In Search of the Forest in Côte D'ivoire, parts 1 & 2

André Aubréville[1]
Translation by Ilona Bossanyi[2]

[1] Inspector-General for Water and Forests in Overseas France

[2] *Bois et Forêts des Tropiques*

Part 1
Translation from the original article published in French in the issue n° 56 of the journal *Bois et Forêts des Tropiques*, November-December 1957.

Part 2 (p. 86)
Translation from the original article published in French in the issue n° 57 of the journal Bois et Forêts des Tropiques, January-February 1958.

Photo 1.
Protected forest of Konin, in Côte d'Ivoire, 1950.
Photograph A. Mariaux, 1950.

RÉSUMÉ

À LA RECHERCHE DE LA FORÊT EN CÔTE D'IVOIRE

Jusqu'à 1935, on pouvait encore voir en Côte d'Ivoire des forêts intactes le long des routes. Depuis, avec l'extension démesurée de la culture du café et du riz pluvial, le défrichement s'emballe. L'agriculteur fuyant les agoutis et le parasitisme familial défriche dans des forêts éloignées. En 1957, il faut aller à sa recherche pour apercevoir la forêt primaire. L'ouverture d'une route la condamne en une décennie, et l'exploitation forestière ne passe qu'une fois. Avec la disparition des forêts denses humides africaines, les régions soudano-sahéliennes subiront une saison sèche plus longue. En outre, il importe d'établir des cartes d'aires de présence avant la disparition des forêts primaires. L'étude ici présentée vise à classifier la végétation forestière ivoirienne et repose sur le parcours de 12 transects en forêt dense humide. L'approche phytosociologique est en effet trop imparfaite pour analyser cette végétation. Deux ensembles caractérisés par des groupes botaniques spécifiques ont été distingués : les « forêts denses semi-décidues humides à malvacées et ulmacées », et les « forêts denses humides à légumineuses sempervirentes ». Les espèces à grand pouvoir de dispersion, abondantes dans les brousses secondaires, notamment des genres *Triplochiton* ou *Terminalia*, échappent cependant à cette classification. Les ruptures d'aires de présence chez certaines espèces tiennent ainsi à la dispersion des semences, mais aussi à la paléohistoire floristique et climatique. De même, la notion d'aire écologique ne peut s'appliquer pour les espèces rares ou pour les zones d'endémisme local. L'étude évoque également plusieurs espèces invasives indigènes, comme *Scaphopetalum amoemum* et *Chidlowia sanguinea*, dont le développement bloque la régénération forestière. Elle traite enfin de l'inclusion de savanes dans des forêts humides, dont l'origine est toujours édaphique et non pas anthropique.

Résumé adapté par la rédaction de la revue.

Mots-clés : défrichement, déforestation, endémisme, espèces rares, forêt dense humide, forêt primaire, phytosociologie, savanes, Côte d'Ivoire.

ABSTRACT

IN SEARCH OF THE FOREST IN CÔTE D'IVOIRE

Until 1935, tracts of virgin forest could still be seen when travelling along the roads of Côte d'Ivoire. Since then, with the unbridled expansion of coffee and rain-fed rice crops, runaway forest clearing has been the rule. Farmers fleeing the depredations of the *agouti*, or of parasitic family members, move away to clear more distant forests. By 1957, an expedition was needed to search for primary forests. A new road would destroy a forest within ten years, and loggers would only come through once. With the disappearance of Africa's dense humid forests, the dry season in its Sudano-Sahelian regions has grown longer. It is also important to map the areas of primary forest before they disappear altogether. The study presented here aimed to classify the vegetation of Côte d'Ivoire's forests on the basis of 12 transects in dense humid forests, since the phytosociological approach is not robust enough to produce such an analysis. Two groups characterised by specific botanical families were identified: "dense humid semi-deciduous forests with Malvaceae and Ulmaceae", and "dense humid forests with evergreen leguminous species". However, some species with high dispersal potential, which are abundant in secondary forests, especially *Triplochiton* and *Terminalia*, do not fit into this classification. The fact that the areas of distribution of certain species are discontinuous may be accounted for by seed dispersal, but also by the palaeohistory of the flora and climate. Similarly, the ecological area concept cannot be applied to rare or locally endemic species. This study also discusses several indigenous invasive species, such as *Scaphopetalum amoemum* and *Chidlowia sanguinea*, whose growth prevents forest regeneration. Finally, it discusses the presence within humid forests of patches of savannah, which are always of edaphic and not anthropic origin.

Abstract adapted by the editorial team.

Keywords: forest clearing, deforestation, endemism, rare species, dense humid forest, primary forest, phytosociology, savannah, Côte d'Ivoire.

RESUMEN

A LA BÚSQUEDA DEL BOSQUE EN COSTA DE MARFIL

Hasta 1935 aún se podían ver bosques intactos a lo largo de las carreteras de Costa de Marfil. Después, con la desmesurada extensión de los cultivos del café y el arroz de secano, el desmonte avanza con rapidez. El agricultor que quiere escapar de los agutíes y del parasitismo familiar se va a desbrozar bosques alejados. En 1957, para observar un bosque primario hay que ir en su búsqueda. La apertura de una carretera lo condena en una década y la explotación forestal sólo tiene un turno. Con la desaparición de las selvas húmedas africanas, las regiones sudano-sahelianas soportarán una temporada seca más larga. Por otra parte, es importante establecer mapas de las áreas de presencia antes de la desaparición de los bosques primarios. El objetivo de este estudio es clasificar la vegetación forestal marfileña y se basa en el recorrido de 12 transectos en la selva húmeda, ya que el enfoque fitosociológico es demasiado imperfecto para analizar esta vegetación. Se diferenciaron dos conjuntos caracterizados por grupos botánicos específicos: "las selvas semicaducifolias húmedas de malváceas y ulmáceas" y las "selvas húmedas de fabáceas perennifolias". No obstante, las especies con gran poder de dispersión, abundantes en matorrales secundarios, especialmente las de los géneros *Triplochiton* o *Terminalia*, escapan a esta clasificación. Las rupturas de las áreas de presencia de ciertas especies se deben, por tanto, a la dispersión de semillas, pero también a la paleohistoria florística y climática. Asimismo, la noción de área ecológica sólo puede aplicarse a las especies raras o en las zonas de endemismo local. Este estudio menciona también varias especies invasoras indígenas, como *Scaphopetalum amoemum* y *Chidlowia sanguinea*, cuyo desarrollo bloquea la regeneración forestal. Por último, se aborda la inclusión de sabanas en bosques húmedos, con un origen que es siempre edáfico y no antrópico.

Resumen adaptado por la redacción de la revista.

Palabras clave: desmonte, deforestación, endemismo, especies raras, selva húmeda, bosque primario, fitosociología, sabanas, Costa de Marfil.

"Where have they gone?"

Thus today's tourists, as they look in vain for the magnificent forests of Côte d'Ivoire along the road and see only scattered trees above an amorphous mass of vegetation. Of course, they can always visit the Banco National Park, where they can still admire the site of virgin, or almost virgin, forest as they drive along its well made-up roads. This forest, growing on the sandy soils of lagoon sandstone, is not the finest; its trees are not very tall, but its twining lianas and shadowy undergrowth are nevertheless impressive to travellers stopping off in Abidjan who have never ventured into an equatorial forest before.

Some more or less intact forest can still be seen along the roadside. These are listed forests that are under protection, such as the semi-deciduous Sangoué forest between Hiré and Oumé. There is also the vast uninhabited forest of Cavally between Tai and Grabo, which travellers can see along the bone-jarring road from Guiglo to Tabou, provided they have a four-wheel-drive vehicle, a repair kit, an axe, a winch to drag them out of the potholes and heavy beams to stand in for collapsed bridges, not to mention a few offerings for the forest spirits to avert misfortune.

At the time when I was studying the forests of Côte d'Ivoire as a forester and a botanist, from 1925 to 1935, it was still possible to prospect along certain roads. Forest profiles and tree species could still be discerned along the still sometimes recent tracks cut through the towering vegetation. Today, the forest has receded from the roadside. In some places, it is not far away, but most often, to get there, the traveller has to make his way through several kilometres of bush, fallows and crop fields barred by huge fallen trunks, along a winding and barely visible track leading to a farmer's camp. But nothing can be seen from the road and villagers have to be asked for the way to get to the "deep forest". Forests in Côte d'Ivoire still exist, but they can only be found with some difficulty[1]. Soon, an aeroplane will be needed to find any.

Deforestation obviously begins along the roadside. A track opened up into a wild forest is the beginning of the end. But when the population becomes sufficiently dense, slashing and burning also gains ground in the forest's interior, sometimes encroaching simultaneously over its entire area. Aerial photographs of the Danané region and the neighbouring forest region in French Guinea [Guinea Conakry] clearly show the recent proliferation of these cropfields. Areas of primary forest can be cleared and entirely denuded by man in just ten years, a human equivalent of locusts descending on a field.

Forest clearing has advanced considerably in the last 2 to 3 decades. This is surprising in regions where the population density is still low, such as the forests in the west of Côte d'Ivoire, in the Cavally and Sassandra basins where there are still some uninhabited regions, and therefore large tracts of forest. The population is mobile. Clearing is proceeding at a great rate. Villages shown on the 1:200 000 maps, which are quite recent, sometimes no longer exist, while others have appeared that are not on the map.

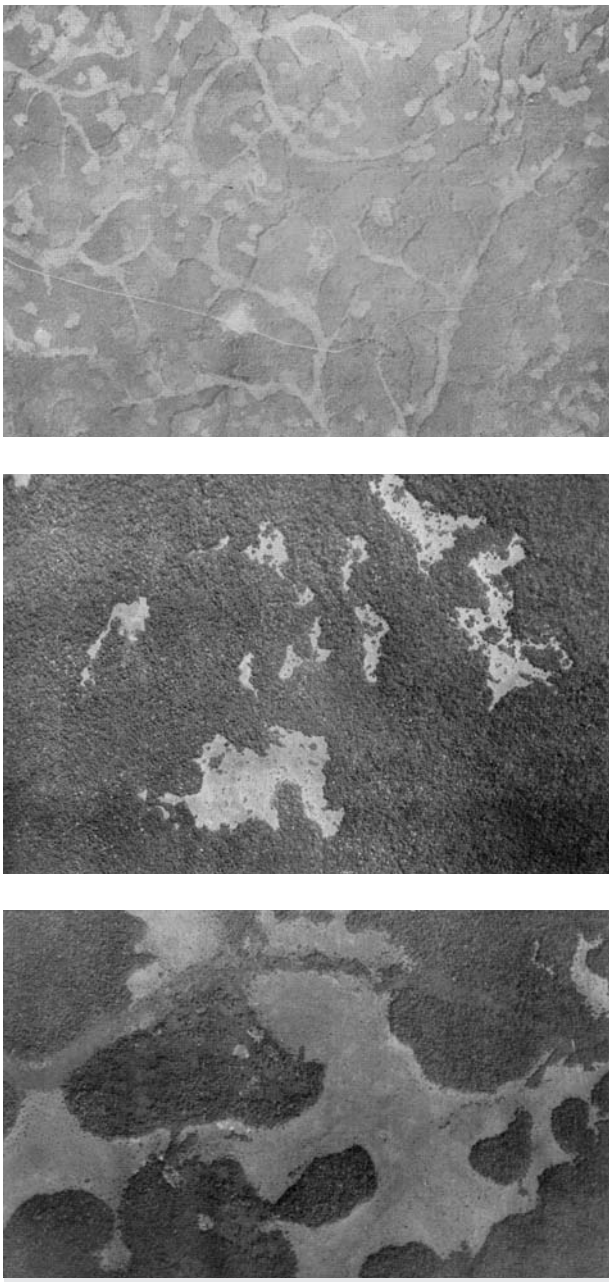


Photo 2.
From top to bottom:
A forest that has become entirely secondary (Danané region).
Tree savannah forming within a primary forest (Sassandra basin).
Poorly drained savannah with shrubs growing on termite mounds.
Photographs National Geographic Institute of France, 1957, N°s: 20 - 55 V – 1056; 103 - 55 V – 1056; 95 - 55 V – 1056.

1. « *Le botaniste qui recherche des lambeaux de forêt "noire" a souvent quelque peine à les trouver* » (A botanist seeking fragments of 'deep' forest often has some difficulty in finding them). G. Mangenot - 1955.

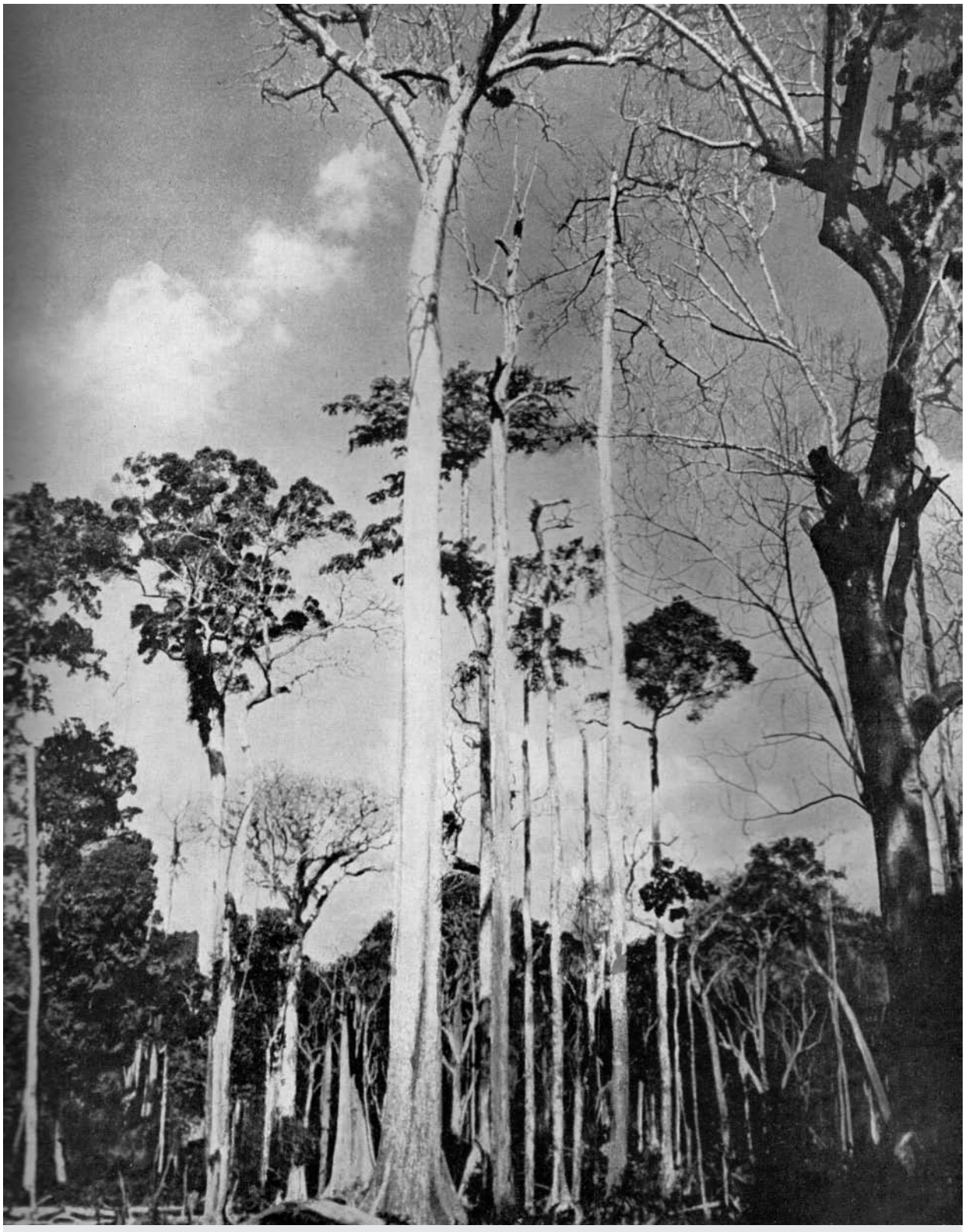


Photo 3.
A clearing in primary forest (Guiglo region).
Photograph A. Aubréville, 1957.

There are two main reasons for this frenetic clearing in the western regions I prospected this year from February to March: the extraordinarily rapid development of coffee plantations and dry rice cultivation. Along every road and forest track and around every bush camp, coffee trees are being planted on newly cleared ground in primary forests. This is undoubtedly one reason for Côte d'Ivoire's prosperity and would deserve applause, after a few tears have been shed for the fine trees that were cut down, were it not for the sense of disproportion between the areas cleared and the possibilities of maintaining and harvesting the coffee plantations. This impression is based on the apparently semi-abandoned state of many older plantations. We also recall the example in Brazil, where the first coffee plantations in the forests between Rio de Janeiro and São Paulo, on soils that were probably unsuitable, have now been abandoned and are being replaced by scrub and savannah, while the plantations have moved away to the southern plateau area with its cooler winters.

In Guéré country, rice is grown in primary forests, and only in primary forests. The crop is planted only once on the same soil. Each year, farmers clear a new forest parcel. Does the soil become exhausted so quickly that it will only support a single harvest? This is what was said and believed in the past. In reality, the soil does not lose its fertility after a single rice harvest: if a farmer abandons his field so soon, this is because if he were to plant a new crop in the following year, he would have to work the soil to prevent it from being overgrown by perennial weeds and regrowth, despite previous burning. Maintaining the crop field would thus require more work than clearing a new parcel of primary forest, where the soil remains free of weeds, or nearly, after burning and until the harvest. It is therefore easy to understand how, even with a sparse population, forest clearing is proceeding so rapidly.

There may be many other reasons for this shifting pattern of cultivation. In the north of the Tai forest, along the forest road towards Cavally, I discovered a camp of straw huts near a stream running through a patch of spiny liana palms, which was being cleared to plant rice. The farmers were from the village of Zahipoli, lying on the roadside 6 to 7 km away across an area of primary forest, which, though magnificent, was infested by elephants in the rainy season. Their footprints were everywhere, with rubbing marks left by the animals at the base of enormous makoré trees (*Tieghemella heckelii*). On one gigantic abalé tree (*Combretodendron africanum*), the bark had been stripped up to a height of 3 metres. The undergrowth was crisscrossed by a multitude of tracks leading in every direction, along which the animals habitually walked, leaving their footprints in the marshy hollows. Why then, when peasant farmers often complain about the damage caused by elephants in their plantations, had they left their village to plant rice in the middle of a forest full of elephants?

It turned out that the reason for this exodus was the "*agouti*", a type of rodent, which had infested the plantations near the village. To get away from the animals, which are impossible to eradicate, the villagers chose to move their rice crop into the middle of the "deep" forest, far away from the fields around the village. But the elephants! The villagers feared them less than the *agouti*, because elephants in the vicinity can be scared off by making a noise, but this does not work for *agouti*.

Elsewhere, near the end of the made-up part of the road from Guiglo to Buyo, clearing was everywhere in evidence in a magnificent primary forest with an abundance of sipo (*Entandrophragma utile*), azobé (*Lophira alata*), *dabema* (*Piptadeniastrum africanum*), fraké (*Terminalia superba*), *abalé* (*Combretodendron africanum*) and *oualélé* (*Pycnanthus angolensis*). Although this was Guéré country, Yacobé people from the Man region had established camps two or three years earlier to clear the forest, with permission from the Guéré head of the canton. Why had they left their own region? They had done so to get away from all the "parasites" in their village who were living off their work without doing anything themselves. From time to time, a Yacobé acquaintance would join their little settlement to work. This was only a bush camp with a few huts, but a small denominational school had already arrived. A new village was appearing, and a forest full of useful species – sipo, *aboudikro*, white mahogany, *tiama*, *dibétou*, *kosipo*, *vioko* – was disappearing.

Photo 4.
A clearing in primary forest in the Guiglo region.
Photograph A. Aubréville, 1957.

Photo 5
A clearing in primary forest.
Photograph A. Aubréville, 1957.

This is how Côte d'Ivoire's forests are being devastated. The boundaries of forests that were listed for protection in time already stand out from the patchwork of cropfields around them, in what the British vividly describe as "broken forest". These forests are envied by others in the vicinity: easier cultivation in wild forests will always attract, but the day is bound to come when none are left. As M. Mangenot has written, "except in the almost uninhabited region between Cavally and Sassandra, where forest clearing does not yet occur on a large scale, the reserves of the water and forests service are now the only more or less intact specimens in which studies of dense forests can be made".

But how long will these reserves last? The question is not an idle one. Listed forests were already being protected in Côte d'Ivoire 30 years ago, with the limited means of the water and forests service and support from government administration (with some exceptions). But these listed forests were not well guarded. How could 45,000,000 ha of forests be protected by just 160 people, not all of whom worked on site? Nevertheless, some forest areas have been more or less protected until now, thanks to a degree of moral respect for administrative decisions and the vigilance of the forest rangers. Will this still hold true in the future, with the new political freedoms granted to local assemblies? Will they not be tempted to dispense with forest protection to please an electorate with an insatiable appetite for new forest lands? Everything will depend on how they perceive the higher interests of the country: the future of the protected forest domain is in their hands.

The forests of Côte d'Ivoire could be in danger of extinction tomorrow, with a few temporary exceptions in some uninhabited regions. Unless a protection policy is implemented with a firm hand, the title of this article will have to be taken literally within a few decades at most.

What would be the consequences of such destruction?

Distances from forests to sawmills are already increasing. Some sawmills are still lucky enough to be close to listed forest preserves. Others, even in the heart of the forest interior,

have to get their timber from 20 km away and more. Many small sawmills that have proliferated around the centres now have to be content with removing valuable trees that have been left standing in recently cleared forest because of their large size. The area will be logged over once, but never again. These magnificent trees will be gone for good, and the entire country become an unlovely patchwork of encroaching secondary bush.

Considerable reserves of valuable timber are under threat in the west, in the forests of Tai, Guiglo, Soubré and Duékoué with their outstanding abundance of sipo, *Entandrophragma utile,* and makoré, *Tieghemella heckelii*.

At present, these trees may be of no interest for export as they are too far from the coast, but who can say whether this will always be the case, or whether the currently negligible local demand will one day increase? Wasting such fine timber in favour of income from ephemeral rice crops clearly demonstrates the primitive state of Africa's agricultural economy, which is lagging far behind its political development.

Who can predict what could happen to the climate should these forests virtually disappear? I described in a previous article[2] how the humid forests along the Atlantic coast of West Africa, from Liberia to the Congo estuary, relay moisture from the Atlantic monsoons as they advance into Africa's interior, towards the arid and semi-arid Sudanese regions, where rainfall and water resources in the rainy season therefore depend on the Atlantic Ocean and the dense coastal forests. If these no longer existed, the coastal countries would still have torrential rains from May to October, but the Sudanese hinterland would receive much less, and the dry season would last for longer. As for the coastal countries, although the monsoon rains would still be abundant, they would experience more severe drought from December to February. The dry Harmattan wind is already a perceptible threat to the coffee plantations, even when it blows for only a few days. The forests of Côte d'Ivoire protect these plantations. Both need to coexist as a harmonious system across the territory.

Wisdom suggests that productive and protective forests in Côte d'Ivoire should be preserved in sufficient proportions and evenly distributed across the entire forest zone. The country's future depends on its forests. My hope is that the population and the Assembly will be convinced of this and will willingly adopt the necessary line of conduct.

Will we be able to fully understand Côte d'Ivoire's climax forests, those ancient forests that were home to a pygmy population that has now disappeared, before deforestation destroys them completely?

By this I mean exhaustive scientific knowledge covering all plants, trees, herbaceous plants, mosses, fungi, bacteria, etc., their geographical distribution, their ecology and the interactions between all these plants and the environments that make up biogeocenoses, and therefore implying an understanding of climates and biomicroclimates. For these scientific studies of an ancient and vanishing biological system, which will probably never return to its initial state, we must call on botanists, climatologists, ecologists, zoologists, phytogeographers and soil scientists. Although research on the flora has progressed, it is by no means complete, and we still know very little of the biology of forest plants, their temperament and their interactions.

I was moved by curiosity to look into the position of Côte d'Ivoire's forests in the overall classification tropical forests, and then to go further by forming an opinion on whether different types of forest zones could coexist in the general pattern of the country's forests. These are not new questions, but the answers have been varied and could still vary. Since the first descriptive essays on the dense forests of Côte d'Ivoire written by Auguste Chevalier, and the studies I published in 1933 after my first prospecting tours, there have been many others and the flora is better known. M. Mangenot has attempted to analyse and interpret forest groupings using the phytosociology methods applied in Europe by certain botanists. He has described plant "associations" based on comparisons of numerous exhaustive flora surveys, each

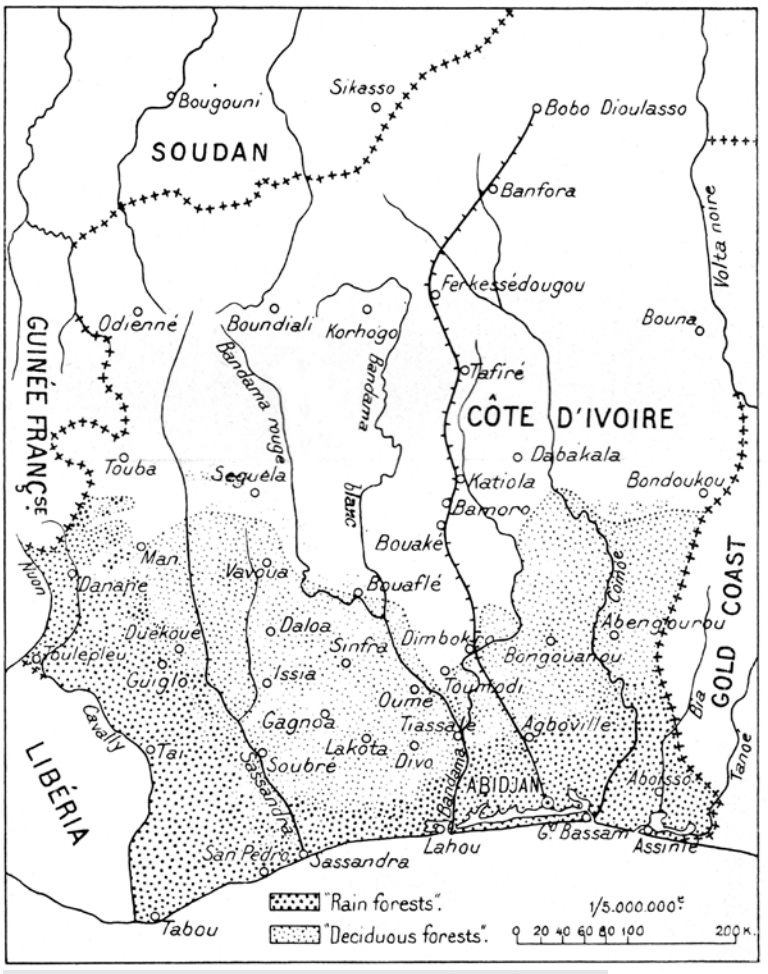


Figure 1.
Map of the main forest formations in Côte d'Ivoire.
From *La Forêt Coloniale* by A. Aubréville.

2. Climates, forests and desertification in tropical Africa. 1949.

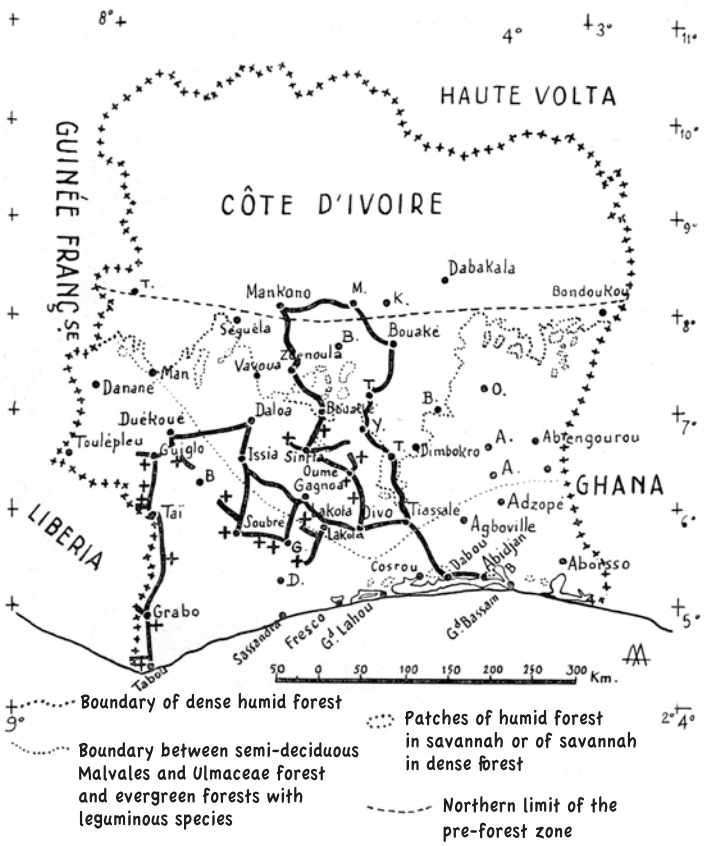


Figure 2.
Map of the itineraries and forests prospected, from January to March 1957.

conducted on very small plots (10 m²). It seemed to many connoisseurs of the tropical vegetation of humid regions that the complexity and heterogeneity of its composition were ill-suited to abstract statistical treatments. A controversy arose between botanists in favour and against the use of these analytical methods in equatorial forests, and is still ongoing. A recent study by M. Mangenot[3] summarises his ideas, which are clearly summarised in an even more recent map[4] (figure 1). I could have had no better experts to guide my attempts to understand the intimate nature of a forest I had not prospected for 20 years, and which I was in a sense seeing afresh as a new forest but for the fact that I quickly regained my familiarity with the trees, whose names, appearance and botanical morphology I soon remembered with the help of excellent African prospectors, one of whom, the forest warden Aké Angué, now with hair as white as my own, had already been my loyal prospector 20 or 30 years ago. We therefore understood one another perfectly, and I was pleasantly surprised to hear, perfectly enunciated by the younger forest wardens, the Abé, Attié and other local names we had chosen so long ago to refer to the different tree species. Given these promising conditions, I was able to quickly analyse forest types, using not the phytosociology method requiring minutely detailed surveys of parcels no more than a few dozen square metres in size, but by following itineraries along several hundred metres or several kilometres, depending on stations. I will return later to the value of each method. With their help and guided by our earlier and well-tried experience as a team, we were able to dissect an entire forest in 1 to 3 days (excluding lianas and herbaceous plants), with little to be gained by extending the survey period.

With 60 to 70 species, and sometimes more, being counted in a single day, with indications on their local abundance, we had to search for a long time to add three more. The task then became disappointing for lack of new results and I was soon convinced that it was better to move 10, 20 or 30 km further to have any chance of finding new species, or more often the same species but with a different stand composition.

I analysed 12 types of dense humid evergreen forest, 5 between Tabou and Guiglo (Cavally basin), 2 in the Guiglo area, 3 in the Soubré area (middle reaches of the Sassandra basin), 2 in the Lakota area (Upper Niouniourou) and 4 in dense, humid semi-deciduous forest in the Oumé-Sinfra area.

All these forests had the characteristics usually found in primary forests. Cross-comparisons of all these analyses immediately clearly brought to mind the division of the forest into two distinct types formations: "dense humid semi-deciduous forest", to follow the terminology recommended by the phytogeography meeting at Yangambi , and "dense humid evergreen forest". These used to be called "deciduous forest" and "rainforest". The terms have been inconveniently lengthened, but foresters still use them, although the term "deciduous forest" is inaccurate because no forest ever loses its foliage entirely to leave the familiar skeletal branches of a temperate forest in winter. In fact, when the term "deciduous forest" was used, it was always pointed out that this was a conventional term and that the loss of foliage is relative. It is nevertheless better to use more exact language. The phytogeographers at Yangambi chose the expression "semi-deciduous forest", meaning that leaf fall in the dry season is only partial. In the rainy season, a "semi-deciduous forest" is as green as any so-called "evergreen" forest. In the middle of the dry season, some isolated trees without leaves are found in the "rainforest", but they are far more numerous in semi-deciduous forests, where sometimes, depending on composition and season, more than half of the large tree crowns may be denuded at the same time. This is often the case, for example, when samba trees (*Triplochiton scleroxylon*) are abundant in the stand. The differences are obviously only a matter of degree and vary over space and time in the dry season. There is a well-known technological reason for the terminological allusion to deciduous foliage in a context where persistent foliage is fundamental. Dense humid semi-deciduous forest is of a type that needs to be distinguished by a specific name from dense humid forest (taken in the broad sense).

3. Études *sur les forêts des plaines et des plateaux de la Côte d'Ivoire*. Études *éburnéennes*, IFAN, 1955.

4. *Esquisse botanique de la Côte d'Ivoire d'après les prospections de G. Mangenot and J. Miège. ORSTOM.*

Photo 6.
Dense, humid, semi-deciduous Malvales and Ulmaceae forest (dry season), Oumé region.
Photograph A. Aubréville, 1957.

The distinction between these two main formations in Côte d'Ivoire is much clearer from the flora. High tree stands in semi-deciduous forests are made up of species that do not exist in evergreen forests, or only as isolated individuals; conversely, the most characteristic species in the latter are virtually absent in the former. It is therefore logical, since the dominant flora is specific to each formation, to refer to them in terms of the most representative botanical groups. M. Mangenot refers to semi-deciduous forests as "Celtis forests", which is entirely pertinent because a number of *Celtis* species are indeed dominant in the composition of high stands. Correlatively, in the Zurich-Montpellier tradition, he also proposed the name "*Celtidetalia*". Schnell had proposed the name "*Triplochitetalia*", also valid since it emphasises the remarkable abundance of the samba tree, a large Sterulacea of the *Triplochiton* family. If I had to choose between the two botanical groups to represent the formation, I would tend to prefer the former as the latter is more likely to cause confusion. *Triplochiton* is highly invasive, becoming established in forest clearings and gradually spreading into the south and west of Côte d'Ivoire in the climax zone of the evergreen forest where it is usually absent. Sometimes, what appears to be a *Triplochiton* forest is actually secondary forest adjacent to a true evergreen forest in which *Triplochiton* is entirely absent.

Celtis species disperse less readily than *Triplochiton* (by drupes, as opposed to the winged fruit of the latter).

However, species other than *Celtis* and Samba are dominant in semi-deciduous forest, and often more abundant. Besides *Triplochiton*, Sterculaceae and Malvaceae are very common, including large tree species such as: *Sterculia rhinopelata* (Cabbage palm); *Cola gigantean (*Giant cola); *Ceiba pentandra* (Kapok tree); *Pterygota macrocarpa* (Koto); *Mansonia altissima (*African black walnut).

Two Tiliaceae can also be added to the Malvales group: *Nesogordonia kabigaensis (*Kotibé); *Christiana Africana* (Kobahia; a small, rather rare tree).

These species (except for *Mansonia*) are also found as dispersed trees in more humid forests of the evergreen type, but they proliferate in semi-deciduous forests and are dominant in some places.

Besides *Celtis*, *Holoptea grandis* (kékélé) is another less common Ulmacea, which is exclusive to semi-deciduous forests. Several large Sapotaceae, equally abundant and

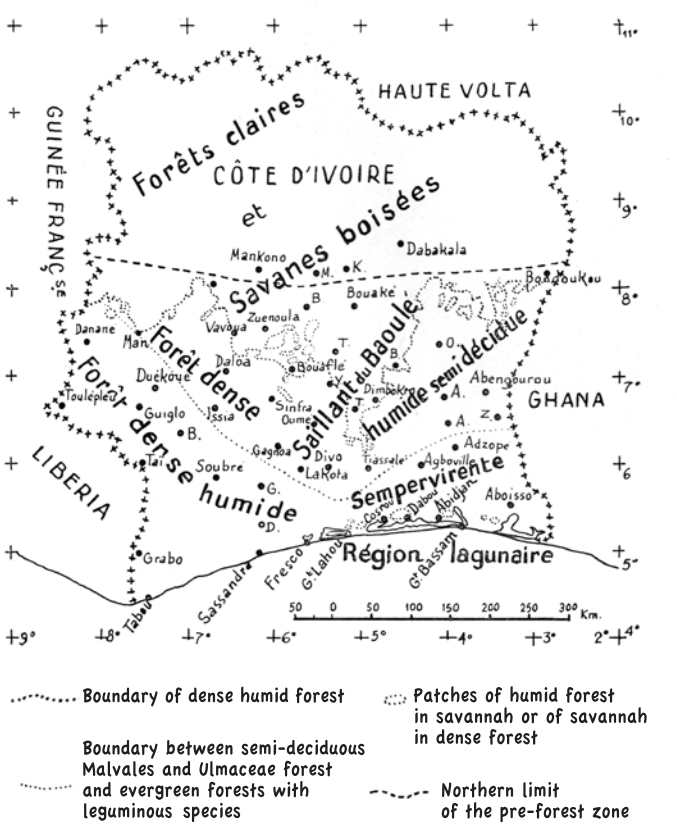


Figure 3.

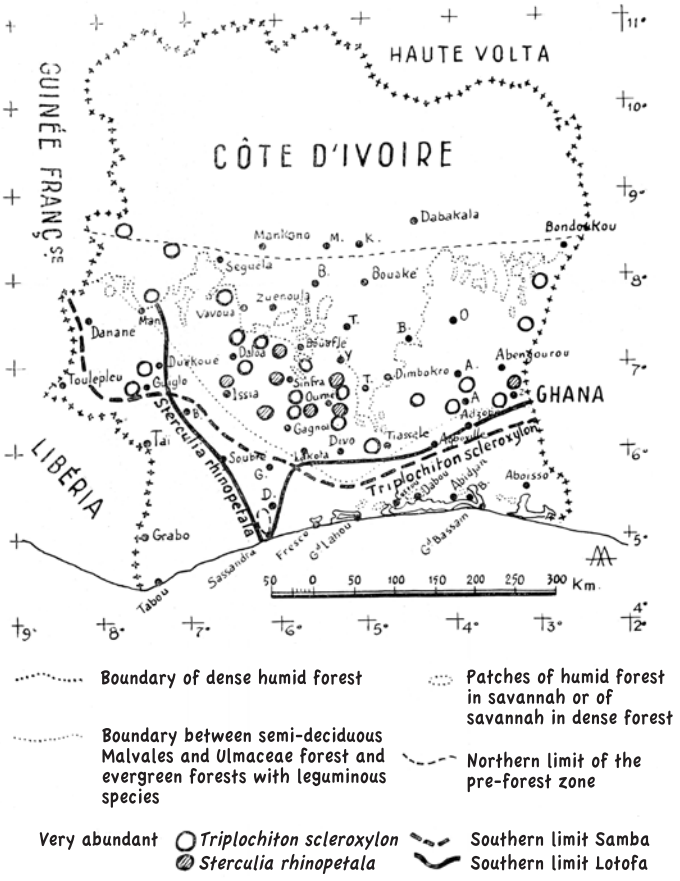


Figure 4.

characteristic, can also be included among these semi-deciduous forest species: *Chrysophyllum perpulchrum* (red aningéri); *C. giganteum* (koanandio); *C. glomeruliferum* (acatiocoton; bush); *Aningeria altissima* (grogoli); *A. robusta* (aningéri).

Other species are exclusive or abundant, but perhaps less common:

- Moraceae: *Milicia excels* (Iroko); *Antiaris Africana* (ako; and not A. Welwitschii, the akédé tree found on the coast); *Morus mesozygia* (difou); *Trilepisium madagascariense* DC. (daocou);
- Oleaceae: *Schrebera arborea* (oualio).

To my mind, the term **"semi-deciduous Malvales and Ulmacea forests"** would be quite adequately representative of semi-deciduous forests in Côte d'Ivoire, in so far as it can be described by a few botanical groups that clearly characterise a formation, which is the case here.

Along the edges of semi-deciduous forests may be found a number of particular species that do not usually find their way into the interior. It is possible to describe a leguminous forest sub-type that occurs in the most arid dry-season conditions, where it is in contact with the savannah:

- Legumes: *Aubrevillea kerstingii* (kodabéma); *Albizia ferruginea* (latanza; non-exclusive); *Afzelia africana* (lingué); *Detarium senegalense* (tamba); *Erythrophleum suaveolens* (alui); *Parkia filicoidea* (pipigbalé);
- Sterculiaceae: *Cola cordifolia* (ntaba);
- Meliaceae: *Khaya grandifoliola* (large-leaved mahogany);
- Sapindaceae: *Zanha golungensi; Blighia sapida* (baza).

It may be noted that the Leguminaceae and Meliaceae, which are generally abundant in Côte d'Ivoire's forests, are not listed here among the truly characteristic species of semi-deciduous forests, except of the peripheral type. Large leguminous trees, as we will explain further on, tend to cluster in more humid forests.

They are also found in semi-deciduous forests, but only as a secondary or ancillary species : *Piptadeniastrum africanum* (dabéma); *Amphimas pterocarpoides* (lati); *Guibourtia ehie* (amakazoué); *Distemonanthus benthamianus* (movingui; occurs in both evergreen and semi-deciduous forests).

However, some eucalyptus species in the understorey of humid forests are sometimes also common in the undergrowth of semi-deciduous forests. To describe a forest formation, it is always essential to separate species found in the upper and lower storeys; simply drawing up a list of species, without making this distinction can lead to confusion.

Among the giant Meliaceae, *Entandrophragma utile* (sipo), *E. cylindricum* (aboudikro) and white *Khaya anthotheca* (mahogany) are often very abundant in semi-deciduous

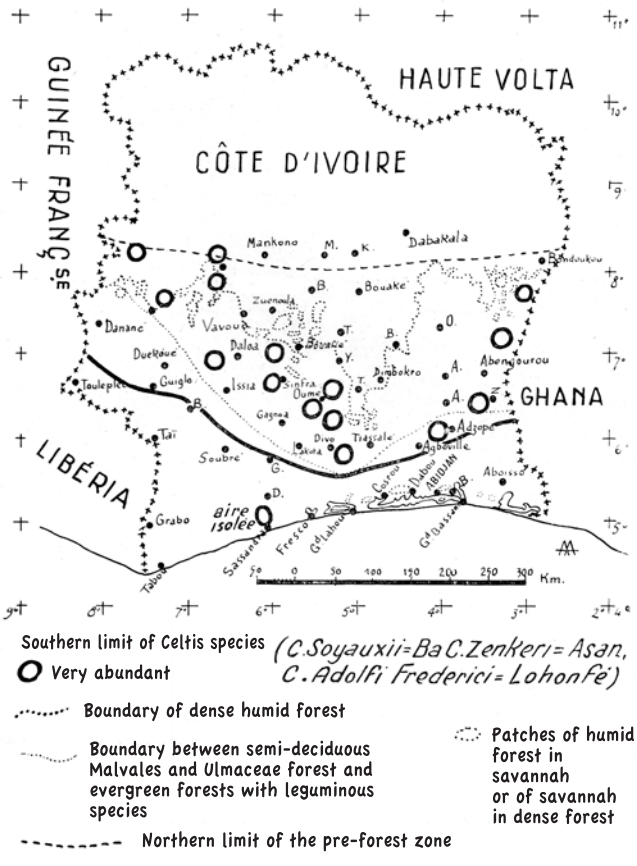


Figure 5.

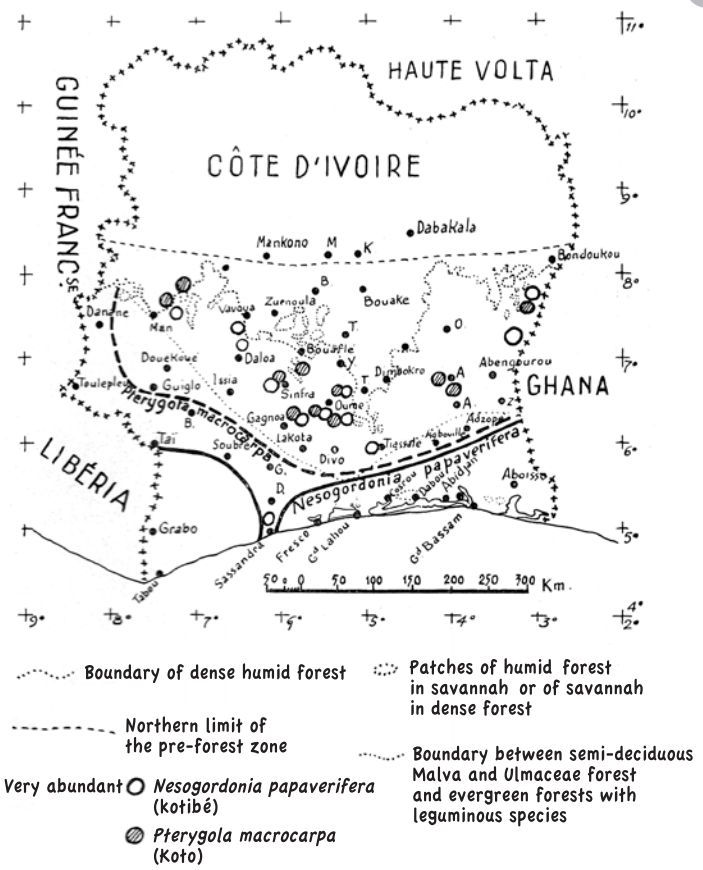


Figure 6.

forests, but also in more humid forests, so that they are not truly representative of either. Sipo, for example, is as common in the dense humid evergreen forests of Tai, Guiglo, Buyo and Lakota as in the semi-deciduous forests of Oumé and Sinfra. It disappears towards the transition zone between forest and savannah. *Trichilia prieuriana* (asamoiaké) is a small tree or shrub which can be abundant in the semi-deciduous forest understory, which it therefore characterises, although it is sometimes found in the understorey of more humid forests.

Fraké, *Terminalia superba*, a large deciduous tree, is a common and highly characteristic feature in the landscape of the Northern forests sectors. However, it is also found, sometimes in abundance, in more humid forests (Tai, Guiglo, Soubré). Dispersal is highly effective in this species, which is invading cleared areas and becoming increasingly invasive along roadsides. Although fraké is a typical secondary forest species, large isolated trees are sometimes found in evergreen primary forest. Its distribution range is expanding southwards.

M. Mangenot also refers to these semi-deciduous forests as "mesophile forests", suggesting an intermediate forest type in terms of water and moisture requirements between hygrophilous forests and wooded savannah. Rather vague name that could reform to any form of vegetation with average ecological requirements, as opposed to other more extreme ecological requirements, is less relevant than the others.

Dense humid semi-deciduous Malvales and Ulmacea forests (the term "deciduous forests" was certainly more concise!) are extensive in the centre of Côte d'Ivoire. They are often magnificent, great colonnades of high, straight-trunked trees with hardly a branch up to the crown. Many of the trees are of great value, and they generally have more high quality timber trees than the very humid evergreen forests of the south: sipo, aboudikro, white mahogany, samba, mansonia, kotibé, iroko and fraké are often abundant.

M. Mangenot estimated that they cover two thirds of Côte d'Ivoire's entire forest area. However, their climatic zone is probably more limited than the zone they now occupy after taking over from evergreen forest after clearing.

For example, along certain roads in the Guiglo area, magnificent stands of giant samba trees (*Triplochiton*) can be seen, mixed with other species in the usual patchwork of cultivated forest areas. These huge trees could easily be mistaken for the vestiges of the old-growth forest that lies a few kilometres into the interior. But no *Triplochiton* grows in this primary forest, which is of the very humid type with *Lophira*, *Piptadeniastrum*, *Irvingia*, *Parinari*, *Erythrophleum*, *Combretodendron*, *Pycnanthus*, etc., and very different to that I have

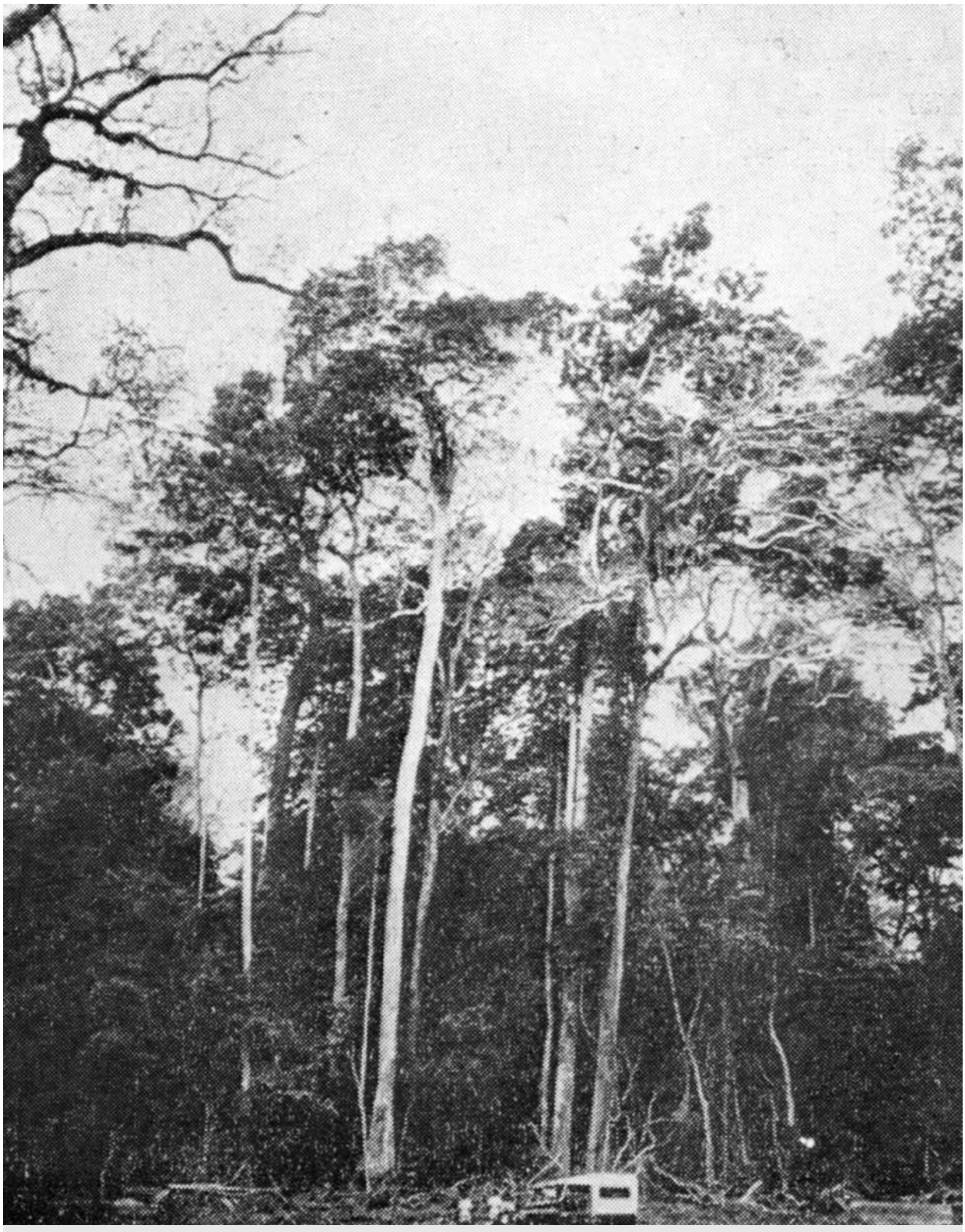


Photo 7
Dense humid semi-deciduous Malva and Ulmacea Forest (dry season). Oumé region.
Photograph A. Aubréville, 1957.

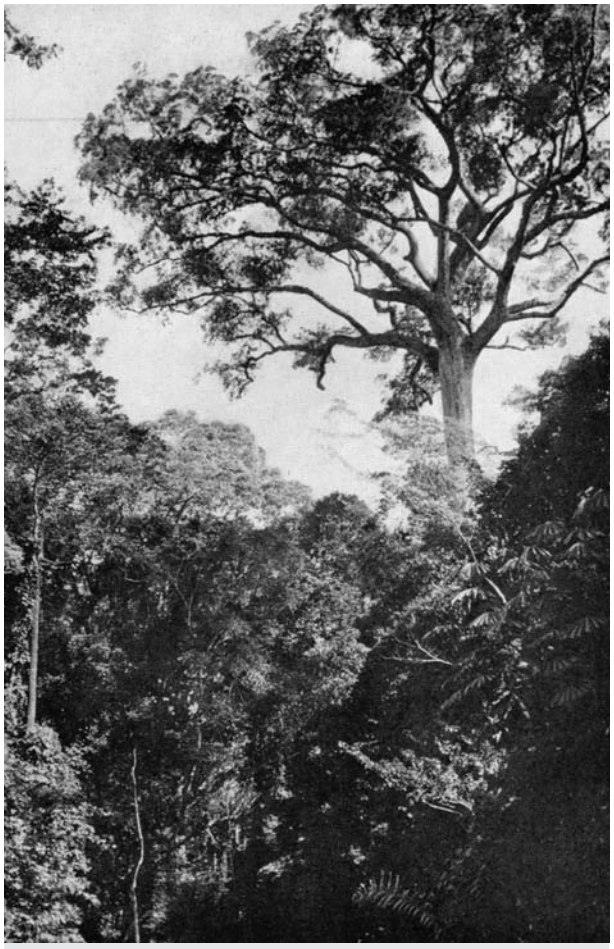


Photo 8.
Dense humid and evergreen forest with Legumes, with a high makoré Soubré region.
Photograph A. Aubréville, 1957.

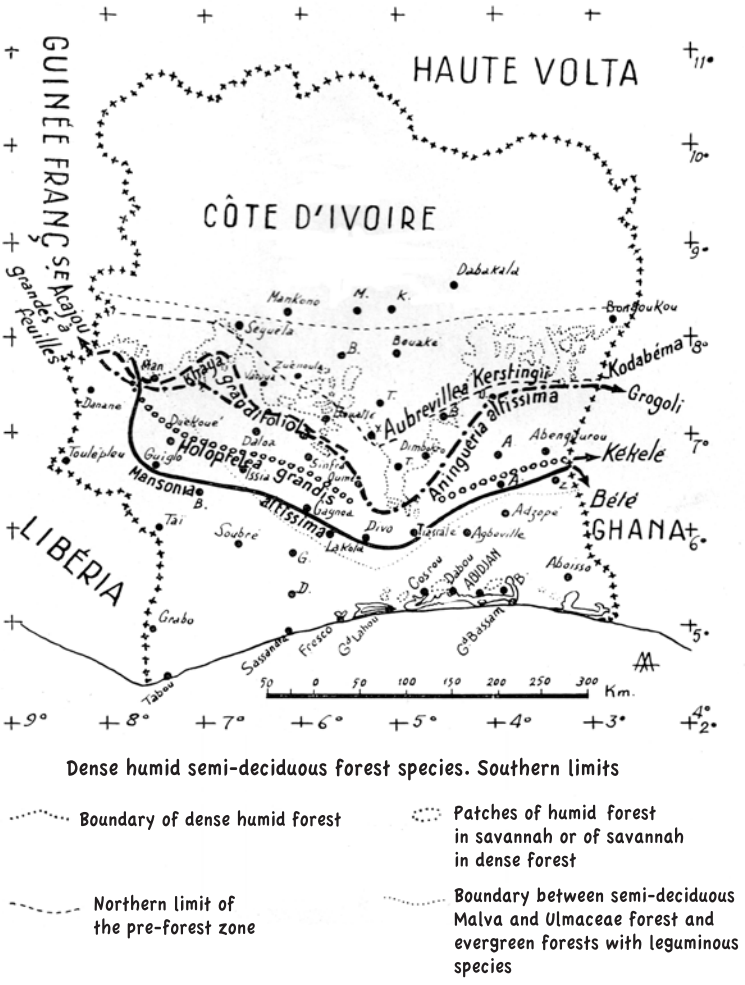


Figure 7.

just characterised by their abundance of Malvales and Ulmaceae. We therefore have to admit that these fine stands of *Triplochiton*, *Terminalia superba* and others are in fact components of old secondary forests. *Triplochiton* and *Terminalia* are now rapidly advancing towards the coast as and when clearings, and therefore roads, are made. In the future, once these old-growth forests have been entirely cut down, the coastal forests of Côte d'Ivoire may well become pseudo-climax forests of *Triplochiton* and *Terminalia*.

My point of view on Côte d'Ivoire's dense semi-deciduous forests therefore coincides, apart from a few details, with that of M.Mangenot. Problems of interpretation will no doubt arise on the subject of the rest of the forest where rainfall is more abundant and the dry season is shorter and less arid, in other words, the forest we refer to, as do our English friends, quite simply as **"rain forest"**. In accordance with the nomenclature adopted at Yangambi, it is now referred to in French as "*forêt dense humide à feuilles persistantes (ou sempervirentes*)", or, in English, **dense humid evergreen forest**. M. Mangenot uses the term **"Uapaca forest"** or, following the Montpellier-Zurich school, "Uapacetalia". In the same year as M. Mangenot, M. Schnelle had proposed "Lophiretalia". It Uapaca (*U. guineensis* and *U. esculenta, U. rikio* and *U. borikio*) and *Lophira alata* (azobe) are indeed both very characteristic of these forests, as are many others. This is a case where just two species do not stand out as particularly characteristic, and choosing them to designate the type of forest formation can be a source of error because it suggests, despite the many restrictive qualifications that can be made in a descriptive monograph, that these are forests where Uapaca (Mangenot) or Lophira (Schnell) are **particularly** abundant. These species are indeed statistically common and locally abundant, but often absent or isolated, as are all the other characteristic species. There is no reason to distinguish just one of these among the large group of representative species in the formation. This is why I prefer the general term agreed to at Yangambi.

But if term based partly on the forest flora were needed, then I would suggest **"dense humid evergreen forest with leguminous tree species"**.

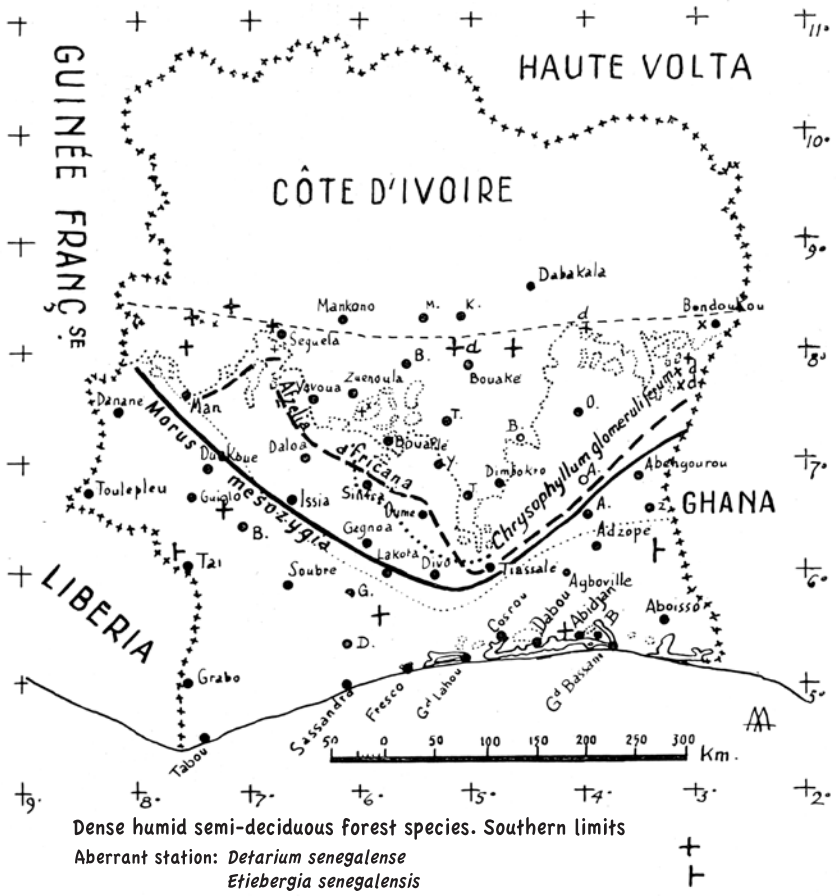


Figure 8.

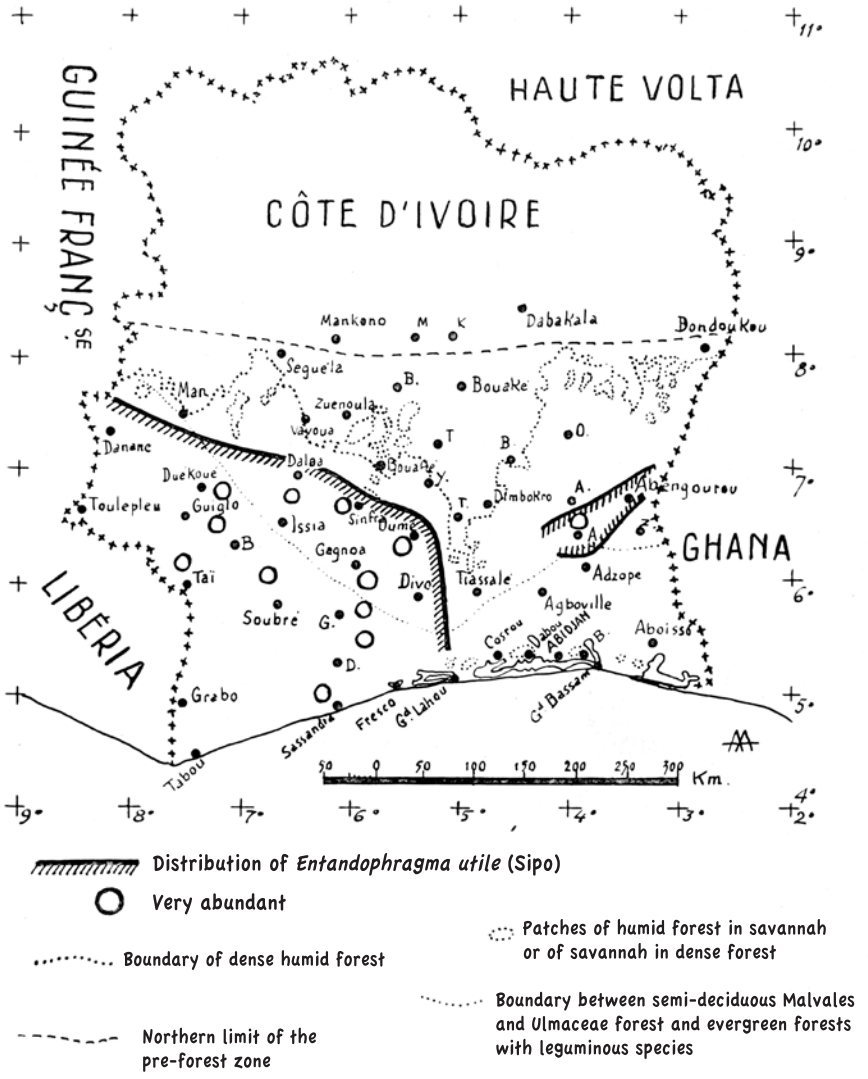
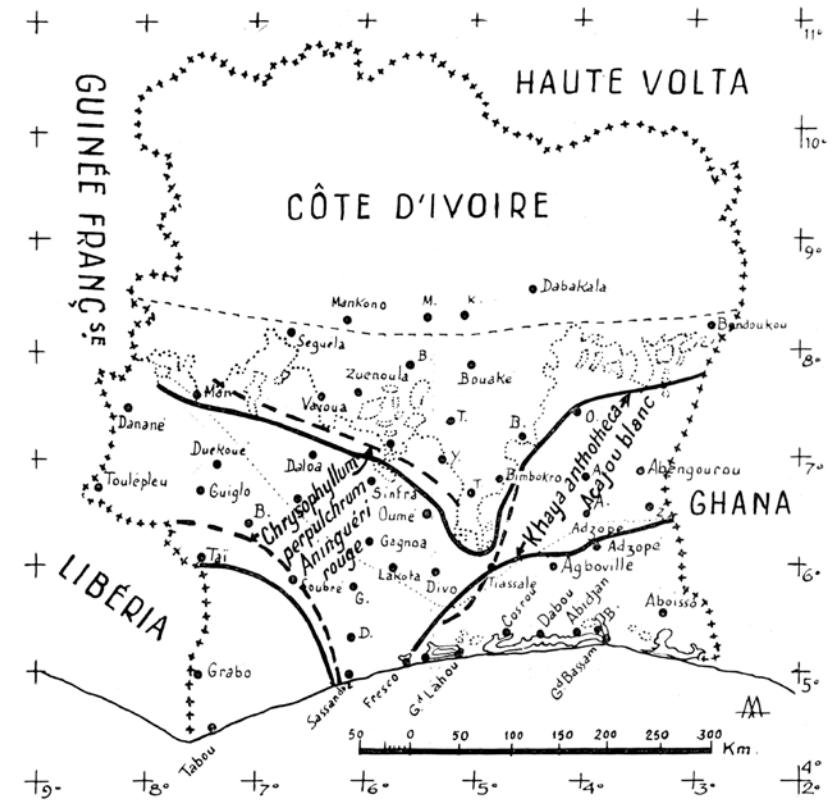


Figure 9.



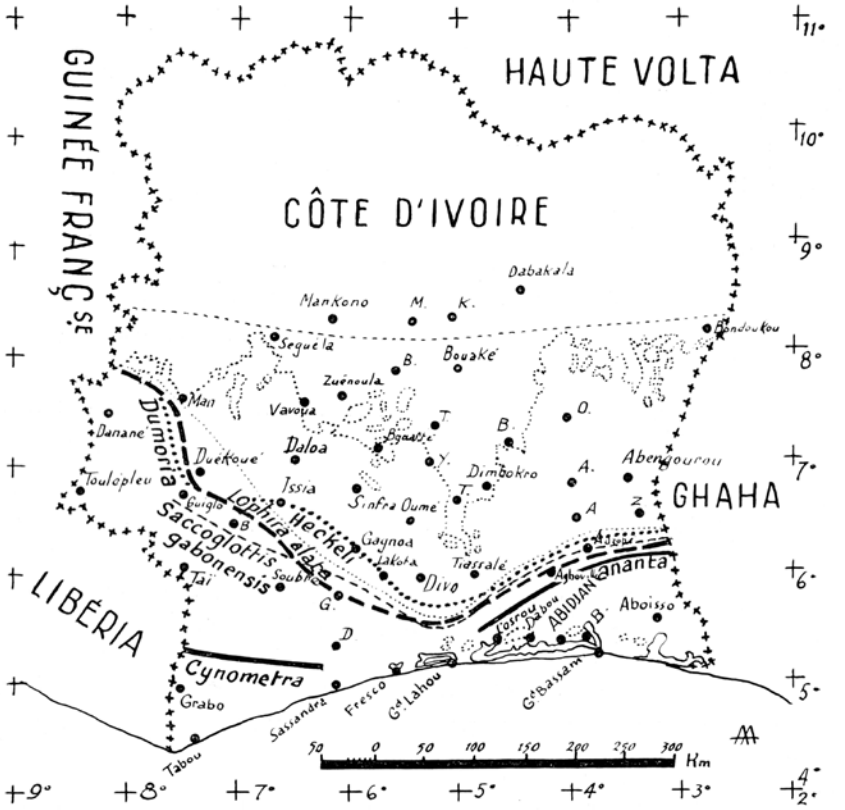
Boundary of dense humid forest

Patches of humid forest in savannah or of savannah in dense forest

Northern limit of the pre-forest zone

Boundary between semi-deciduous Malvales and Ulmaceae forest and evergreen forests with leguminous species

Figure 10.



Dense humid evergreen forest species. Northern limits

makoré

azobé

apomé

akouapo

Boundary of dense humid forest

Patches of humid forest in savannah or of savannah in dense forest

Northern limit of the pre-forest zone

Boundary between semi-deciduous Malvales and Ulmaceae forest and evergreen forests with leguminous species

Figure 11.

Part 2

I pointed out previously that few characteristic leguminous species are found in semi-deciduous forests (except in forest margins). However, they are abundant in more humid forests, where they are undoubtedly, and by far, the most common group of species (table I).

The list is incomplete, as it does not include leguminous species found on very humid ground or riverbanks, such as *Arthrosamanea*, *Gilbertiodendron* or *Berlinia*.

The species cited are exclusive to, and especially have a preference for, humid evergreen forests, where they are creatively characteristic in the sense that some have a very large range of distribution, while others are very localised, and some are often very abundant and others always dispersed.

Generally, leguminous species are more abundant than other families in terms of both species and individual specimens.

For purposes of comparison, the table below shows the other characteristic species in the upper storey, by family in alphabetical order (table II).

In this way, Côte d'Ivoire's dense forests can be classified into two main types:

Dense, humid semi-deciduous forest with Malvaceae and Ulmaceae.

Dense humid evergreen forest with leguminous species.

This analysis did not raise any great difficulties as it simply refines the work already conducted 24 years ago.

Table I.
Most common group of species in forest of Côte d'Ivoire in 1958.

Corrected name of genus and species or botanic synonymy	Botanic name used by the author and transcribed in the original article
Very large and tall trees	
Piptadeniastrum africanum (Hook. f.) Brenan	*Piptadeniastrum africanum*
Parkia bicolor A. Chev.	*Parkia bicolor*
Anthonotha fragrans (Baker f.) Exell & Hillc.	*Antonotha fragrans*
Amphimas pterocarpoides Harms	*Amphimas pierocarpoïdes*
Dialium aubrevillei Pellegr.	*Dialium aubrevillei*
Newtonia aubrevillei (Pellegr.) Keay	*Newtonia aubrevillei*
Erythrophleum africanum (Welw. ex Benth.) Harms	*Erythrophleum africanum*
Cynometra ananta Hutch. & Dalziel	*Cynometra ananta*
Guibourtia ehie (A. Chev.) J. Léonard	*Guibourtia ehie*
Daniellia thurifera Benn., *Daniellia ogea* (Harms) Rolfe, *Daniellia pynaertii* De Wild.	*Daniella thurifera, ogea, pynaerii*
Aubrevillea platycarpa Pellegr.	*Aubrevillea platycarpa*
Stemonocoleus micranthus Harms	*Stemonocoleus ferrugineus*
Brachystegia leonensis Hutch. & Burtt Davy	*Brachystegia leonensis*
Toubaouate brevipaniculata (J. Léonard) Aubrév. & Pellegr.	*Toubouate brevipaniculata*
Newtonia duparquetiana (Baill.) Keay	*Newtonia duparquettana*
Gilbertiodendron taiense Aubrév.	*Gilbertiadendron taïensis*
Afzelia bella Harms	*Afzelia bella*
Small trees	
Calpocalyx aubrevillei Pellegr.	*Calpocalyx aubrevillei*
Chidlowia sanguinea Hoyle	*Chidlovia sanguinea*
Berlinia occidentalis Keay	*Berlinia occidentalis*
Bussea occidentalis Hutch.	*Bussea occidentalis*
Stachyothyrsus stapfiana (A. Chev.) J. Léonard & Voorh.	*Kaoue stapfiana*
Dialium guineense Willd.	*Dialium guineense*
Albizia dinklagei (Harms) Harms	*Samanea dinklagei*

Table II.
Characteristic species in the upper storey, by family in alphabetical order.

Family name	Corrected name of genus and species or botanic synonymy	Botanic name used by the author and transcribed in the original article
Bombaceae		
	Bombax brevicuspe Sprague	*Bombax brevieuspe*
Euphorbiaceae		
	Uapaca guineensis Müll. Arg.	*Uapaca guineense*
	Uapaca pynaertii De Wild.	*U. esculenta*
	Oldfieldia africana Benth. & Hook. f.	*Oldfieldia africana*
	Bridelia ndellensis Beille	*Bridelia aubrevillei*
Drypetes		
	Keayodendron bridelioides Leandri	*B. sassandraensis* (species not yet clearly identified)
Humiriaceae		
	Sacoglottis gabonensis (Baill.) Urb	*Saccoglottis gabonense*
Irvingiaceae		
	Klainedoxa gabonensis Pierre ex Engl.	*Klainedoxa gabonensis*
Ledythidaceae		
	Petersianthus macrocarpus (P. Beauv.) Liben	*Combretodendrum africanum*
Meliaceae		
	Khaya ivorensis A. Chev.	*Khaya ivorensis*
	Turraeanthus africanus (Welw. ex C. DC.) Pellegr.	*Turreanthus africana*
	Lovoa trichilioides Harms	*Lovoa triclisoides*
Moraceae		
	Antiaris toxicaria var. welwitschii	*Antiaris welwitschii*
Ochnaceae		
	Lophira alata Banks ex C. F. Gaertn.	*Lophira alata*
Olaceae		
	Ongokea gore (Hua) Pierre	*Ongokea gore*
	Coula edulis Baill.	*Ceala edulis*
	Strombosta pustulata Oliv.	*Sirombosta pustulata*
Rhizophoraceae		
	Anopyxis klaineana (Pierre) Engl.	*Anopyxis occidentalis*
Rosaceae /CHRYSOBALANACEAE		
	Parinari spp.	*Several Parinari*
Rubiaceae		
	Nauclea diderrichii (De Wild. & T. Durand) Merr.	*Nauclea trillesii*
Sapotaceae		
	Tieghemella heckelii (A. Chev.) Pierre ex Dubard	*Damaria heckelii*
	Chrysophyllum spp.	*Chrysophyllum*
Scytopetalaceae		
	Scytopetalum tieghemii A. Chev. ex Hutch. & Dalziel	*Scytopetalum tieghemii*
Simarubaceae		
	Tarrietia utilis (Sprague) Sprague	*Tarrietia ulliis*

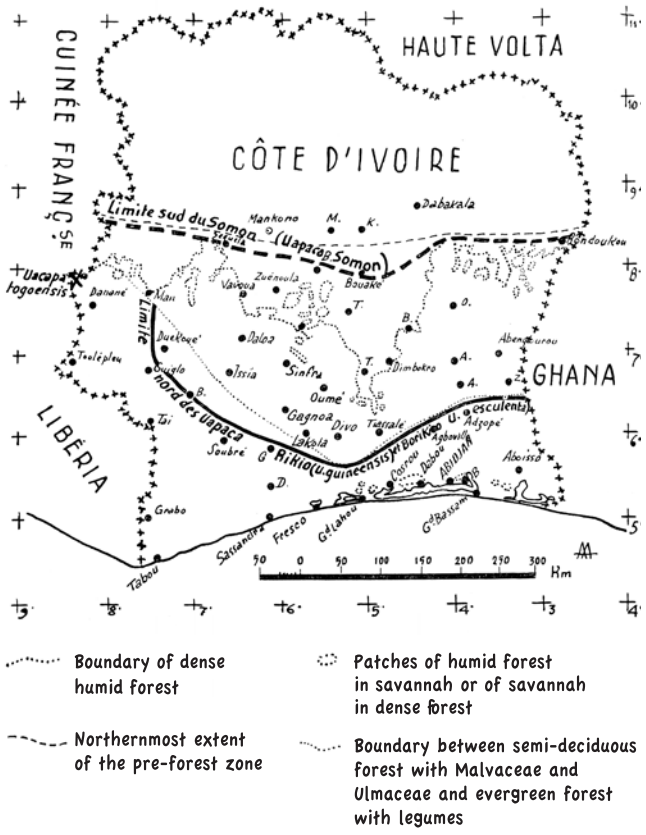


Figure 1.
Uapaca of dense humid forest (Rikio Borikio) and of dry forest. Mountain forest *Uapaca togoensis* (Nimba mountain).

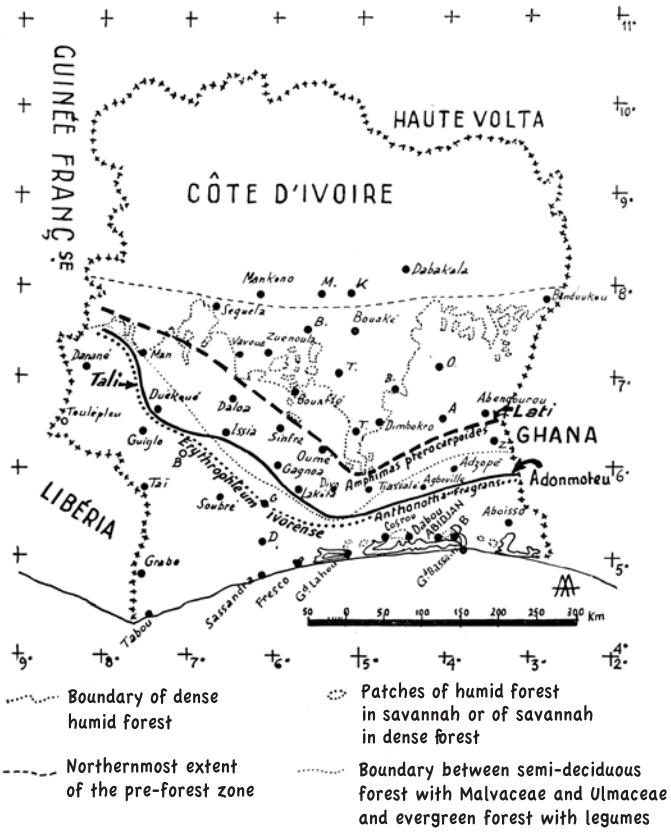


Figure 2.
Northernmost extent of dense humid evergreen forest species.

A more difficult task was the attempt to classify the Uapaca forest (Mangenot) with its dominant legumes (our analysis) into ecologically, geographical and plant subtypes. The table below summarises the conclusions set out by M. Mangenot in his study of the lowland and plateau forests of Côte d'Ivoire.

A) Forests with Mapania (clay soils), or pelohygrophilous forests

These are identified with a single association, *Diospyros* sp. and *Mapanietum* sp., and characterised in particular by numerous Diospyros in the undergrowth, a large leaved herbaceous Mapania-type plant found in humid stations, and by a well-known forest species, *Tarrietia utilis* (Sprague) Sprague (niangon).

B) Forests with Turreanthus (sandy soils), or psammohygrophilous forests

These are compounded of two fundamental associations, very polymorphous, the *Turraenthus* sp.- *Heritieria* sp., and the *Eremospatha-Mabetum*.

These are roughly characterised by another well-known forest species, *Turraeanthus africanus* (Welw. ex C. DC.) Pellegr., Paminimon, a small, low growing shrub (*Tarrietia utilis* (Sprague) Sprague) spiny *Eremospatha* spp. palms and another small shrub, *Diospyros soubreana* F. White (piakambo).

Côte d'Ivoire's very humid, dense forests therefore appear to be composed of just two forest types, one on clay soils, making up a single association, and one on the sandy soils, which is divided into two basic associations. According to M. Mangenot, they are more or less polymorphous.

The summaries made of the many detailed analyses of plant species found over very small areas thus point to just two types of very humid forest, one on clay soils and the other on sandy soils, or, if we refer to the Montpellier-Zurich school of thought, just three associations. Foresters are unlikely to be surprised by the distinction made between forests on clay soils and forests on sandy soils. I am surprised, however, by the small number of basic associations identified, which suggest that my view of the composition of Côte d'Ivoire's forests is very close to that of M. Mangenot. The basic (Mangenot) association equates with a pedo-climatic forest type extending across a large area and made up of numerous characteristic species in different combinations depending on stations (polymorphous). In my view, this basic polymorphous association, covering large areas and

well-defined in terms of flora, ecology, biology and physiognomy, is a type of formation that can be described as multifaceted climax forest: the issue is merely one of vocabulary.

I had been concerned that applying the method involving plant surveys over very small surfaces would produce purely statistical descriptions of multiple associations, resulting from the numerous possible random combinations of the many characteristic species of a forest formation (= basic association) due to factors such as the interaction of species competing for soil and sunlight, species inherited from widely varying past plant compositions, and the possible and unknown action of insects, fungi and bacteria. I had pointed on a number of occasions to the potential dangers of such interpretations. In the field, however, and therefore on principle, M. Mangenot's thesis and my own now appear to converge.

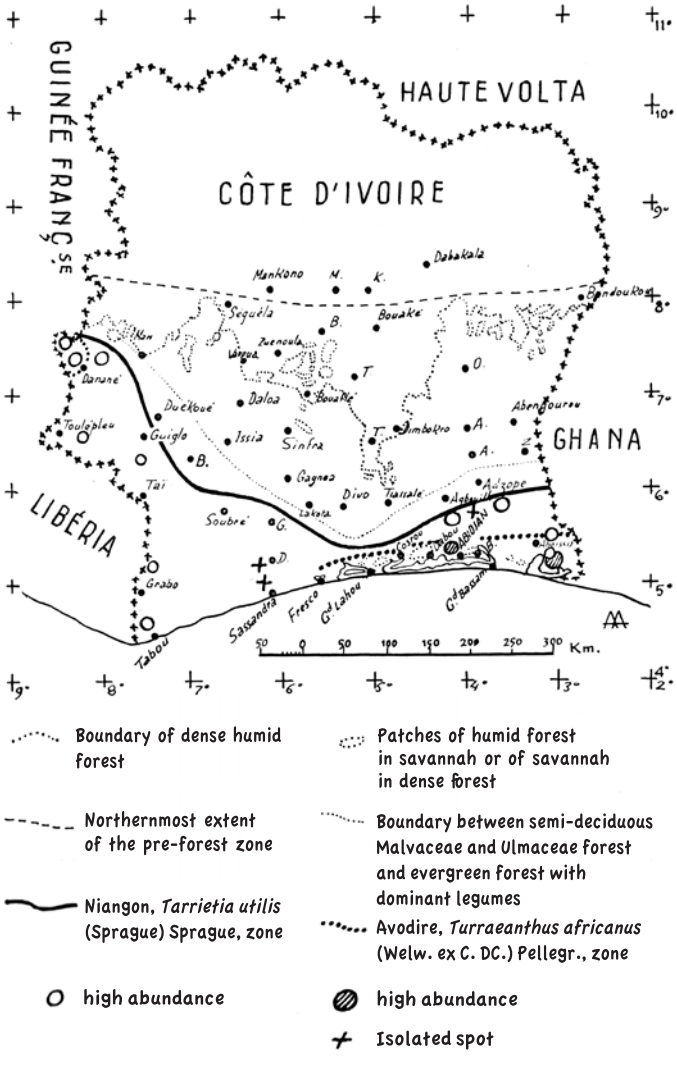


Figure 3.
Tarrietia utilis (Sprague) Sprague forest limite
& *Turraeanthus africanus* (Welw. ex C. DC.) Pellegr. forest limite.

In the Belgian Congo, M. Lebrun identified 4 basic associations, and only 4, in the whole vast extent of dense forest in the central basin. It is interesting to note that in Côte d'Ivoire, M. Mangenot found a similar number. Neither Humbert nor Perrier de la Batie, the two botanists with the most exhaustive knowledge of the extraordinarily heterogeneous forests of Madagascar, believe that it is possible to classify these into multiple types of associations in accordance with the Zurich-Montpellier school. But in Madagascar, the dense humid forests in the east make up a single basic polymorphous association, the western forests two or three associations, also polymorphous (on alluvial, lateritic and sandy soils) and the southern forests yet another association characterised by Dideraceae, so that a basic polymorphous association could be identified with a forest formation, thus creating a consensus of opinion. It is my feeling that the equatorial forests have dissolved the purely phytosociological doctrine applied in Europe.

Leaving theory aside for the present, let us look in detail at the associations in Côte d'Ivoire defined by M. Mangenot. It is obviously surprising to note the very small number of large tree species he considers to be characteristic of the association. In the Mapania forest (*Diospyros* sp.-*Mapanietum* sp.), he identifies only two or three, *Tarrietia utilis* (Sprague) Sprague (niangon), *Chrysophyllum pruniforme* Pierre ex Engl. (boa) and *Duguetia staudtii* (Engl. & Diels) Chatrou (anlouketi), and again only two in psammohygrophilous *Turraeanthus* forest, avodire (*Turraeanthus africanus* (Welw. ex C. DC.) Pellegr.) and *Synsepalum afzelii* (Engl.) T. D. Penn. (akuedao). The number is small indeed compared to the impressive numbers of species characterising dense humid evergreen forests in general. It does seem somewhat disproportionate to emphasise, in describing equatorial forests, these secondary variations in the flora, compared to the overall plant composition. The fundamental characteristic of these forests, it seems to me, is the abundance of a large number of tree species in each storey that find satisfactory or optimum ecological conditions for growth in different places. Chance together with competition for soil produce a great many fluctuating combinations that make up the forest. On some soils, plant diversity is poor, as in the forests on sandy soils in the coastal lagoon area of Côte d'Ivoire, but even here, the plant composition is not very different to that in other dense humid evergreen forests. True, the abundance of avodire is remarkable, but it is by no means the only species present. The differences are of a much smaller order of magnitude than differences in characters.

Synsepalum afzelii (Engl.) T. D. Penn., the second large tree species considered as characteristic, is found at Tabou, in mid-forest on clay soil at Grabo, and everywhere else – Tai, Soubré, Lakota – but always in small numbers, and is therefore of little value, in my opinion, as an indicator species.

Although widespread, I have never seen the two other tree species cited as characteristic of Tarrietia forests on clay soils, *Chrysophyllum pruniforme* Pierre ex Engl. and *Duguetia staudtii* (Engl. & Diels) Chatrou, in great abundance, especially the former. They are therefore valid as indicators, as are dozens of other dense humid evergreen forest species, but mediocre in terms of characteristics according to my own

conception of phytosociology, in which the essential criterion is vitality. However, there is another species that could characterise humid coastal forests on clay soils (pelohygrophilous forest) even better than niangon, *Cynometra ananta* Hutch. & Dalziel *Cynometra ananta* (apome). It is well known in two areas, which are probably separate: a small area at Tabou up to slightly north of Grabo, where apome is one of the main forest species, and another to the east, between the Bandama river and Ghana, just below the 6th parallel, where it is often abundant and almost gregarious inside an area described by M. Mangenot as forested on clay soil. From this area, *Cynometra ananta* Hutch. & Dalziel extends southwards following the rivers as far as the tertiary sandstone strip in the coastal lagoon region, where it is found in abundance in the Banco valley near Abidjan.

The distribution range of *Cynometra ananta* Hutch. & Dalziel therefore corresponds almost exactly with the sectors in Côte d'Ivoire with the highest rainfall. It is found exclusively in the southern Côte d'Ivoire, unlike niangon (*Tarrietia utilis*) and avodire (*Turraeanthus africanus*), which will grow up to the northern edges of the forest in the Man region and the Nimba range close to French Guinea.

We have examined only the large trees in M. Mangenot's lists of representative species, but not the question of characterisation by herbaceous plants and lianas. I cannot give an opinion on this subject. It is very likely that these plants are more sensitive than trees to environmental micro-variations and that they could therefore be used to distinguish plant groups associated with a particular ecological conditions. It might even be possible to classify forests by their mosses and even their bacterial flora. Nevertheless, it seems to me that as forests are also made up of trees and shrubs, this means – provided there has been no notable variation in the plant composition – that the environmental conditions have not changed. If they do, this is clearly reflected in the tree species composition, as in Côte d'Ivoire, where in dense humid forest, which appears to be the same from south to north, two distinct formations are clearly apparent during the

Photo 1.
For Understorey in the Banco forest, a dense humid evergreen forest on sandy soil.
Photograph A. Aubréville.

rainy season. I have called these Malvaceae and Ulmaceae forests, in the knowledge nevertheless that they can be classified into montane, swamp and other types that we have not investigated here.

The botanical outline of Côte d'Ivoire drawn up by Mangenot and Mlège shows, especially in the west, and covering a considerable area, a forest type that is not described or even named – unless I have misread the text – in M. Mangenot's monograph: this is the "sub-hygrophilous" forest type, which in some areas is dotted with fragments of Mapania forest (humid stations) and *Turraeanthus* forest. This type is distinct from the pelohygrophilous type, the latter being found only along the tertiary sandstone margin in the coastal region from north of Fresco to north of Aboisso and, in the south-western corner of the country, in a large patch to the north of Tabou. I have not read any commentary on this outline that explains how these two types of dense humid evergreen forest can be distinguished by their flora.

How ecology accounts for species ranges

Ecology cannot account for every factor in the geographical distribution of species. This is why it is not easy to choose the characteristics of ecological forest types and why, therefore, it is difficult to define their spatial boundaries. The same species can thrive in very different ecological conditions. This is not an argument against technological determinism, but a sign of the flexibility of the species. This is the case with most species that are characteristic of dense humid evergreen forests and which are found in all these forests, whether pelohygrophilous, psammohygrophilous or sub-hygrophilous. But there are also cases where the range of distribution of the species extends from the most humid forests to the driest.

I gave the example, above, of the abundance of *Entandrophragma utile* (Dawe & Sprague) Sprague (sipo) in all of

Photo 2.
A patch of savannah on hard ferruginous ground inside a dense forest fringed with *Hildegardia barteri* (Mast.) Kosterm (meko), in the Oumé region.
Photograph A. Aubréville.

western Côte d'Ivoire, south of the 7th parallel (subhygrophilous and pelohygrophylous forest), but also in the semi-deciduous forests extending from Daloa in the east to Sinfra in the west and eastwards from Abengourou.

Also needing interpretation is the anomalous presence of species outside their range distribution, where individual specimens, no doubt finding optimum conditions, begin to spread and group together into what could be called climax, normal or preferred habitats. These are all the highly invasive species that spread outwards from primary forests to colonise forest clearings, thus gradually moving into sectors that ecologically distinct from their original habitats (*Triplochiton, Terminalia superba* Engl. & Diels, etc.).

Other examples are well known and more curious. Some non-riparian species will spread along river valleys as far as the river mouth, reaching a considerable distance from their climax zone. In Côte d'Ivoire, some semi-deciduous forest species have spread from the north towards the coast, through the evergreen forest zone.

Triplochiton, for example, reached the lower Sassandra region a long time ago. But these species remain exclusively within valley forests, close to the riverbank. Near the Sassandra Falls (Soubré), in a typical valley characterised by a spiny legume (*Plagiosiphon emarginatus* (Hutch. & Dalziel) J. Léonard), I have observed *Triplochiton, Morus mesozygia* Stapf*, Celtis zenkeri* Engl.*, Celtis adolfi-friderici* Engl.*, Mansonia altissima* (A. Chev.) A. Chev. *and Holoptelea grandis* (Hutch.) Mildbr., which are characteristic of semi-deciduous forests, despite the fact that none of these species are found in the evergreen forests beyond the valley. One can see how species ranges can easily be misinterpreted on the basis of tree counts alone if a country's overall phytogeography is not well known. Each species has a maximum range defined by a curve surrounding each known station, including those most distant from the climax zone, meaning the normal habitat zone within the range, and these maximum ranges can vary widely in area.

The normal habitat range is linked to the environment and its vegetation, but does not usually cover the entire area where these are found. Again, ecology alone cannot explain why a species can become scattered over a fragmented range, or why some ranges are highly localised or very small, forming isolated patches, and so on.

Outside their main distribution range in south-eastern Côte d'Ivoire, *Tarrietia utilis* (Sprague) Sprague (niangon) and *Turraeanthus africanus* (avodire) are widespread across the whole of western Côte d'Ivoire, from coast to savannah, with no connection between these many fragments. They appear to be vestiges of much older, larger and continuous areas that have become fragmented for reasons unknown. They could also be accounted for simply by animal-borne seed propagation between favourable zones. This would be plausible in the case of windborne dissemination (winged seeds or fruit), but in the case of niangon, the "satellite" distribution ranges do not lie in the same direction from the main area as the prevailing wind direction. In the case of avodire, the seeds are heavy and perishable. The first hypothesis seems more likely.

Fruit consumption by animals is often another likely explanation for the extension of a range of distribution. Our examination of elephant dung, which is frequently found in the forests of western Côte d'Ivoire, is significant in this respect, since it contains a great many heavy seeds of pulpy fruit such as *Tieghemella heckelii* (A. Chev.) Pierre ex Dubard*, Sacoglottis gabonensis* (Baill.) Urb*, Chrysophyllum taiense* Aubrév. & Pellegr.*, Panda oleosa* Pierre, various *Parinari*, etc.

Many species in dense humid evergreen forests have very localised distribution areas; some are in the west, others in the east. The reasons are probably to be found in the history of the flora and climate rather than in ecology.

The problem of rare species

With certain species, the notion of distribution ranges does not apply. They are known only from a small number – no more than a dozen in the present state of knowledge – of isolated individuals, standing entirely on their own in the

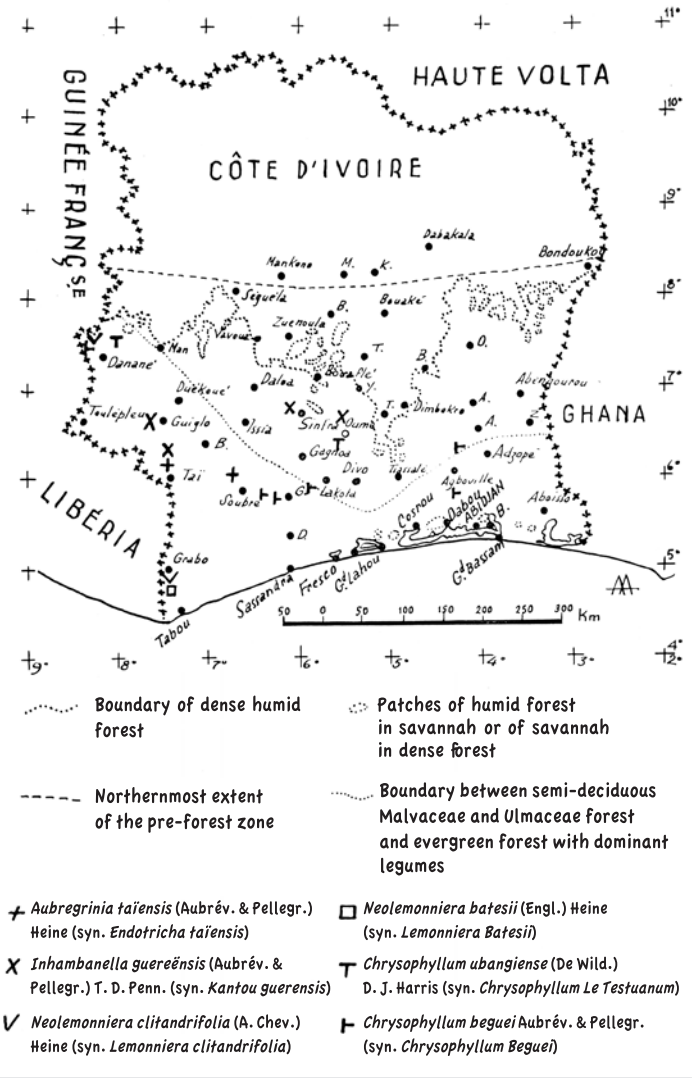


Figure 4.
Rare Sapotaceae.

Photo 3.
Thinned forest growing on hard ferruginous ground near the patch of savannah in the previous photograph.
Photograph A. Aubréville.

vast tracts of surrounding forest. Their existence is not an obvious characteristic, but it is of interest to studies of the evolution of Africa's flora; here again, ecology alone cannot account for the presence of these species, which are doomed to vanish given the current rate of deforestation.

In 1932, while prospecting in the Taï region, I collected some flowering twigs of a large, lone Sapotacea. There was no other specimen to be found in the area and the local people did not know the species. Later, with M. Pellegrin, we identified it as a new genus, Endotricha. Its fruit was unknown. When I returned to the study of Côte d'Ivoire's flora, 25 years later, I realised that the species had never been sampled since. My new search for Endotricha in the forests of the Cavally basin, around Taï in particular, has been fruitless. Were it not for my samples from 1932, now in the Museum herbarium in Paris, I would have doubted that it ever existed. A little later, between Soubré and the Lobo river in the Sassandra basin, I was intrigued by a large tree by the roadside, whose habit was completely unfamiliar. It had a great deal of fruit, large globular berries that were scattered over the ground. I had not only found my Endotricha – the comparison made with typical leaves left me in no doubt – I had even found it in fruit. The species is rare in this area, but local people knew it and had a name for it: "Zankoré sou".

I have gone into the particular case of this Endotricha in some detail to show that there are some species of large trees that can only be found by chance. *Aubregrinia taiensis* (Aubrév. & Pellegr.) Heine samples have thus been collected only twice in 25 years in Côte d'Ivoire, and it has never been observed elsewhere up to now.

On the other hand, despite all my care and attention, another large Sapotacea, *Lemonniera clitandifolia*, which I found in 1932 in the Nimba Mountains, has remained elusive and its fruits are still unknown. Another species of the same family, *Lemonniera batesii*, is known only from a single sample taken in Côte d'Ivoire, in the Tabou region, and the same goes for *Synsepalum aubrevillei* (Pellegr.) Aubrév. & Pellegr., a small shrub found in Attié country.

However, during my botanical prospecting in 1957, luck was with me when I discovered a new Sapotacea, a very big tree with large red fruits classified as a new genus, Kantou, a rare species of which I have seen only half a dozen lone individuals, always very distant from each other in the evergreen forests of Guiglo and Taï and the semi-deciduous forests of Sinfra.

The Sapotacea family seems to include quite a number of rare or very rare species: *Chrysophyllum ubangiense* (De Wild.) D. J. Harris is another example.

Although rare in Côte d'Ivoire, they are sometimes found in very distant equatorial forests. *Lemonniera batesii* was discovered in Cameroon and *Chrysophyllum ubangiense* (De Wild.) D. J. Harris in Gabon. *Breviea sericea* Aubrév. & Pellegr., another large Sapotacea, which, though not abundant, is not rare in the western forests, has also been found in the Belgian Congo. Is it not likely that these very widely disseminated large tree species are the relics of an ancient, now fragmented forest that contained far more individuals of the same species? The distances between individuals are so great that it is unlikely that their heavy seeds have been transported by large animals.

Endemism in the eastern and western dense humid evergreen forests

In dense evergreen forests, the same essential tree species are found in both western and eastern Côte d'Ivoire, in different combinations. However, there are remarkable examples of local endemism. Their ecological significance is nil, but endemism appears to be more pronounced in the west. There appears to be one highly localised centre in the Tabou-Grabo region, with large endemic leguminous trees (table III).

The Cavally and Sassandra basins have other localised species, sometimes in abundance, that are not generally found elsewhere in the Tabou region (table IV).

Tree species considered as endemism in the eastern forest of Côte d'Ivoire are classified as follows in table V.

It is still difficult to provide definitive answers to the question of endemic species as there is too little botanical prospecting, whether in Côte d'Ivoire, or in any of the other countries with forest cover of the Guinea-Congo type. Often, a species is found very far from the country where it was first discovered and a long time after its description was published.

It seems nevertheless that some equatorial flora is indeed found in Côte d'Ivoire, from the Nigeria-Cameroon-Gabon basin and also from Liberia and Sierra Leone to the west. The former are found only in the eastern forests of Côte d'Ivoire, and the latter only in the west.

It is a fact that there are species in the western forests that do not exist or are very rare in the east. The indicative

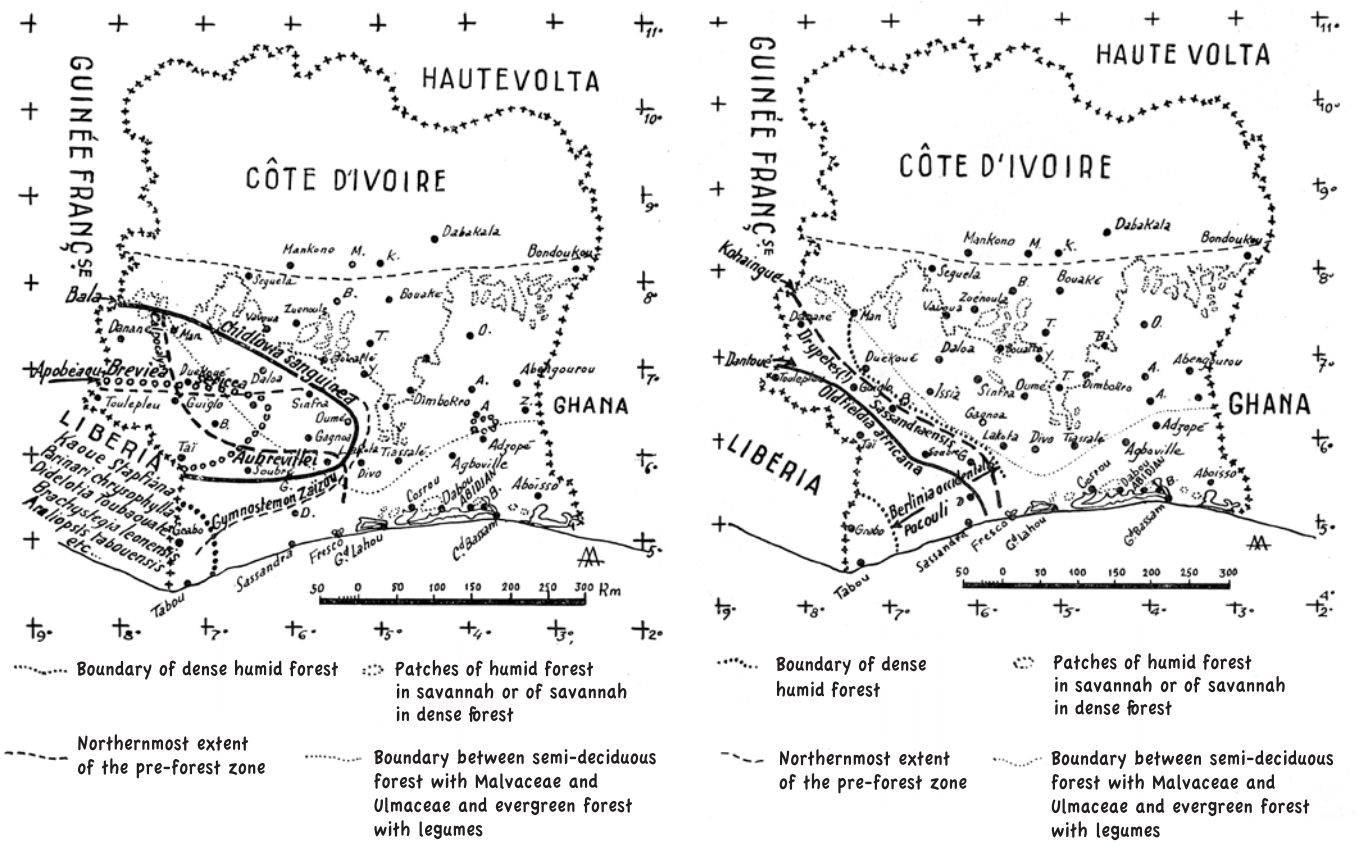


Figure 5a & 5b.
Western endemisms.

Table III.
Endemism appears to be more pronounced in the west. There appears to be one highly localised centre in the Tabou-Grabo region, with large endemic leguminous trees.

Corrected name or botanic synonymy	Comment	Botanic name used by the author and transcribed in the original article
Brachystegia leonensis Hutch. & Burtt Davy	One of the largest forest trees, found in abundance over a small area. Species discovered in Sierra Leone.	*Brachystegia leonensis*
Toubaouate brevipaniculata (J. Léonard) Aubrév. & Pellegr., *Didelotia unifoliolata* J. Léonard	Large tree found in abundance over a small area, may also exist in Gabon.	*Toubouate brevipaniculata*
Didelotia brevipaniculata J. Léonard		*Didelotia unifolia*
Cryptosepalum minutifolium (A. Chev.) Hutch. & Dalziel	Not well known.	*Cryptosepalum minutifolia*
Stachyothyrsus stapfiana (A. Chev.) J. Léonard & Voorh.		*Kaoue stapfiana*
Polystemonanthus dinklagei Harms	Discovered in Liberia.	*Palystemananthus dinklagei*
Gilbertiodendron ivorense (A. Chev.) J. Léonard	Small shrub.	*Gilbertiodendron gabonensis*
Gilbertiodendron preussii (Harms) J. Léonard	among other families.	*G. taïensis*
Maranthes chrysophylla (Oliv.) Prance subsp. chrysophylla	Rosacea. Also found in Cameroon and Gabon.	*Partnari chrysophylla*
Rhizophoracea		
Cassipourea hiotou Aubrév. & Pellegr.	Shrub.	*C. hiotou*
Cassipourea nialatou Aubrév. & Pellegr.		*Cassipourea nialatou*
Lauracea		
Beilschmiedia djalonensis A. Chev.		*Bellschmeidia bitehi*
Rutacea		
Vepris tabouensis (Aubrév. & Pellegr.) Mziray		*Araliopsis tabouensis*

Table IV.
Endemism in the Cavally and Sassandra basins, sometimes in abundance, with other localised species that are not generally found elsewhere in the Tabou region.

Corrected name or botanic synonymy	Comment	Botanic name used by the author and transcribed in the original article
Chidlowia sanguinea Hoyle	A small, twisted tree, gregarious and extremely abundant in the upper Cavally and Sassandra basins. Also found in the understory is of semi-deciduous forests in the centre of Côte d'Ivoire (Oumé, Sinfra). The species is also found in the Gold Coast [actually Ghana], but is unknown in the East of Côte d'Ivoire.	*Chidlovia sanguinea*

Calpocalyx aubrevillei Pellegr.	A small, twisted tree, gregarious and common throughout the west, including Tabou.	*Calpocalyx aubrevillea*
Breviea sericea Aubrév. & Pellegr.	A large Sapotacea found in the middle reaches of the Cavally and Sassandra basins. Also found, but rare, in eastern Côte d'Ivoire.	*Brevia sericea*
Chrysophyllum taiense Aubrév. & Pellegr.	Small tree producing berries.	*Chrysophyllum taïensis*
Plagiosiphon emarginatus (Hutch. & Dalziel) J. Léonard	Legume found on riverbanks.	*Plagiosiphon emarginata*
Berlinia occidentalis Keay	Small gregarious tree.	*Berlinia occidentale*
Hoplestigma klaineanum Pierre	Small tree from Gabon, very rare, found in the Soubré region.	*Hoplestigma klaineana*

Table V.
Endemism identified in eastern forest of Côte d'Ivoire.

Corrected name or botanic synonymy	Comment	Botanic name used by the author and transcribed in the original article
Khaya ivorensis A. Chev.	Widespread as far as Gabon.	*Khaya ivorensis* mahogany
Cylicodiscus gabunensis Harms	Widespread as far as Gabon.	*Cylicodiscus gabonensis*
Pericopsis elata (Harms) Meeuwen	Widespread as far as Gabon, Cameroon, and Belgian Congo.	*Afrormosia elaia*
Gluema ivorensis Aubrév. & Pellegr.	Sapotacea.	*Gluema ivorensis*
Gymnostemon zaizou Aubrév. & Pellegr.	Large tree, common in the middle reaches of the Cavally basin. Found as far as the semi-deciduous forests of Oumé.	*Gymnostemnon zaizou*
Keayodendron bridelioides Leandri	a little-known Euphorbia, probably not a *Drypetes*. Large tree, common in the middle reaches of the Cavally and Sassandra basins. Said to be also found in Attié country to the east. Exists in Nigeria	*Drypetes sassandraensis*
Oldfieldia africana Benth. & Hook. f.	Large tree, common in the middle reaches of the Cavally basin. Found in the lower Sassandra basin. Said to be also found to the east, but rare.	*Oldfieldia africana*

species lists given are neither exhaustive nor definitive – and they may never be! Sooner or later, endemic species will disappear with the destruction of their forests, while false endemics, those isolated by human activities, may appear.

Analysing forests by their flora and by their chorology

Of these two methods, the oldest, used by botanists and itinerant foresters, consists of drawing up inventories of some or all the plants – mainly trees and shrubs in the case of foresters – found along forest tracks or prospecting trails, sometimes over considerable distances (several hundred metres to several kilometres: some prospecting trips in French Equatorial Africa have covered several thousand hectares).

The second method, used for the first time in French colonial Africa by M. Mangenot, consists of collecting every plant found, from the smallest to the largest, in a very small plot (10 m²) and to conduct about a dozen of these phytosociological surveys in a given forest area, in randomly chosen plots, so that the total inventory covers a minimum of 100 m².

These are two very different, but complementary, methods for analysing a forest. It would be virtually impossible to make an inventory of all plants in an entire forest

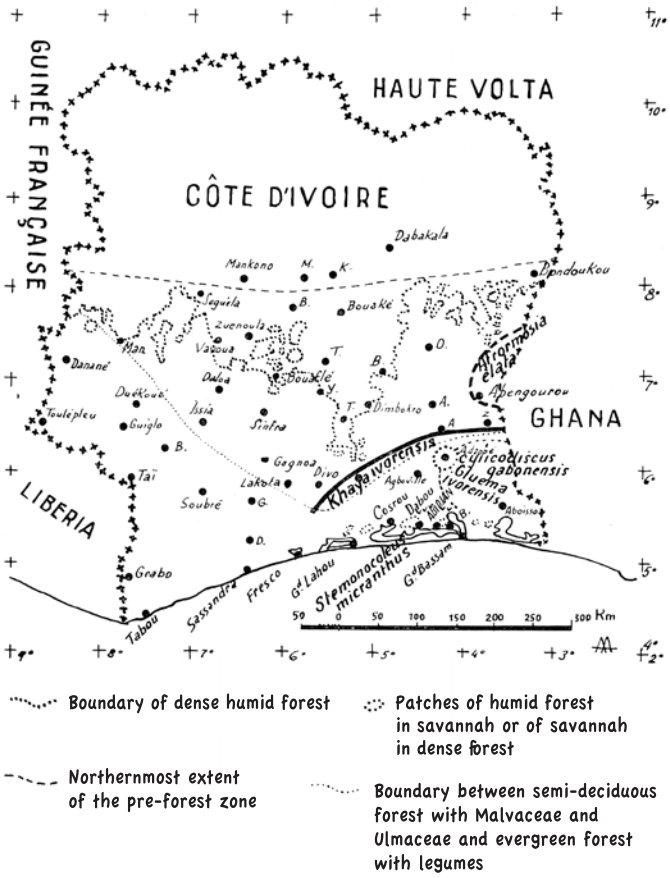


Figure 6.
Eastern endemism.

area: extensive inventories only collect tree samples. Knowledge of a given vegetation type and descriptions of a biocenosis can only be exhaustive if they also cover all herbaceous plants, lianas and epiphytes, all of which have a role – secondary, but nonetheless real – in a forest's biological spectrum and biology. Such detailed analyses would be enhanced by scientific knowledge on the microclimate of the biocenosis. I have already mentioned that the INEAC botanical department at Yangambi in the Belgian Congo has recently taken up this approach[1].

Experience in Côte d'Ivoire has shown that these exhaustive inventories over small areas are enough to identify the entire local range of herbaceous plants and lianas.

However, I believe that this method alone cannot suffice to classify a forest type. How can we possibly know everything there is to know about a forest, which M. Mangenot himself describes as polymorphous, at least as regards its tree population, from a dozen 10 m² sampling plots no larger than a small room in a Paris apartment? Such surveys can be used to identify indicator species that will determine the type of forest in which they were made, without having to list all the flora found in the area. But this is not the same thing as knowledge of a plant association with its many characteristic species, each of which has its own importance from the phytosociological and biological point of view and making up a community whose composition varies from one station to the next. Only inventories made over large areas will give an exact picture of a forest. Those conducted in French Equatorial Africa, but only for trees more than 40 cm in diameter, clearly show how characteristic forest species are distributed in patches, but without necessarily showing the ecological conditions governing the way these patches develop. The classification of characteristic tree species into species that are dominant, abundant, few in number, scattered or very numerous, and the distribution of abundant species in patches, reveal important phytosociological characters of humid tropical forests that surveys in small 10 m² plots obviously cannot show. In his description, M. Mangenot does not sufficiently emphasise – in my view – this essential characteristic of the forests of Côte d'Ivoire, though he is obviously aware of it. "The physiognomy of a forest can change abruptly from one point to another, giving itinerant botanists an impression of anarchy that can prompt them to reject rational explanations in favour of chance alone." There is always a possible rational explanation for any plot in a given station, but because the factors involved are so numerous, and appear throughout the long duration of a forest's existence, it is easy to account for the result as a matter of chance.

The idea of chance, here, serves only to express the infinite and infinitely complex unknowable causes that produce, at a given moment, a group of plants with a given composition, which will always be unstable since the composition is continually evolving. A deck of cards has a fixed number of cards, but 20 of them can be dealt out indefinitely in different combinations. In this case, the result is entirely random. In a plant community, the species belonging to the group of characteristics that are "dealt out" in a given place are not generally the result of chance alone, as in a game of cards, but the result of a conjunction of various causes that include the influence of the soil and the temperament of the species that is competing most successfully. As in a game of cards, though, the result is also a large number of combinations of species and individuals that vary from one place to another.

When interpreting a survey made over a small area, phytosociologists look for species or groups of species that are always present in that area, although they may not be found elsewhere. All the other species that are found together, but elsewhere in the forest, are referred to as companion species. The former, considered as characteristic by the Montpellier-Zurich school, are very infrequent in the upper storey, as indicated above. The latter, the companion plants, which in my view include a great many species that are characteristic of the formation in question, are very numerous. Thus, in practice, fundamental plant associations where few tree

1. *Bois et Forêts des Tropiques*, Jan-Feb 1957, on the study by Germain and Evrard entitled « *L'Étude écologique et phytosociologique de la forêt à* Brachystegia laurentii ».

species are exclusively or preferentially established can no longer be distinguished from "formations" with abundant characteristic species. Looking for "associations" in equatorial forests (except in a very specific environments, of course) in Côte d'Ivoire has no doubt added to our knowledge on these forests, but without really bringing anything new. This in no way detracts from the usefulness of conducting exhaustive inventories of plants over small areas. It is only the interpretation of their results in order to identify "associations" that has not produced indisputable results. Any other outcome would be surprising given the nature of equatorial forests, or at least, this is my impression on reading M. Mangenot's profoundly interesting study.

To determine coherent plant groups with any certainty, in order to produce a rational chorological classification of Côte d'Ivoire's forests, I believe that the best method consists of first establishing the geographical range of a species, using signs to indicate, within these ranges, those areas where the species is known to be abundant and those where they are merely scattered or infrequent. A comparison of the frequencies thus indicated in these diagrams will show similar areas of distribution. This method reveals the existence of two types of forest formations in Côte d'Ivoire, semi-deciduous Malvaceae and Ulmaceae forests, and forests with leguminous species. It also shows centres of endemism, for example around Tabou and in the middle reaches of the Cavally and Sassandra basins. It would probably also show secondary chorological classes that could be linked to ecology, but also to causes yet to be discovered in the palaeohistory of the climate and flora. I have used this method in the past to study the two types of dense forest formations in Côte d'Ivoire, as well as the flora in the dry Sudano-Guinean zone. Unfortunately, because my own observations were often the only ones available, I had to fill too many gaps by extrapolation. More accurate and detailed maps of the geographical ranges of species would undoubtedly be very useful. They also need to be accurately interpreted in the case of currently invasive species. It is high time to draw up such maps; this may no longer be possible in the future as forest destruction proceeds, and the gaps will multiply. On this subject, the need for foresters and botanists who spend any length of time in Côte d'Ivoire to draw up monographs on local forests cannot be emphasised too strongly: they will be useful today and precious in the future.

Forest pests

M. Mangenot has pointed to the nefarious role of an invasive shrub, *Scaphopetalum amoenum* A. Chev., in the undergrowth of humid forests everywhere, and sees its proliferation as a forest disease which he calls "scaphopetalosis". These shrubs often lie prone on the ground, producing numerous curved or vertical shoots that form large clumps covering the bare soil on which trees obviously cannot regenerate. Many forested areas in the west of Côte d'Ivoire are affected by this "disease", which appears to prevent high forest trees from ever reproducing. I do not think, as M. Mangenot suggests, that this pest is proliferating as a result of intensive logging. I have travelled through primary forests that are heavily infested by the shrub, in the upper Niouniourou area and to the east of Soubré, but have never been logged.

Other species are also seen as pests because they prevent the regeneration of forest trees. *Chidlowia sanguinea* Hoyle, or bala, is one of these. This is a small, ribbed, twisted tree that that grows to a considerable girth at the base, with a densely branched crown sprouting a great many vertical shoots. In the west, it is often found in pure stands under which nothing will regenerate except the species itself, so that there are very few high trees above them, if any. This should perhaps be referred to as "chidloviosis"!

This is not the only legume whose proliferation in the understorey prevents tall trees from regenerating. The same is true of all the shrub and small tree species with twisting branches and thick foliage in the understorey that become locally gregarious. Rationally managed destruction of this excessively invasive plant cover would be a useful general forest maintenance task, and essential where enrichment planting is undertaken.

Savannah patches in forests

Aerial photographs sometimes show small patches of savannah enclosed in apparently primary forest. I have observed some of these curious patches myself. Their origins are diverse, but always edaphic.

Near the road to Divo at Oumé, in the listed forest of Sangouiné, which is of the semi-deciduous type dominated by fine stands of tall Malvaceae such as *Pterygota macrocarpa* K. Schum., *Mansonia altissima* (A. Chev.) A. Chev., *Triplochiton* (samba), *Sterculia rhinopetala* K. Schum. (lotofa), *Nesogordonia papaverifera* (A. Chev.) Capuron ex N. Hallé *Nesogordonia papaverifera* (kotibe), *Chrysophyllum giganteum* A. Chev. (koanandio, a Sapotacea) and *Terminalia superba* Engl. & Diels *Terminalia superba* (frake), I was following a track in a curious forest where the high tree stands became less and less diverse as the understorey increased in vigour, when I suddenly emerged into a small circular patch of savannah, about 100 m in diameter. Strangely, it was fringed with a pure population of *Hildegardia barteri* (Mast.) Kosterm. (meko). This is an average sized tree that sometimes grows very large. It is a curious species for several reasons: it will grow on rocky ground, where its roots twine around the stones and push deep down into fissures. It is characteristic of the woody vegetation that can sometimes be seen clinging onto granite knolls in parts of West Africa. The bole can grow to a considerable girth, becoming bottle-shaped like a small baobab. The species is found only exceptionally in semi-deciduous forests, and only in groups when growing on rocky outcrops. It is a Sterculacea belonging to an Indo-Malay group that includes several families classified together by their flowers and spongy fruit. The fruits of *Hildegardia barteri* (Mast.) Kosterm. are red and indehiscent.

Photo 4.
A patch of savannah in dense forest, on hard ferruginous ground.
Photograph A. Aubréville.

Photo 5.
Savannah in the previous photograph 4. View of the forest border with *Hildegardia barteri* (Mast.) Kosterm (meko) and Aloe.
Photograph A. Aubréville.

This species will propagate very easily by cuttings: near Issia, telegraph poles of young meko wood, probably cut from a nearby stand growing on a granite knoll, have sprouted and begun to flower. Its flowers and fruits are also very decorative in parks and gardens.

The fringe of meko trees around this small patch of savannah was obviously linked to the rocky ground, in this case a ferruginous crust covered with a thin layer of peat and grasses. Dense undergrowth beneath the meko trees formed a compact mass of vegetation. The hard ferruginous ground continued as a shallow layer below the surrounding forest, hence the apparent lack of vigour of its sparse trees above a dense growth of twisted shrubs and lianas, within which I noted the pure white flowers and typical branching pattern of *Lasiodiscus chevalieri* Hutch. (ouindo) and a small *Rinorea kibbiensis* Chipp (small-leaved ehoue), among many other species I was unable to identify.

I am sure it would have been possible, say on a hot sunny day in the middle of the dry season (end of February), to set fire to the undergrowth around the patch of savannah. Who can say whether, in the past, a bolt of lightning might have set fire to the tinder-dry growth that previously covered the iron-hard ground?

On the way to Oumé, there is another patch of savannah, larger than the first, also covering hard and slightly sloping ferruginous ground. Again, the margins are clearly marked by numerous *Hildegardia*. This patch is near the town and burned during the dry season.

When approaching Bouaflé from Sinfra, the road skirts the base of several wooded granite knolls, crossing an area of savannah with thinly scattered shrubs and granite outcrops here and there. The sandy soil is almost white and clearly sterile.

The "elephant lands" between Sinfra and the Bandama river form a long strip of savannah on poorly drained land, which probably floods during the rainy season. This is the third type of savannah found enclosed in forests, typically with clusters of trees that are often interspersed with small groups of shrubs and lianas and a great many Phoenix palms growing on small mounds of earth, which are probably abandoned termite mounds.

On rocky ground or ferruginous outcrops, on sterile sand poorly drained soils (dambos), with tree clusters on old termite mounds: these are some examples of these savannah patches that have curiously formed with no human intervention within dense tropical forests.

Appendice I. List of scientific names used in the text and figures by the author, and corrected or updated by the journal with the assistance of Michel Arbonnier (Cirad).

Corrected name or botanic synonymy	Botanic name used by the author and transcribed in the original article
Gilbertiodendron	*Gilbertodendron*
Tarrietia utilis (Sprague) Sprague	*Tarrietia utilis*
Turraeanthus africanus (Welw. ex C. DC.) Pellegr.	*Turreanthus africana* (avodire)
Diospyros soubreana F. White	*Maba soubreana*
Tarrietia utilis (Sprague) Sprague (syn. *Heritieria parvifolia* Merr. ; syn. *Tarrietia parvifolia* (Merr) Merr. & Chev.	*Hesiteria parvifolia*
Type de végétation composé de *Diospyros* sp. et *Mapania* sp.	*Diospyros-Mapanietum*
Chrysophyllum pruniforme Pierre ex Engl.	*Chrysophyllum pruniforme*
Duguetia staudtii (Engl. & Diels) Chatrou	*Pachypodanthium siaudii*
Turraeanthus	*Turreanthus*
Turraeanthus africanus (Welw. ex C. DC.) Pellegr.	*Turreanthus africana*
Synsepalum afzelii (Engl.) T. D. Penn.	*Afrosersallsia micrantha*
Cynometra ananta Hutch. & Dalziel	*Cynometra ananta*
Entandrophragma utile (Dawe & Sprague) Sprague	*Entandrophragma utile*
Terminalia superba Engl. & Diels	*Terminalia superba*
Plagiosiphon emarginatus (Hutch. & Dalziel) J. Léonard	*Plagiosiphon emarginata*
Morus mesozygia Stapf	*Morus mesozygia*
Celtis zenkeri Engl.	*Celtis zenkeri*
Celtis adolfi-friderici Engl.	*Celtis adolfi frederici*
Mansonia altissima (A. Chev.) A. Chev.	*Mansonia altissima*
Holoptelea grandis (Hutch.) Mildbr.	*Holoptelea grandis*
Tieghemella heckelii (A. Chev.) Pierre ex Dubard	*Dumoria heckelii*
Sacoglottis gabonensis (Baill.) Urb	*Saccoglottis gabonensis*
Chrysophyllum taiense Aubrév. & Pellegr.	*Chrysophyllum taiensis, Antrocaryon*
Panda oleosa Pierre	*Panda oleosa*
Aubregrinia taiensis (Aubrév. & Pellegr.) Heine	*Endotricha taïensis*
Neolemonniera clitandrifolia (A. Chev.) Heine	*Lemonniera clitandifolia*
Neolemonniera batesii (Engl.) Heine (syn. *Mimusops batesii*)	*Lemonniera batesii*
Synsepalum aubrevillei (Pellegr.) Aubrév. & Pellegr.	*Sideroxylon aubrevillea*
Chrysophyllum ubangiense (De Wild.) D. J. Harris	*Chrysophyllum Le Testuanum*
Breviea sericea Aubrév. & Pellegr.	*Brevia sericea*
Scaphopetalum amoenum A. Chev.	*Scaphopetalum amoeum*
Chidlowia sanguinea Hoyle	*Chidlovia sanguinea*
Pterygota macrocarpa K. Schum	*Pterygota macrocarpa* (koto)
Mansonia altissima (A. Chev.) A. Chev.	*Mansonia altissima* (bete)
Sterculia rhinopetala K. Schum.	*Sterculia rhinopetala*
Nesogordonia papaverifera (A. Chev.) Capuron ex N. Hallé	*Chrysophyllum giganteum*
Terminalia superba Engl. & Diels	*Terminalia superba*
Hildegardia barteri (Mast.) Kosterm.	*Hildegardia barteri*
Lasiodiscus chevalieri Hutch.	*Lasiodiscus chevalieri*
Rinorea kibbiensis Chipp	*Rinorea kibbiensis*