Petapan], at a short distance beyond we were stopped by a fire in the woods. We turned back, and attempted to pass by another road, but were unable. Before we returned the fire had reached the place we left, and increased so fast that we had apprehensions for the luggage-mules, and hurried them back with the men toward the village. The flames came creeping and crackling toward us, shooting up and whirled by currents of wind, and occasionally, when fed with dry and combustible materials, flashing and darting along like a train of gunpowder. We fell back, keeping as near as we could to the line of fire, the road lying along the side of a mountain; while the fire came from the ravine below, crossing the road, and moving upward. The clouds of smoke and ashes, the rushing of currents of wind and flames, the crackling of burning branches, and trees wrapped in flames, and the rapid progress of the destroying element, made such a wild and fearful scene that we could not tear ourselves away. At length we saw the flames rush up the side of the ravine, intercepting the path before us. We spurred our horses, shot by, and in a moment the whole was a sheet of flame. The fire was now spreading so rapidly that we became alarmed, and hurried back to the church, which, on an elevation strongly defined against the immense mountain in the background, stood before us as a place of refuge. By this time the villagers had become alarmed, and men and women were hurrying to the height to watch the progress of the flames. The village was in danger of conflagration; it would be impossible to urge the loaded mules up the hill we had descended, and we resolved to deposite the luggage in the church, and save the mules by driving them up unburdened. It was another of those wild scenes to which no effect can be given in words. We stopped on the brow of the hill before the square of the church and while we were watching the fire, the black clouds and sheets of flame rolled up the side of the mountain, and spared the village. Relieved from apprehension, we sat down under a tree in front of the church to the calm enjoyment of the terrific spectacle and a cold fowl. The cinders and ashes fell around, and the destructive element rushed on, sparing the village before us, perhaps to lay some other ruins.

"We were obliged to wait two hours. From the foot of the hill on which the village stood the ground was hot and covered with a light coat of ashes; the brush and underwood were burned away; in some places were lying trees reduced to masses of live coal, and others were standing with their trunks and branches all on fire. In one place we passed a square of white ashes, the remains of some miserable Indian hut. Our faces and hands were scorched, and our whole bodies heated when we emerged from the fiery forest."

Strugnelli, E. J. (1932) The teak forests of Java. *Empire Forestry Journal* XI, No. 1, pp. 34-41. 1932.

It is interesting that a somewhat similar modification of the ladang system is found in Java. One of the chief revenue-producing operations of the Netherlands-Indian government was the well known teak forestry of eastern Java. After clear felling teak, cultivation of the land for food crops by contract with local cultivators was customary for a year. Leucaena glauca was grown for a year with the teak as a nitrogen-fertilizing companion, but could not be left uncut because of competition with the teak and danger of its burning. Well grown teak is fire resistant, but the fires which formerly ran over the forest floor are now under control, as a measure of saving humus.

Sucillon, Lieutenant-Colonel (1897) Notes sur le Cercle de Tsiafahy. Colonie de Madagascar. Notes, Reconnaissances et Explorations, Vol. II, No. 8, pp. 118-127, map. Tananarive (Imprimerie Officiel) August, 1897.

One of the most useful official itineraries for reconstruction of the vegetational picture of Madagascar as it was before the end of the last century is that of Lieut.-Col. Sucillon. He made a round trip of fourteen days from Antananarivo due southward, roughly parallel to the edge of the belt called by the French the Grande Forest, occupying the declivity from the Imerina plateau to the eastern coastal plain. His map shows the edge of the forest as far as Ambodifiakarana "where one passed near the ancient forts of Rainibetsimisaraka, of which the emplacements were well chosen for communication with the forest and for seeing, to a great distance, the deforested region which extended to the west." His mission was to plan improving the means for transport of timber from the "Great Forest" to the capital, where lumber was scarce and expensive.

His notes on the boundary between prairie and forest indicated that Tsinjoarivo, near the upper course of the Onivé River, was very near the edge. Here there were numerous small woods scattered about, which could not be exploited for timber because of difficulty of transportation.

On the return trip, Sucillon inspected three block-houses near the edge of the forest south of Nosi-Vola, and noted that at the edge of the forest the transition to prairie was abrupt. The woods were replaced almost completely by tall and dense herbaceous vegetation which seemed suitable for pasturage but human resources and supporting agriculture were lacking.

Still farther north near the block-house of Ambohibe there were forested elevations four or five meters above the general level, separated from each other by a great area of fern. These forested spots seemed to have been extensively culled, for Sucillon noted that they would furnish fire-wood but not lumber for construction. It was the same from there to Ambiaty, where they entered the edge of the "Great Forest", which was continuous and fairly dense, but like the isolated patches, of little use as a source of lumber for carpentry because big trees were scarce. Then, when he reached a better area at Ambohibazaha, the French were engaged in forest exploitation, but were greatly handicapped by difficulties of transportation.

Sulit, Carlos (1947) Forestry in the Philippines during the Japanese occupation. Phil. Journ. Forestry Vol. V No. 1, pp. 22-49. 1947.

The Japanese occupation of the Philippines disrupted the economy and caused unprecedented food shortage, aggravated by the presence of many thousands of Japanese troops. On May 14, 1942 all available idle public and private lands were opened to cultivation by executive order. The order expressly forbade kaingin in the public forests except as approved by the Director of Forestry, but this was misunderstood or disregarded. The Governor of Antique, for instance, declared the entire province as open to agricultural occupation during the emergency. In Makiling National Park great damage was indirectly caused by the Japanese for by commandeering the best agricultural lands around the park they forced the population to kaingin in the park, so that 200 hectares of forest were destroyed. War operations in the forests also caused great destruction. It is notable that the Japanese never wholly suppressed the guerilla movement and that some forestry work and regulation was attempted from 1941 until 1953 under guerilla government and in 1942 under the Free Leyte Government of Col. Ruperto Kangleon. The various guerilla regimes did their best under impossibly difficult conditions and especially tried to counteract the proclamation of the Governor

of Antique which had the effect of legalizing forest destruction. In all, however, the Japanese occupation period was one of forest retrogression.

Tansley & Chipp (Vegetation); Taylor (Africa); Terra (S.E. Asia). 511.

Tansley, Arthur George and Chipp, T. F. (1926) Aims and Methods in the Study of Vegetation. London: British Empire Vegetation Committee and the Crown Agents for the Colonies. xvi + 383 pp., 62 figs.

The chapters bearing on the tropics are by special authors and are listed included under Bews (1926), Chipp (1926), Stamp (1926), and Troup (1926).

Taylor, J. E. (1942) Termite Mounds used for Manure. Farm and Forest, or Land Use and Rural Planning in West Africa. Vol. III, No. 1, p. 49. March 1942.

J. E. Taylor encountered a unique method used at a pagan village in Alawa District, Niger Province, for fertilizing the soil. The red termite mounds were pulverized and scattered over the land. Fifty acres had been kept continuously fertile and productive by this method. The same people arranged for the Fulani to kraal cattle on their land, and had thus developed two modes of maintaining permanent agriculture.

Terra, G.J.A. (1953) Some sociological aspects of agriculture in S.E. Asia. Indonesia, Vol. VI, no. 4, pp. 297-316; No. 5, pp 439-463. Jan. and Mch. 1953.

G.J.A. Terra has compared some aspects of the status of native agriculture in regions using Austronesian languages (i. e., those of Indonesia and linguistically related areas) with the same aspects among the peoples of South East Asia by whom the Austroasiatic languages are spoken. He has tried to establish certain ethnological correlations which would seem logical enough for which the evidence, as he presents it, seems decidedly precarious. At any rate, his arguments cannot be followed with satisfaction and conclusions do not emerge with sufficient clarity to be convincing. He has followed the language groupings of Schmidt and Kern in classifying data, and if the present reviewer has not oversimplified his thesis, has sought to show that within the two great groups of "Austro" peoples the agricultural correlations are as follows: (1) matriarchal groups have mixed gardens, do not hold cattle, and do not live in such a manner as to bring about the development of grasslands; (2) patriarchal groups do not have mixed gardens, have numerous cattle, and live amid grasslands which have originated by shifting agriculture and repeated grass fires. Terra seems to argue circuitously, however, in concluding that when patriarchal peoples have mixed gardens, they were formerly matriarchal. This may well be true, but

would require proof. Likewise, we are left to infer, without any evidence, that a patriarchal people such as the Batak are a cattle-raising people. There is some cattle-raising in the Batak lands, chiefly to supply carabao for sacrificial feasts, but it was of slight extent even after the colonial government tried to encourage it. Thus, Tideman () gives the data for the Simeloengoen Batak, who had vast and largely unutilized lalang prairies but few cattle.

Another circuitous type of argument is to assume that a people having grass plains but few or no cattle displaced a former population of different habits and merely inherited the grasslands without having produced them.

At any rate, even if the present writer has been unable to follow Terra's argument, he finds great value in Terra's having called so strongly to attention the social significance of the mixed gardens from the standpoint of permanent settlement and utilization of land. Village gardens are associated with some degree of permanency of occupation of the land. As villages became established from original distant forest clearings, as population centers, the houses or other buildings came to be too valuable for abandonment, for they would be solidly built of materials no longer easy to get, elaborately ornamented, and some of them traditionally of great ceremonial and social significance. By the time this came about family groups would have flocked off and established colonies connected with the parent village, and depending upon shifting agriculture, whereas the parent village having become a regional market center, would have established more and more permanent plantings largely of trees, but also of other plantings for which the land would inevitably be fertilized because of proximity to a dense human and animal population, for there would be domestic animals such as village carabao to raise for sacrifice or to tread the wet rice fields, pigs, goats, and fowl. The few carabao kept under the Batak houses and fed on grass brought in from a distance, or driven out daily to pasture under the care of the children, are as far as possible from having the status of the herds of a pastoral people.

Thuy, G. de (1898) Six Semaines dans le Sud-Ouest. Colonie de Madagascar. Notes, Reconnaissances et Explorations. Vol. III, whole no. 13, pp. 26-64. Tananarive: Imp. Officielle. Jan. 1898.

Captain G. de Thuy of the French Foreign Legion in a notable paper on the south-west of Madagascar said that the plain of Ikalamavona had scattered little trees here and there which did not exceed a height of two or three meters which did not seem as if they could be of much use except for fire-wood. There were a few fine trees along three main water courses but he said that the time had come to take protective measures if one did not wish to see the last vestiges of forest disappear. He found the chain of Bongo-Lava to have been completely denuded except in ravines, and even there fire was at its destructive work, for travellers resting over night had no respect for the trees and their cooking fires consumed the lower branches. At the summit called Madinikamala were a fair number of palms with scorched trunks signifying what they had survived.

Approaching Mt. Ambohibola the number of trees increased, and at Mahereza there was actual forest in a belt perhaps two or three kilometers across, which continued along the Mangoky River. Approaching Volambita the forest disappeared and the Maha massif appeared bare, but on reaching the Marirano basin there was forest again and fine valuable timber menaced by fire.

South of Mangoky there developed a forest band as much as 30 kilometers across. The borders of the Mangoky river were beautifully forested. Proceeding eastward woods become thinner and at Menamaty, as at the north of Manoky one finds himself in a country absolutely deprived of trees, save immediately along streams.

To summarize, de Thuy found that from the 43° to the coast there were very important forest resources in need of conservation as well as isolated trees always endangered by fire and by the deplorable method by which the natives felled them, i. e., making a fire around the base and burning them down, thus wasting much of the trunk. If wasteful exploitation and fire were not prohibited, he predicted the quick destruction of all forests and scattered trees.

Tideman, J. (1922) Simeloengoen: het Land der Timor-Bataks in zijn vroegere Isolatie en zijn Ontwikkeling tot een Deel van het Cultuurgebied van de Oostkust van Sumatra. Leiden: Louis H. Becherer. xii + 306 pp., 26 pl., 2 maps.

Simeloengoen is one of the major linguistic and (under the Dutch) administrative divisions of the Batak-lands of North Sumatra, lying east of Toba Lake, north of Asahan, and south of Karoland. Before World War II it was the scene of great agricultural progress, for much land had been taken up for rubber and tea estates. This had been at the cost of relatively little primary forest, for most of the land had been transformed by shifting cultivation and fire, repeated not once but many times, into great stretches of lalang grass and poor second growth woodland.

Tideman (1922, p. 124) remarked on the important difference in this area between the permanent cultivation of wet-land rice (sawah cultivation) and the dry-land or ladang cultivation which prevailed prior to his intelligent administration as Assistant-Resident. It was Tideman, as a matter of fact, who introduced irrigation, fostered immigration of surplus population from Toba, and was responsible for remarkable forward steps in the rehabilitation of a rundown and desolate part of the Batak lands. He was a model administrator.

Condemning the ladang system as true robbery agriculture, he said that the same piece of land was seldom used continuously as long as four years. By preference forest-land was cleared, for it was the most fertile and required the least attention in the way of cultivation during the first and second years. The unburned trees and branches were chopped up with the little Malayan axe (bëlioeng) and chopping knife (parang). Weeds were removed with the knife called tadjak and later, when the crop was growing with a curved knife (kiskis). In preparation for the second year's sowing the soil was superficially worked over with a bamboo stick with two sharp points (gogo), by which the weeds were uprooted.

Because the ladang areas were burned over yearly after cultivation was discontinued a great deal of the once forested Simeloengoen was deforested. The Government forest service had taken measures to prevent this during Tideman's regime. Devastation of forest had reduced some cultivators to the necessity of using alang-alang (Batak rih) plains for their crops, but this required extreme toil with noe (hoedali) and digging sticks (pakoeh) of the extraordinarily hard wood of the niboeng palm. The planting was done by punching holes in the ground with planting sticks (parlobong) held in each hand. The hole-puncher (either man or woman) was followed by someone who put three or four rice grains in each hole.

Rice was followed by maize and root crops, for the Simeloengoen Batak, like all their kin (at least in the East Coast region) generally planted a mixture of plants after the primary rice crop was harvested so that there was something available for another couple of years or possibly three. One of the secondary crops had always been cotton until the home industry of weaving was displaced by the importation of cheap cotton goods from Europe and Japan.

Tothill, J. D. (Editor) (1940) *Agriculture in Uganda*, by the Staff of the Department of Agriculture, Uganda. London: Oxford University Press. 551 pp., 30 pl., 5 maps and charts.

This volume consists of chapters by several authors, the four of whom should especially be cited because the following summary is based upon their contributions. They are:

Haig, N. S. *Native Agriculture. Land Tenure in Buganda Province*, pp. 24-38.

Hansford, C. G. *Topography and Vegetation*, pp. 7-14

Hayes, T. R. *The Development of Ox-cultivation in Uganda*, pp. 54-59.

Martin, E. F. *Native Agriculture. Land Tenure in the Northern Province*, pp. 38-53.

Prior to the introduction of European agricultural practices in Uganda, which as Tothill (1940) said, developed rapidly in the two or three decades before his summary was written, the old native system of shifting agriculture prevailed. Hansford (1940) wrote:

"Shifting agriculture, as practiced in Uganda, meant in most areas opening up grass or bush land, using it for the production of annual crops for two or three years, and then abandoning the land for about eight years. During the eight years it would become clothed in a succession of weeds, grasses, bushes, and sometimes trees, by which time it would be completely renovated and ready again for annual crops. The surveys show that in many areas there is no longer sufficient land to permit an eight-year resting period, and that in some places the demands made upon the land have become so great that the resting period has been reduced to three or two years, and locally to an even shorter period, and that in these areas soil deterioration has set in . . . the African in Uganda has no tradition of soil conservation to assist him to adopt anti-erosion measures. There has never been a shortage of agricultural land. . . He still uses the fire-stick on

resting lands to give young grass for grazing, to make hunting easier, and because he does not understand that the presence of grass and bushes has anything to do with soil regeneration."

The photographs of the Tothill volume show that large areas have lost original vegetation entirely and have become grassland with some brush. On Mt. Elgon at the lower altitudes, cultivated areas alternate with scrub and grassland, but higher up there is forest. To the northward there is scrub and grass, but no cultivation except for a little sorghum. The people live on milk and blood, the latter bled from the living animals. The grass provides for herds, and is burned over frequently. The somewhat more rainy Kioga Basin has more agriculture. "The trees are small to medium-sized; their canopy is seldom dense enough to prevent a rich growth of grass beneath, and the annual grass fires limit the tree flora to species whose bark and buds are able to withstand them. . . ."

The Lake Victoria Basin still had about 120 square miles of forest (the Mabira Forest) in 1937, and there was dense forest along the streams, but most of the area was a dense growth of elephant grass, Pennisetum purpureum, six to ten feet high, in which were scattered trees of the same species found in the forest.

The Ankole pasporal area of Uganda formerly occupied by Bantu agriculturists, of the Bairu tribe, is now the home of the Bahima, a group who live on their cattle. "Over much of this area there appears to be little prospect of agricultural development."

The Southwestern hill region is still occupied by agriculturists. Adjoining Toro is largely elephant grass at lower levels, with forest above. It also has much native agriculture. European planters have replaced part of the elephant grass area by coffee. The natives of the Semliki Flats (Bwamba) have followed suit, and have a flourishing coffee industry where there was formerly elephant grass. The Lake Albert plains, mostly dry grassland, have a scanty population but the country merges into forest.

According to T. R. Hayes the whole of the Eastern Province of Uganda is Crown land, held in trust for the tribes inhabiting various portions of it under the Buganda busulu system of administration, somewhat modified by Semei Kakungurn, a gifted Muganda who was native advisor during the early days of colonial administration. Alienation of land is allowed only for essential public services. The policy is that every man can hold the land he occupies as long as he makes use of it. Chiefs and others performing administrative duties are entitled to busulu, or tribute.

Under the old conditions there was usually more than enough land for everyone and it was as free as air. Abolition of warfare, improved health, and famine relief so greatly increased the population that there was a vast increase in cultivated land and in cattle raising. It was not until 1907, T.R. Hayes tells us, that ox-plowing was at last taken up by the people. It has enabled grassland to be cultivated that formerly could not be broken.

In the Teso District custom permits any man to settle wherever he can find an unoccupied place. He needs no permission from anyone. There are clans, but no clan ownership or control of land. The payment of busulu or tribute is a personal obligation of a man to his chief and is quite unconnected with the location of his land. Hays tells us that as long as a Teso native cultivates his land, including periods of fallow, he remains in undisputed possession. If he forsakes his holding by removing his residence or by failure to cultivate for a year, his rights lapse. The first comer may take it. A son, a brother, or a widow may inherit a homestead.

Other districts of the Eastern Province of Uganda have other modifications of custom regarding land ownership and use. It has seemed impossible to defy native custom by granting of freehold rights to each proprietor of land. On the contrary, it has been impossible to enforce conservation policies for land and soil if the proprietor neither had nor wanted permanent possession.

In the Northern Province of Uganda, Martin tells us that there is so much land that it has no commercial value. There is some village and clan ownership. The boundaries of a village are not fixed, but change if the community shifts its area of cultivation. In some areas "resting" land which has been unused for several years can be settled by a newcomer only with permission of the last holder, but disputes are so very unusual that one District Commissioner never encountered one.

In the Western Province of Uganda "Land abandoned for a period may be returned to, but it appears to be more usual to start afresh on new land. This type of cultivation is wasteful of land and forest, and as a result the mountain forest adjacent to the Bakonjo settlements is receding rapidly. The eastern slope of the northern end of the mountain is now practically denuded of trees and only a narrow strip of forest remains adjacent to the bamboo belt. Denudation is rapid and progressive and if unchecked may come to have far-reaching results on the climate of the country. Owing to annual grass fires little natural regeneration is taking place, except perhaps in the deep gullies which scar the hills at frequent intervals, and measures to stop the destruction of the forest are therefore under consideration."

Tothill, J. D. (Ed.) (1948) *Agriculture in the Sudan: Being a Handbook of Agriculture as Practised in the Anglo-Egyptian Sudan*. London: Oxford Univ. Press. 974 pp., 408 figs., 17 maps, tables, etc.

This volume is an assemblage of chapters by various authors, of whom the following are cited in the present connection:

Andrews, F. W. *The Vegetation of the Sudan*, Chapter IV, pp. 32-61.

Andrews, W. *Geology of the Sudan*, Chapter VI, pp. 84-128.

Burnett, J. R. *Crop Production*. Chapter XV, pp. 275-301.

Crowther, Frank *A Review of Experimental Work*. Chapter XX, pp. 439-592.

Ferguson, H. *Equatoria Province*. Chapter XXXI, pp. 875-918.

Tothill, J. D. *A Note on the Origins of the Soils of the Sudan, from the Point of View of the Man in the Field*. Chapter VII, pp. 129-143.

Tothill contributes an interesting discussion of the probable climatic change since the deposition of the Gezira plain, which change has brought about progressive restriction of the range of the snail Limicolaria flammata. In deposits apparently laid down following the major wet period of Glacial times this snail is abundantly represented by fossils. In view of the vast amount of theorizing about climatic change and the recession of the African forest it is a great satisfaction to find tangible geological evidence of the greater extension of moist habitats in relatively recent times. The pertinent quotations from Tothill's chapter follow:

(p. 138) "When the Gezira plain was built up to its present level, the climate by analogy with Kenya and Uganda, probably became drier even than it is today, but there is insufficient evidence as yet either to support or disprove this notion. A. J. Arkell has shown, however, that the snail Limicolaria flammata was abundant at what is now Khartoum at some date between 5000 B.C. and 3000 B.C. when a village of that period flourished on the plot of land just east of the Khartoum civil hospital, so that the age of these clays [older than the period of the present climate including the alluvial clay of the Gezira] is not necessarily identical. . . The best dating so far is Arkell's determination of the layer just beneath the Gezira clay at and near Singa as being close to Kenya Fauresmith on the basis of artefacts found in that layer. This dates the Gezira clay as probably Gamblian, this representing the final major wet period of Glacial times although there may have been a dry period after completion of the plain, perhaps represented by the salty layer

of the Gezira soil, there was subsequently a period that was a good deal wetter than now close to the beginning of Egyptian historical times. At this period this land snail, now so common over the clay plain of the Acacia Tall Grass Zone in areas not subject to annual flooding, occurred all over the Gezira. This moist period of roughly predynastic late neolithic times possibly corresponds to the Makalian wet period of Kenya and Uganda. The adult semi-fossil shells of Limicolaria obtained by A. J. Arkell at his Hospital site excavation are notably smaller than is normal today for Suki to Gedaref specimens, which suggests that the climate was changing to the present one in which this conspicuous cone-shaped land mollusc is uncommon north of Singa and unknown except as a semi-fossil north of Wad Medani. . ."

Garnier, "M. le Lieutenant-colonel", (Ed.) (1900) Notice sur le Laos Francais, publiée par ordre de M. Paul Doumier, par le personnel administratif du Laos. Hanoi: F. H. Schneider. pp. 191, map.

Following Garnier progress was made in classifying the primitive groups of Laos who were all called Kha by Garnier. An official work compiled by Tournier stated (p. 102) that there were sixteen different groups, speaking different dialects, and making up a third of the population. He did not attempt to make any distinction among them so far as agricultural practices were concerned. They were not strictly nomades, but changed their residence rather frequently, whenever they had cleared, cultivated and exhausted all the land near their habitation. During the dry season all the people of a village joined in the common labor of chopping and clearing, let the debris dry and burned it. At the beginning of the wet season they dropped a few grains of rice in little holes punched in the ground, and at length harvested from fifteenfold to twenty-fivefold. Except for one group, the northern groups planted only glutinous rice. The planting was called a raï, and all the raïs were at a considerable elevation, since the more cultured lowlanders exploited and enslaved the Kha who came too close to the valleys.

Trapnell, C. G., and Clothier, J. N. (1937) The Soils, Vegetation and Agricultural Systems of North Western Rhodesia. Report of the Ecological Survey. n.p., n.d. [Lusaka?, 1937?] x + 81 + v pp., plates, maps (folio).

One of the major achievements in the field of ethnology is a remarkable report by Trapnell and Clothier on northwestern Rhodesia. It shows the differences that actually exist among the forest associations of the area, depending upon soil and site, the parallel variations that exist in the man-made grasslands, and the many types of agriculture characteristic for the vegetational areas and the numerous tribes. Except for another contribution by Trapnell () it is hard to find its equal as a meticulous study of tropical man's agricultural adaptation to his various habitats.

To quote the authors themselves, they say:

(p. ix) "It should be understood that ecology is not, as often supposed, a new science but rather a method of approach to biological subjects. In its broadest application it may be defined as a study of plant, animal or human life in the light of the control exercised upon living things by the external factors of the environment and by their own interactions. Agriculture, as a human activity concerned with living things, admits of such an approach. Instituted with a view to making an ecological investigation of the country and thereby of its natural resources, the Survey has extended the application of ecology to native crops and agricultural customs and finally to native agricultural development. It may be said to have provided a new approach to native agriculture whereby native practices can be investigated as the product of their environment, and their development guided by comparative study and scientific knowledge of the country.

Trapnell and Clothier () say of the older ironstone soils of Northern Rhodesia:

(p. 5) "Under this head are designated partially denuded soils of the older land surfaces. These are shallow pallid soils of clayey to sandy texture, loaded with ferruginous nodules and fringed with massive concretionary ironstone. These "fossil" soils are exemplified on the Lusaka limestones but are best preserved along the Congo border and towards the Lukanga Swamp. They vary little with geological formation and answer to the class of Murram soils on the East African Soil Map. Except that they are employed by natives for finger-millet cultivation, they are agriculturally useless".

(p. 23) "It will be seen that the distribution of crops is throughout consistent with changes in type of country, and that a distinctive combination of crops is accordingly found in each agricultural system."

(p. 26) "The preparation of the bush garden in one form or another forms the traditional basis of native agricultural systems with the exception of the Central Kalahari Plains system. . . In the Chiteme (or Fiteme) method employed by the Lamba-Kaonde group of the Northern Plateau, trees are felled over an area larger than that which is to be planted, the branches lopped, carried to preserve the leaves, and laid in low stacks or flattened piles for burning, forming thick ash patches which are subsequently cultivated. Among the Luvale, Lunda, and allied tribes on the heavily wooded Northern Kalahari soils, the whole or greater part of the area cut is covered indiscriminately with chopped branches and the trunks of the smaller trees, larger trunks often being left standing, and all is taken under cultivation. Among the southern tribes generally, branches are chopped off the felled trees and dragged into shallower piles spread about the trunks. After firing, remaining incompletely burnt wood may be again stacked and burnt in the same or the following year. Only parts of the garden are thus much burnt but the whole area cut is taken under cultivation. . . A heavy burn and a liberal supply of ash is general either for the cultivation either of finger or of bulrush millet [*Eleusine typhoides*], *E. coracana* and *Pennisetum* with a view both to destruction of weeds and to fertilizing the land. The heavy burn is retained for kaffir corn in the Chiteme method of cultivation on Northern Plateau clays to which it gives increased friability. But only in the case of the primitive Chiteme garden for finger millet and of some associated first-year Chiteme patches for kaffir corn [*Sorghum*, spp.] is the seed sown directly into the ash without hoe cultivation. Maize and pumpkins are planted with the hoe on the thicker ash patches on Plateau soils because of their greater fertility. With these exceptions, the burning is done primarily with a view to clearing the land."

The Southern Plateau system is varied, but there are certain general characteristics of most of the variants:

(p. 34) "The branches of the felled trees are normally dragged into spread piles about trunks and stumps. The whole area of the clearing is hoed up after the burning. . . The cultivation of any one piece of land is carried on for two to four years."

(p. 35) "By contrast with the somewhat primitive shifting cultivation of the Mashasha and Lenje, the Tonga have developed a more elaborate system. . . The bush gardens of the entire village are laid out in one large block. . . Each man extends his garden into the bush every year with areas of groundnuts [*Arachis hypogaea*] and ground beans [*Voandzeia*] on unburnt land together with some kaffir corn and maize and pumpkins on smaller burnt areas, and finger millet in patches on the thickest ash where branches have been piled and burnt round stumps."

(p. 36) "Neither chiteme gardens for finger millet nor ridge cultivations of Livingston potato are proper to the Southern Plateau tradition. . . Exceptions are, however, found among the Lenje and Kaonde who make small chiteme gardens, not exceeding one-eighth of an acre, about anthills in the bush. These gardens, which are unrelated to their main bush gardens, resemble the chiteme gardens of the Bulima of the Northern Plateau system but are small and scattered. They are prepared in the same fashion, and are planted for one year with finger millet on level ground . . . for one or two years. After this they are abandoned."

In the Northern Kalahari there are gardens of distinctive type for the region and others showing transitional stages from the "Southern Plateau System". The transitional chiteme planting is made as follows:

(p. 38) "Two to five acres of land are cut by each man and the branches stacked in a series of circular or elongated piles. In areas of taller bush the trees are climbed and the branches lopped off as in North-Eastern Rhodesia. The piles collectively usually occupy one-eighth to one-fourth of the area cleared. In the low watershed scrub cut by the Luba, one-tenth to one-sixth is occupied, often by very small piles (under fifteen feet in diameter) which are sometimes scattered through the bush and not made in one clearing. Each man in this case is said to burn ten to fifteen piles. The ash is broadcast with finger millet, with a little sesame or Tephrosia. No cultivation is given and the sites are abandoned annually."

Further variants are too numerous to be detailed, but the fact emerges that the more elaborate cropping systems become modified so as to make some use of land cleared for chiteme enrichment and therefore not burned over, because the wood has been removed for concentrated burning.

The Central Kalahari agricultural system has at least seven types of gardens which are related to particular types of vegetational associations and have special names. Some of them are highly distinctive and show much understanding by the natives of each sort of a natural vegetational habitat. Passing over numerous types of field or garden in progressing southward, our authors finally describe the Londe cultivation of the lower [Zambesi] Valley System.

"The cut thicket is spread in piles over the ground and produces a heavy burn. Some three acres is cleared and increased to five by annual extensions of one-half to one acre. . . Old land is abandoned as new land is taken up in extensions."

As to the effects of fire we read:

(p. 63) " Fires are most devastating in their effects on indigenous Kalahari vegetation. The most spectacular destruction is seen

in the denser Baikiaea and Cryptosepalum types of forest. Fires generally make ingress into these forests by spreading from the tall grass and inflammable shrub growth of an old garden, with the result, not merely of the seedling destruction and arrested growth which is caused by grass fires in open woodland, but of wholesale devastation, the trees being charred to the crown. . . ."

(p. 64) "It may be fairly said that the danger of fire damage in open woodland of this type is only less [than in denser] because the damage has already been done. Thicker and taller growth with a greater proportion of valuable timbers would certainly exist but for the grass fires which pass through them every year or two."

(p. 64) "Through a wide belt on the east side of the Barotse Plain and narrower belts to the west, former Baikiaea woodland has been reduced to Baphia scrub known as Isunde and it is recognized by the Rozi themselves that where Isunde has come in the valuable trees will no longer return. . . . The recent great influx of Luvale and other Angolan tribes . . . is extending deforestation. These tribes, the "Mawiko" are generally made the scapegoats for the destruction which is taking place, but it would seem that the most serious damage has already been done by the central peoples about the Barotse Plain whose recultivation system, necessitated by close settlement causes more permanent destruction of bush and greater soil depletion than the repeatedly shifted gardens of the immigrants."

Trapnell, C. G. (1943) *The Soils, Vegetation and Agriculture of North-Eastern Rhodesia. Report of the Ecological Survey.* Lusaka, N. Rhodesia: Government Printer. 111 pp. (folio).

The monograph of Trapnell on Northeastern Rhodesia is one of his two extraordinary performances whether judged from a botanical or an anthropological standpoint. He gives a systematic and detailed account of shifting agriculture among many tribes that is exceedingly satisfying to one who searches the literature only to find repetition of vague generalities. The multiplicity of agricultural systems cannot even be referred to in this article which is concerned chiefly with fire, but all of them start at some point in time with a fired clearing. The modifications of the simplest form of ash cultivation are such as prolong the utility of the clearing by fertilization of various sorts, and they have extraordinary significance as beginning stages by way of various systems of Chitemene cultivation, on the way toward permanent land utilization, and, finally, the transformation of chitemene into a permanent form of agriculture. Trapnell says of chitemene:

"The method of garden preparation known among the Lamba-Lala group of tribes as Chiteme (literally "cutting place") and among the Wisa and Wemba-speaking peoples as Chitemene has already been described in a modified form in the Northern Plateau system. . . In North-Eastern Rhodesia the essential characteristics of the method, the lopping or felling of trees over an area many times larger than that which is to be cultivated and the annual stacking of the stacked branches, have given it an exceptional notoriety as a destructive method of cultivation of finger millet, which has only lately been mitigated by experimental proof of its merits as a means of growing the crop in the wooded plateau regions. . . It actually forms the basis of three different agricultural systems in which millet is of varying importance."

The Northern system is different from the Southern in many respects, but chiefly in its less spectacular rate of consumption of woodland. From it is derived the Northern Grassland system, in which the Mambwe, forced by dearth of new forest, have developed at least semi-permanent cultivation. Trapnell's works can hardly be too highly commended as contributions to ethnobotany in the special field of ethnoecology.

Trapnell, C. G., Martin, J. D. and Allan, W. (1948) Vegetation-Soil Map of Northern Rhodesia . . . with an Explanatory Memoir by C. G. Trapnell. Lusaka, Northern Rhodesia: Government Printer. 20 pp., 2 maps, in portfolio.

One of the best phytogeographic maps for any tropical region is that for Northern Rhodesia by Trapnell and others (1948). The botanically informative explanatory memoir, which accompanies it, concludes (p. 20):

"Development of land resources in the Territory hitherto has largely been confined to the better agricultural areas and tobacco lands adjoining the railway line. . . Mention may be made of the potential value of the remarkable forest and agricultural land of the Chipya tracts . . . and the forestry importance of various woodland types on the Kalahari Sands. . . At the same time it should be made clear that many of these areas are at present wasting assets which are deteriorating under the influence of late fires, uncontrolled cultivation and destruction of their more valuable timbers. Extended measures for their conservation and proper utilization will be necessary if the country is to obtain the benefit of its resources."

Troup, R. S. (1926) Problems of Forest Ecology in India. Chapter XV (pp. 283-313): in Tansley and Chipp (1926), q. v.

Troup (p. 305) stated that man's activity in destroying or modifying vegetation in India is in four main directions. These are: "(1) By clearing the existing vegetation, generally for temporary or permanent cultivation; (2) by cutting or lopping trees; (3) by burning, often for producing pasture; (4) by introducing domestic animals to graze and browse."

"There is evidence that many of the grasslands in the forest regions owe their origin to former clearances of forest for shifting cultivation, responsible not only for the destruction of the original forest, but also for a complete alteration of the original forest types over large areas. Under this system of cultivation, patches of forest are cleared and burnt, field crops are raised for one or two years and the clearings are then abandoned. . . . The vegetation springing up on these abandoned clearings varies; in some of tree forest following on a temporary herbaceous growth, in others of bamboo alone, in others of grass grass tends to replace tree growth where there is a long dry season during which intense annual fires are prevalent."

"In this connection bamboos should be regarded as trees rather than as grasses. When forest is cleared and burnt their rhizomes, to a great extent, escape destruction. . . . For this reason, extensive areas of pure bamboo forest have originated as a result of shifting cultivation."

(P. 307) "Fire is an agency of the first importance in regulating succession; its effect is the more marked if it follows on temporary cultivation which has already destroyed the pre-existing forest. . . . There is little doubt that in the regions of heavy rainfall much of the area now covered by deciduous forest was at one time covered by evergreen rain-forest; this is evident from the fact that if the forest is protected from fire evergreen species tend to invade the ground and to oust the deciduous species. . . . Many tracts which were once covered with forest are kept in the condition of open savannas, covered with tall grasses, through which fires of great intensity rage every hot season. But, in spite of these severe fires, tree-growth may successfully invade the grasslands and eventually establish itself, killing out the grass. Only the most fire-resistant species, of which sal (Shorea robusta) is an example, are capable of doing this, and the process is a long one, the young plants being burnt back annually to ground level while the root-system continues to develop until the stems produced are vigorous enough to withstand the fire."

(p. 310) "Evidence points to the fact that. . . . India is primarily a forest country, and that most of the extensive grasslands have been created and maintained as such by the agency of successive generations of pastoral and agricultural peoples. Even at the lower elevations, however, natural grasslands are

to be found, particularly on old swamps and river beds which have partly or wholly dried up, but these are probably not permanent.
. . .

(p. 311) "The grazing and browsing of domestic animals, which is prevalent in many of the forest tracts of India has in certain cases resulted in an almost complete alteration of type. Generally speaking, it causes 'retrogressive succession,' partly through the hardening of the soil, resulting in xerophytic conditions, partly owing to the fact that thorny xerophytic plants have a better chance of escaping destruction. . . . Among armed species Zizyphus Jujuba often forms a dense shrubby growth on heavily grazed areas, where it affords protection to the seedlings of trees and enables them to establish themselves."

Vanderyst, H. (1924) L'evolution des formations botanico-agronomique dans le Congo Occidental. Rev. des Quest. Scient., 1924, 20 Jul., 65-83. (Not seen: discussion based on the review by Kuhnholz-Lourdat (1939).)

It has been argued that the Bantu system of agriculture in tropical Africa is not to be considered as on a par with the more primitive tavy system in Madagascar, or the ray system in Indo-China. The matter has been discussed by Vanderyst and Kuhnholz-Lourdat (1939). It is indeed a great improvement if one is disposed to accept the former's conclusion that Bantu agriculture has actually extended the area of the forest.

Vanderyst believed that the primitive tropical African forest had been receding, because of climatic change, before prehistoric human populations came upon the scene, and had been replaced at the border by mixed steppe vegetation which had more trees and bushes than the savana of today. This was the sort of land, he believes, that was cleared for agriculture by the Bantu tribes. Soon allowed to lie fallow after agricultural use, it became more forested than before, rather than less, and each successive clearing with many or several years intervening, brought about a rotation in which the forest phase has become more and more dominant. The Bantu occupation has extended, according to Vanderyst's hypothesis, into the steppe, and continues to do so, leaving man-made forests behind. He stated that this belief was held by old Bantu chiefs whom he quoted as saying that their country was more or less forested because their agriculture had favored tree growth on fallow land and that many of the forest areas had been created by their own efforts or those of their ancestors. So Vanderyst concluded that agriculture favored the change of a bare steppe into a wooded one, and eventually into a forest. The latter, judiciously exploited for agriculture every fifteen or twenty years, would restore and sustain soil fertility indefinitely.

Needless to say, this high opinion of Bantu agriculture is not held by all. It is based upon a conception that is directly contrary to the usual beliefs of other observers, who conclude that the areas of secondary forest have replaced primary forest, and not climatically produced savana or prairie.

(It should be noted that French and Belgian writers very frequently use "savana" interchangeably with prairie or grassland, with no implication that there are palms or other trees in a savana.) Vanderyst would have it that the postagricultural secondary forests resulted from the forestation of prairie, through the intervention of man. In his experience, it was the European who commenced the destruction of virgin forest. His conclusions, even though locally justified are far out of accord with the wide experience of others who have studied the Congo forest, and who would undoubtedly maintain that any prairie or savana land transformed into forest by Bantu agriculture must have been fire-produced and not climatic prairie.

Vanderyst thought that the effects of Bantu agriculture in the western Congo were beneficial, and it is by no means out of the question that they might locally have been so, where grassland was maintained only by fire, and in exceptional places where the Bantu system included protection from fire. Then the conditions might have been similar to those which Cook (1908) described for the South Texas coast, where cessation of grass burning led to extension of forest.

Certainly much could be said for the Bantu agricultural system if Vanderyst's observations were correct, and if it was actually a rotation in agricultural land use with a long "bush" fallow, drawing upon no new areas of primary or old forest.

Verdaguer, (1912) Contre le déboisement. Menace de déforestation en Indochine, Revue des Eaux et Forêts, Vol. LI, No. 14, pp. 421-426, Jul., 1912.

Verdaguer made a vigorous protest against allowing the continuation of unregulated "ray" agriculture in Indochina. "Ray" is there the equivalent of kaingin in the Philippines or ladang in Malaya, namely, felling and burning forest to make the clearings of primitive agriculture. He advocated regulation such as had been put into effect in the Philippines by the Americans and in India by the British. Free cutting of forest, without method, without regulation, without control, ought to give way to scientific silviculture. The special, even though traditional and hereditary rights of certain villages and tribes to the ignorant, barbarous, and destructive use of wild land should not be allowed to imperil the general economy. A transient, fleeting culture should not compromise the permanent culture of the deltas upon which the security and life of the people depended. Unregulated deforestation, "ray" agriculture, repeated burning for the improvement of pasturage, threatened just that.

Intentional burning over of vast tracts for the better pasturage of a disproportionately small number of buffaloes was intolerable, even if sanctioned by barbarous, irrational ancient custom, deeply anchored in the customs of the people.

Veth, P. J. (a voluminous work of which the pertinent part should have been alphabetized as follows:)

Van Hasselt, A. L. (1882) Volksbeschrijving van Midden-Sumatra. Leiden: E. J. Brill. x + 430 pp. In: Midden Sumatra. Reizen en Onderzoekingen der Sumatra-Expeditie, uitgerust door het Aardrijkskundig Genootschap, 1877-1879, beschreven door de Leden der Expeditie, onder Toezicht van Prof. P. J. Veth. Vol. I, part 1, sect. 1.

Van Hasselt has an unusually full description (p. 300, seq.) of lands as classified by the natives from the standpoint of cultivation and stages of forest regeneration or degradation to grassland in Middle-Sumatra where social institutions and language are Manangkabo (Minangkabau or Mēnangkabau are more usual spellings, from usage in Padang and Palembang) although not typical of the south. The chief division is into productive and non-productive land, namely tanah hidoelig (Mal. tanah idup--live land) and tanah mati (dead land). The "dead" land includes the rimbo (Mal. rimba) or primary forest, with stages of secondary forest resembling that. If alternating with or containing patches of grassland it is rimbo kāsang. Stages of regeneration following clearing, but younger than rimbo, are all biloeka (Malay belukar), divided into old (bilveka toewó) and young (biloeka moedó). While still showing remains of human occupation, such as houses, etc., it is sasog. Cleared land that does not for any reason revert to forest is called goeroen or padang ilalang, the former word apparently applying to the little places of known history and the latter to the vast and long unutilized lalang plains. Then also belonging to the "dead" lands are the disused rice terraces from which water has been diverted to some other place. These are the sawah liè, grown up to grass or brush, but distinguishable by their form as "dead" terraces.

The "live" lands are of course the fruit trees and permanent horticultural gardens at the kôtó (Mal. kuta or huta) the permanently occupied village center, the sawah or irrigated rice fields and terraces, and the openings in active use, or ladang. All these sorts of lands may be thought of as typically disposed about the kôtó more or less symmetrically, the permanently utilized areas immediately at hand, then disused "dead" lands, and finally, far away or high up and inaccessible, still virgin "dead" land, not yet disturbed.

Van Hasselt gives much further detail about agricultural plants and practices. The land classification in Rawas, for example, differs somewhat from that already given. Untouched virgin forest is rimbo lawoeng, rimbo gedang, or rimbo langgawan. If on very broken or steep land it is rimbo loenggam. Forest that is secondary but well on the way toward being identical with primary is rimbo boedjang. Intermediate stages of regeneration are rimbo moeda (young, but big forest) and the various sorts of béloekar. A very special sort of forest is that which cannot be used because taboo, as sacred to spirits. It is tanah seloeman. Lands which are flooded in the wet season and become dry during part of the year are tanah demam panas, upon which "wet" rice may be grown. Tanah repo is land on which forest has been filled, but which cannot be burned over and used for another year. Tanah djerami is land which has been cropped and awaits the proper season for further planting before abandonment. Land that has gone into lalang grass is distinguished from that which has other grasses.

The most important point from the standpoint of permanent agriculture in Middle Sumatra is the fact that grasslands become the joint property of the community within whose jurisdiction they fall. They are used for grazing only, and no individual can assume proprietorship. Thus they are eliminated from the agricultural (cropping) cycle unless at some time they come back into dense enough bush for the grass to be killed out. If this should occur they would become agricultural lands again, subject to assignment to or occupation by individuals.

Vigne, C. Forests of the Northern Territories of the Gold Coast. Empire Forestry Journal. Vol. 15, no. 2, pp. 210-213. 1936.

Vigne (1936) considered that the annual fires of the dry season limited the forest of the Gold Coast to fire-resistant species growing in grassland, i.e., to savannah forest as distinguished from the closed forest of the Guinea region.

Vogt, F., Material zur Ethnographie und Sprache der Guayaki Indianer. Zeitschr. f. Ethnol. xxxiv, Heft 1, pp. 30-45. Berlin, 1902.

Living in southeastern Paraguay only three or four miles from Itapua (Villa Encarnación) and still nearer Jesus, and Trinidad, Vogt (1902) found Indians of a nomadic type, the Guayaki, still using stone axes in 1897. The tribe had been more or less known since 1870. Vogt considered that they had no agriculture at all, but said that they used a diorite axe for felling and working wood. They made fire by twirling a stick in a cavity of another piece of wood in which meal from a palm (Cocos australis) was placed.

Wagner, Helmuth O. y Lenz, Hans (1948) *El Bosque y la Conservacion del Suelo: su Importancia cultural y economica*. Mexico. Editorial Cultura, T. G. S. A. 171 pp., illust.

This commendable educational work of propaganda for forest and soil conservation by Helmuth O. Wagner and Hans Lenz (1948) is dedicated to the young people of Mexico. Copiously illustrated with hundreds of effective cartoons, some printed in black and red, if fire is indicated, this book should have a counterpart in many tropical countries and some others, and should appeal to adults as well as intelligent children. It is certainly worthy of imitation!

Waibel, Leo (1949) *A Vegetação e o Uso da Terra no Planalto Central*. *Revista Brasileira de Geografia* Ano X, No. 3, pp. 335-390. July.-Sept. 1948. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística, Conselho Nacional de Geografia.

Waibel made two studies of vegetation and land use in the Planalto of Brazil, in 1946 and 1947, assisted by the botanist João Evangelista de Oliveira in the second. He found that the Planalto had three isolated areas of what he terms first-class forest, the Mata da Corda highlands, the Triangulo Mineiro, and the "Mato Grosso" of Goiás, of 5000, 18000, and 20,000 square kilometers, respectively, of which all but the first, which is without railroad connections, have been subjected to modern pioneering movements and are somewhat densely populated. The first-class forest is found on rich soil derived from basic volcanic rock and about 3% of the ground surface is reached by the sun's rays. The climate falls in the "savanna" type, according to the Köppen classification, but there is little if any true savanna in the region, and the vegetation of areas that are not first-class forest falls into types that depend upon soil relations. So far as fire is concerned in the modification of the first-class forest, Waibel says that a layer of dry leaves collects on the ground during the dry season. Fires that start in this layer cause great destruction of animal and plant life. Modern agriculture is most destructive, apparently, for it is only the rich volcanic forest soils that are suitable for the cultivation of the major crops, which, in Brazil, are sugar-cane and coffee.

Regarding other types of vegetation in the Planalto Central, Waibel says that there is great variety, depending on type of soil, parent rock, and position of the water table, not the climate at all, for that is uniform. He distinguished several other plant associations as follows: (1) Second-class forest, of different botanical composition, on sandy clay with an upper layer of humus, often at the headwaters of streams, forming regular islands of forest known as capões. The soils are used as pastures, and the

land is cheaper. Up to twenty or thirty percent of the ground is reached by direct sunlight. (2) "Cerradão". This is transitional from forest to "campo cerrado", and 20 to 30% of the ground surface is reached by direct sunlight. There are more grasses than in forest, and about 70% of the trees belong to the next association. The soils are very sandy, with a thin layer of humus, and useful for pasture, pineapples, and rice. When cerradão is burned, vegetation very different from the original replaces it, which is not true of the "campo cerrado." (3) Campo cerrado. This most distinctive vegetation type was considered by Warming a natural climax, and Waibel agrees that it is original rather than man-made, whereas Lunde considered it to be an altered climax type. Only 10 or 20% of the soil surface is shaded. From a distance it looks like forest, but the trees are too widely spaced, small, and twisted. Between them the dense growth of grass is from one to two meters tall. The trees are of species with thick corky bark, protective against fire, and singularly large leaves. The soil is deficient in humus. What agricultural use can be made of campo cerrado, aside from its low value for grazing, is a perplexing problem. Waibel agrees with Warming that although it is a natural plant formation, fire is a secondary influence in maintaining it as such. He believes that if fires could be stopped, the lateritic surface crust (canga, sometimes several meters thick) might perhaps be broken up and phosphates applied, with a resulting complete change in agricultural methods. (4) Campo sujo and (5) Campo limpo are the more treeless types of campo, the former a grassland with scattered shrubs, and the latter even poorer, with low bunch grass. Both are of little utility.

Waibel finds the nearest vegetational analogue of campo cerrado to be the Australian bush, both being climax associations. He believes the campo cerrado maintained its original aspect because primitive human population was sparse. In the latter respect it differs from the savannas of tropical western Africa, which he considers to be an altered climax, modified by a dense agricultural and stock-raising population and also by an abundant fauna of large animals, such as does not exist in Brazil.

Wallace, Alfred Russel (1869) *The Malay Archipelago: the land of the Orang-utan and the Bird of Paradise. A Narrative of Travel. . . . Second Ed., 2 vols. London: Macmillan and Co. xix + 312 pp.; ii + 341 pp., ill.*

The great naturalist Alfred Russel Wallace not infrequently remarked that in the Malay Archipelago extensive grasslands were the least productive territory for the zoological collector of most groups of animals. This would seem to be because of the narrow range of plant species in most of the grassland, and the small number of animals which were naturally dependent upon or could adjust to living in association with those species. On the contrary,

small new clearings in old forest were the best collecting grounds. This would appear to be because the highly diversified flora of the forest supported a complex dependent fauna. So great man-made areas of grassland were commented upon by him and avoided.

It was to his habitual avoidance of grassland that we owe his relatively early observations on the island of Buru (Bouru), due west of Ceram in the Moluccas. Here there was grassland which may be in part natural rather than man-made.

Wallace arrived in Buru before the rains had ceased. Cultivation appears to have been largely horticulture rather than agriculture, for he described the chief village, Cajeli, as having every foot of ground between the houses so crammed with fruit trees that the sun and air had no chance of penetrating, and made no mention of plantations nearer than the edge of the forest, from which one may infer that land near the villages had become infertile and abandoned to grass, whereas new cultivation was going on in clearings at the edge of the forest. Thus there resulted clear demarcation between the permanent horticultural utilization of the land actually at a permanent village and the scattered "plantations" at the edge of the forest some miles away. Wallace's notes on the barren grasslands follow.

(II, p. 72.) "About a mile behind and to the east of the village the hills commence, but they are very barren, being covered with scanty coarse grass and scattered trees of the *Melaleuca cajuputi*, from the leaves of which the celebrated cajuput oil is made. Such districts are absolutely destitute of interest for the zoologist. A few miles further on rose higher mountains, apparently well covered with forest, but they were entirely uninhabited and trackless, and practically inaccessible to a traveller with limited time and means."

Since the vicinity of Cajeli was so unsuitable, Wallace made a trip ten miles up the river to spy out the land, and sent his servant eastward to a village where there were said to be hills and forest, for the same purpose.

(II, p. 72.) "The Rajah of Cajeli, a good-tempered old man, offered to accompany me, as the village was under his government; and we started one morning early, in a long narrow boat with eight rowers. In about two hours we entered the river, and commenced our inland journey against a very powerful current. The stream was about a hundred yards wide, and was generally bordered with high grass, and occasionally bushes and palm-trees. The country round was flat and more or less swampy, with scattered trees and shrubs."

(II, p. 73.) "The path was bordered with high rigid grass, growing in dense clumps separated by water, so that nothing was to be gained by leaving the beaten track, and we were obliged to go floundering on, never knowing where our feet would rest, as the mud was now a few inches, now two feet, deep, and the bottom

very uneven, so that the foot slid down to the lowest part, and made it difficult to keep one's balance. One step would be upon a concealed stick or log, almost dislocating the ankle, while the next would plunge into soft mud above the knee. It rained all the way, and the long grass, six feet high, met over the path; so that we could not see a step of the way ahead, and received a double drenching." . . .

"The next morning was clear and fine, and I set out soon after sunrise to explore the neighbourhood. The village had evidently been newly formed, and consisted of a single straight street of very miserable huts totally deficient in every comfort, and as bare and cheerless inside as out. It was situated on a little elevated patch of coarse gravelly soil, covered with the usual high rigid grass, which came up close to the backs of the houses. At a short distance in several directions were patches of forest, but all on low and swampy ground. I made one attempt along the only path I could find, but soon came upon a deep mud-hole, and found that I must walk barefoot if at all; so I returned and deferred further exploration till after breakfast. I then went on into the jungle and found patches of sago-palms and a low forest vegetation, . . ."

(II, p. 74.) "On my return to the village I was told that the same kind of ground extended for many miles in every direction, and I at once decided that Wayapo was not a suitable place to stay at. The next morning early we waded back again through the mud and long wet grass to our boat, and by mid-day reached Cajeli, where I waited Ali's return to decide on my future movements. He came the following day, and gave a very bad account of Pelah, where he had been. There was a little brush and trees along the beach, and hills inland covered with high grass and cajuputi trees--my dread and abhorrence. On inquiring who could give me trustworthy information, I was referred to the Lieutenant of the Burghers, who had travelled all round the island, and was a very intelligent fellow. I asked him to tell me if he knew of any part of Bouru where there was no 'kusu-kusu', as the coarse grass of the country is called. He assured me that a good deal of the south coast was forest land, while along the north was almost entirely swamp and grassy hills. After minute inquiries, I found that the forest country commenced at a place called Waypoti, only a few miles beyond Pelah, . . ."

"The journey was made as arranged, and on May 19th we arrived at Waypoti, having walked about ten miles along the beach, and through stony forest bordering the sea, with occasional plunges of a mile or two into the interior. We found no village, but scattered houses and plantations, with hilly country pretty well covered with forest, and looking rather promising." . . .

(II, p. 75.) "Although there were numerous plantations of maize and plantains, there were no new clearings; and as without these it is almost impossible to find many of the best kinds of insects,

I determined to make one myself, and with much difficulty engaged two men to clear a patch of forest, from which I hoped to obtain many fine beetles before I left.

"During the whole of my stay, however, insects never became plentiful. My clearing produced me a few fine longicorns and Buprestidæ, different from any I had before seen, together with several of the Amboyna species, but by no means so numerous or so beautiful as I had found in that small island." . . .

The ready diversion of forest clearings to grassland would have been favored by the strongly contrasted wet and dry seasons. One gets the impression that the sago palm may have been largely depended upon in Buru. Later, in Ké (Kei, Key, Ki) Wallace noted that this was true. There were plantations of coconut palms, plantains, and yams, but, he said (II, p. 107):

"In all the little swampy inlets and valleys sago trees abound, and these supply the main subsistence of the natives, who grow no rice. . . ."

In the Aru Islands, Wallace said (II, p. 136):

"To begin with the most important fact in the existence of uncivilized peoples--their food--the Aru men have no regular supply, no staff of life, such as bread, rice, mandiocca, maize, or sago, which are the daily food of a large proportion of mankind. They have, however, many sorts of vegetables, plantains, yams, sweet potatoes, and raw sago; and they chew up vast quantities of sugar-cane, as well as betelnuts, gambir, and tobacco."

At the edge of forest at Wanumbai Wallace became acquainted with "a fair sample of the true savage inhabitants of the Aru Islands" and said of their cultivation (II, p. 143):

"A little way on several paths branched off through patches of second-growth forest to cane-fields, gardens, and scattered houses, beyond which again the dark wall of verdure striped with tree-trunks, marked out the limits of the primeval forests."

Wallace, Anthony F. C. (1951) Mentawaiian Social Organization. *American Anthropologist* 53: 370-375. 1951.

In this brief article the author undertakes a reinterpretation of the basic structure of Mentawaiian society. He concludes that the uma, pertains to a single clan, which is usually endogamous. This indicates that the people of an uma, are all descended from an original householder. The term may in other areas of the East Indies mean either house or field, and the

reviewer's interpretation is that the Original Malayan meaning must have been homestead instead of either clearing or the house in it. This would account for the divergence of meaning in different languages, and for the occurrence of two similar related words in some languages, such as Batak, one meaning the house and the other the cultivated clearing. Wallace's concept of the Mentawai uma integrates a group of men, women, and children "who live in or near a large communal pile-dwelling and act as a unit on certain ceremonial occasions. Villages are composed of from one to four uma, when more than one uma exists in a village, each uma occupies its own compound. . . ."

This seems to be exactly in accord with the view of Loeb (1928) rather than widely divergent, and is exactly what would be expected if the modern uma were genetically derived from the homestead of a primitive family, to whom the agricultural clearing was a unit with the house as a dwelling place that provided food and shelter.

Ward, F. Kingdon (1921) In Farthest Burma. Philadelphia: J. B. Lippincott Co.

Taungya agriculture is the equivalent in Burma of the ladang cultivation of the Malay lands. Since it has undergone modification into a system of agriculture plus forestry and therefore a system of permanent land utilization, and has become widely publicized as such in Africa, it seems worth while to see what it is like in its homeland, even though our account of it must carry us beyond the tropics. About half of the long axis of Burma is north of the Tropic of Cancer, and the region is so precipitously mountainous that tropical and temperate conditions are found with only slight separation. The more primitive tribes are found in the extratropical region, but there is nothing about the vegetation or the human cultures to make any separation on a latitudinal basis other than very arbitrary.

F. Kingdon Ward describes the taungya system as prevailing vastly over wet-rice farming in upper Burma:

(p. 49.) "So hard up is the North-East frontier for food, the villages even in the most favored districts raising barely enough for their own subsistence, that my Lashi collectors always asked me to supply them with rice. It may be remarked here that the Hpimaw valley [25° 45' N., 98° 40' E.] and the Hkamti plain [27° 20' N., 97° 30' E.] are the only places in the whole vast area of the Burmese hinterland where lowland paddy can be grown. Elsewhere mountain rice, buckwheat and maize are universally cultivated."

As for the dry-field cultivation of the Lashi at Hpimaw, Ward says, using the Burmese word taungya to mean unirrigated hillside cultivation:

(p. 51) "These taungya are simply hill-sides cleared of jungle. The jungle is cut after the rains and lies for a few months. About March, when it is fairly dry, it is set on fire and the undergrowth burnt out; but the stumps and big tree trunks are only charred, and the latter lie about in all directions, making progress across a steep taungya extremely arduous. In the spring the maize is dibbled into the soil, and ripens in the autumn.

"After the first year the soil is exhausted and the taungya abandoned to the jungle which quickly springs up, covering the place with a dense tangle of herbs and bushes, amongst which small trees soon begin to appear; while a new taungya is cleared elsewhere,--a complete change of soil instead of a rotation of crops. It is obviously a very wasteful method of cultivation, but one well suited to such a country."

It was the same with the other frontier people. Ward wrote:

(p. 70.) "Cut away a few trees on those angular slopes, and the hungry water, which has been held in leash watching and waiting, instantly rips bare the hill-side, flinging everything pell-mell into the deep-flowing arteries below, and leaving behind nothing but stark staring rock. . . Wherefore any attempt at cultivation is doomed. It is only in the valleys, or here and there at the mountain foot, that a hill clearing can be made. Two crops cannot be raised on it in successive years--it must be abandoned to the choking undergrowth which springs up amongst the fallen tree trunks till, after six or eight years, it can be burnt, to bear again. Such is the universal method of raising scattered crops throughout the wilderness of the North-East Frontier.

"Villages are tucked away out of sight in the valleys, or cling to the lower slopes and spurs, Lashi below, Yawyin above, and the proud forest tree reigns supreme in the silence beyond."

Warming, Eug. (1892) Lagoa Santa. Et Bidrag til den biologiske Plantegeografi . . . Med en Fortegnelse over Lagoa Santas Hvirveldyr, . . . D. Kgl. Danske Vidensk. Selsk. Skr., 6 Raekke, Afd. VI. 3. Kjøbenhavn: Blanco Lunos Kgl. Hof-Bogtrykkeri, F. Dreyer. 488 p., 43 figs., 10 pl.

A classical ecological study in Brazil was that of Warming who spent three happy years of his youth, 1863-1866, in the home of the Danish zoologist and paleontologist P. W. Lund at Lagoa

Santa, Minas Geraës. So many scientists visited Lund there that the little village became a classic locality in the history of science. It was indeed one of the birthplaces of modern ecology. Rich in experience nearly thirty years later when he published his book, Warming lamented the imperfections of his youthful observations, but his "Lagoa Santa" remains, of course, one of the foundation stones of Brazilian botany. It was preceded by various other and more detailed works, which are listed in his extensive local bibliography.

Warming considered that his conclusions from an intensive study of a small area (only 170 square kilometers) were probably applicable to a large part of Brazil where most of the vegetation is an alternation of forest with campo. The much smaller forest portion occurred along the streams and on the limestone hills, and their flora represented a reduction of the virgin forest of the coastal mountains. The greater portion consisted of campos of two intergrading sorts, namely, campos limpos, nearly destitute of woody plants, and campos cerrados (cerrados, for short) with deep fertile soil and more or less wooded. Secondary formations derived from forest clearings were characterized by brush, by fern (Pteris aquilina var. esculenta) or by fields of capim gordura, Melinis the far from useless but dirty "molasses grass", which (except to cattle) is the chief Brazilian pest.

Warming discusses the effect of fire in detail, disagreeing in the main with his friend Lund who had viewed the cerrados as man-made, over a long period of time, mostly prehistoric. In 1835 Lund* published on the subject. He had journeyed with Riedel,

*Lund, Peter Wilhelm (1837) Bemaerkninger over Vegetationen paa de indre Højsletter af Brasilien, isaer plantehistorisk Henseende. Kgl. Danske Videnskab. Selsk. Skrifter, VI, pp. 145-188. Forelaest 10 Juli 1835. Saertrykkene udkom, 1835. Bindet 1837.

from 1833 to 1835. across the interior of Brazil, and had made a great many observations on the vegetation along a route roughly westward from Rio de Janeiro to São Paulo and Ytu, thence northward to Franca, Uberaba and Catalão to Paracutù, thence south-eastward to Lagoa Santa and Rio Janeiro. In this great journey of which the manuscript journal was consulted by Warming, Lund traversed localities where there was a plant formation known as catanduva, a lower forest than the great virgin forest, less rich in lianas and epiphytes, and having an aspect of sterility and drouth. The bark of the trees was rough, corky, and deeply channelled. Under-shrubs were almost lacking. Areas of such special plateau forest were scarce, and Lund saw it especially on the plateau of Araquara, north of Ytu and northwest of Campinas. He concluded that such forest had been the precursor of all the cerrados and campos, that the burning of catanduva had not been inaugurated by the Portuguese, but, on the contrary, long before their arrival by the Indians, with the motive of hunting.

The ideas of Lund were opposed by Reinhardt* who did not

*Reinhardt, Joh. Th. (1856) Nogle Bemaerkninger om den Indflydelse, de idelige Markbrande have udøved paa Vegetationen i de brasilianske Campos. Videnskab Meddel. 1856.

believe that either Indians or Portuguese would have accomplished such vast transformations of nature. Warming found himself forced to agree with Reinhardt, and cited paleontological evidence recovered by Lund himself from the caves of Lagoa Santa in the form of bones of prairie-inhabiting animals such as extinct species of horses and lamas which could not have lived in the forest. Warming believed that throughout the later geological time that would cover the period of man's occupation, the greater campos of the interior of Brazil had existed much as they do today. He dedicated his book to Lund and Reinhardt, jointly! He believed that fire could turn a dry forest into a cerrado, by preparing a favorable habitat for migration of species from the cerrado into the depleted forest, but not that fire and man had made the hundreds of thousands of square kilometers of campo out of forest.

Whiffen, Thomas. The North-West Amazons. London: Constable Co. 1915. xvii 319 pp., 55 pl., 5 maps.

Whiffen traversed the headwater regions of the northwestern affluents of the Amazon in 1908 and 1909. His trip had been inspired by Alfred Russell Wallace's Travels on the Amazon and Rio Negro. It happened that he passed through some of the same region that had been explored only shortly before by Koch-Grunberg. Whiffen told of the secretiveness of the upper Amazonian Indians about their clearings--how they had the most devious and hidden routes to them from known paths and rivers, so that a traveller in the forest would stumble into a clearing only by accident. He wrote of tribes on the Rio Aporis (p. 40):

"Out of the silence and gloom of the forest the traveller will emerge into the full light of a clearing. . . There is but one great house, thatched and ridge-roofed like a gigantic hay-rick, standing four-square in the open. This is the home of some three-score Indians. . . First of all characteristics is that nothing makes for permanence. . . After about two or three years the house will fall into a state of disrepair, but the tribesmen will not patch or mend it. They will simply discard it like all useless things. The women will be loaded up with the few tribal possessions . . . the house will be burnt and the whole of this grosse famille departs to seek a new site on which to build another habitation.

"Building material is easily come by, and though to clear the land from the virgin forest entails considerable hard work, it is periodically a necessary task. However rich it may have been in the first instance, successive crops rob the soil of its fertility, as the Indian is only too well aware, and fresh ground must, perforce, be broken up every few years. . . ."

Regarding the Witoto north and east of the Issa River (Rio Putumayo) he said:

(p. 102.) "They are not a pastoral people and have no cattle. . . The greater part of the agricultural work falls . . . to the lot of the women, though the preliminaries--the heavier work of clearing, cutting, and breaking up the untouched soil--are undertaken by the men. Each tribal house stands in the midst of a small clearing. . . Near by are the cultivated plots that belong to the chief. The Indian with his own private lodging in the bush, or any married Indian . . . has his special plantation patch by his country house. . . But no plantations are made actually surrounding the maloka [tribal house]; they are perhaps half a mile away. . . The tribal plantations belong to the chief, as he, having all the unattached women, is better able to cultivate them.

"To prepare the plots of ground the smaller trees are felled, the larger ones are burnt. The stumps of trees, cut about four feet above the ground, decay with some rapidity, and, directly the branches are dry enough to burn, fire is brought out and the clearing made into a gigantic bonfire, or rather series of bonfires, for the always damp wood will never do more than smoulder, but it is sufficient to destroy the brushwood and the tangle of creeping plants. There is then a savannah, . . . a wilderness of charred posts and vegetable ashes which make a most excellent manure."

Whiffen estimated the Witoto group of tribes at 15000 persons, and the whole Indian population of the Issa-Japura region as less than a hundred thousand, but such a number moving frequently and with inefficient agriculture would make great inroads on primitive forest. The area of Whiffen's observations was along the equator and as far south of it as two degrees, between 69° and 75° W., therefore in Colombia and Brazil. He found that the natives preserved fire carefully, taking it from place to place, and only by hear-say could he learn of building of fire by friction; they prized the white man's matches exceedingly.

White, Stanhope (1944) Agriculture Economy of the Hill Pagans of Dikwa Emirate, Cameroons (British Mandate). Farm and Forest or Land Use and Rural Planning in West Africa. Vol. V, No. 3, pp. 130-134. Sept. 1944.

Stanhope White has called attention to a remarkable group of eight ancient clans who occupy the Mandara Mountains, the westernmost of a peninsula of hills which run out from the south into the plain surrounding Lake Chad. Their ancient habitat is elaborately terraced with stone-walled terraces which, the present population believes, were built by a more ancient race. Living among them are a few people reputed to be of older occupancy, who have a monopoly of the "juju" or magic of rain-making. In the two hundred square miles of their old mountain home there are an estimated 20,000 miles of terrace walls, varying from a few inches to ten feet in height, the majority four feet high and the terraces five to 10 feet wide. On these terraced hills the people maintained a unique culture which embodied all the principles that European reformers have attempted to inculcate in African society, these being permanent agriculture, soil conservation, erosion control, animal husbandry, use of every available manure, including composted refuse and weeds, crop rotation, and the growing of trees. Instead of encouraging them to retain their culture intact, some of them have been coaxed down into the plain for greater ease of administering them. The British took control of the region in 1919. Before that, at the focal point of stronger rival people, the Fulani of Madagali, the Kanuri of Bornu, and the Mandara of Mora, they were constantly in danger from slave raiders.

The age of the terraces is unknown but one paleolithic and one neolithic implement were found by White. The terraces have a vertical range of about 2500 feet and extend to the very summits, which have been surrounded by walls and filled in level. Some terraces are only a few inches wide and give room for only a single line of corn.

This remarkable cultural development may have been forced on the people by slave raiders, but if so, raiding has been a practice of long standing. Some of the lower terraces of the Kuvoko clan were forced away from the lower terraces by the Fulani about 1904 and took refuge higher up. One of the best watered valleys was abandoned in the early 1930's after the first locust invasion. It lies partly in French territory. White tells us:

"The abandonment of a terrace means its inevitable destruction, progressing slowly at first and then increasingly fast as more and more places of attack are exposed. The slow and laborious work of centuries in gathering and fixing the earth is washed away in a few rainy seasons, and bare and barren hillsides are the result. The terraced areas contain many springs and are well wooded; the de-terraced areas are useless slopes of bed rock with an immediate run-off of rain-water, leading to increased erosion on the plains. The heavy rains of 1937 and the excessively heavy ones of 1938 have done much damage in the area. . .

"In this small part of Africa, as opposed to the greater part of the continent, an indigenous agricultural economy has been evolved, which, to a layman at any rate, seems to possess

all the desiderata enumerated by Lord Hailey, and to contain nothing which brings permanent harm to the soil, and as such seems to be worthy of every encouragement."

Whitford, H. N. The Vegetation of the Lamao Forest Reserve. Philipp. Journ. Sci., Vol. I, No. 4, pp. 373-431, pl. I-XXVII, map. May, 1906.

This contribution is one of the most informative that we have concerning spontaneous secondary vegetation in the Philippines. It is particularly important as dealing with a plant association which alternates with grassland following clearing for shifting cultivation. The latter, in Luzon and rather generally throughout the Philippines is the caingin system. There are great areas in Luzon and elsewhere in which bamboo has followed abandonment of temporary clearings. Quotations from Whitford paper on the Lamao forest reserve follow. The region is that across the bay from Manila, on Mt. Marivales in the province of Bataan where the Philippine-American forces made their desperate last stand during World War II.

(p. 384, 385.) "The vegetation at the base of the mountain has been given the name Bambusa-Parkia because it is believed that in the genera Bambusa and Parkia are exhibited forms of plants which best indicate the response in the habitat in which these genera prevail. The response is such as to meet the almost xerophytic conditions present during the dry season. The genus Bambusa, represented by several species, has some of the ecological advantages of trees and many of those of grasses. Often reaching to a height of 15 or 20 meters, the bamboo is able successfully to compete with the dicotyledinous trees of the same height. This advantage is best utilized during the favorable season, when conditions for growth and photosynthesis are at their maximum. While none of the bamboos of the Lamao Reserve are completely deciduous during the dry season, yet the total area of the foliage is much less than during the wet one. This is brought about in two ways. Many of the leaves of individual shoots are shed, leaving them with from one-third to one-half as many leaves as they would have during the rainy season. In this way the bamboos simulate the semi-deciduous trees with which they grow. Those which remain may reduce their transpiration surface by curling up like grass. Again, some of the culms die down altogether during the dry season, thus reducing the transpiration surface of the clumps from which they spring. Grasses may either form sod by sending out runners or underground shoots which radiate in all directions from a common center, or they may be caespitose, when they are commonly known as "bunch" grass. Bamboos, like other grasses, may be represented by species of both types, although the "bunch" type is the predominant one on the Lamao Reserve. While

the individual shoots are short-lived, the permanency of the "bunch" is maintained."

(p. 386.) "The best expression of the Bambusa-Parkia formation is peculiar. The species called "boho," probably Bambusa lumanpao, is the characteristic form. Clumps composed of fifteen or twenty culms, some dead and some alive, and 12 to 18 meters in height are on an average set at a distance of from 3 to 4 meters apart, not infrequently growing so close together that it would be found difficult to wedge one's way between the individual colonies. These make a shade so dense as practically to prevent the development of herbaceous and woody forms which are not adapted to such conditions. Among the clumps here and there are seen the trunks of isolated dicotyledinous trees. In some places there are groups of three or four individuals, usually of different species, as closely set as the bamboo colonies but more often they are 15 to 20 meters apart. Indeed, if the bamboo growth should entirely be removed and replaced by a grass such as Saccharum spontaneum, the aspect of the forest would very much resemble the park-like forests of the savannah or prairie regions. One has only to imagine the grass in the open spaces between the trees in these latter places to be 15 instead of 2 meters high to obtain an approximately correct idea of the aspect which the bamboo forests of the Lamao region presents.

(p. 387.) "The type of the Bambusa-Parkia formation, which has just been described probably occupies one-third of the area mapped as such. The other two-thirds come under sub-formations which are considered to be stages in development. As already indicated, isolated groups of bamboo are present throughout and these may or may not be accompanied by the dicotyledinous species named above. The closed bamboo forest does not approach nearer than $1\frac{1}{2}$ kilometers to the shore, though "boho" and other bamboos are present near the coast line."

(p. 388.) "Effect of artificial disturbances on the formation.-- There is both historical and vegetational evidence that much of the area under consideration has been cultivated. Clearings called "caingins" by the natives are merely openings made in the forests by cutting and burning the vegetation. There are all degrees of this destruction, and after the existing vegetation is wholly or partially destroyed, the clearing thus made may perfunctorily be cultivated and then abandoned, or it may be more thoroughly tilled and after a number of years deserted. In any event, whatever the state of the removal of the original vegetation, the natural equilibrium has been disturbed by this means and a new but temporary habitat has been created which allows of the invasion of a type of vegetation which differs from that which has preceded it. Either these clearings may grow up to form grass lands, in which event they may become known as "cogonales," or they may be occupied by arboreal species. The nature of the vegetation which first gains an entrance depends on the extent to which the clearing is cultivated, on the nature of the surrounding vegetation, on the kind of habitat, or on disturbances after the clearing has been abandoned.

It should be emphasized that the term caingin is applied to the place which is cleared for cultivation. It may remain this name as long as its origin is recognized, no matter what sort of vegetation may invade after it has been abandoned.

"Vidal first called attention to a peculiar type of tropical vegetation, prevalent near Manila, and called by the natives "parang." (Pls. III and IV.) His description of the origin of parangs is as follows:

"Abuse in the utilization, which until a very recent time was not subject to any restriction whatsoever, has reduced to shoots the masses of forest which formerly covered the lowlands, eradicating almost all good timber trees. In fact, the aspect of these tracts covered with shoots and saplings differs from the one to be observed in analogous localities of the temperate zones. Being so covered with woody vegetation and young trees, to an unpracticed observer they would appear to be regular woods. Such places are called in Tagalog "parang," a name which should find acceptance in the technical phraseology of the Philippines in the same way as has the word "jungle," which as been admitted by the foresters of British India, because new things must have new names. The "parang" might be defined as an extensive area, covered with brushwood and the trees of the invading species, which have taken the place of those existing before the cutting or burning. The study of these places has a practical importance in the great question of the throwing open of public territory for settlement, because usually they are the most salable of the unoccupied Government lands."

Wildeman, É. de (ed.) 1910 Compagnie du Kasai, Mission permanente d' Études Scientifique, Résultats de ses Recherches Botanique et Agronomique. Bruxelles: Imprimerie A. Lesigne. 1910. 465 pp., 45 pl., 2 maps.

De Wildeman, p. 239, expressed the opinion of the Compagnie du Kasai, after nine years of occupation of much of the region lying from 17° to 24° E. and 3° to 11° S. that it was because of the agency of man that brush had gained over forest in much of central Africa, and that "desert" had taken the place of fertile regions. There had been difference of opinion, some maintaining that brush fires had a certain utility. It was said that they aided in the chase of the great gibbons (gros gibier) which were so numerous as to destroy plantations, that by fire the indigenes were able to secure food: but frequently not to chase the gros gibier but only insects and chiefly grasshoppers. Sometimes one couldn't get any help for a whole village would be chasing grasshoppers in the recently burned brush. They were prepared by smoking, and whole caravans were encountered by M. A. Sapin transporting grasshoppers from Luluabourg (22° 25' E., 6° S.) to Lusambo.

The distribution of vegetation in the river basins of the Kasai region, as generalized by Sapin for the volume of De Wildeman (1910, Pl. XXIII) was (1) intermittent marsh alternating with sandbanks along the larger valleys, (2) prairie above the high water level, (3) gallery forest subject to inundation along the tributaries, (4) dry gallery forest bounding that, (5) rolling savanna behind that, (6) hilly savanna along the upper courses of the brooks, and (7) wooded swamp at the sources.

The De Wildeman report is rich in excellent pictures of the vegetation and of diagrammatic cross sections of various streams at various points. He reported the belief that gallery forest more readily developed or remained on the ravine slopes of the affluents of the rivers because of the greater constant humidity and protection from evaporation. His account seems to make it clear, however, that man's activities have not created certain unwooded marsh areas along the rivers subject to such extremes as intermittent flooding and such complete desiccation that the mud baked dry and cracked by contraction. The variety of conditions enables one to understand why there should be a variety of vegetational formations, and why there should be a legitimate difference of opinion sometimes as to whether islets of forest had once been continuous or not. After all, nothing is more natural than to suppose that there would be islets of forest in a region of natural transition from forest to grassland, and that precariously equilibrated islets of forest and forest borders would be the first to be destroyed by man's agency. De Wildeman's conclusions were obviously influenced by the sweeping generalizations of O. F. Cook regarding the essential non-existence of natural forest in Central America.

Wildeman, Émile de (1911) *Études sur la Flore des Districts des Bangala et de l'Ubangi (Congo Belge): Plantae Thonnerianae Congolenses. Série II . . . Introduction par M. Fr. Thonner.* Bruxelles (Misch & Thron) 1911. pp. xix + 467 pp., 52 figs., 1 + 20 pl., map.

De Wildeman largely relying upon observations of Fr. Thonner, presented an instructive map and flora of the region between the Congo and Ubangi rivers between 17° 30' and 24° 30' E., showing the line between forest and savanna. The boundary is of course irregular and could not be precisely shown, but the general trend is slightly southward from about 4° N. on the west to 3° 30' on the east. The region which he discusses is mainly that north of the great bend of the Congo and eastward, divided into the mostly forested District of Bangala along the Congo and the mostly savanna District of Ubangi south of the river of the same name. French Ubangi is of course on the north of the Ubangi River.

About the exact delimitation of the tall Congo rain-forest there has been difference of opinion, depending upon whether one believes that man's activities have or have not caused its retrogression beyond its climatic limitations, upon whether one includes areas where there is only gallery forest along the rivers, and upon whether one draws the line around outlying "islands" of forest or not. The limits accepted by De Wildeman (1911, p. 9) were on the north of the line shown on his map between the Congo and Ubangi rivers, passes into the District of Uele, thence extending further toward the east to the foot of Mt. Ruwenzori and breaking down beyond Ruwenzori and Lake Albert into the relatively separated tropical forest areas of Uganda.

As to human influence De Wildeman (p. 10) said that the limit had been and would continue to change as the result of cultivation, which continually, more and more, diminished the area of the great forest, and was abundantly demonstrated by the remnants found in various peripheral areas. He quotes with approval the study of W. Busse (1908), who said that the primitive forest was rarely reconstituted after it had been once felled and the brush fires had destroyed the remnants. Furthermore he believed that too many travellers, travelling by river, had believed that they were travelling through unbroken forest when as a matter of fact there were only stretches of gallery forest along the streams. On the contrary, rather than to lay too much stress on gallery forest, one should also call attention to the herbaceous zones of from 10 to 150 meters in width that often occupied the banks of Congo rivers where the interior between the rivers was compact forest. Furthermore, the concept of "gallery forest" was elastic, varying from a screen one or two trees thick to a belt perhaps hundreds of meters or several kilometers across.

One observer who had written much on the Congo and had placed the limit some 50 kilometers north of Thonner's was Aug. Chevalier, who might have been led to do so on the basis of the labels of herbarium specimens, for altogether too many collectors had been content to indicate localities very vaguely. When one is concerned with such a problem as the "march of the Sahara" or "the recession of the equatorial forest", in our own time the accuracy of labels should be incontestable.

Wildeman, M. E. de (1932) *La forêt équatoriale congolaise; ses problèmes biologiques*. Acad. Roy. de Belgique, Bull., Cl. Sci., 5^e Ser. XVII (1931) no. 12, pp. 1475-1514. 1932.

De Wildeman regarded it as certain, in spite of lively controversy, that Africa was undergoing gradual drying up. Whether, as some held, it was because of deforestation, or, as others thought, deficiency of water, it seemed to him that man would be able to retard the march of events by reforestation where the forest had

been cut, and by conservation of forest in critical regions where it was still possible to maintain a protective forest cover. In a review of the subject, he considered temporary agriculture of the natives to be a leading cause of the replacement of tropical forest in Africa by brush, its effect more recently increased by the clearings of white colonists. Both used fire to extend the area for agriculture, which was all too soon abandoned. He called attention to the work of J. Risbec on the influence of brush fires on the prolongation of periods of drought, which was caused by heat absorption by soil surfaces not only exposed to the sun but blackened, so that radiant heat raised the temperature of the soil, dried it excessively, and caused ascending convection currents of heated air. He also noted the recommendations of certain economic entomologists that the control of tsetse required the destruction of gallery forests in Nigeria and cited others who denied that this was true. He approved the views of those who held that man's destruction of forest by clearing and burning was not a matter which concerned forestry alone, but that the future of African agriculture was placed in jeopardy. He quoted with approval Gill's "Tropical Forest of the Caribbean (1931)", to be reviewed under Central America.

Willer, T. J. (1849) The Battas of Mandheling and Pertibi. Journ. Indian Archipelago and Eastern Asia, Vol. III, No. VI, pp. 366-378. June 1849.

One of the most remarkable areas of Sumatra, Padang Lawas, has been the subject of a far more extended account (i. e., that of Neuman) than the one here reviewed, but it is to be the subject of a special article by the reviewer. The editor of the Journal of the Indian Archipelago has a footnote to Willer's article which calls attention to the fact that the areas discussed are directly across the straits from Singapore, occupying Sumatra almost from coast to coast, forming a square of about 6600 square miles. The "Battas" are of course the Batak. Willer, who was an Assistant Resident, wrote (p. 367) of the approach to Padang Lawas from densely populated Angkola, by way of forested Adian Nagungan, as follows:

"On the other side of the Adian Nagungang we come into Padang Lawas which, with the thoroughly mountainous district of Batang Onang, is locked to the higher mountains of Ankola. Although this little favored highland has scarcely any covering but lalang, the ravines and small vallies shew a certain measure of fertility; we are hence surprised that we do not find here and there a human dwelling.

"It is otherwise when we have ascended Gunong Tua and cast our eye downwards from the summit Sipolpal. There we see unrolled a plain without horizon and without variety; an unbounded carpet

on which the more or less luxuriant growth of the lalang makes the only diversity, and on which not a single living creature appears to move; where a tree is literally a rarity and has an appearance of stunted dwarfishness, where at the distance of miles, we descry like an oasis in the desert an insignificant thicket, or a small strip of brushwood along the banks of a marsh or stream; where a fell scorching wind blows for months together and from the numerous conflagrations of lalang generally spreads a dull glow, through which the sunlight scarcely forces itself wavering and heavy--in a word where all nature appears to have gone to an eternal sleep. Such is the appearance of Padang Lawas; as of the greatest part of Pertibi."

Williams, Thomas (1858) Fiji and the Fijians. Vol. I. The Islands and their Inhabitants. Edited by George Stringer Rowe. London: Alexander Heylin. xi + 266 pp., pl., figs., map. (Vol. II, by another author, is a history of the Fijian missions).

In one of the early missionary accounts of Fiji one finds an excellent account of Fijian agriculture in the 1840's before it had been modified by foreign influence or the immigration of aliens. Thomas Williams (p. 63, 64) has this about the use of agricultural tools, the digging stick in particular, at a time when rice cultivation was still unknown in the islands:

"The agricultural implements used by the Fijians are few and simple; yet a notice of them may please the curious. A tool, lancet-shaped and about a yard long, made of hard wood, is used in breaking down the brushwood and coarse grass, which, when dry, is burnt. The ground thus cleared is ready for the digging-stick--the plough of Fiji. This tool is generally made of a young mangrove tree, not larger nor longer than the handle of an ordinary hay fork. The bark is kept on, except at the end which is used for digging, and which is tapered off on one side after the shape of a quill tooth-pick. In digging, this flattened side is kept downwards. When preparing a piece of ground for yams, a number of men are employed, divided into groups of three or four. Each man being provided with a digging stick, they drive them into the ground so as to inclose a circle of about two feet in diameter. When, by repeated strokes, the sticks reach the depth of 18 inches, they are used as levers, and the mass of soil between them is thus loosened and raised.

"Two or three lads follow with short sticks and break the clods, which are afterwards pulverized by hand, and formed into mounds, in the summits of which the yam-set is placed. Thus the best use is made of the light soil, and the training of the vines facilitated, which run from mound to mound, until nothing is seen but a mass of matted verdure. Before this is the case, the land has to be weeded several times; an operation which is accomplished

by means of a tool shaped like a Dutch hoe. . . . The blade used formerly to be made of a bone from the back of a turtle, or a plate of tortoise shell, or the valve of a large oyster, or large kind of pinna. An oval iron blade or toy spades are fast superseding these.

"Among the two heads of the vineyard group I saw a large dibble in use, eight feet long, and the lower part eighteen inches in circumference at about two feet from the point, to which it tapered. . . .

"An annual or triennial change of their planting grounds, with occasional drainage or irrigation, constitute the entire system of tilth throughout the islands."

Willis, John C. (1905) A Report upon Agriculture in the Federated Malay States. Kuala Lumpur: F. M. S. Govt. Printing Office. 106 pp.

Willis while director of the Royal Botanic Gardens, Ceylon, made a tour of the Federated Malay States, and wrote a report on the status and prospects of agriculture. This was before the boom caused by rubber planting and there was little agriculture except for local subsistence. The waste lands were those caused by tin mining, which was the only industry of great international importance, and the "lalang" wastes, great grass lands covered with *Imperata*, which were a heritage from the shifting agriculture of many centuries, although the ladangs of any one time were of slight extent in comparison with the forest. Willis wrote:

"One of the first things to strike a traveller in the Peninsula is the great patches of land, sometimes 1000 acres in a block, which are covered by a waving growth of lalang grass (*Imperata arundinacea*) to the exclusion of almost every vegetation. . . . Fire . . . does not seriously injure it . . . and the grass is thus the commonest of weeds . . . upon any piece of ground which is denuded . . . of . . . forest and not kept weeded.

"These lalang wastes . . . represent in general, abandoned cultivations. . . . Land abandoned to lalang is very liable to fires. . . . Lalang land, as it stands, is practically useless."

Willis suggested cutting the lalang grass with "some of the light American horse mowers, built for use with bulls, or the Deli ponies."

Willis, J. C. (1922) *Agriculture in the Tropics*. Cambridge: Univ. Press. 224 pp., 24 pl.

Willis wrote:

(p. 1.) "A very favorite method of cultivation . . . is what is called in Ceylon chena. . . The forest, or rather the trees in it below a certain girth, is felled and burnt, and . . . after one to three crops, the land is abandoned and grows up in scrubby jungle, and may be again chena-ed after 8-50 years. Vast areas of good forest land have been ruined in southern Asia by this destructive practice, and in most countries chena permits for crown land are only issued under stress of very hard times and failure of the regular crops."

(p. 35.) "To this day it is one of the standing minor grievances of the Eastern native against the British government that he is not allowed free and unrestricted chena in the crown lands. The fact that such practices are utterly destructive of the natural capital of the country does not in any way appeal to him--so long as there is land left to chena he considers that he should be allowed to chena it."

(p. 154.) "A word in conclusion about chena. This is a vicious mode of cultivation, and both wasteful and destructive. It should be put a stop to as soon as possible, at any rate on lands owned by the Government, and experiments to determine the best rotation of crops to practice upon the chena in private lands should early be put into practice. There is little doubt that the common contention of the natives, that the land is too poor to stand continuous cropping, is untrue. The real reason, in many cases, at any rate, is that in two years it gets too weedy, and that it pays them better to chena a new piece of land. In fact, like most things in agriculture, it hinges on finance. It is possible for a poor man to chena when he cannot afford real 'cultivation'."

Wilson, Fergus (1950) *Agriculture in Zanzibar*. (1) Peasant Agriculture. Chapter XXVII in Matheson and Bovill (1950, pp. 250-267) q. v.

Although Matheson and Bovill (1950, q. v.) allude slightly to primitive agriculture, their discussion of the East African region is mainly of introduced colonial agriculture and of African agriculture as influenced by the colonial. For one area, however, their collaborator, Fergus Wilson, has a chapter on native agriculture, or at any rate long-established Asiatic African cultivation, that is not touched upon in other sources here reviewed. The area is Zanzibar, (the islands of Zanzibar and Pemba) which has a fused culture, now Muhamadan, dating from the 12th century and earlier. Here there is a cultivation introduced from the Orient, of coconut

palms and clove trees, and of rice. Subsidiary crops are many, and the one which our authors call "millet" is shown by their figure to be grain sorghum (Kaffir corn). In ancient times slaves were prohibited from eating rice, but had to be content with the inferior foods. We may assume that the sweet potato was held in especially high regard when first introduced, for a specially prized variety still bears the name "halimtumwa" (not to be eaten by slaves).

Outside of the coconut and clove plantations is land called wanda, not in private ownership but belonging to the various communities that inhabit it. The ancient type of shifting cultivation is described by Matheson and Bovill (op. 255, 256) as follows:

"Weathering of the coral limestone has produced a fine, brown, humic soil which in most places supports a dense, bushy scrub 8 to 12 feet high. Upon this country, known as the wanda, occur patches of overlaid red soil of varying depths. Where these are shallow the semi-wanda, or open grass plains, occur. Where a greater depth of 3 or 4 feet or more occurs, a village settlement has usually grown up surrounded by its typical coconut palms and mango trees. In all cases, the line of demarcation between soil overlay and bare coral is clearly shown by the abrupt finish of tall tree growth and the commencement of the scrub bush. Most of the plains of Zanzibar are of heavy clay, with characteristic flora of annual grasses, borassus palms, and mango trees. The valleys consist of alluvial soils and clays, many of them of considerable fertility.

"The typical red earths of Zanzibar are not common in Pemba, where most of the undulating plantation lands consist of multi-coloured non-calcareous earths and clays."

"All agricultural operations are performed by hand, and it may be added that, apart from heavy digging operations with the long-handled hoe, a great deal of the cultivation work is done by women. It will be appreciated that the restrictions imposed by manual work place a limit upon the area cultivated by the peasant family. This is, to a great extent, compensated for by the tree crops of the Protectorate, which require limited attention once they are established, and also by the comparatively high level of husbandry amongst the Shirazi peoples.

On the wanda all cultivation is of necessity on the flat, although special holes are often dug for such plants as yams or bananas. Elsewhere, the cultivation of many crops--for example, cassava, and sweet potatoes--is on large ridges, often measuring 6 feet from the centre of one furrow to that of the next."

There is an extraordinarily interesting anciently established horticultural industry in Zanzibar, centering in the cultivation of the clove, which is treated by S. E. Tidbury in the second part of the same chapter which starts with the contribution of F. Wilson.

Woodford, Charles Morris (1890) *A Naturalist among the Head-hunters. Being an Account of three Visits to the Solomon Islands in the Years 1886, 1887, and 1888.* Melbourne and Sydney: E. A. Petherick & Co. xii + 249 pp., 16 pl. 3 maps.

It is not too easy to find records of shifting cultivation for Melanesia. One of the best relates to Savo in the Solomon Islands, about midway between the northern ends of Florida and Guadalcanal, which was called Guadalcanar, when visited by Woodford (1890, pp. 170-171). On a visit to the summit of Savo he made the following observations:

"Around us a dense jungle of reeds, and the small second-growth timber that springs up after the original forest has been cleared for planting, among which were dotted the yam patches. Savo is a small island, nearly circular, and about four miles in diameter. For its size it is very thickly populated, and as the natives do not plant upon the same ground two years in succession, there is comparatively little virgin forest left. Only upon the extreme summits and sides of some of the numerous conical peaks of the island, where the ground is too steep even for a Savo native to plant, a thick covering of forest trees contrasts with the less dense second growth."

This island of Savo was named Sesarga in 1568 by the Spaniard Hernando Gallego, pilot of Mendaña's expedition, who was the first European to mention it.

Worthington, E. B. (1938) *Science in Africa: A Review of Scientific Research Relating to Tropical and Southern Africa.* London, New York, Toronto: Oxford Univ. Press. 746 pp., 5 maps, 8 plates.

This valuable summary touches upon the problems of forestry versus primitive agriculture as follows:

(p. 186.) "It is a general opinion among expert foresters that the areas which have been acquired as reserves are not yet sufficient to assure future prosperity in any African territory, but the degree of deficiency varies widely. . ."

(p. 187.) "The principal agent in modifying the original forest vegetation of Africa is the native practice of shifting cultivation, which is often aided by fire. . . As the population increases and the available areas of forest decrease, the results will be more and more serious, and yet the forest areas are the only reserves on which agriculture can draw for its expansion in many parts of the continent, and some experts are of the opinion that shifting cultivation in a modified form will always be the mainstay of native agriculture."

Ypes, W. K. H. (1932) *Bijdrage tot de Kennis van de Stamverwantstchap de inheemische Rechtsgemeenschappen en het Grondenrecht der Toba- en Dairibataks 's Gravenhage: Martinus Nijhoff. xi + 553 pp., pl., 3 maps & charts.*

In one of the best and most informative books ever written on land usage by a group practicing a relatively primitive but transitional system of agriculture, Ypes (1932) has given an amazingly full account of the types of land recognized by the Toba and Dairi Batak of Sumatra who occupy the regions to the westward and southward from Toba Lake. He divides the whole region into twelve areas of which the ancient focus of Batak culture, the sacred island of Samosir in Toba Lake is one of the most modified by human occupation, whereas the most primitive are the two occupied by the Dairi, namely, Dairiland proper and Boven Baroes (upper Barus) which is the coastal part of Tapianoei. The ten Toba and sub-Toba areas on Samosir, and to the southwestward and southward of Toba Lake are densely populated and some of them have long since ceased to have any considerable area of primitive forest. They have developed wet rice-field culture extensively, but toward the borders still practice some shifting agriculture.

The land classification of the more primitive Dairi, according to Ypes (1922, p. 81) is as follows:

- 1, kérangan longo, extended primary forest, far from the villages;
- 2, taling toea, isolated old forest patches nearer at hand;
- 3, rambah kédép, secondary woodland cleared and cultivated about every sixteen years by the Pak-pak (subgroup of the Dairi) Batak;
- 4, balik batang, similar land good enough to be cleared and cropped about every ten years;
- 5, alang-alalang, grass plains which may gradually by natural reforestation go over into rambah kédép;
- 6, rambah galoenggoeng, formerly cultivated land covered by the shrub galoenggoeng, which dies out when reforestation has taken place, and the land may fall into that with a 16-year cultivation cycle;
- 7, tahoema or djoema, newly cleared land used for upland rice without irrigation;
- 8, ombak or pérgadoengén, the root-crop fields on which a crop of upland rice has been grown, now planted to oebi;
- 9, pérkémindenén, benzoë gardens;

- 10, ěmbal-ěmbal or djampalan, walled pastures;
- 11, djalangan, pasture-land with defined natural boundaries;
- 12, ladjangan, extensive pasture land with undefined boundaries.

The latter two categories are defined, apparently, more from the legal standpoint of village jurisdiction than from a vegetational, and fall into a class of grass plains devoted to grazing and probably by that fact prevented from passing back into the cycle of cultivation by natural reforestation.

One of the most interesting features of tahaoema or djoema cultivation by the Pak-pak Batak is the planting of certain fruit trees and other useful trees in the cultivated clearings during or at the end of the rice and root-crop sequence. Thus arise the pěrkemindaněn or benzoě gardens from which gum benzoin is obtained. They mark an interesting and significant advance toward permanent land utilization which affords a clue for devising and introducing an agricultural-forestry sequence that could be agronomically and economically adapted to the region and the people. Other tree crops planted in the same way as the benzoin gardens are taroetoeng (the well known fruit of which the Malay name, durian, is familiar to all), pola (Arenga pinnata, the sugar-palm, mentions more particularly in the account of djoema or ladang agriculture in Asahan), nangka, parira (Malay něte), gěrat, pinang (betel-nut palm, Areca Catechu), langsar, bachang (the wild or stinking mango, not appreciated by Europeans, but liked by Sumatrans and Malaysians elsewhere), pali and rimo (lemon,). In the last 30 or 40 years there has been more or less coffee culture. Bamboo is generally planted.

Forest enrichment. Closely related to the planting activities which point in the direction of permanent agriculture is the somewhat unsystematic but important enrichment of forest which falls under definite group control but is nevertheless seldom recognized by European visitors. Ypes does recognize it for the Dairi Batak, for approaching land use from a legal standpoint he could hardly have failed to encounter it. The gathering of forest products depletes the forest, so that continued productivity depends upon constant forest enrichment. This is particularly true for the valuable types of kětang (rattan, climbing palms) which can easily be exterminated if not artificially replanted, for rattan is not infrequently harvested before seeds have been produced. As for benzoe, Ypes tells us that in the Dairilands practically all is from planted trees. Definite regulations and tithes for the chiefs are connected with the collection of forest products. The chief, aside from benzoe and rattan, are meang (getah, or gutta in English) Barus camphor, and honey from "bee trees". Rattan is planted only in tall forest, for it climbs high and cannot develop properly in bush land. The right to harvest bamboo, if planted, is reserved to the planter.

In the Dairi lands a djoema (batac ladang) goes through a cycle of three to six years in three periods, each of which has a name. The first or rice-planting period is roba or rëba, the second, in which the root crops are planted, is anggala, and the third, of no new planting of annual crops, but only of harvesting, is këtöloen. The preliminary labor of selecting land, clearing, burning, etc. follows definite ceremonial procedures for propitiating certain spirits, invoking the aid of good ones, driving away bad ones. All who participate have their plot assignment, in which little individual plantings are first made in their respective parts of sugar-cane, medicinal plants, cucumbers, and pandanus (for making mats, etc.). Then the chief planting is done by all concerned. Every operation is accompanied by ceremonies, one of the chief being the sacrificial feast when a buffalo is killed at the building of the sapo djoema (ladang watch-house).

The benzoë trees are planted in the ladangs during the anggala period, as fruit trees are likewise. They are first tapped when seven years old, and can then be profitably tapped for about twelve years. They can then be destroyed to make a new ladang, as can insignificant plantings that never became profitable. Good fruit trees in private ownership must not be destroyed to make a new djoema (ladang). The same is true for individually owned plantings of palms, and certain other miscellaneous useful trees, but in the whole of the Dairi region Ypes found only one piece of forest reserved as a source of house timbers. The forest was prized chiefly for minor products rather than timber.

Sacred groves. The Dairi maintain certain groves which it is forbidden to fell because they are considered to be the dwelling places of good spirits. In such a sacred grove (poelo-poelo sëmباهën i. e., an island-like place for prayer) a particular tree (kajoe sëmباهën, the prayer tree) is considered the exact residence of the spirit. Other groves are left because they are thought to be haunted by bad or banished spirits. One may cut down such a grove if he dares, and there are tests by which he may know how likely he is not to be harmed. Finally, other reserved places where nothing may be cut are the two burial places of each village, one up-stream and one down-stream.

The land classification and the application of particular terms varies somewhat from district to district in the area so exhaustably studied by Ypes, but the details need not concern us. Among the Dairi Batak of Boven Baroes he found a general agreement in customs with the Pak-pak of the Dairi lands proper, and confirmation of individual possession of perennial plants. Although a person had only a share in the joint produce of annual crops, he could not alienate land. He had personal ownership of such things as he had planted that outlasted the djoema, but could not dispose of them except within definite limitations designed to protect the integrity of the community.

If they were not of significant value he could not retain possession against the right of the community to clear the land again for agriculture.

Among the Toba Batak the customary law regarding land, agriculture, and crops was even more highly developed. There were areas where little of the terminology of primitive shifting agriculture could persist with its primitive significance, and such areas had mostly the permanent agriculture of irrigated rice fields (sawah). On thickly populated Samosir the preparation of a dry-rice field (haeoma toer) could hardly require the felling of tombak, old forest, primary or so old as to be indistinguishable from primary, because only inviolate sacred groves were left, but young second-growth was called tombak by some. Also, the preparation of a sawah (wet-rice field) required making offerings to the homban ni djoema, or spirit of the dry-rice field that might presumably resent making it into something else. Such an offering, martoea oma-oma, preserves in its name a reduplication of a cognate word for djoema, namely oma.

Vestiges of the original vegetation of even the most populous parts of the Toba region presumably still remain at the sacred places believed to be inhabited by a higher order of spirits called sombaon. Of these groves the most famous in the Batak lands is a little patch of forest at the very top of the hill called Poesoek Buhit ("navel hill") under which the "world serpent" Radja Padoha is thought to dwell. This is on the Toba high plateau south of the lake, and there are many others, such as one near Balige on the mountain Dolok Tolong. In addition there are often bits of old forest at burial places which it is forbidden to touch. As for other reserves, they were at least to be found at the headwaters of streams, where groves were left for the protection of springs, and at places of bad omen.

Postscript

One who advocates control of primitive agricultural practices or interference with the "rights" of human groups who have never developed the concept either of individual ownership of land, or of the state holding certain resources in trust for the benefit of all, is sure, sooner or later, to encounter opposition. It may not come from those who are supposedly injured, but often, as likely as not, from persons or groups who take a short view of man's responsibility as custodian of reserves for the future and conceive that they are on the side of impartial justice.

Some anonymous contributor to "The Indian Forester" must have been worried over the knotty problems posed by aboriginal tribal practices when he wrote the amusing doggerel debate which appeared in 1877 (p. 218).

"W." must have been Mr. W. H. A. Wallinger, of the Indian Forest Department and "H." may possibly have been Mr. Horsley. Both were participants in the Forest Conference of 1875. Mr. Wallinger had read a long paper on the prickly pear, and Mr. Horsley one on the Bhils. But who wrote the 'pome' which follows?

THE GENTLE BHEEL

A Conference Poem

I.

(H.) I keenly feel that every Bheel
Should have his wood and water free,
That with his axe, and ne'er a tax
He may take every forest tree.

II.

(W.) But one may steal, tho' not a Bheel.
(H.) Yes, true! but here's my dodge so neat,
I hang a ticket round his neck
Or brand him (gently but complete.)

III.

(W.) Then with a squeal that branded Bheel
Would make the forest tribute pay,
Tree-bush and shrub, root stem and twig,
He'll fell; then where your forest (?) say!

IV.

(H.) The hungry Bheel must have a meal,
So out of trees I'll pick out nine,
And say "my Bheel that list is yours,
And this my gentle Bheel is mine."

V.

And lest that Bheel again should steal,
 I'd teach him manners, give him fields;
 A college, schools, both high and low,
 Good roads, and all that science yields.

VI.

(W.) I also feel, I love the Bheel,
But with your plan I disagree!!
 I'd shut up every forest tract
 And never let him see a tree.

VII.

But as that Bheel must have a meal
 On prickly pear I would him feed;
 And seat him on the cactus top,
 If moral suasion he should need.

VIII.

And as the Bheel the want might feel
 Of clothes, I'd take a haversack
 And fill it up with seeds of kinds,
 And place it gently on his back.

IX.

And o'er the hills, so void of rills,
 That Bheel the seed should broadcast sow;
 Thus trees would rise before our eyes
 And springs would gush and fountains flow.

X.

Then looking down the stream of time
 With mental eye like Dollinger,
 I see the Bheel, opuntia fed,
 Will bless the name of W-ll-nger.

There are no entries for subjects that might occur on almost any page. Minor locality names are omitted. All old geographic designations are not included if more precise modern designations are entered. Under the name of such a broad area as "Africa" only general references to more than one country or region are listed. The index is not intended to be complete for the names of plants mentioned only once or twice, and those which occur very frequently (rice, for example) are not listed at all.

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