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André Aubréville (1897-1982), a pioneering forester and a visionary mind



Photo 1.

On 17 June 1970, Aubréville was elected to the Academy of Sciences and received his academician's sword from Yves Marcon, the former director of the Tropical Forestry Technical Centre (CTFT).
Photograph CTFT/Cirad.

RÉSUMÉ

AUBRÉVILLE (1897-1982), FORESTIER TROPICAL PRÉCURSEUR ET VISIONNAIRE

André Aubréville fut un forestier d'exception. Formé à l'École forestière française de Nancy, il rejoignit dans les années 1920 les services forestiers coloniaux. Ses livres qui font encore référence témoignent d'un esprit encyclopédique, d'une grande lucidité et d'un talent de visionnaire. Comprenant combien l'avenir de la forêt tropicale était menacé par les activités humaines, il mit en place des structures forestières susceptibles d'assurer ce qu'on nommerait aujourd'hui une production soutenue. Il devint en 1939 Inspecteur général des Eaux et Forêts de l'Afrique occidentale française mais était aussi déjà réputé comme botaniste spécialiste des Sapotacées et biogéographe. À l'âge de 60 ans, il fut nommé Professeur au Muséum national d'histoire naturelle de Paris, et entra à l'Académie des Sciences de l'Institut de France. Travailleur infatigable, il considérait la botanique comme un outil permettant de mieux comprendre la complexité des forêts tropicales. S'insurgeant contre les généralisations abusives, il montra pourquoi la climatologie actuelle ou passée déterminait localement la composition floristique et les contours de la forêt africaine, forêt malmenée par les feux dont il mesurait l'effet dévastateur et durable. Il fut le premier à entreprendre une véritable tropicalisation de la foresterie, à démontrer la faiblesse du concept de forêt primaire et à suggérer la valorisation des forêts secondaires. Il ne doutait pas que le matériau bois tiendrait, cinquante ans plus tard, face aux matériaux concurrents, et que les espèces les plus demandées le demeureraient encore pour leurs qualités technologiques supérieures. L'ensemble de son œuvre appelait à une forme d'interventionnisme susceptible de préserver les ressources forestières tropicales de toute forme d'exploitation abusive. D'aucuns ont pu y voir l'expression d'un tempérament jugé trop colonial. Mais on peut tout autant aujourd'hui y déceler, par l'ampleur des propositions formulées en faveur de la protection de la végétation forestière, l'œuvre d'un forestier résolument précurseur et visionnaire.

Mots-clés : botanique forestière, désertification, érosion, feux, flore forestière, forêt coloniale, forêt tropicale, paléogéographie, sapotacées.

ABSTRACT

AUBRÉVILLE (1897-1982), A PIONEERING FORESTER AND A VISIONARY MIND

André Aubréville was a remarkable figure in the field of forestry. In the 1920s, after training at the Nancy School of Forestry, he joined the colonial forestry service. His books reflect an encyclopaedic mind, clarity of thought and a visionary talent, and still serve as reference works. Realising that the future of tropical forests was under severe threat from human activities, he established forestry bodies that would work to ensure what is known today as sustainable forest production. In 1939, he was appointed Inspector-General of Water and Forests in French Equatorial Africa, but had already achieved renown as a botanist specialising in Sapotaceae and in biogeography. At the age of 60, he was appointed as a Professor at the National Museum of Natural History in Paris, and entered the Academy of Sciences of the *Institut de France*. He was an indefatigable worker who considered botany as a means to reach a better understanding of the complexity of tropical forests. He vigorously opposed ill-founded generalisations, showing how climate, past and present, determines the contours and the local composition of African forest flora, which was being severely harmed by wildfires whose devastating and long-lasting effects he was well aware of. He pioneered the "tropicalisation" of forestry techniques and was the first to demonstrate the inadequacy of the "primary" forests concept and to point to the potential of "secondary" forests. He had no doubt that timber would maintain its value against competing materials in the fifty years to come, and that the most sought-after tree species would remain so for their superior technical properties. In all of his work, he advocated a type of interventionism designed to prevent any form of over-exploitation of tropical forest resources. Some may discern an overly colonialist mindset, but in the sheer scope of his proposals in favour of forest protection, it is also possible to see a pioneering and visionary mind at work in the field of forestry.

Keywords: forest botany, desertification, erosion, wildfires, forest flora colonial forests, tropical forests, palaeogeography, Sapotaceae.

RESUMEN

AUBRÉVILLE (1897-1982), DASÓNOMO TROPICAL PRECURSOR Y VISIONARIO

André Aubréville fue un experto forestal excepcional. Formado en la Escuela Forestal Francesa de Nancy, se incorporó en la década de 1920 a los servicios forestales coloniales. Sus libros, que siguen siendo una referencia, revelan una gran lucidez y un talento visionario. Comprendió que el porvenir del bosque tropical estaba amenazado por las actividades humanas e implantó estructuras forestales capaces de garantizar lo que hoy denominaríamos una producción sostenida. En 1939 alcanzó el puesto de inspector general de aguas y bosques del África Occidental Francés, pero ya había adquirido fama como botánico especialista de las Sapotáceas y biogeógrafo. A los 60 años fue nombrado profesor del Museo Nacional de Historia Natural de París e ingresó en la Academia de Ciencias del Institut de France. Trabajador incansable, consideraba la botánica como un instrumento que permitía comprender mejor la complejidad de los bosques tropicales. Arremetió contra las generalizaciones abusivas y demostró por qué la climatología actual o pasada determinaba localmente la composición florística y los contornos del bosque africano, un bosque maltratado por los fuegos, de cuyos efectos devastadores y duraderos era plenamente consciente. Él fue el primero que acometió una verdadera tropicalización de la silvicultura, el primero que demostró la fragilidad del concepto de bosque primario y sugirió la valorización de los bosques secundarios. No dudaba de que la madera de construcción resistiría, cincuenta años después, al empuje de los materiales competidores y que no caería la demanda de las especies más solicitadas debido a sus superiores propiedades tecnológicas. Toda su obra apuntaba a una forma de intervencionismo capaz de proteger los recursos forestales tropicales de cualquier forma de explotación abusiva. Algunos pueden ver la expresión de una mentalidad marcadamente colonial. Pero, asimismo, hoy podemos descubrir, por la amplitud de las propuestas planteadas para proteger la vegetación forestal, la obra de un experto forestal claramente precursor y visionario.

Palabras clave: botánica forestal, desertificación, erosión, incendios, flora forestal, bosque colonial, bosque tropical, paleogeografía, Sapotáceas.

Introduction

Many of the authors who paid tribute to the great French forest botanist André Aubréville after his death realised how difficult it was to illustrate the sheer diversity of his work and the scope of his erudition. In writing the following pages to present this remarkable figure, I came up against the same difficulty. These pages aim nevertheless to introduce our readers to this outstanding botanist, not only for the reasons I have given, but also because Aubréville himself emphasised the distinctiveness of forestry in the tropics (Aubréville, 1949a), which prompted his in-depth and often visionary analyses of many of its facets.

Over and above the inherent interest of André Aubréville's life and work, it is fascinating to see that in the first half of the 20th century, talented minds and astute observers, who had no fear of venturing into wild and difficult terrain, had already discovered a number of governing principles of tropical forests that we are still rediscovering today.

A highly qualified engineer who went on to become a tropical forest botanist

André Aubréville was born on 30 November 1897 at Pont Saint Vincent, near the city of Nancy, which was renowned for its School of Forestry. Growing up in a modest household close to the forests of Lorraine, he was fascinated from an early age by the distant colonies. He attended secondary school at Pont-à-Mousson and Commercy, and was mobilised in January 1916 as a corporal in the infantry. He then experienced the human carnage that took place in the devastated forests of the Somme, the Argonne, Champagne and Verdun. He was wounded, and returned from battle with the Military Medal and the War Cross with three commendations, but also with a profound sense of patriotism. With an overriding concern to embark on a career that would be worthy of the sacrifices already made to serve his country, he then decided he would work in colonial administration.

This eclectic and brilliant young man was admitted to the prestigious *École Polytechnique* with the special 1920 cohort. His aim was now to join the newly created Corps of Colonial Water and Forests Engineers. In 1922 he graduated to the National School of Water and Forests in Nancy, where he received a solid grounding in botany from Philibert Guinier, a leading authority in forest botany, and also became chairman of the school's Association of Friends and Alumni.

In 1924, the Minister for the Colonies established a training programme for young foresters who would be serving in the tropics, which combined lectures and practical work. Aubréville seized the opportunity, taking the specialist course on the French colonies at the National Natural History Museum with professors Henri Lecomte and François Pellegrin. Here, he trained in phytogeography but also discovered the threats to forest cover in the tropics (Aymonin,

1983). And so he found his career: he would become a "forest botanist", as he liked to describe it (Aubréville, 1961).

When he took up his first position in February 1925, the tropical forest was not what he had imagined: "aesthetically, the equatorial forest is disappointing; the impression is one of vigorous plant growth, chaos and mystery" (Aubréville, 1932). Appointed to the post of Water and Forests Inspector for Côte d'Ivoire, he soon became the Head of the Water and Forests Service, a post he occupied until 1937. He immediately realised the specific nature, but also the diversity, of tropical forests. This was a world that suited his energetic temperament and whose unique character he was determined to bring to light, but it was also a fragile world whose only ally, it must be acknowledged, was the colonial forest management service. For over a decade, thanks to his robust health, he mounted expedition after expedition through French Equatorial Africa. At the same time, he set up a forestry service for Côte d'Ivoire, and in so doing became passionately interested in forest botany. He saw to the establishment of a forest station in the Banco forest, which he then listed for protection. But on his return in 1957, he was dismayed to see how sparse the forests had become, to the point of remarking that "soon, we will need an aeroplane to see any forest at all" (Aubréville, 1957). This was not the cynicism of disillusion, but the insight of a visionary, who had already understood, at that time and as Auguste Chevalier had envisaged earlier, what was to come.

During all these years, Aubréville deployed his boundless curiosity for the forest, investigating every one of its components in depth, and seeking answers to all of his own questions. He helped to define a series of colonial forest regulations, to introduce development schemes and to build up training programs for African forest managers. But he never lost his botanist's eye. On 26 October 1934, he was elected to the French Botanical Society, whose Secretary-General at the time was François Pellegrin (Aymonin, 1983).

In 1935, the Academy of Overseas Sciences launched a competition on tropical forests. Aubréville, who in ten years had accumulated a vast store of knowledge on tropical vegetation, won the prize. His submission to the Academy of Colonial Sciences was the manuscript of a study on colonial forests and the forests of French West Africa in particular. This manuscript won the Grand Prize awarded by the Academy and was published in 1938 by the *Annales de l'Académie des Sciences Coloniales* (Aubréville, 1938a). In 1936, he spent a year working with Professor Henri Humbert at the National Museum of Natural History, which he described as "this great house scientific study, as intense as it is discreet" (Aubréville, 1950). On 25 June 1936, he became a corresponding member of the Academy of Overseas Sciences. In 1939, he was appointed to the post of Inspector-General for Water and Forests for French West Africa, which he occupied until his retirement in 1955, also becoming the technical adviser to the Ministry for Overseas France, and subsequently became the Inspector General for Water and Forests in Overseas France.

In 1947, when the shadows of the war had passed, economic recovery in the colonies was the order of the day.



Photo 2.
Aerial view of dense forest cover in Côte d'Ivoire, in 1964.
Photograph CTFT/Cirad.

The Commission for Overseas Modernisation and Infrastructure decided, as provided for by the Act of 30 April 1946, to establish an institute of tropical forest research. Aubréville, who would have liked to see an “Imperial Institute for Colonial Forests”, became the main founder of the *Centre Technique Forestier Tropical* at Nogent-sur-Marne, which was officially launched in 1949 (Marcon, 1950) and would later become the forestry department of International Cooperation Centre for Agronomic Research for Development (*Centre de Coopération Internationale en Recherche Agronomique pour le Développement* or Cirad). He was actively involved in creating the journal *Bois et Forêts des Tropiques*, founded in 1947, and took the chair of its editorial committee in 1956, shortly after his retirement. At that time, Aubréville was travelling a great deal. In August 1948, during a mission of inspection of Madagascar's forests, a country he was visiting from the first time, he met René Capuron, who had also just arrived in Madagascar, and who, following in the footsteps of Henri Perrier de la Bâthie and Henri Humbert, would become one of its most eminent botanists (Aubréville, 1972a). The two remained friends with Catinot, Aubréville dedicated the *Capurodendron* genus of

the Sapotaceae family to him, among several other species (Aubréville, 1972b).

In 1958, in response to the insistence of Professors Humbert and Heim, he applied, successfully, for a professorship at the National Natural History Museum in Paris, of which he had been a corresponding member since 1936. At the age of sixty, he took over from Professor Humbert as Professor of Phanerogamy, but also directed the National Herbarium and the associated laboratory at the *École Pratique des Hautes Études* (EPHE), to which he sent hundreds of specimens during his time in Côte d'Ivoire.

Aubréville left his post as Professor in 1968, at the age of 70, only to receive the honour of becoming a member, on 18 March in the same year, of the Academy of Sciences of the *Institut de France*, where he succeeded to the Chair of Botany held until then by René Souèges. His submission for the post comprises no fewer than 92 publications, including a number of authoritative works. His academician's sword is inscribed with a hunting horn, the emblem of the forestry profession, and a baobab flower, and has a small Gesneriaceae flower embedded in the resin (Aymonin, 1983).

**Photo 3.**

Undergrowth in the Banco Forest, Côte d'Ivoire.
Photograph A. Aubréville (1957).

Botany as a means of comparison in the tropics

Following in the footsteps of Auguste Chevalier, who had been compiling a remarkable herbarium of West African plants since 1907, André Aubréville immersed himself in the identification of forest species in French West Africa. But this was not only to assuage his curiosity, as he explains in the introduction to his reference work on the flora of the Sudano-Guinean zone: "Trees are the most reactive organisms in the environment, just as forest formations are its most accurate integrators. And unless botanical species are accurately identified beforehand, it is not possible to produce any exact conclusions, comparisons or theories based on environmental knowledge on the agricultural potential of a country" (Aubréville, 1950). In his view, botany is a tool to be pressed into service to develop the value of colonial forests, but it is also a means to understand the organisation and the deep structure of tropical vegetation. In our modern-day jargon, we would say that botany provides a *model* with which to investigate the complexity of the tropical world.

Aubréville very soon became an experienced and hard-working botanist. His work was rewarded by taxonomy, with several plants named after him, such as *Aubrevillea kerstingii*, *Aubrevillea platycarpa*, *Cassia aubrevillei*, *Croton aubrevillei*, *Dialium aubrevillei*, *Okoubaka aubrevillei* and *Manilkara aubrevillei*. When not yet 40 years of age, he published a notable and much admired reference work on the forest plants of Côte d'Ivoire (*Flore forestière de la Côte d'Ivoire*) (Aubréville, 1938b), which completed some 20 research notes published between 1929 and 1936. This authoritative work comprises over 600 species and 351 plates drawn by the author, and is still used as a reference work today. This volume, prefaced by Professor Henri Humbert, earned the author the Baron de Joest Prize awarded by the Academy of Sciences. He was awarded the same prize again in 1948 for his work as a whole.

In 1950, André Aubréville became interested in the Association for Taxonomic Studies of African Tropical Flora (*Association pour l'Étude Taxonomique de la Flore d'Afrique Tropicale* or AEFTAT), a recently established international organisation of botanists working in every area of specialisation,

which was conducting studies on the flora and plant life of sub-Saharan Africa and its offshore islands (Normand and Renauld, 1957; Aymonin, 1983). The association was chaired by Professor Henri Humbert. Aubréville immediately became a member and joined the committee responsible for drawing up a map of African vegetation. The Association's head office was hosted in the premises of the CTFT.

As a distinguished botanist, he was elected to the presidency of the French Botanical Society for the year 1951 to 1952. But for many years, his investigations had been reaching beyond the field of botany alone to assess not only the influence of present-day climatic factors on the distribution of plants and forest formations, but also the influence of palaeoclimatic and palaeogeographic factors (Letouzey, 1982). He could only have been disappointed by the antiquated view of the FAO (the United Nations Food and Agriculture Organisation), which considers all tropical forests as the same undifferentiated "virgin forest" (Aubréville, 1949a). However, this view encouraged him to pursue his own goal of bringing the multiple forms of these forests to light, as he had recently done in his authoritative work on climate, forests and desertification in tropical Africa (*Climats, forêts et désertification de l'Afrique tropicale*, Aubréville, 1949b). In parallel, from 1946 to 1955, our indefatigable botanist was also teaching tropical forest economics at the Nancy School of Forestry.

He became a full member of the Academy of Overseas Sciences in January 1954. In 1955, having reached the age limit for employment with his initial Corps, he asked to be discharged from his administrative duties and returned with

renewed enthusiasm to his work on botany, ecology and the biogeography of forests. He continued to travel widely in the tropics while directing the publication of new reference works on tropical flora at the National Museum of Natural History. He regularly attended meetings of learned societies, and in 1959 became a full member of the French Academy of Agriculture. He became an Officer of the Legion of Honour, the Agricultural Order of Merit and the Academic Order of Merit and also received numerous decorations from other countries.

In January 1960, Léon M'ba, head of the government of Gabon, and Professor Heim, the director of the National Museum of Natural History, signed an agreement whereby the Museum's Laboratory of Phanerogamy was commissioned by the government of Gabon to prepare and publish a reference work on the flora of Gabon (Aubréville, 1961). The first volume, on Sapotaceae, prefaced by Léon M'ba and prepared by Aubréville, was published one year later (Aubréville, 1961). This was followed by reference works on the flora of Cameroon (1963) and New Caledonia and its dependencies (1967). In parallel, Aubréville returned to the flora of Madagascar and the Comoros, and also of the countries of former Indochina (Cambodia, Laos and Vietnam), taking over from Professor Humbert as editor in chief of the revised versions (Aubréville, 1960).

For each of these works, he personally took charge of several plant families and drafted the entire volume on Sapotaceae, the key plant family in the equatorial tropics, which comprises 700 pages entirely written and illustrated by his own hand (Aymonin, 1983). This is the plant family to which he had been devoting patient and passionate study since 1934 and which accounted for the largest share of his botanical investigations until, 30 years later, he published a synopsis on Sapotaceae genera across the world (Aubréville, 1965). He justified the worldwide scale of his investigations by the fact that on the species level, this family exhibits discontinuous variability, but not on the genus level, where there is greater continuity (Aubréville, 1965). The worldwide scale of his approach was possible thanks to his numerous expeditions in the main tropical forest regions, but also, and especially, because he had been making full use, since the 1920s, of the herbarium housed at the National Museum of Natural History. The volume on Madagascar's Sapotaceae alone covers 11 genera and 84 species (Aubréville, 1973a). In the volume on Gabon, Aubréville covers not only Sapotaceae, but also three other plant families (Irvingiaceae, Simaroubaceae and Burseraceae) (Aubréville, 1962).

In 1961, he modernised the *Notulae systematicae journal*, merging it with the *Adansonia journal* to form a second series of which he was the co-editor until 1980, first with Professor Henri Humbert and subsequently with Professor Jean-François Leroy. This was the journal in which he published most of his work on tropical botany, essentially on the Sapotaceae family. He was held in great esteem by his peers in the botanical community, and Hallé and Oldeman (1970) dedicated one of their architectural models to him by naming it the « Aubréville architectural model ».



Photo 4.

André Aubréville, then Inspector-General of Water and Forests, during the inauguration of the *Centre Technique Forestier Tropical*. Photo CTFT/Cirad.

Tropical forests from a global perspective

To a botanist such as Aubréville, who was able to consider plant life on many different scales and in close contact with reality on the ground, the purely quantitative approach could never suffice. In his views on phytosociology, which could not easily be applied in tropical contexts, he was less than conciliatory, sometimes even mocking the discipline: “phytosociology, with its purely abstract statistical notion of association, never seeking to establish cause and effect or any ecological or other explanation, and its learned or complicated nomenclature, is tempting to many, despite, and perhaps because of its complexity, its abstract nature and its mathematical rigour” (Aubréville, 1951). As a field botanist with extensive experience of the complexity of plant associations, Aubréville was wary of over-standardised or incomplete approaches. He was a pioneering spirit, and many years before the battle between niche theory and neutral theory to explain the distribution of species, he had realised that plant associations have to do not only with physical determinism, but also with chance events related to patterns of seed dispersal where the future of any seed is governed by an environmental filter, with chance rearranging environmentally determined combinations (Aubréville, 1951).

In the 1940s, building on his experience in Africa, he developed his own method, which he called “corridor inventories”, with which forest vegetation could be quickly characterised in the form of vegetation profiles. He thus brought the eye of a biologist and ecologist to bear in addition to that of the botanist or phytosociologist, and used this method to characterise not only secondary bush vegetation in Africa (Aubréville, 1947), but also forest formations in Brazil (Aubréville, 1948a). The idea was that conventional phytosociological descriptions should include the physiognomy, but also the biological spectrum and the ecology that governs plant composition (Aubréville, 1961). These descriptions required drawings of all the vegetation observed in a strip about 100 m in length and 5 m in width, divided into 5 x 5 m squares, and covering all plants of 3 m in height or more. His well-known article on secondary bush formations in equatorial Africa, published in 1947 in *Bois et Forêts des Tropiques*, is based on the use of this method for describing forest vegetation (Aubréville, 1947).

But Aubréville had also been interested for a long time in how forests evolve, constantly seeking to distinguish between the human and non-human factors that influence their evolution over time, and above all the use of fire. He then undertook a statistical study of tropical forest climates, or “eco-climates”, in Africa, from which he produced a wide-ranging typology that forms the basis for his classification of the main types of forest formations in tropical and subtropical Africa (Aubréville, 1949b). In 1949, he published an authoritative synopsis on climates, forests and desertification in tropical Africa (*Climats, forêts et désertification de l’Afrique tropicale*, Aubréville, 1949b), followed by a palaeo-history of tropical forests (*Paléohistoire des forêts tropicales*) (Aubréville, 1949c), which served as reference works

for many years. For both publications, he applied an innovative approach he described as “comparative forest climatology”. We see here that André Aubréville has something in common with the anatomist Étienne Geoffroy Saint-Hilaire, who was also quick to discern trends, or “component units”, from wide-ranging observations. Erudite minds that quickly see the complexity and context of each situation are always wary of generalisations. Taking a side-swipe at Professor Mangenot, who held the chair of plant biology at the Paris Botanical Institute and whose capacity for drawing over-hasty conclusions he did not hold in great esteem, Aubréville concludes with the biting aphorism that “generalisations are a danger to truth” (Aubréville, 1951).

In these two works, both published in the same year, Aubréville elaborates on his theory that desertification in tropical Africa, a region not greatly affected by oceanic influences and exposed to long dry seasons and high temperatures, was gaining ground as savannah lands encroached into deforested areas, which then had insufficient water regulation capacities to preserve Africa from drought (Aubréville, 1949b). Again revealing a visionary mind at work, he wrote in 1957: “Who can say what might happen to the climate if the forests were to virtually disappear!” (Aubréville, 1957). In his *Palaeohistory of tropical forests*, he elaborated further on his hypothesis that the plant cover of the equatorial band migrated from north to south during the Tertiary age, following the shift of the warm, moist climatic belt and allowing the dry palaeotropical vegetation of the Sudan-Zambezi region (Aubréville, 1962) to colonise the vast areas that had dried out with the climatic shift (Aubréville, 1949c). The equatorial flora that remained in refuge zones later moved northwards, together with the equatorial climatic band. Aubréville founded his hypothesis on a great many observations suggesting that the contrast between the two main types of African forest formations, dry and humid, was due not only to their flora, but also to their biology, meaning that the species characteristic of one type could not survive in the other. The two types of vegetation are sometimes adjacent but do not cohabit (Aubréville, 1949c).

While keeping to the principle that equatorial forests will grow on any type of soil of whatever nature, and are therefore not dependent on geology, Aubréville realised that there were exceptions to the rule. For example, the forests of Gabon and the middle reaches of the Congo coincide with certain geological formations, approximately but nonetheless systematically. He devoted an entire study to this singular exception (Aubréville, 1948b), which was published in the *Bulletin de la Section Technique d’Agriculture Tropicale* (Aubréville, 1948c). Aubréville considered in particular that dense humid forests in Gabon, where the dry season lasts for more than three months, was an ecological exception, all the more so as the dry season, in some years, lasts for four months in some localities (Aubréville, 1948b). However, the drought phenomenon at work is different in these cases, as it is linked to human activities, and in particular to the devastating effects of forest fires (Aubréville, 1949c). The influence of fire on tropical forests is a strikingly constant theme in Aubréville’s entire work.

From the 1960s, and building by then on a great many years of experience, he began to work on the international uniformisation of nomenclatures. He published a classification of biological forms (*Classification des formes biologiques*, 1963) and later, with Jean-François Leroy, also a professor at the National Museum of Natural History, a biogeographical terminology for tropical regions (*Vocabulaire de biogéographie appliqué aux régions tropicales*, Aubréville and Leroy, 1970). But spatial scales, however broad, could not satisfy his encyclopaedic mind, and he began to delve more deeply into palaeogeography. At the age of 76, he wrote a remarkable synopsis on the decline of tropical conifers, the present-day vestiges of a population of tropical Gymnosperms that reached its apogee in the Mesozoic, after which it declined in number with the expansion of Angiosperms (Aubréville, 1973b).

Judicious adaptations of silviculture to the tropics

When he first arrived in Africa in 1925, Aubréville realised how clichéd and unicist were the cultural representations of tropical forests, and how ill they matched reality. He immediately rejected the idea that tropical forests are composed of three distinct levels of vegetation (Aubréville, 1932). Observing how tropical forests were being destroyed, Aubréville the engineer sought and thought out innovative solutions to regenerate them in ways that were adapted to local constraints. He naturally thought on the lines of forest engineering, which he was one of the first to deploy in dense tropical forests (Catinot, 1982). As well as a descriptive work on forest vegetation, his study on colonial forests (*La forêt coloniale*), published in 1938, was the first major treatise on tropical silviculture (Letouzey, 1982). He realised that the art of silviculture in temperate countries, where the essential task is to “ensure the right amount of light in forests to allow trees to grow and regenerate in optimum conditions”, did not suffice. To this principle would need to be added knowledge on the biology, flora, sociology and evolution of forests that are unique to the tropical environment (Aubréville, 1949a).

In 1953, following a sharp controversy between naturalists and the Water and Forests Service, which was taken to Congress, Aubréville wrote an eloquent and lively article entitled, with his usual foresight, “No to a eucalyptus war in Madagascar” (*Il n’y aura pas de guerre de l’eucalyptus à Madagascar*) (Aubréville, 1953). His perceptions had changed since *La Forêt coloniale*, in which he appeared to agree with Curator Lavauden, to whom the existence of these eucalyptus seemed precarious and their future uncertain (Aubréville, 1938a). In late 1957, and again in late 1959, he spent two months in Brazil as a guest of the National Research Committee to conduct an ecological study of the country’s main forest formations. Thanks to his insatiable curiosity, his robust constitution at nearly 60 years of age, and his outstanding ability to grasp the overall picture, he was able to take enough notes to write a 256-page book,

three years later, on the plant formations of Brazil. In the state of São Paulo, he could see the potential of these eucalyptus plantations, and would not forget the vast 15 000 ha. plantation established in 1904 by the railway company (Aubréville, 1948a). As a fervent advocate of silviculture, he was delighted by this planted forest, all the more so as he was fully aware that without the science of silviculture, the plantation would be doomed to failure as it could not regenerate naturally.

In the same article, which could be perceived, although wrongly, as a pamphlet against naturalist associations, he puts forward objective, learned and pragmatic arguments in favour of using eucalyptus trees, whose potential and limitations he was nevertheless well aware of. He is particularly scathing about the sentimental reason for rejecting species because they do not belong to the “native old-growth forest” (Aubréville, 1953). It is true that the argument he uses to justify his activities in the specific case of the Périnet forest in Madagascar harks back to a somewhat old-fashioned form of forest rhetoric. And we know today that even the forests that reappear in Madagascar after slashing and burning are in fact capable of producing high quality timber from indigenous species (Razafintsalama *et al.*, 2014). But a review of their history 60 years later, shows that, contrary to all expectations, peasant farmers themselves were responsible for the success and widespread use of eucalyptus in Madagascar, and that in socio-economic terms at least, this species has become an integral part of Madagascar’s rural landscape (Verhaegen *et al.*, 2014).

Aubréville also became involved, as from 1935, in enrichment operations in tropical forests using species such as African mahogany or okoumé in planted strips. On the grounds that demand for timber would increase even as world resources decreased, he saw okoumé forests in particular as a source of “permanent wealth” in Gabon, and believed that the country could become one of the world’s leading timber exporters within 50 years, alongside the USSR, Finland and Canada (Aubréville, 1948b). He recommended planting seedlings in patches along broad cleared strips about 20 m wide in secondary forests, alternating with wooded strips of the same width (Aubréville, 1947, 1948b). He was heavily criticised, and responded with an article entitled “Wild forests or silviculture?” (*Forêts sauvages ou silviculture*), in which did not spare his opponents, stating that their arguments were based on ignorance, uncertainty or egocentricity (Aubréville, 1954b). But his own arguments in favour of developing secondary forests, whose extent and pre-eminence over primary forests he does not underestimate (Aubréville, 1947), are perfectly valid. And he has clearly been proved right in his prediction that in 50 years time, wood as a material would still be holding up against competing materials and that the most sought-after species would remain so because of their superior technical qualities.

He was particularly clear-sighted on this point, because many years would pass before the scientific community took an interest in these secondary forest formations (Lugo, 2009). Furthermore, he described patterns and stages in plant successions, with quantified information, and took an interest in seed dispersal mechanisms and seed banks in the soil that



Photo 5.

The native old-growth forest of Périnet (Madagascar). Photograph taken by Aubréville during a mission in Madagascar in May 1954. The photograph is captioned "Palms and ferns in the Périnet forest". Photograph CTFT/Cirad.

would germinate as soon as a clearing was made (Aubréville, 1947). His perspective as an engineer was undoubtedly of considerable help to him in identifying and synthesising the various specific mechanisms governing plant succession, so much so that one might wonder whether he had not already discerned the main lines and principles of what we understand today using different terms and different concepts. But as we know, he was an astute observer: for example, in *La Forêt coloniale*, he explains how he grasped the role of the hornbill in the dispersal of *Guarea cedrata* seeds (Aubréville, 1938a).

In Brazil, during his first visit to the state of Parana for the

first meeting of the FAO forest committee for Latin America, Aubréville took a close interest in its forests of *Araucaria angustifolia*, the monkey puzzle tree or Parana pine (Aubréville, 1948a). What he observed was a forest with three distinct storeys, but developing in a singular manner since the 20 to 25 m high araucarias were growing above dense and heterogeneous broadleaves which in turn overshadowed a thick layer of undergrowth (Aubréville, 1961). To Aubréville, the presence of this broadleaved forest below the araucarias, which could not regenerate in the shadowy undergrowth, suggested the hypothesis that the plant association was derived from a

long-ago human settlement at the time when the araucarias first appeared (Aubréville, 1948a). The araucarias would have been pioneer plants in clearings within the broadleaved forest. This forest would then have gradually closed in around the high crowns of the conifers that were unable to regenerate in the vegetation beneath.

A far-sighted view of the dangers to tropical forests

Aubréville frequently warned of the dangers of uncontrolled deforestation, which would not only dry out the regional climate (Aubréville, 1938a) and cause soil erosion (Aubréville,

1948b, 1959), but also deplete the region's genetic resources. In *La Forêt coloniale*, he notes the many pharmaceutical properties used by indigenous populations in both humid and dry forests, commenting that every single tree might well be used in some way in the local pharmacopoeia, and immediately adding, 40 years before the concept of biodiversity first emerged, that “not a single unknown species should be disregarded” (Aubréville, 1938a).

He believed that the loss of forest cover was a direct threat to mankind, and that international protective measures should no longer focus solely on rare and threatened species. In 1954, at an international conference on fauna and flora protection in Bukavu, he issued a strong call, in the name of the French delegation, for action from the international community to protect not only these species, but also all plant cover, soils and water resources (Aubréville, 1954a). While his reasons were more functional than “compositional” at the time, he was very much ahead of his time. On the more conventional topic of forestry proper, he laid particular stress on the need to maintain sufficient forest cover and to protect the most valuable species, but also to strengthen regulations in order to control fires around forest margins (Aubréville, 1954a).

Aubréville relentlessly castigated ill-conceived forest management practice that resulted in fewer trees and inherently undermined their seeding potential (Aubréville, 1938a). Thanks to his sheer common sense and powers of observation, he was ahead of his time in making such assessments (Putz *et al.*, 2012). He also knew that a tropical forest in which the few tall trees have all been cut down is virtually valueless, and that this was the reason why the Amazon's vast forests were shrinking to make way for crops or livestock. The worst example he observed was in Brazil, where araucaria forests, which could not regenerate naturally, were in fact being cut down to make way for crops or grazing lands (Aubréville, 1961). In his view, the landowners he observed during his second visit to Brazil were faced with two very simple alternatives: “either they preserve a forest but cannot use it for many years, or they cut it down to make way for livestock and immediately make a profit with no technical complications or any need for further investment” (Aubréville, 1961). Aubréville the pragmatic forester never lost sight of hard economic fact, which weighed even more heavily on forests than climate.

Criticisms of Aubréville's work and conclusion

André Aubréville died in Paris on 11 August 1982, just before his 85th birthday. He was buried at Frouard, in his native Lorraine, not far from where he was born. He left a legacy of some 20 books and more than 300 articles, but also, and especially, a vision of tropical forests that has left a profound mark on forest management today, in France and its former colonies, but also far beyond. Throughout his long career, his brilliant mind and rigorous and inflexible temperament elaborated a far-reaching system of thought on the



Photo 6.
Enrichment planting in what is now the Republic of Congo.
Photograph Aubréville (1952).

Bibliography

development of tropical forest resources. He has left us with the image of an exceptionally talented, conscientious and indefatigable forester, at once a thinker and a practitioner, a sharply analytical observer with a supreme grasp of the overall picture and a capacity for handling not only extreme conditions in the field, but also the demands of high-level administration and day-to-day management. Thanks to his astute grasp of the diversity of local situations, he was well aware of the pitfalls of overarching legislation, denouncing overall measures that “in just a few lines, impose obligations and restrictions on an entire country which the people concerned never even know about” (Aubréville, 1938a). Generalisation is always an injury to truth.

He surely cannot be criticised for showing that the present-day forests we readily believe to be primary formations were in fact often modified by humans, and continued in a state of virtual equilibrium between the environment and human activities (Aubréville, 1950), or for demonstrating how wildfires could jeopardise a forest’s potential to re-colonise previously deforested areas (Aubréville, 1938b, 1948b). Yet today, he is seen in France as one of the main advocates of the primary forest concept (Arnould, 2010), although he was among the first to provide evidence of early human settlements that could explain the origins of forests stands characterised by a great many sun-loving pioneer species such as okoumé, framiré and ilomba (Aubréville, 1949c). He advanced the hypothesis that human settlements had spread at one time across all the lowland forests of Gabon, but that the populations had eventually died out as a result of famine, disease and slavery, leaving forests that are still characterised today by their plant composition (Aubréville, 1948b).

Aubréville’s ability to demonstrate the impact of human populations on forest vegetation, combined with the general inclination of the forestry corps he represented to claim sole competence in deciding on the best future for forests, was often ill-received. His entire life’s work called for a type of interventionism that could preserve forest resources from uses that did not sit well with his views as a forest engineer and administrator, whether the demand was for agricultural or livestock farming or for purely extractive logging. Should he be criticised for this?

But perhaps this far-sighted forester should be remembered above all because today, the approaches he developed on the interactions between forests, climate, desertification, forest fires and agriculture are more relevant than ever before.

Acknowledgements

The author would like to thank Marc Malmejean, from the CIRAD document centre in Baillarguet, for enabling him to consult the greater part of Aubréville’s work.

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