

THE BIRDS  
OF THE BELGIAN CONGO

PART I

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BY JAMES P. CHAPIN

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BY JAMES P. CHAPIN

FRONTISPIECE; PLATES I TO X; TEXT FIGURES 1 TO 208; AND 1 MAP

SECTION A.—GENERAL SURVEY OF THE COUNTRY AND ITS  
BIRD LIFECHAPTER I.—THE ORNITHOLOGICAL EXPLORATION OF THE  
BELGIAN CONGO

## INTRODUCTION AND ACKNOWLEDGMENTS

In the letter of instructions from The American Museum of Natural History to its Congo Expedition, the main purpose of our work was outlined as a zoölogical survey of the Belgian Congo, with special attention to vertebrates. Even now, this would seem a comprehensive aim, but in 1909 only two attempts had been made to list and describe the members of single classes of vertebrates as represented particularly in the Congo.

One of these, successful in the highest degree, though necessarily still incomplete as regards the full number of species, was Dr. G. A. Boulengers' 'Les Poissons du Bassin du Congo,' published in 1901. The other work to which I refer is Professor Alphonse Dubois' 'Remarques sur l'Ornithologie de l'Etat Indépendant du Congo,' in the *Annales du Musée du Congo, Zoologie, I, fasc. 1, 1905*, important in the present connection, inasmuch as it must be taken as the forerunner of the list I am here introducing. Save in general surveys of birds of the whole continent, such as Professor Anton Reichenow's 'Die Vögel Afrikas,' no comprehensive attempt to list the birds of the Congo, either as a political or a geographical area, had previously been made.

Many papers on collections from that region had appeared, beginning with descriptions of species collected by Perrein, near the mouth of the river Zaire or Congo, at the beginning of the 19th century, and the list of birds collected by the Tuckey Expedition of 1816. The account of George Maxwell, in the *Edinburgh Philosophical Journal, 1822*, entitled 'Observations on the Countries of Congo and Loango, as in 1790,' is interesting reading; but the travelers who visited the Loango Coast and Congo mouth in earlier years made only casual mention of birds.

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<sup>1</sup>Scientific results of the Congo Expedition. Ornithology, No. 12.

Up to the time of Dubois' writing, most of the collections reported from the Congo had been made in the border regions. The Belgian museums had now obtained numerous skins of birds from many different districts, even in the central Congo; but Professor Dubois, instead of including the records of others, already published in several languages, contented himself with merely listing the names and localities of all the specimens preserved in the Royal Museum of Natural History in Brussels, and in the Congo Museum at Tervueren, adding descriptions and taxonomic notes for only a very few species of particular interest. Most of this material had been gathered voluntarily by army officers, government administrators, physicians, and missionaries. Far from giving an adequate idea of the avifauna of the Congo, even as known at the time of its publication, Dubois' list mentioned only 485 species. Approximately 1040 species are now to be recorded from the Belgian Congo and mandated territories.

When we recall that Reichenow's 'Die Vögel Afrikas,' completed in the same year, placed the number of species inhabiting the Ethiopian Region at about 2400, and actually reported only 601 of them from the territory of the present Belgian Congo, we can easily perceive the gaps which remained to be filled in the fauna of this, the largest political area of equatorial Africa. Despite the merit of Professor Reichenow's admirable work, which continues a mainstay of African ornithologists even to-day, his treatment of the Congo was certainly less complete than of any similar area south of the Sahara. Except for the deserts, the Congo was the last great country in Africa to be opened to travel and commerce. In the useful atlas accompanying 'Die Vögel Afrikas,' the Congo is nearly a blank. The collectors' localities indicated are mostly restricted to the eastern borders and the region where the Congo River approaches the Atlantic.

The time has scarcely come when Congo birds are fairly represented by collections from all parts of the colony. But a great deal of work has been done during the last twenty-five years along the eastern border, somewhat less in the Katanga; and the Congo Museum has continued to receive material from widely scattered sections. For many years the Equator district and the Kasai remained almost as completely untouched as they appear in Reichenow's atlas. These districts have now been investigated personally by Dr. H. Schouteden, Director of the Congo Museum; and it does not seem as though the central forested areas of the Upper Congo, from which relatively few bird specimens have been garnered, would yield many more distinct, undescribed species.

To Mr. W. L. Sclater we now owe an up-to-date check list of African birds. It is quite feasible, therefore, to offer to-day a comprehensive view of Congo ornithology; to give an idea of bird distribution within this area such as cannot be gleaned from Professor Reichenow's work; and to add many well-marked species which have been discovered since the date of its publication. We venture to affirm that the present area is of the highest importance in a general discussion of bird distribution throughout Africa. The Lower Guinea forest, besides possessing a peculiar fauna of its own, is a vast humid area about which the ranges of many of the widely distributed African birds can be shown to gravitate, when indeed it does not cause a balancing of representative forms on opposite sides.

For an undertaking such as this an author may be expected to present his qualifications. During a five and a half years' sojourn in the Congo I collected and carefully observed the birds across the entire width of the colony, along a route of approximately 1800 miles, from Banana on the coast to Aba and the adjoining border of the Lado district. After returning from the Congo seventeen years ago, I endeavored to profit by every opportunity to further my knowledge of Ethiopian birds. These studies were rendered possible by the generous support given by The American Museum of Natural History in the working out of its Congo collections. The means were willingly furnished to enable me to make extensive comparisons of our own material with many other collections; and other museums have done their utmost to assist me in studying their African specimens. Thus I have worked at five of the other important museums of the United States, as well as at eleven museums in Europe. To the authorities of these many institutions I owe a debt of gratitude for their courtesies and their interest.

Early in 1926 the American Museum, through the generosity of Mr. Henry W. Sage, was able to send me again to Africa, where I planned to make the acquaintance of as many mountain-dwelling birds as possible. During this second expedition a year was spent in the eastern and southeastern districts of the Belgian Congo, and especially on the mountains and highlands from Lake Albert to the Upper Katanga. My third visit to the Congo, in 1930-1931, was made with the purpose of collecting materials for a habitat group of forest birds in the vicinity of Lukolela. This group is the gift of the late Mrs. Dwight Arven Jones.

During the preparation of his '*Systema Avium Æthiopicarum*,' Mr. Sclater favored me with advance sheets of his manuscript, besides giving me most valued assistance during my visits to the British Museum,

and answering many questions that have arisen since then. Dr. C. W. Richmond helped me exceedingly with ornithological advice and the loan of numbers of specimens. Messrs. Outram Bangs, W. E. Clyde Todd, and Dr. Herbert Friedmann have generously accorded me similar assistance. Among my friends in Europe to whom I am most deeply obliged, I must mention particularly Dr. Ernst Hartert, Professor A. Reichenow, Professor O. Neumann, Dr. H. Schouteden, Mr. D. A. Bannerman, Dr. E. Stresemann, Mr. C. Mackworth-Praed, Mr. J. Berlioz, Dr. M. Sassi, Dr. F. Frade, and Mr. H. Grote. Both in Munich and in Chicago, Dr. C. E. Hellmayr has responded cordially to my appeals. From Tervueren, Dr. Schouteden sent me many specimens of his own collecting for examination. Even from Africa, Mr. G. L. Bates and Dr. V. G. L. van Someren courteously furnished me with information.

Here at the American Museum, President Henry Fairfield Osborn has given his fullest support to every phase of our investigations. In the securing of much needed comparative material he was vigorously seconded by Dr. L. C. Sanford. After urging the inception of the present report, Dr. Frank M. Chapman, Curator of the Department of Ornithology, has continued to stimulate it in every way, while my colleagues in the Museum, especially Mr. Herbert Lang, Dr. J. Bequaert, and the late W. DeW. Miller, coöperated in more ways than I can enumerate.

In the actual preparation of the manuscript I have had the faithful assistance of Mr. Rudyerd Boulton, Miss Frances Brown (Mrs. J. Bequaert), Miss Kathryn Johns, and Mrs. E. B. Bardwell. The majority of the drawings which illustrate the text were prepared in this department by Mrs. H. von Ziska, who has done so much excellent pen work for other reports in this Congo series.

#### LIMITS OF TERRITORY TREATED

In choosing the limits of the territory to be covered in the present report, I soon found that there were two principal alternatives. Either I could take the basin drained by the Congo River, without regard to political boundaries, or I could confine myself to the present boundaries of the Belgian Congo, arbitrary lines which do not enclose by any means the whole of the Congo basin, and extend beyond it only in the Kivu, Ruwenzori, and Lake Albert districts. As compared with the total area drained by the Congo, which approaches one and a half millions of square miles, the Belgian Congo covers 910,000 square miles.

It may seem that the first-named area—that of the Congo basin—would be a much more natural subdivision of the continent of Africa,

and that I could not long hesitate to adopt it. Nevertheless, I quickly found that the political delimitation was preferable, for the following reasons. The watersheds between the Congo-Nile and Congo-Zambesi drainages are not formed by ranges of mountains. The transitions are gradual, often difficult for the traveler to note as he passes over them, and they offer no important barrier to the distribution of birds or mammals, seldom marking an abrupt division of the faunal areas. Many of the sharpest lines of demarcation are well within the physical frontiers of the Congo, as a result of the predominant influence of rainfall and vegetation.

It seemed desirable to include the birds known from the western side of the Ruwenzori range. The mountain forest there is connected with an extension of the Ituri forest, a fact of considerable interest. It is only on the eastern edge of the Congo that we have an opportunity to study the relation of altitudes to the distribution and differentiation of bird-life.

Furthermore, by taking political rather than orographic or hydrographic boundaries I was able to exclude large areas east of Lake Tanganyika and Lake Bangweolo which have a fauna predominantly East African, and therefore do not properly belong with most of the remaining territory. The northwestern corner of the Congo basin, extending into the Cameroon, is an area in which Mr. G. L. Bates has done his remarkable work. This region is treated fully in his 'Handbook of Birds of West Africa.' Many of the species living there range eastward to the Ituri district, others will yet be found along the lower Ubangi River or the Middle Congo.

Restriction of the territory is of course desirable, in order that I need not include too many species which we have not collected ourselves, and which I may have studied insufficiently. For this purpose, too, the political outline is better suited.

One of the practical advantages of the political boundary is that a number of valuable lists of birds inhabiting contiguous areas have already been established in the same way. We have Reichenow's lists of the birds of the Cameroon,<sup>1</sup> and of German East Africa,<sup>2</sup> Sclater and Mackworth-Praed's of the birds of the Anglo-Egyptian Sudan,<sup>3</sup> van Someren's for British East Africa and Uganda,<sup>4</sup> and finally, though it is not at all recent, Bocage's '*Ornithologie d'Angola*,' I, 1877, and II, 1881.

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<sup>1</sup>1911, *Mitteilungen aus dem Zoologischen Museum in Berlin*, V, pp. 239-258.

<sup>2</sup>1894, '*Die Vögel Deutsch-Ost-Afrikas*,' pp. 1-250.

<sup>3</sup>1918, *Ibis*, pp. 416-476; 602-721; 1919, *idem*, pp. 628-707; 1920, *idem*, pp. 781-855.

<sup>4</sup>1922, *Novitates Zoologicae*, XXIX, pp. 1-246.

Lastly, I aim to write a practical paper which may serve the cause of ornithological science by aiding those who may have occasion to travel or dwell in the Congo as officers, administrators, planters, missionaries, sportsmen, or merchants, and to whom the political boundary will be the most familiar.

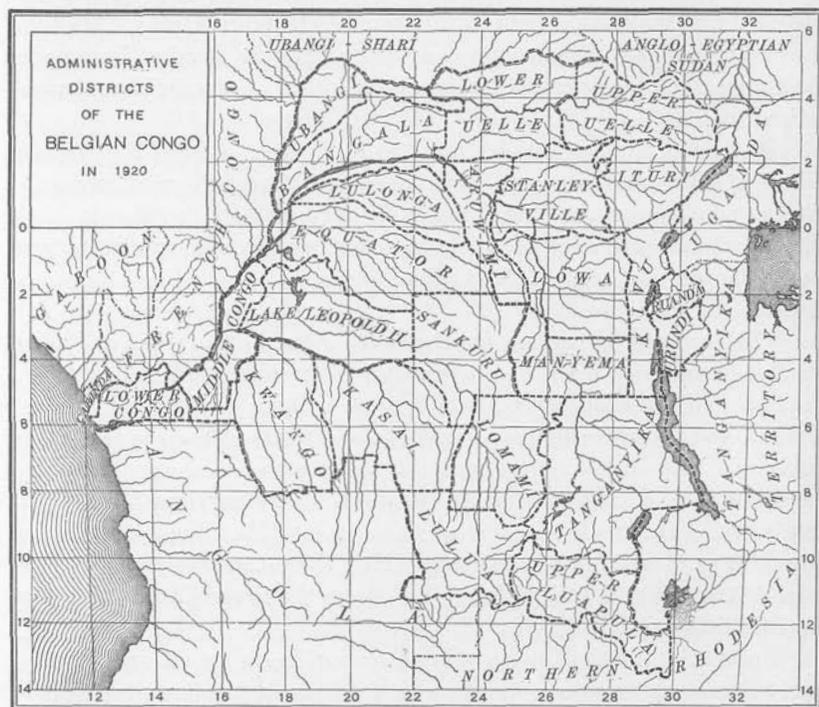


Fig 1. Districts of the Belgian Congo and Mandated Territories at the time when this report was begun. The Upper Luapula District is commonly known as the Upper Katanga. Recent alterations in some of these divisions are shown in L. Franck, 1930, 'Le Congo Belge,' II, map.

It will be unnecessary here to delimit the exact territory to be treated; an examination of the map (Fig. 1) will be the simplest method of ascertaining the position of its boundaries. The territories of Ruanda and Urundi, occupied by Belgium under mandate, are included with the Belgian Congo proper, so that the total area amounts to some 932,000 square miles. For the sake of brevity I shall frequently use the word "Congo" to mean the Belgian Congo.

## HISTORICAL NOTES ON CONGO ORNITHOLOGY

We have already traced the investigation of the bird fauna of the Congo region back to about 1800, when the French traveler **Perrein** collected specimens near the mouth of the river then better known as the Zaire, and sent them to the Paris Museum. Vieillot described some of them for the 'Nouveau Dictionnaire d'Histoire Naturelle,' from 1816 to 1819.

The earlier voyagers to the Congo and Loango had not failed to notice many of the characteristic birds, and they made some real observations, such as the brief accounts of the habits of the honey-guide and the seasonal molt of bishop-birds by **Father Jerome Merolla da Sorrento**. But the notes to be found in the relations of Andrew Battell, Samuel Brun, Odoardo Lopez, Father Merolla, Barbot and Casseneuve, and L. de Grandpré are now of less scientific than historic interest. It must be remembered, too, that the Kingdom of Congo lay largely outside our limits in northern Angola, although extending north to the Zaire.

The earliest paper dealing particularly with the avifauna of the Belgian Congo will be found in Appendix No. IV, of **Tuckey's** 'Narrative of an Expedition to Explore the River Zaire,' published in 1818. It is a list by Leach of the 36 species collected by **John Cranch** during the disastrous expedition in which he, as well as the commander and so many of their comrades, perished from the fevers of the Lower Congo. The scientific names used by Leach are anything but satisfactory, for in many cases they consist only of a generic term with a reference to some similar species figured in Savigny's 'Oiseaux d'Egypte.' Some of the birds, in consequence, are unidentifiable. Others seem not to have come from the Congo. A few new forms were described, including *Hirundo smithii* and *Pternistis cranchii*.

Soon after this, there appeared a popular account of birds in this region by **George Maxwell**.<sup>1</sup> The author had visited the Congo as early as 1790, and as master of a trading ship ascended the river to Embomma—later the capital of the Belgian colony, known under an abbreviated name. Twelve of his voyages had taken him up the Congo. Maxwell was acquainted with the salient points of the fauna, and even mentions a great ape, surpassing the "chimpanzee," under the name of "poongo." Among the birds, he tells of the "boolicoco," and corrects the impression of some travelers that it was a peacock, his remarks making it clear that the bird has preserved its name to our day, and is none other than the great plantain-eater, *Corythæola*. The fruit-

<sup>1</sup>1822, Edinburgh Philosophical Journal, VI, pp. 62-64.

pigeons, pelicans, parrots, love-birds, hornbills, swallows, and a weaver-finch are all recognizable in his quaint relation; but the mention of a "small horned owl, about the size of a canary" can at best only apply to a scops owl. The "vast flocks of Flamingoes" frequenting the islands and sand-banks of the river are not to be seen to-day; the birds are rare on the lower Congo, and it is possible that Maxwell himself was mistaken. He may have seen them farther south in Angola, and assumed they would visit the Congo in equal numbers.

For many years after the voyages of Cranch and Maxwell, the exploration of the Congo basin lagged far behind that of the remainder of the continent. More important reasons than mere remoteness were the difficulty of passing the cataracts of the Congo River and the malarious nature of the region. The travels of **Paul Du Chaillu** in the Gaboon during the fifties, though not within my limits, have an essential bearing on Congo ornithology, since they furnished the material for the description of so many species now known to occur in the nearby portion of the Lower Congo, and others extending across the whole basin of the Congo.

The renowned missionary traveler, **David Livingstone**, on his expedition from the Zambesi to Angola and return (1851-1852), probably crossed a small part of our territory, in the neighborhood of Lake Dilolo; and later (1865-1873) he explored a considerable area in the southeastern corner of the Congo basin, without, however, securing any collection of birds. Nevertheless we owe to Livingstone a number of notes on the habits of birds of the Zambesi region.

It was during the sixties of the last century that the penetration of the northeastern corner of the Congo basin was begun. First **Piaggia**, who lived more than a year among the Azande in the southern Bahr-el-Ghazal Province, made his way across the watershed as far as the village of Chifa (or Keefa), which we know to be near the present station of Bafuka. He collected but few birds within the area covered by the present work, and these were reported upon by Antinori.<sup>1</sup>

Piaggia was followed shortly (1868-1870) by the gifted botanist, **Dr. Georg Schweinfurth**, who reached Tingasi, the Mangbetu capital south of the Uelle River. But he brought back no ornithological material, so the field was left open for Emin Pasha a few years later.

In August 1872, **Captain R. M. Sperling** of the British Navy made a small collection of birds which Bowdler Sharpe reported in the Proceedings of the Zoological Society of London for the following year, as from the river Congo. The only exact localities cited, however, are Kabinda

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<sup>1</sup>1868, *Bollettino della Societa Geografica Italiana*, I, pp. 91-165, with a map.

and the Bay of Malimba, so we may be permitted to doubt whether Sperling actually ascended the river.

Other collections were soon made on the coast just north of the Congo mouth, which we cannot overlook, though they are mainly extralimital. The **German Loango Expedition** established its headquarters at Chinchonxo (Tschintschotscho), just north of Landana in 1873, and continued its investigations until 1876. Among its members was **Dr. J. Falkenstein**, who busied himself with obtaining birds for the Berlin Museum.

**Dr. A. Lucan** and **L. Petit**, between 1876 and 1884, made valuable collections at Landana, which supplemented the work of the German Expedition at practically the same spot. Whereas Du Chaillu had collected mainly in the areas of heavy forest, these specimens from farther south were the representatives in part of the savanna fauna that occupies so much of the Lower Congo. Lucan and Petit did indeed collect some specimens on the Congo itself, up as far as Boma.

Again we must turn to the northeastern border. **Emin Pasha**, or **Edouard Schnitzer** by his European name, became Governor of Equatorial Africa in 1878, with headquarters at Lado on the White Nile. His province, although then part of the Sudan, included all of the present Upper Uelle district of the Congo; and he traveled extensively and collected along the border of our territory, finally pushing westward as far as Tingasi, the town of the Mangbetu king, and south of the present station of Niangara. Emin secured the first bird collection of importance from this region, continuing his activities until 1889, when he had been cut off from Egypt by the Mahdists, and then accompanied Stanley to the East Coast. Most of this material was reported upon by Hartlaub, von Pelzeln, and Shelley; it contained more than fifty species new to science.

In October, 1890, Emin again started from Bagamoyo with **Dr. Franz Stuhlmann**, explored the shores of Lake Victoria, and entered what is now Congo territory in Mpororo, south of Lake Edward. From Karevia in the Semliki Valley Stuhlmann ascended Ruwenzori to an altitude of about 13,300 feet, and together they proceeded to the region then called Ndussuma, and to the Lendu Plateau west of Lake Albert. In December, 1891, the travelers separated in Ndussuma, Stuhlmann returning to the East Coast, whereas Emin, in the following March, started farther into the Congo, journeying southwest toward the neighborhood of Kibonge on the Lualaba River, and was murdered by Arabs in October, 1892. The birds collected by Emin and Stuhlmann in the

eastern Congo were studied by Reichenow; but Emin's last collections were of course lost, and only his notebooks subsequently recovered in a captured stronghold of the Arabs. From these, extracts have been printed in the *Journal für Ornithologie*, XLII, 1894, pp. 162-171, and in the *Proc. Zool. Soc. London*, 1894, pp. 596-606. A new and more complete edition of Emin's earlier notebooks is being edited by Drs. Stuhlmann and Schubotz, of which the first volume appeared in 1916. Volume six (1921) deals especially with mammals and birds.

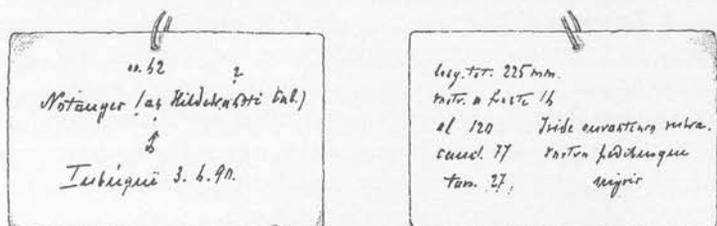


Fig. 2. One of Emin's characteristic labels,  $\times 1$ . From a glossy starling in the Berlin Museum. Note measurements and color-notes on reverse side.

**Dr. Wilhelm Junker**, the geographer who traveled so systematically over the Upper Uelle district, was accompanied on some of his journeys in the years 1879-1886 by a careful collector, **F. Bohndorff**, who secured valuable material, not only in the Bahr-el-Ghazal, but also in the Azande country just on our northern limit, in the neighborhood of Semio and Sassa (1883). Bohndorff later took service with the new Congo government, and sent home further collections from stations on the lower Congo, as well as from a few points on the upper river, and between Kasongo and Lake Tanganyika (1885-1886).

By this time the birds of the Tanganyika region were being collected by **Captain Emile Storms** (1882-1886), at Karema and Mpala especially. This region, and even the Upper Katanga, were also reached by **Dr. Richard Böhm**, who had begun his field work in 1880 in East Africa between Zanzibar and Lake Tanganyika, and after two years of successful activity suffered the loss of important collections, equipment, and all his notes through a brush fire. Nevertheless, with his companion **P. Reichard**, he traversed Lake Tanganyika in July, 1883, and determined to cross the continent to the West Coast. Passing over the Marungu highland, the Luvua and Lufira rivers, they discovered Lake Upemba on the upper Lualaba; but after a long siege of fever Dr. Böhm succumbed on March 27, 1884. This journey nevertheless supplied most important

zoögeographic data, proving that Lake Tanganyika marked approximately the division between the East and West African faunistic subregions. Böhm's notebooks contained invaluable observations on the life histories of birds in the regions journeyed over. His last collections and notes furnished the subjects of papers by Schalow and Matschie.

Along the southern edge of our territory in Angola two German travelers, **O. Schütt** and **Major von Mechow**, busied themselves about this time with bird collecting, especially near Malanje and the Kwango River; and while there is some doubt as to admitting any of these as Congo records, they long furnished almost the only indications of what we might expect in the southern Kasai. A little farther east, in the country known as Mwata Yamvo (from the title of its reigning chief), **A. Sesinando Marques** also collected a few specimens toward 1886.

**Sir H. H. Johnston**, between the latter part of 1882 and the beginning of May, 1883, made a trip up the Congo River as far as Bolobo. He embodied his experiences in a very readable book, 'The River Congo' (1884), which is to be recommended for a good general impression of the region and of methods of travel and administration in those days. The identifications of birds observed are only to be used with caution, though there is much of ornithological interest in the book, and a list of species noted on the Congo (pp. 364-372).

At about this time the German traveler **Teusz** also collected some 200 species of birds near Stanley Pool, a few of which are briefly mentioned by Reichenow in the *Journal für Ornithologie*, 1885, pp. 217, 218. Many of these specimens are preserved in the Berlin Museum.

**Capello and Ivens**, the Portuguese travelers who crossed the continent from Angola to Mozambique in 1884-1885, made a short stop in the Upper Katanga, and they noted a few birds which were observed and collected there.

At the end of 1885, **Jacques de Brazza**, brother of the founder of the French Congo, returned from that region with a considerable ornithological collection, made with the assistance of **MM. Pecile and Thollon**. Several of these birds were described as new by Oustalet. One is a small swallow, *Phedina brazzæ*, which was taken at Nganciu, on the Congo River, just below Kwamouth. It has been rediscovered only recently in the Kasai.

Thus far, with the exception of a few of Bohndorff's birds, practically all the Congo specimens had been gathered in peripheral regions. In 1886, **Sir H. M. Stanley** was preparing his expedition to relieve Emin Pasha; and **James Sligo Jameson**, sportsman and traveler, attached

himself to the expedition in the hope of making a zoölogical harvest in the unknown country to be explored. On the way up to the Aruwimi, despite the difficulties of travel, he managed to secure 126 specimens of birds. In the camp at Yambuya, where Stanley left him, the opportunities for such research were gravely limited by the hostility of the surrounding natives; yet Jameson kept bravely on till his scientific ardor cost him his life, at Bangala, August 17, 1888.

Stanley had little sympathy for serious zoölogical study. He failed completely to understand either Emin Pasha or Jameson, and in his own books of travel one may seek almost in vain for zoölogical observations of value. One of Jameson's companions in the Rear Column, **Mr. W. Bonny**, also brought home a few birds from Yambuya, which found their way to the Tring Museum.

Toward the year 1889, **Mr. A. Greshoff**, a well-known representative of the Dutch House on the Upper Congo, appears to have collected a few birds, among which were the types of *Nectarinia congensis*. In 1891, **J. Dybowski**, on behalf of the French government, led an expedition up the Congo and Ubangi to the Kemo River, and collected many birds all along his route for the Paris Museum. During the nineties little more was heard of ornithological activity in the Congo, though a number of State officials seem to have been gathering material for the museums of Belgium.

In 1899, **Dr. W. J. Ansorge**, coming home from Unyoro (where he had already done ornithological work), crossed Toro and the plain of the Semliki southwest of Ruwenzori, entering the great forest near Beni and making his way to the Ituri, the Aruwimi, and out by the Congo. The birds collected on his journey through the Ituri district are all noted in *Novitates Zoologicae*, VII, 1900, pp. 25-53. **Sir. H. H. Johnston**, in 1900, obtained some birds—and discovered *Ruwenzorornis*—on the eastern slope of Ruwenzori, and then visited the region of Fort Beni in the Congo Free State. But he seems not to have secured any birds in Congo territory.

The visit of **Geoffrey Archer** to Ruwenzori in 1902, although restricted to the southeastern slope, is of interest to us in the present study, the birds being much the same on both sides of the range. His results were not made known until 1906, in an article for the *Ibis* by his uncle, Sir Frederick J. Jackson.

The year before this, the third and final volume of **Professor Reichenow's** 'Die Vögel Afrikas' was completed, establishing a new and substantial foothold for African ornithologists, and meanwhile preparing

the way in a most efficient manner for the rapid progress immediately to follow. I cannot pass on without expressing my admiration for this monumental work, fully worthy of the dean of Ethiopian ornithology, who had already described and named so large a proportion of the birds he now placed before the world in orderly sequence.

Of **Professor Dubois'** list of Congo birds, which also appeared in 1905, a word has already been said. We cannot but regret that this paper was not made available a few years earlier for incorporation in 'Die Vögel Afrikas,' because it would have filled a wide gap in the faunal aspect of Reichenow's masterpiece. On the other hand, Dubois made no attempt to utilize the material Professor Reichenow had already published. According to his own statement, he realized that a more complete list could have been compiled, but he preferred to limit himself to the material under his own charge.

First among the donors of Dubois' material was **Colonel Storms**, of whom we have spoken, and whose collections are largely in the Royal Museum at Brussels. Practically all the other collections made by officers of the Congo Free State had been deposited in the Musée du Congo, founded at the time of the International Exposition of 1897, and then housed in the Park of Tervueren. The list of these contributors and the districts in which they collected is as follows:

**Major Weyns**—Mayombe, Bumba, Province Orientale; **Commandant Cabra**—Mayombe, Cataracts; **Commandant de la Kethulle**—Umangi in Bangala district; **Commandant Charles Lemaire**—Katanga; **Commandant Nahan**—Banalia, Ituri; **Captain Lepez**—Zambi; **Sous-Intendant Menicken-Adams**—Ruzizi-Kivu; **Mr. Emile Coart**—Leopoldville; **Mr. Huisman**—Lake Leopold II; **Mr. Legat**—Kasai; **Mr. Cocu**—Cataracts; **Dr. Julien**—Mayombe; **Rev. Father Goossens**—Kisantu; **Dr. Lovizetti**—Lake Leopold II; **Mr. Questiaux**—Lake Dilolo; **Dr. Polidori**—Uelle, Lado; **Commandant Millo-Ribotti**—Uelle, Lado.

The last name I have added myself, for some birds collected by Polidori and Ribotti were listed by Dubois as from the Uelle and the Ituri. The latter locality was clearly erroneous, but Ribotti's collection, during its transfer from the Colonial Ministry to the Museum, lost its history and was catalogued as coming from the Ituri. Unfortunately Professor Dubois took no extraordinary pains in verifying his localities, and one of Ribotti's specimens from the Lado (of *Zosterops senegalensis superciliosa*) was mentioned as coming from Lake Dilolo. Some other records in this work, as of *Pseudochelidon* from the Ituri, and *Numida* from Umangi, are likewise open to doubt.

During his memorable journey from the Niger to the Nile (1904-1906), **Lieutenant Boyd Alexander** made a tedious trip by boat up the Ubangi, Uelle, and Kibali rivers, stopping at a number of places to collect birds. It was on this trip that he lost his comrade, **Captain G. B. Gosling**, at Niangara. After quitting his last collecting station at Gudi-ma, River Ira, above Nzoro, where he expended all of his ammunition, he proceeded overland to the northeast, to the headwaters of the river Yei, and thus into the Anglo-Egyptian Sudan. In both the Ubangi and Uelle districts Boyd Alexander made notable collections and a number of discoveries. He was as eager in the naming of new forms as he was earnest in the pursuit of his field work. The journey of **J. J. Harrison** from the Lado Enclave to the lower Uelle River in 1905 added some valuable specimens to the British Museum collection.

The western and central parts of the Congo, it might seem, were now being neglected. A Swedish missionary, **K. E. Laman**, in the Lower Congo, was gathering specimens in 1905 for the Stockholm Museum; but this could not be compared with the ornithological activity in the eastern sections, which was now to increase. With the completion of the Uganda Railway, sportsmen and travelers became more and more numerous in Uganda, and soon zoological collectors began frequently to enter Congo territory from that side.

**The British Museum Ruwenzori Expedition** (1905-1906), after a careful survey of the southeastern slopes of Ruwenzori and of the Mubuku Valley up to the eternal snows, attempted a repetition of the work on the western side, in the valley of the Butahu. This was foiled, unhappily, by an attack of the natives. **Woosnam** and **Dent** then proceeded homeward through the Ituri forest, while **Wollaston** and **Carruthers** tarried to visit the Kivu and northern end of Tanganyika, then regaining the Lualaba at Kasongo. No specimens were collected by either party below Basoko.

While the Ruwenzori Expedition was still at work, the **Duke of the Abruzzi** arrived and led his party in the first successful ascent of Mt. Stanley. One of his assistants, **Dr. Roccati**, made a small collection of birds on the mountains.

At this time, too, **Rudolf Grauer**, an Austrian alpinist, visited Ruwenzori and began to take an interest in the birds of the region. He later made several trips to the mountains of the Kivu region and the forests of the eastern edge of the Congo, securing very extensive collections, and discovering a number of remarkable new birds, among which *Pseudocalyptomena graueri* takes first rank. Grauer's material is now in the museums of Tring, Vienna, and Berlin.

In 1906, **C. F. Camburn** made a well-prepared collection of birds (about 145 specimens) for Baron Maurice de Rothschild in the eastern Ituri district, from which Professor Oscar Neumann described four new forms.<sup>1</sup> The more complete report which Neumann intended to publish has not appeared. The collection contained many other rare species from the northeastern Ituri. From a detailed study of the dates and localities on Camburn's labels, I have satisfied myself that he came over from Uganda, collected just within the border of the forest, in the vicinity of Irumu and Kilo, and then left Congo territory by way of Mahagi and the White Nile.

The following year **Duke Adolf Friedrich of Mecklenburg** led an expedition of varied aims and scientific interests from German East Africa and the Kivu district to the west side of Ruwenzori and down the Ituri River. The zoölogist of the party was **Dr. H. Schubotz**, whose collection of birds, with others made about the same time by **von Stegmann** and **Grauer**, served as a nucleus for Professor Reichenow's list of the birds of the Lake Region,<sup>2</sup> a convenient faunal list for the specialist and a valuable supplement to 'Die Vögel Afrikas.'

Count Salvadori published in 1907 a list of 60 species of birds which had been collected by **Doctor Ascenso** near Lake Moero. Although most of them were stated to come from Lukonzolwa, it would seem that Ascenso's collecting was not confined to the lowlands. Some of his birds, like *Diatropura progne*, are probably restricted to the plateaus.

The Upper Katanga, too, was visited in 1907 by **S. A. Neave**, who came in from Northern Rhodesia. He wrote a valuable paper on the birds of this section of the southeastern Congo for the Ibis, 1910. In 1909 **Captain Michell** visited the Lualaba River and collected a few birds, among which was the first example of *Balæniceps rex* from the Congo. These were acquired by the Munich Museum.

**Commandant Ribotti** continued to collect in the Uelle district, but his specimens now went to Count Salvadori to be studied, as did a number taken in the Kasai by **A. Crida**. This latter district was long the most neglected; and it is worth noticing that **E. Torday** and **L. Frobenius**, though both anthropologists, also preserved a number of species from that general region.

Toward 1909 the **Reverend H. M. Whiteside** sent some birds to the British Museum from the Lulonga River and vicinity; but relatively little had thus far been done with the forest fauna of the central Congo.

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<sup>1</sup>1908, Bull. Brit. Orn. Club, XXI, p. 42.

<sup>2</sup>1911, 'Wiss. Ergeb. D. Zentr.-Afr. Exp. Mecklenburg, 1907-1908,' III, pp. 231-374.

We cannot proceed therefore without alluding to the bearing upon this question of ornithological work done in the southern Cameroon. Ever since the German occupation of the region, bird collections had been accumulating from it in the German museums, labeled with the well-known names of Zenker, Preuss, and Carnap. Professor Reichenow himself had visited the Cameroon River.

But the most original and accurate field work was carried on by an American, **Mr. G. L. Bates**, who resided for many years in the Cameroon forest region, particularly at Bitye, near the river Ja, and thus within the Congo basin. Bates' notes on the avifauna of this woodland area will be found scattered through the *Ibis* from 1902 to the present time, and I can render grateful homage for the pleasure and instruction I have derived from their perusal. A majority of the species he deals with extend eastward into the Belgian Congo, many even to its farthest border. Bates has done for the Cameroon what Heuglin accomplished in his day for the fauna of the Egyptian Sudan, and what I aspire to carry out in the case of the Congo.

Another recent publication which stands in close relation to Congo ornithology is **Mr. H. Grote's** report on the avifauna of "Neukamerun" in the *Journal für Ornithologie*, 1924, pp. 479-517, 1925, pp. 77-98. It is based upon extensive collections made in the Cameroon and French Equatorial Africa by Tessmann, Elbert, Houy, and Escherich; and as many of their specimens came from districts adjacent to the Ubangi, they furnish indications of what may be expected along that edge of our territory. Especially is this true of the birds taken near Nola and Mbaiki.

Our progress brings me to the point where personal experience with the Congo begins. It was in June, 1909, that the author, as assistant to **Herbert Lang**, arrived in the Lower Congo. This was the commencement of the **American Museum Congo Expedition**, which was destined to remain in the Congo twice as long as expected, its leader finally completing his sixth year. On the journey from Leopoldville to Stanley Falls, birds were collected at almost every stop along the river; and after a short stay at the Falls we continued overland to Avakubi in the heart of the Ituri forest. Our search for the okapi leading us northward to the Medje country, it was not until October, 1910, that we finally quit the unbroken forest for the more varied savannas of the Uelle district.

A little over two and a half years were passed in the region from Rungu and Niangara northeast to Aba, where we also investigated the chain of granite hills that marks the Congo-Nile watershed and the

borders of the Anglo-Egyptian Sudan. Here we were within the ranges of the Derby eland and the "white" rhinoceros, even while still in Congo territory. The bird fauna, however, was still predominantly West African, the abrupt change to the Nile fauna, just as predominantly north-east African, taking place a little farther to the northeast, between Yei and Redjaf.

To return to our base at Stanleyville and wind up all our affairs took another two years, a part of which was spent by Lang in studying the okapi in the forests of the Makere country, and by the writer in the region of Avakubi, on the Ituri River. And so, it may be added, of my own five and a half years in the Congo, two years and eight months were spent within the limits of the rain-forest area, the remainder in what I shall call "Guinean" savannas, north and south of the forest, almost entirely in Congo territory and always within the boundaries of the West African zoological subregion. In the vicinity of Garamba, however, we were very close to the Sudanese savanna.

My pen, I fear, must fail to record the full measure of my admiration for the tireless energy and the thoughtful consideration of my leader and comrade, Herbert Lang. Our seasoned friendship and the results of the expedition offer fitting testimony.

Of the extensive zoological collections made by our expedition, 6265 specimens were birds, the largest single collection that had yet been made in the Congo, and including 640 of the 1040 species now known from the entire Belgian Congo. While our efforts in the Congo continued, other museums and travelers of course furthered their activities, so that the knowledge of the Congo avifauna has been continually widening.

Early in 1911, at Dungen, we were welcomed by **Commandant Ribotti**, still an enthusiastic collector of birds, despite his administrative responsibilities. During the course of the second expedition of the **Duke of Mecklenburg**, the main party ascended the Ubangi River to Bangui; and after the visit to Lake Chad, **Dr. Schubotz** again returned to the Ubangi, ascending it and then the Uelle, leaving the Congo by the Nile route from Aba. I had the pleasure of spending several days in his company at Faradje in August, 1911. From his bird collection several new forms were described by Professor Reichenow.

It was at Faradje, too, that we lost Dr. Van der Gucht through a fatal attack of blackwater fever. Dr. Van der Gucht was botanist of the **Mission Hutereau**, which collected a number of birds for the Congo Museum in the Uelle district, although the aims of this expedition were chiefly ethnographic.

At Avakubi, on the last day of the year 1913, I first made the acquaintance of my good friend **Dr. Joseph Bequaert**, then in charge of a botanical mission which he conducted to Ruwenzori and the Kivu district, collecting a small number of birds along his route. In 1910 Dr. Bequaert had accompanied the Sleeping Sickness Mission of **Dr. Rodhain** through the Katanga district, and they had gathered many of the larger birds of the region, especially the whale-headed stork of Lake Kisale, of which they sent the second Congo specimen to the Congo Museum at Tervueren.

While Bequaert, his assistant Mr. Dewaet, and I were working at Avakubi, **Dr. Cuthbert Christy** also arrived there, so we had for a time a lively biological gathering. Doctor Christy collected vertebrates of all classes, and many of his birds are now divided between the British Museum and the Congo Museum. He left us to go northward, meeting Lang at Medje, and then continuing on to Poko and the Upper Uelle. Three years later Dr. Christy made another bird collection—during a sleeping-sickness investigation along the Congo-Sudan border—and his material was used by Selater and Mackworth-Praed in their Sudan report in the *Ibis*, 1918–1920.

In 1913, **L. B. Mouritz** observed and noted the birds in the Katanga, during a prospecting trip over the region southeast of Elisabethville, and wrote a semi-popular account in the *Ibis*, 1914, which supplements many of Neave's remarks.

Work along the eastern Congo border meanwhile was being carried on by **Thélie** (near Kilo), **Arrhenius** and **Pauwels** (in the Kivu district), **Bonnevie** and **Borgerhoff** (near Beni), and **Dr. L. Bayer** (Irumu and Semliki Valley). Although Thélie's specimens were all listed by Dr. Schouteden<sup>1</sup> as coming from Kilo, they include a certain number of montane species. It may be suspected, therefore, that some of them were secured on the highlands between Kilo and Lake Albert. **André Pilette** made a notable hunting trip in 1912 and 1913, from Irumu and the northwestern slope of Ruwenzori southward through the plateaus and volcanoes to Lake Tanganyika and the Manyema district. He also obtained a considerable bird collection for the Congo Museum. Others who collected a few birds in the Kivu district about this time are **Dr. Gromier** and **Le Petit**, **Mrs. Roby**, and **T. V. Fox**. **Sir Frederick J. Jackson**, who was Governor of Uganda from 1911 to 1917, collected many birds in Toro and in British Ruanda, close to the Congo border.

In 1914, **Count de Baillet-Latour** and **Dr. L. Charliers** carried out an agricultural and zoölogical investigation of the Lulua district, the western-

<sup>1</sup>1914, *Rev. Zool. Afr.*, III, pp. 260–272.

most portion of the Katanga, their collections including many birds which are now in the Congo Museum, especially from the neighborhood of Kinda and Funda Biabo. Dr. Charliers also sent home birds from the Kwango district.

The World War, as might be expected, soon reduced scientific collecting in the Congo. **Dr. R. van Saceghem**, nevertheless, in 1915, continued to collect and observe the birds of Zambé on the lower Congo, which he and Monsieur Menegaux have listed in the *Revue Française d'Ornithologie* (1918). After the termination of the war ornithological activities were resumed; and a small collection of birds, made in 1919 by **Father Moons**, a Belgian missionary at Lusambo in the Kasai, was received by Lord Walter Rothschild.

Toward the end of 1919, my old friend **Harry C. Raven**, traveling with **Dr. H. L. Shantz** of the United States Department of Agriculture, crossed from Rhodesia into the Katanga, and then descended the Lualaba to Kindu, afterwards regaining Lake Tanganyika, visiting the Urundi highlands and proceeding to East Africa. Raven's birds are in the United States National Museum, and all of them that were taken in the Congo have been loaned to me for examination and comparison.

Between December, 1919, and April, 1920, **Mr. E. Lance**, attached to the botanical mission of Dr. Vermoesen, secured forty species of birds at Malela on the lower Congo and Temvo in the Mayombe. These are listed by **Dr. H. Schouteden** in the *Revue Zoologique Africaine*, VII, 1920, pp. 188-192.

Realizing that the least-worked area in the Congo was now the Kasai, Dr. Schouteden planned a collecting trip to cover the region. Accompanied by his valiant wife, an accomplished botanist, he sailed for Boma in 1920, and visited first the Mayombe forest. Then proceeding to the upper river, **Doctor** and **Madame Schouteden** studied conditions in the equator district. Later, Dr. Schouteden toured the Kasai, remaining about two years in the Congo, and collecting approximately 3000 birds in this very interesting region. One of his remarkable discoveries was a nesting colony of *Pseudochelidon*, which has always been assumed to represent the *Artamidæ* in West Africa. Dr. Schouteden forwarded a goodly number of his skins to me for examination, and this generous favor I appreciate most warmly.

Since Dr. Schouteden's visit to the Kasai, extensive collections of birds have been made by **Reverend Father R. Callewaert** of the Mission of Scheut in the vicinity of Luluabourg. Some of these have gone to the Congo Museum, some have been acquired by other museums in

Europe, and a large share by The American Museum of Natural History. The present knowledge of the avifauna of the Kasai, due almost entirely to the efforts of Dr. Schouteden and Father Callewaert, reveals a surprising intermingling of the Congo forest fauna with grassland species of Angola and the Lower Congo. The condition is readily explained by the nature of the vegetation in the Kasai district, where the grasslands alternate with strips of heavy forest, often along the watercourses.

In the eastern Congo valuable information has been yielded by the expedition of **Prince Wilhelm of Sweden**, which included **Count N. Gyldenstolpe** as zoölogist. During the first half of 1921 this party made a special investigation of the Kivu volcanoes and the eastern border of the Ituri forest near the Semliki River and Irumu. The varied collections brought home to the Stockholm Museum included nearly 1700 birds of about 400 different species, and several new forms. Count Gyldenstolpe's report<sup>1</sup> is an unusually useful work, replete with detailed information as to the specimens collected, the habits of the various species, and their recent taxonomic history. **Dr. V. G. L. van Someren**, so well known for his ornithological work in East Africa and Uganda, has sent native collectors to the Kigezi district of British Ruanda, very close to the Belgian Kivu district. **Arthur Loveridge** also had a number of specimens collected near Kigezi.

During the early part of 1924, **Dr. J. C. Phillips** made a journey through much the same part of the Congo border, forming a well-chosen collection of birds for the Museum of Comparative Zoölogy of Harvard University. Of a total of 328 species and races, a very large part came from Congo territory, the others from British Ruanda, Uganda, and the western bank of the upper Bahr-el-Jebel. With the utmost kindness, Dr. Phillips and Mr. Outram Bangs invited me to study the whole of this collection at Cambridge, and have sent me numbers of specimens for comparison with material in the American Museum.

Still more recently **Dr. Schouteden**, accompanied over a part of his route by **Mr. G. F. de Witte**, again returned to the Congo, traversed its entire width to the Upper Uelle and Lake Albert, and then turned his attention to the Manyema district, Kivu Volcanoes, and Katanga. A valuable collection of some 4000 birds has again resulted from his activity.

**Mr. A. Pilette** has also made another zoölogical expedition to the eastern Congo and neighboring regions. In 1926, **Messrs. H. B. Conover** and **J. T. Zimmer** crossed Lake Tanganyika and visited the upper

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<sup>1</sup>1924, Kungl. Svenska Vet. Akad. Handl., (3) I, No. 4, pp. 1-326.

course of the Lualaba. There they worked especially at Katobwe and also made a short visit to Katapena, the specimens being secured for the Field Museum in Chicago.

In the latter part of 1926 and the early months of 1927 the **Akeley-Derscheid Expedition** carried on an important survey of the Parc National Albert in the Kivu District. Despite the sad loss of their leader, **Mrs. Akeley** and **Dr. J. M. Derscheid** completed their investigation, which included a topographic, vegetational, and faunal survey of the volcanic region. Few birds were collected, but the other results will be of deep interest to the student of bird distribution.

Of the **American Museum Ruwenzori-Kivu Expedition** something has already been said. The itinerary may here be given in more detail. When visiting the north end of the Ruwenzori Range, in Uganda, at the end of July, 1926, we were accompanied by **Mr. Frank P. Mathews**. Then **De Witt L. Sage** and I entered the Congo at Kasenyi on August 10, collected along the southwest shore of Lake Albert, and on the Lendu Plateau near Djugu and Nioka.

From Irumu we traveled on foot to the new post of Beni, in the hills just west of the Semliki Valley. In early November, 1926, we crossed the Semliki Valley to the western slope of Ruwenzori, and from the village of Kalongi at 6900 feet in the Butahu Valley we made two ascents, finally reaching 15,400 feet on the western side of Mt. Stanley.

Toward the end of January I visited the northern shore of Lake Edward, and then followed the western base of the range north again to the Luami River and ascended the slope to 6500 feet. Returning to Beni, Sage and I took the road to Lubero and Luofu through the mountains west of Lake Edward and reached Rutshuru on April 1, 1927. Excursions were made to Kabale in British Ruanda and to the lower Rutshuru Valley.

Next a visit of one month was paid to the Parc National Albert, where the Belgian Minister of Colonies had graciously given me permission to collect birds. On the central group of the Kivu Volcanoes I attempted the ascent of Mt. Mikeno, in company with Fathers Van Hoef and Van den Houdt, but did not quite reach the summit. Mt. Karisimbi was easily climbed, and a trip was afterward made to the main crater of Mt. Niragongo.

Crossing Lake Kivu, we descended the Ruzizi Valley, with a digression to the southwest of Luvungi as far as Lemera and the summit of Mt. Kandashomwa. Then by steamer Albertville was reached, by railway Kabalo; and we started for Bukama by boat. Few birds could be

collected during the stops along the Lualaba, and after Elisabethville was reached there was only time for three excursions into the adjacent savannas. Finally on August 17, 1927, we left by rail for South Africa.

During this trip through the eastern Congo we secured 1829 specimens of birds, but above all I became personally familiar with the topography of the highlands and the special conditions that affect the distribution of birds there. The present report had been written before my second departure for Africa, but had not been printed when I returned. I therefore took the opportunity to go over it again in the light of my new experience. The specimens gathered by the Ruwenzori-Kivu Expedition will not be listed in detail, but remarks have been inserted in cases where this material extends the known ranges or throws new light on systematic questions.

The expedition of the Harvard University Medical School led by **Professor R. P. Strong**, after working in Liberia in 1926, ascended the Congo River and visited the Kivu District in 1927. Birds were collected by **Mr. Loring Whitman**, with the aid of **Dr. J. Bequaert**, **Dr. D. H. Linder**, **Mr. H. J. Coolidge, Jr.**, and other members of the party. We had the pleasure of meeting this expedition in the Kivu District.

At the same time **Mr. G. Babault**, assisted by **Mr. J. Deprimoz**, made a collection of birds in the Kivu District, especially in the vicinity of the Mokoto Lakes, for the Paris Museum.

**Mr. J. De Riemaecker** is collecting birds in the country around Elisabethville and has already published one list of his captures in the *Revue Zoologique Africaine* (1927). He has also secured other specimens during a stay at Coquilhatville.

Marungu, the highland region southwest of Lake Tanganyika, was one of the places I wished I had been able to visit myself. So in 1928, when my friends, **Messrs. J. Sterling Rockefeller** and **Charles B. G. Murphy** expressed a desire to make a collecting trip in Africa, I urged them to go to Marungu. They secured the services of **Allan L. Moses** as taxidermist and started from Dar-es-Salaam. After visiting Albertville they reached Moba on February 19, 1929, and traveled southward over the highlands to Lake Suse and the Kampemba River, close to the Rhodesian border. Then from Selembé they traversed the highlands again by a more westerly route, and returned to Moba on May 18. About 600 birds were collected during this survey of Marungu, among which there are several species never before observed in Congo territory.

Messrs. Rockefeller, Murphy, and Moses turned next to the Ruzizi Valley and the mountains to the west, and there made an earnest and

successful search for the green broadbill (*Pseudocalyptomena*). Finally they traveled through the southeastern corner of the Congo forest to Itula and Kindu, and came down the Congo River to its mouth. Between the Ruzizi and Kindu an additional collection of 335 bird-skins was obtained.

Recent numbers of the Bulletin du Cercle Zoologique Congolais have contained interesting notes on ornithological activity by members of the Cercle. From his voyage to the Congo, **Prince Leopold of Belgium** brought back a number of skins of birds for the Congo Museum, and some whale-head storks for the Zoological Garden of Antwerp. At Buta, **Brother J. Hutsebaut** has conducted an aviary and also made a collection of skins. On Lake Kivu and in the Katanga, **Dr. R. Van Saceghem** has continued his observations on the avifauna, while **Mr. Douce** has made a bird collection on the northern shore of Lake Kivu. Specimens and notes of interest have been received at the Congo Museum from **Mesdames Tinant** and **Babilon**, **Monsignor de Hemptinne**, **Captain Van Delft**, **Father de Montpellier**, and **Messrs. Achten, Bock, Colback, Collart, Ghesquière, Guilmot, Jobaert, Mayné, Michaëlis, Scops, and Vrydagh**.

In July, 1930, I returned to Lukolela to secure materials for a habitat group of the birds of the Congo forest, a gift to the American Museum by the late Mrs. Dwight Arven Jones. During a stay of eight months in this border region of the equatorial forest I made a collection of some 600 birds, in addition to the vegetation needed for the group. On my way home I had a week in which to visit the Mayombe forest, particularly the vicinity of Ganda Sundi.

**Mr. G. F. de Witte** revisited the Upper Katanga in 1930 and 1931. In addition to his herpetological work he made an important collection of bird's skins for the Congo Museum. The **Hon. M. Hachisuka** and **Dr. J. M. Derscheid** have meanwhile traveled in the Kivu district, and **Mr. L. Lavauden** is reported to have crossed the Belgian Congo on his return journey from Madagascar.

A great stride in the advance of African ornithology is marked by the appearance of **Mr. W. L. Sclater's** 'Systema Avium Æthiopicarum,' completed in 1930. This splendid check list, including also the birds of Madagascar and the Mascarene Islands, enumerates 4439 species and races, with references to original descriptions and ranges, as well as additional notes on names not deemed worthy of recognition. Approximately 1400 of the valid forms are known to occur in the Belgian Congo.

The ornithological exploration of equatorial Africa continues with redoubled vigor. A general work on the birds of the Congo, at the

present time, will be of special service to those who are sure to take up such investigations in the immediate future.

A complete bibliography of Congo ornithology will be presented at the conclusion of my systematic report, as well as a list of localities where birds have been collected within this great area.

## CHAPTER II.—TOPOGRAPHY AND GEOLOGY OF THE CONGO

### OROGRAPHY

Africa has sometimes been compared to a mirror-image of South America, with its principal rivers draining toward the west, instead of the east, and its highlands extending down the eastern side. But as soon as

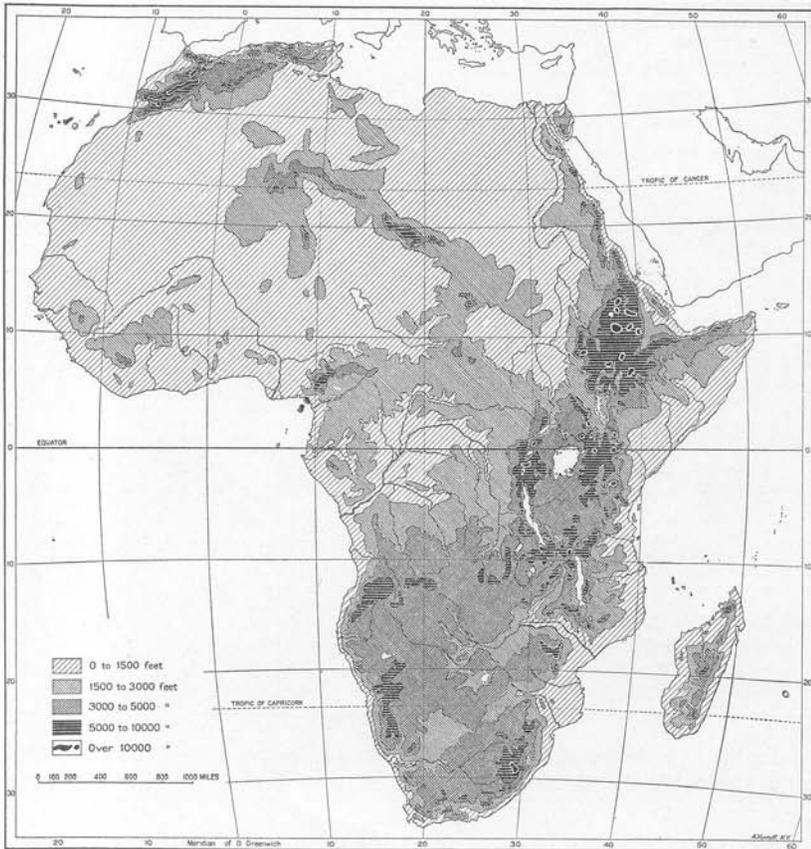


Fig. 3. Orographic map of Africa.

one begins to examine details, the likeness dwindles. Africa, lying so much more to the north, suffers extreme dessication in the broad Saharan region; and its mountains do not form any long, continuous chain like the Andes.

A glance at an orographic map suffices to show, nevertheless, that Africa has great elevated ridges, extending from Abyssinia through the eastern half of the continent as far as Nyasaland and Northern Rhodesia, with isolated extensions in Angola and in South Africa. The elevations in West Africa are much restricted in size, while the Atlas ranges in the north are more related geologically, as they are faunally, to Europe.

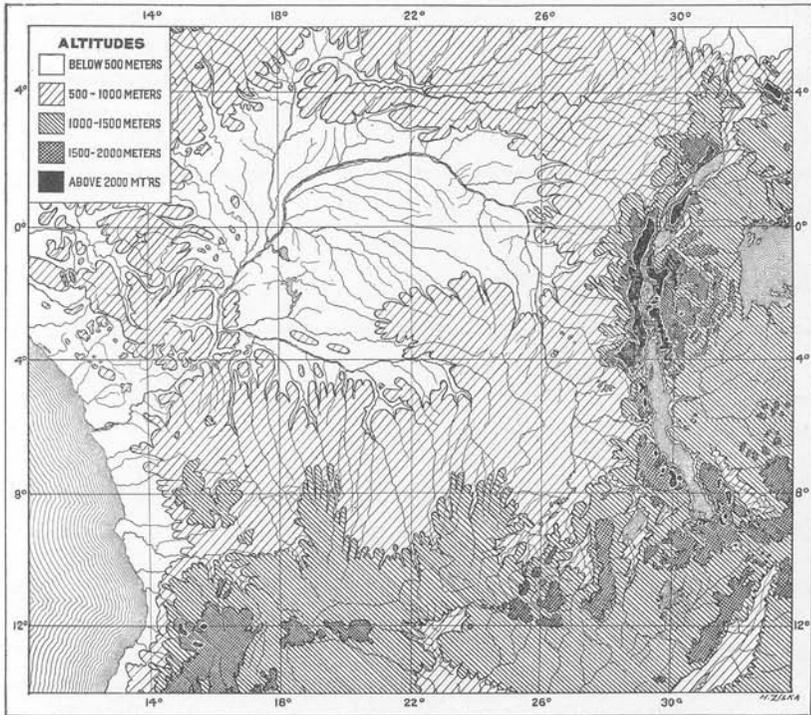


Fig. 4. Altitudinal map of the Belgian Congo, redrawn from Map No. 2895, British General Staff, 1918.

From the highlands of eastern Africa rise mighty peaks such as Kenia and Elgon, but they are distinctly isolated, and often due to local volcanic action. The eastern and southeastern borders of the Belgian Congo encroach upon this backbone of the continent, and are correspondingly elevated; but the greater part of its area is relatively low and level. The central portion of the basin of the Upper Congo is mostly below the 1600 foot contour, and is connected with the western coastal

plain by a deep gorge cut through the so-called "Crystal Mountains." These low mountains extend northward from Angola across the Lower Congo to the interior of the Gaboon and Cameroon. They are the cause of the cataracts of the lower Congo, and form a belt of very rough country about 120 miles wide, yet nowhere within our limits do they exceed a height of 3500 feet. They are continued in the elevated rim of the Congo basin, forming the uplands of the southern Kasai drainage and the Uelle, and then rising into the series of highlands that line the eastern frontier. West of Lake Albert is the Lendu Plateau (6000 feet) with mountains above 7000 feet overlooking the lake. A ridge, more than 600 miles long, extends from northwest of Lake Edward southward to the western shore of Lake Tanganyika. In many spots, such as Mt. Tshabirimu near Lake Edward, the ridges west of Lake Kivu, and those northwest of Tanganyika, this range attains altitudes of 9000 and 10,000 feet. It is the western lip of the Albertine Rift, a great trough marked by a chain of lakes.

The eastern margin of this rift valley is again elevated, forming an escarpment along the shore of Lake Albert, then rising as the Ruwenzori Range to a height of 16,794 feet. After the break occupied by Lake George it continues southward to the broad, rugged highlands of Ruanda and Urundi. The western edge of this plateau rises to more than 8000 feet, and the hilly upland elsewhere averages between 4500 and 6000 feet above sea level. Though often deeply dissected and eroded, it presents few rocky outcrops.

The Albertine Rift is drained by two different river systems. Waters from its northern section flow to the Nile. From Lake Kivu (4788 feet) they drain southward to Tanganyika and the Congo. The watershed is a chain of eight volcanoes, the "Birunga," culminating in the extinct cone of Karisimbi (about 14,800 feet), and all arising from within the rift.

After allowing the passage of the Lukuga River, the highlands just west of Tanganyika widen into the plateau of Marungu and, encircling Lake Moero, connect with those of the Upper Katanga. About Lake Bangweolo there is much level country at some 3000 to 4000 feet altitude. The adjacent Congo-Zambesi watershed averages about 4500 feet, but to the northwest in the Katanga district of the Congo there are two important plateaus, the Kundelungu and the Bianco (or Manika), both breaking up into rougher mountainous country at their northern extremities. Large areas rise above 5000 feet.

The watersheds between the Congo basin and the neighboring drainages of the Ogowé, the Shari, the Nile, the Zambesi, and the Kwanza

are in no case so high or continuous as to offer important barriers to the distribution of birds or mammals. A small part of the Nile basin might seem to be isolated by the mountains of the eastern Congo, but a large avenue is open across the rolling country of the Upper Uelle and Bahr-el-Ghazal, where only scattered groups of gneiss, granite, and ironstone hills break the general level. Even these seldom attain a height of 4000 feet.

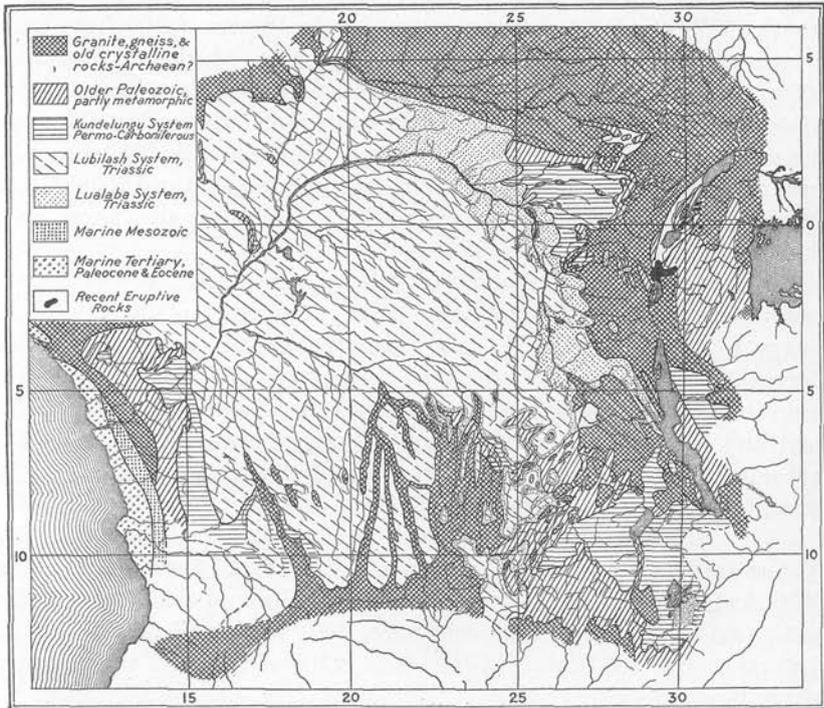


Fig. 5. Sketch-map of the Geology of the Belgian Congo, mainly after Fourmarier.

#### GEOLOGICAL SKETCH OF THE CONGO<sup>1</sup>

Africa is an old continent, especially that part of it lying south of the Sahara, and its outlines cannot have changed much since the Cretaceous. Pre-Cretaceous connections with Eurasia and Madagascar may have varied; but attempts to postulate a land-bridge to tropical America as

<sup>1</sup>For a short summary of Congo geology and an excellent geological map, see Professor P. Fourmarier, 1924, *Revue Universelle des Mines, Liège*, (7) IV, pp. 182-208. A more extended description will be found in M. Robert, 1923, 'Le Congo Physique'; and a bibliography by J. Cornet, 1916, 'Bibliographie Géologique du Bassin du Congo,' *Annales Soc. Géol. Belgique*, 1916, fasc. spéc., pp. 1-81.

late as the Eocene are unconvincing. The continent is built upon a mass of Archæan and Paleozoic rocks, elevated and folded over the eastern half especially.

In the Lower Congo there are a few Mesozoic rocks, supposedly Cretaceous, and doubtless resulting from an invasion of the Atlantic. Tertiary rocks (Paleocene and Eocene) are found only along the extreme coastal border of the Lower Congo, where they constitute rather thick, gently sloping strata. At Landana they are very rich in fossils, including elasmobranchs and a few teleost fishes, a turtle, and a crocodile. The remainder of the Congo is extraordinarily poor with respect to fossils, and no fossil bird has ever been found there.

#### THE CONGO BASIN

For the most part the central Congo is a simple natural region. Sedimentary rocks underlying it show that it was the bed of an extensive fresh-water lake during the Upper Triassic, and perhaps even as late as the Tertiary. Cornet's Lualaba and Lubilash Systems are composed mainly of friable whitish sandstones, variable in nature, which have been found to contain remains of Triassic fishes (including *Lepidotus*).<sup>1</sup> The Lubilash sandstones cover the entire central part of the Congo basin, often in beds several hundred meters thick, and in places along the Sankuru River they rise as cliffs. Extending into the Kwango and southern Kasai districts, they occasionally become silicified, and on the Kasai-Angola boundary these hardened rocks have been found containing fossils of fresh-water origin, such as *Cypris* (Ostracoda), *Physa* (Gastropoda), and the cryptogamous plant *Chara*.<sup>2</sup> The light-colored sandstones of the Lubilash System reach even far into the Katanga, where they are found nowadays at a considerable elevation, between Sandoa and Saka-binda.

Bordering the Lubilash formation on the east, in an irregular strip from the Lower Uelle to the Manyema, and also in narrower areas as far as the Katanga, is the Lualaba formation. It is largely composed of yellowish sandstones, but includes also shales and deposits of soft coal such as those near Albertville and Luena.

The few fossil plants and fishes which have been found in the Lubilash and Lualaba beds date them as of the Triassic, with some indications that point back almost to Permian time, others in the Lubilash to the latter part of the Triassic. On the whole, it may be said that they

<sup>1</sup>Hussakof, 1917, Bull. Amer. Mus. Nat. Hist., XXXVII, pp. 761-767; Leriche, 1920, Rev. Zool. Afr., VIII, pp. 87-86.

<sup>2</sup>Leriche, 1928, Rev. Zool. Afr., XV, pp. 403-409.

correspond approximately to the upper Karroo formation of South Africa.

Except in the Katanga, the older Paleozoic conglomerates, hard sandstones, and shales, partly buried beneath the Triassic sediments, come to the surface only in a narrow discontinuous zone, near the periphery of the basin. Schists and limestones, and a red feldspathic sandstone are found, for example, to the south and southwest of Stanley Pool. Similar rocks appear in a few places on the Ubangi River, and on the upper Kwango, while at Stanley Falls there are also ledges of hard red sandstone. An important area of Paleozoic rocks extends from Avakubi and the Aruwimi River almost to the Lualaba River.

When they have not undergone marked folding, these deposits are referred to the Kundelungu formation. Some of the elevated plateaus in the Katanga, the Kundelungu and Bianco, consist of this formation. Such Paleozoic rocks are found unaltered near Lake Moero, and in the drainage of the upper Lualaba, the Lufira, and the upper Luapula, covering considerable areas, and composed of conglomerates, shales, sandstones, and limestones, which seem to be of Permian or Carboniferous age. Some authorities hold them to be Devonian, but there are no fossils to give a clue. The same formation extends to the southern end of Lake Tanganyika, and to the west of that lake.

In the Katanga there is also an important series of older metamorphic formations, in which—according to various authors—are represented the Precambrian (quartzites and phyllites showing pronounced effects of pressure), Cambrian (similar, but phyllites predominating), and Silurian (metamorphism less pronounced, and here thick banks of limestone with nodular cherts make their appearance). The conglomerates, coarse sandstones, and quartzites accompanying these metamorphic formations are formed of materials derived from granitic rocks, gneisses, and quartzites of the Archæan. The geology of this southeastern angle of the Congo has long attracted expert investigation because of its many rich mineral deposits; and it has now become one of the world's greatest copper-mining regions. Metallic ores are always found in the areas that have undergone pronounced folding.

There are metamorphic areas of more limited extent in several other quarters of the Congo basin, especially in the Lomami district, along the Aruwimi and Ubangi, and in the cataracts district. In the last-named area they share in forming the elevated rim of the Congo basin, as they do also in the southern Katanga.

## THE BORDERS OF THE BASIN

The peripheral ridge of the Congo basin, which is rather uniform in its geologic constitution, consists mainly of Archæan rocks, such as granite, gneiss, and mica-schists. These rocks may be regarded as belonging to the primitive crust of the earth. This ridge first appears some fifty miles above the mouth of the Congo. At Matadi the banks of the river become exceedingly steep, and some six miles to the south can be seen the well-known "Pic Cambier" (or Mongo, of natives) and another high granitic hill called Loadi.

Starting inland from Matadi, the Congo Railway first traverses a rough hilly belt, distinctly Archæan, and composed of a variety of gneisses, schists, granites, and other igneous rocks. Beyond the Lufu River more recent metamorphic rocks, previously mentioned, appear as synclines, and deposits of magnetite and hematite, as well as a few veins of auriferous quartz, occur with them. This zone is covered for the most part by a deep layer of alteration soil, but quartz dykes are common. They break up into large blocks, which lie abundantly on the surface, and from which the "Crystal Mountains" derive their name. Next comes a belt of the Paleozoic Kundelungu formation. By the time Stanley Pool is approached, the railway has reached the soft Triassic sandstones of the Lubilash System.

Coming north from Angola, the Crystal Mountains may be traced through the Mayombe and Gaboon. This same peripheral ridge of Archæan and old Paleozoic rocks is encountered again at the first rapids of the Ubangi, and forms the hilly country of the Mbomu, the Upper Uelle, and Upper Ituri. The underlying structure of the Uelle basin consists chiefly of Archæan rocks. Crystalline rocks such as gneiss, mica-schist, quartzite, diabase, and amphibolite are found at the Bandupoi Mountains, at the rapids near the mouth of the Bomokandi, near Niangara, and at the falls of Mokwangu.<sup>1</sup>

Along the Congo-Nile divide, from Yakuluku to Aba and beyond, there are great numbers of rocky hills. Mts. Baginze and Danvo were found by Schweinfurth<sup>2</sup> to consist largely of gneiss. About Aba many groups of granite hills rise from the undulating country, but seldom more than 600 or 800 feet higher than the surrounding territory. From the summit of one of them, about seven miles south of the post, we could count on a clear day from 75 to 100 similar elevations, lying mainly to the north, east, and south. They are often partly bare of vegetation, with

<sup>1</sup>Cornet, 1898, *Bull. Soc. Belge Geol. Pal. Hydr.*, XII, pp. 26-30.

<sup>2</sup>1874, 'The Heart of Africa' (English translation), II, pp. 213, 217.

slopes of naked rock, broken by fissures, or dropping off in precipices. Similar eminences are scattered along the Kibali River, composed of granite or gneiss, such as Mt. Gaima near Nzoro, and others above and below the post of Dungu.

A little to the southward, in the Lower Uelle and northern Ituri districts, is another irregular series of elevations, usually not so high, and less precipitous. They are probably of old Paleozoic formation, for they are largely built of ironstone, often with a visible core of hematite. These are the hills described by de Calonne-Beaufaict in connection with prehistoric native carvings to be seen on some of the rocks. From them came no doubt the material for the fine ancient implements of hematite that are occasionally discovered in the Uelle and Ituri.

The long ridge which stretches southward along the western side of the Albertine Rift is also formed mainly of Archæan rocks. On the Lendu Plateau near Mahagi and Nioka there are granite hills, and west of the Semliki Valley related igneous rocks are exposed. The escarpment west of the Rutshuru plain, however, consists principally of mica-schist, while the summit of the ridge west of the Ruzizi Valley is composed of a coarse-grained granitic rock. The mountains of Kabambare in the Manyema are made up principally of granites and gneisses, but between Tanganyika and the Lualaba this foundation of crystalline rocks is partly covered with layers of continental sandstones having conglomerates at their base.

The shores of Lake Tanganyika just south of 7°, as well as Marungu and the region to the southwest toward Lake Moero, are formed of granitic rocks and crystalline schists, but covered locally by red feldspathic sandstones of the Kundelungu. In the Katanga the Archæan is again exhibited in the Bia Mountains, which border the Lualaba Valley on the east, just south of Lakes Kisale and Upemba. Granites, gneisses, and mica-schists are accompanied by intrusions of basic rocks. On the opposite side of the Lualaba the Hakansson Mountains are largely constituted of granites, passing often into gneiss. The same granites reappear in places on the upper Lualaba, the Lubudi, and even on the right bank of the Luapula.

There are granite outcrops in the valleys of the Lovoi and upper Lomami, and in the region between the Lubilash (Sankuru) and Kwango rivers the ravines worn in the softer sandstones frequently expose an underlying granite. Following these ancient crystalline rocks through Benguella, we should find them reaching back toward the Crystal Mountains. Thus, there extends all around the present Congo basin a nearly

complete belt of very old rocks, elevated and doubtless much eroded. Only on the eastern side do they now attain the dignity of high mountains.

#### GEOLOGICAL DEVELOPMENT OF THE BASIN

Both the Kundelungu and the overlying Lubilash and Lualaba formations are to be regarded as deposits in vast lakes which covered large parts of the Upper Congo basin. They show a discordance of stratification, and the deposition of the Kundelungu beds must have been followed by a long period of denudation, during which they were removed from large areas. Later the central Congo again became inundated; and the resulting Lubilash and Lualaba formations can be referred, as already shown, to the Triassic.

The later history of the Congo basin begins with the emptying of the Lubilashian Lake. The outlet resulted less probably from overflowing than by a process of capture on the part of some small coastal river, which thus became the terminal stem of the Congo, one of the largest rivers of the globe.<sup>1</sup>

Subsequent erosion made of the Congo a great river system emptying into the ocean by a delta terminating near the present site of Boma. Communication was possible with its upper course and branches, so that many fishes of marine origin could reach them; and the closer communications with neighboring river systems explain the similarities in the malacological and ichthyological faunas of the Nile, Congo, and Zambesi. Then came a final raising of the peripheral parts of the Congo drainage, damming the river again, and giving rise to the extensive alluvial deposits to be seen between Bolobo and the mouth of the Lomami. A new lake was formed, but again the waters found their way out, and are even yet cutting down the gorge that carries them to the ocean.

The Congo River drains a basin exceeded in area only by that of the Amazon, and its annual discharge into the ocean has been estimated at 419 cubic miles. At the season when its lower course is in flood, it carries 1,200,000 cubic feet of water per second into the Atlantic.<sup>2</sup>

#### THE ALBERTINE RIFT AND ASSOCIATED MOUNTAINS

A small part of the drainage from the eastern Belgian Congo finds its way into the Nile; and another part, farther south, reaches the Congo River only indirectly through Lake Tanganyika and the Lukuga. The

<sup>1</sup>Cornet, 1897, *Mouvement Géographique*, XIV, pp. 507, 508.

<sup>2</sup>J. Murray, 1887, *Scottish Geogr. Mag.*, III, p. 76. P. van Deuren, 1928, 'Aménagement du Bas-Congo.'

lofty ridges of this region tend to a north and south direction, for they were brought into being by the uplift and faulting which have produced such widespread and striking features in the geology of eastern Africa. They are the upraised borders of the more westerly of Africa's two long "Rift Valleys," gigantic trenches from twenty to forty miles wide, each lying between two parallel lines of up-throw, the whole apparently being due to lateral pressure in the earth's crust.



Fig. 6. View from the western base of Ruwenzori across the Semliki Plain to the western escarpment of the Albertine Rift.

#### Description of the Rift

The Western or Albertine Rift, lying in the neighborhood of the 29th and 30th meridians, extends from the vicinity of Gondokoro on the Upper White Nile, by way of Lakes Albert, Edward, and Kivu to the southern end of Tanganyika. It seems to be connected by way of Lake Rukwa with the similar depression that encloses Lake Nyasa and extends somewhat south of the Zambesi mouth. This southern trough is in

turn regarded by Professor J. W. Gregory as a continuation of the Great Rift Valley, which is easily traced from Tanganyika Territory (near Kilimatinde) northward through Kenya Colony, Abyssinia, and the Red Sea to Palestine.

The abruptness of the escarpments along the rift valleys is an indication that they are not very ancient, speaking geologically. After many years of study Professor J. W. Gregory<sup>1</sup> concluded that their formation "began later than the Upper Eocene and earlier than the Upper Pliocene." It resulted from subsidences along the crests of long ridges trending north and south, to which the upraised borders of the rifts still bear witness. The earth-movements which led to the formation of the rifts are believed to have begun in the Upper Cretaceous, as indicated by associated volcanic history in East Africa. The three main series of faults and eruptions are placed by Gregory in the Miocene, Pliocene, and Pleistocene periods.

The forces which produced the rifts have not yet been completely stabilized. There has been very recent volcanic activity in both the Great Rift and its Albertine parallel. Lake Kivu has been mentioned as sending its waters to Tanganyika and the Congo, but this is believed to be a very recent change, due to the elevation of the transverse range of Kivu Volcanoes, otherwise known as the Mfumbiro, Virunga, or Birunga. Formerly Lake Kivu must have found an outlet through Lake Edward to the Nile.<sup>2</sup>

The deep gorge of the Ruzizi River has every appearance of relatively recent origin, while the broad plain of the Rutshuru indicates greater age. Beautiful Lake Kivu may well owe its present high level to the rise of the Birunga chain.

By adding to the waters of Tanganyika the Ruzizi is supposed to have emphasized the importance of the Lukuga, and thus to have augmented the relations between the lake and the Congo River. Moore's contention that Tanganyika was an ancient remnant of a Mesozoic sea<sup>3</sup> has not been borne out. On the contrary, says Gregory, it is one of the youngest of the East African lakes. Professor Cornet, too, has always opposed Moore's view.

Tanganyika is the largest lake in the African rift valleys. Second in depth only to Lake Baikal, it lies in a high-walled trough broken by a few river valleys, that of the Lukuga being regarded as a lesser, intersecting rift, extending to Lake Upemba.

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<sup>1</sup>1921, 'The Rift Valleys and Geology of East Africa,' pp. 105, 360.

<sup>2</sup>Gregory, 1921, *idem*, pp. 266-268.

<sup>3</sup>See J. E. S. Moore, 1903, 'The Tanganyika Problem.'

### The Kivu Volcanoes

The northern shore of Lake Kivu is formed of modern volcanic materials, and the floor of the rift at this point is almost completely blocked by a transverse chain of eight high mountains, with innumerable lesser cones and craters. The two westernmost, Niragongo and Namlagira, are still active; but most of the others have weathered to cones or jagged peaks. The highest is Karisimbi, about 14,800 feet; its summit

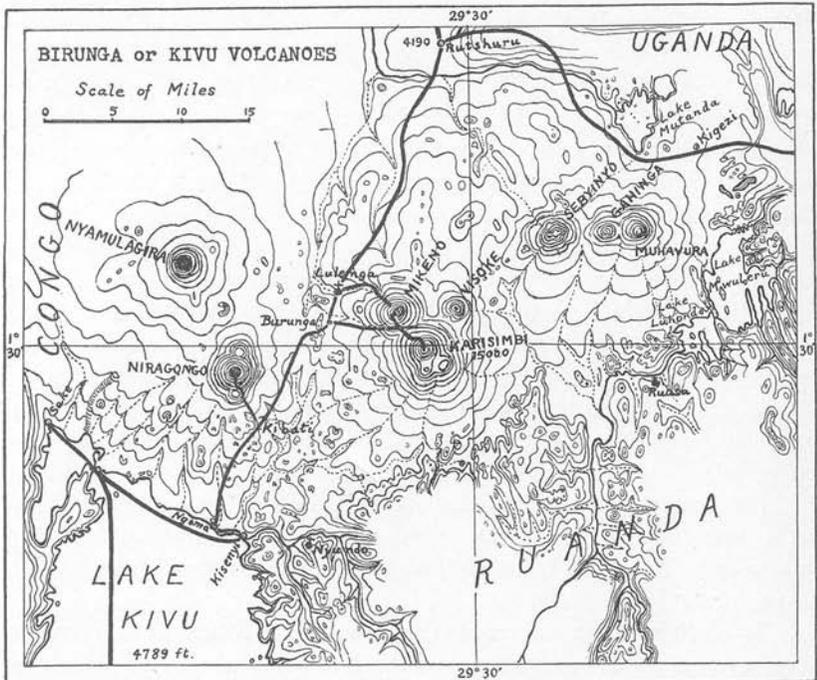


Fig. 7. Sketch-map of the Kivu Volcanoes, after Lieut. M. Weiss. Route of Chapin and Sage indicated by solid black line.

being frequently whitened by temporary snow. Mt. Mikeno, another member of the central group, is only 200 feet lower. The more easterly of these volcanoes are certainly the oldest, they include Muhavura and Sabinyo; but the origin of the whole chain probably does not date back beyond the Pleistocene.

The vast crater of Namlagira still sends up a rosy glow at night; and its lower slopes are strewn with rough lava boulders, so they bear no true forest. Niragongo seldom glows, but sends off steam which appears

to result mainly from rain water seeping through the rocks to the cooling magma lying beneath its majestic crater. On its lower flanks weathering has produced a fertile soil, and there is a well-developed forest, but bamboos seem not yet to have established themselves. Just below the rim of the main crater one walks on smooth gray lava which has scarcely begun to weather.

Erosion has made great progress on the lower slopes of the central group of cones, which are built for the most part of rather soft lavas and cinders, and here both forest trees and bamboos have reached their full development. Some deep gorges have been cut by brooks, but these carry water only during the rains. There are bare rocky cliffs near the summit of Mikeno, as there are also on Sabinyo. The eastern slope of Muhavura is smooth and steep, with relatively little tree-growth.

#### The Ruwenzori Range

Following the rift northward, down the alluvial plain of the Rutshuru, we reach Lake Edward, walled in on the west by a high, abrupt escarpment, but with eastern shores less mountainous. Its waters escape through the Semliki River to the north, keeping to the bed of the main depression. To the northeast there is, however, a branching of the rift, so that one short arm extending toward Toro encloses Lake George or Ruisamba. And in this forking of the rift rises the greatest elevation of all, the Ruwenzori Range, culminating in Mt. Stanley with Margherita Peak at 16,794 feet, and supporting five other snow-capped mountains over 15,000 feet high.<sup>1</sup> The magnitude and sublimity of their scenery has often caused these peaks to be compared with the Alps, despite their position within one-half a degree of the equator, a circumstance that limits the quantity of snow and ice accumulating on their crests. Moreover, a singular tone is added to this scenery by the giant senecios and lobelias that fill the landscape above 13,000 feet, growing far more abundantly than on Kenia or Kilimanjaro.

Less than half the Ruwenzori Range, of course, is included in the Belgian Congo; but the massif may here be treated as a whole. Instead of having a volcanic origin like Kenia and Kilimanjaro—as the early explorers believed—Ruwenzori was shown by Scott Elliot<sup>2</sup> to be merely the exaggerated result of the same folding and faulting that has taken place all along the borders of the Albertine Rift. The only difference is that in the case of Ruwenzori the folding and uplifting, for seventy miles along the eastern side of the Semliki depression, have been so great that

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<sup>1</sup>De Filippi, 1908, 'Ruwenzori,' p. 199, and map

<sup>2</sup>Elliot and Gregory, 1893, *Quart. Journ. Geol. Soc.*, LI, pp. 669-680.

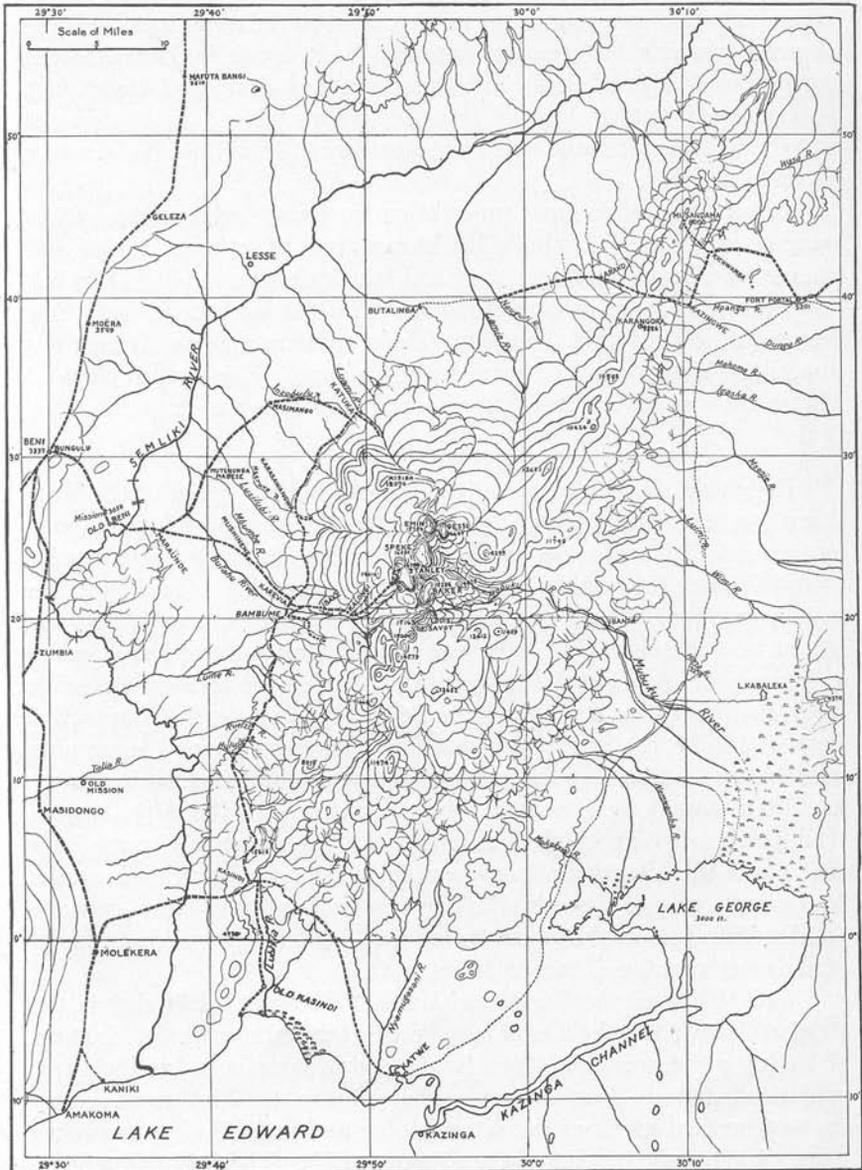


Fig. 8. Sketch-map of the Ruwenzori Range. Routes of Chapin, Sage, and Mathew are shown by the heavy broken line.



Fig. 1. The Ruwenzori Range, seen from the new post of Beni, about thirty miles to the west. Mt. Stanley, to the right, rises highest of all the peaks.



Fig. 2. The eastern group of Kivu Volcanoes, seen from Behungi (8400 feet) on the escarpment to the east. Mt. Muhavura is the nearest of the three mountains.

rock masses more deeply seated than the Archæan layers of gneiss and mica-schist have been uplifted and exposed. These deep-seated rock masses consist of greenstones or amphibolite which were injected into the Archæan layers during the formation of the rift valley. The Archæan rocks must originally have enclosed the central mass of greenstones; but after being exposed by denudation, to which they offered the strongest resistance, the greenstones came to form the loftiest crests of the whole range.

Recent igneous formations at the eastern foot of Ruwenzori serve to indicate the presence of one or more side lines of fracture, the prolongation of that which holds Lake George. In the Fort Portal district volcanic action is indicated by thermal springs, and by stratified tuffs which cover the ground and form a series of craters, now mostly flooded. These form a chain running from south to north. The tuffs are of subaqueous origin, and they certainly indicate a wider extension of Lake Edward in the past.

Ascending the eastern slope by the valley of the Mubuku River, Dr. Roccati<sup>1</sup> noted the following succession of rocks. First came gneisses like those of Uganda, associated with mica-schists. Above 11,600 feet the gneiss gave way to mica-schists and quartzites, which extended up to the zone of the greenstones, toward 12,000 feet. Mts. Baker and Stanley are constituted exclusively of the greenstones; on the other heights gneiss is always associated with them. On the western side of Mt. Baker the mica-schists were found ranging somewhat higher than on the east.

On the western slope of Ruwenzori, in the vicinity of the Butahu River,<sup>2</sup> there are frequent outcrops of mica-schists from 6000 feet up to 10,000 feet at least, but in the heath zone everything is buried beneath moss and peat. Above 13,000 feet one finds only the Plutonic rocks.

Many of the valleys have wide floors from glacial action down to 12,000 feet, or perhaps lower, but the end of a glacier which I visited on the west side of Mt. Stanley was at 14,630 feet. This was during a dry period in early January, and the snow had all melted up to about 15,000 feet.

The western slopes of Ruwenzori are even steeper than the eastern, and their meeting with the alluvial plain of the Semliki is very abrupt. On the lower parts of the Ruwenzori Range, weathering has led to an abundant lateritic formation, on which a rank herbaceous vegetation, or

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<sup>1</sup>De Filippi, 1908, 'Ruwenzori,' App. C, pp. 388, 399.

<sup>2</sup>Following Dr. Stuhlmann's orthography, this stream has often been called Butagu. But the native pronunciation is "Butá-u," and Stanley's spelling, as above, is far more accurate.

even tropical rain forest on the northwest side, is developed. Exposed rocks may have a rounded form that simulates the effects of glaciation. The zone of old moraines is overgrown with mountain forest and bamboos, which tend to arrest erosive action; and above 9000 feet the persistent humidity has developed the characteristic bogs of these mountains and an uninterrupted covering of boggy turf, often twenty inches thick. This forms a thick blanket over everything, until near the level of the glaciers a zone of bare rocks and earth, with a few lichens and mosses, is encountered.

In view of its lack of stratified rocks, the exact age of the Ruwenzori Range will be difficult to fix. From indications that the mountain ridges along the African rifts began to be uplifted at the close of the Cretaceous, we may assume that Ruwenzori is not much more recent in origin. It seems fair to assume that it was an established feature when the modern genera of birds came into being.

All the higher peaks of Ruwenzori now bear snow caps and glaciers, but the latter extend little below the snow line, which is, roughly, at 14,500 to 15,000 feet. Dr. Roccati believes that even to-day they are retreating, and certainly in the past they did extend far lower than now. On the eastern slopes of Ruwenzori they filled the valleys of the Mubuku, the Bujuku, and the Mahoma, forming a powerful ice stream that is sometimes said to have reached down to a level of 4500 feet, whereas the lowest glaciers at present stop at 13,700 feet. Conditions on the west slope may have been somewhat similar, though the valley of the Butahu below 9000 feet is no longer U-shaped.

On the other mountains of eastern Africa the glaciers seem likewise to have had a period of increased extension, which both Gregory and Roccati speak of as being contemporaneous with the glacial period of Europe. On Kenia they extended 5000 feet lower than at present, on Kilimanjaro only about 1500 feet. While Professor Gregory<sup>1</sup> doubts that this can be explained by a general refrigeration of tropical Africa, it does seem evident that the lowering of the zonal distribution of alpine plants, which he discusses, would have a widespread effect on the mountain birds which are so attached to these plants. This would be especially true for the birds of the lower mountain forest, or subtropical zone, the area of which would be so greatly enlarged. Add to this the probability that the elevated belt of Archæan rocks extending from Lake Albert to Nigeria was far less eroded in those days, and we have a theory to explain the occurrence of some of the same species of mountain birds on Mt. Cameroon as on Ruwenzori and Kenia.

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<sup>1</sup>1921, 'The Rift Valleys and Geology of East Africa,' p. 150.

The descent of the eastern glaciers on Ruwenzori, to some 8000 or 9000 feet lower than at present, exceeded that on the mountains of East Africa, thinks Gregory, probably because of Ruwenzori having a heavier rainfall maintained by evaporation from the Uganda and Congo forests. The glaciers moving down the southeastern slopes would be protected from the afternoon sun, and thus they seem to have reached lower levels than any tropical glaciers known in recent geological eras.

The streams issuing from the glaciers of Ruwenzori are not at all turbid, for the erosion of rocks beneath the ice is very slight. Their limpid waters, so different from glacial brooks in northern climes, find their way down all sides of the massif; and yet, because of the unique hydrographic system of Ruwenzori, they all flow into the "Albertine depression" that completely surrounds it, and eventually reach Lake Albert, through a system absolutely distinct from that of Lake Victoria. Thus the greatest group of snowy mountains in Africa, as Roccati points out, though situated in the middle of that continent, does not form a portion of its main watershed.

The actual watershed between the Congo and Nile consists of a relatively low ridge at 4000 feet, not far to the west of the Semliki, over which extends an arm of the equatorial forest. It is a prolongation of the ridge from west of Lake Kivu, and as we follow it northward the country rises again in the Lendu plateau. This is the precipitous bank, frequently described as a chain of lofty mountains with steep walls rising out of the water, on the northwest side of Lake Albert. The lake here fills almost the whole width of the depression; and the Albert Nile or Bahr-el-Jebel issues from the northern termination of the western rift.

#### SUPERFICIAL DEPOSITS

Except in the mountainous districts of the Congo, or the drier, hilly spots, the rocks which we have been discussing are generally covered with a layer of superficial soil, often extremely thick. Such a covering layer may sometimes be of more importance in the distribution of life than the deeper geological structure. It is the product of incessant action by physical and chemical agencies upon the underlying rocks. Owing to its abundant rainfall and warm climate, the Congo basin, like so many other parts of the tropics, exhibits unusually active erosion and decay of the rocks. The superficial deposits have been ranged by Cornet<sup>1</sup> in four categories:

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<sup>1</sup>1896, Bull. Soc. Belge Geol. Pal. Hydr., X, Mem., pp. 44-116.

(1) Products of natural decay in situ of underground rocks. The composition of such soils varies with the nature of the subjacent rocks, being argillaceous where the latter are schists, or sandy where they are the soft white sandstones of the upper Congo Valley.

(2) Products of erosion by rain water on slopes. They are carried off to lower levels and sifted according to size and weight, while the rocks may be left denuded.

(3) Alluvium of existing streams. Rivers like the Congo and its affluents are ever depositing sand and mud, or even building bars and islands in their course.

(4) Alluvium from ancient streams. Deposits at a much higher level than existing watercourses are easily explained by the lowering and modification of the stream valleys by erosion, especially of rock barriers that once obstructed them.

Extensive areas of alluvial soil are seen along the course of the Upper Congo, and at places in the floor of the Albertine Rift such as the lower Ruzizi, lower Rutshuru, and Semliki valleys. But without doubt the soils most widespread in the Congo are the red loams, often lateritic or ferruginous. They are commonly formed by the natural decay of the rocks in place, and may be very deep. The red color is due to pronounced oxidation of the ferruginous content under the influence of the warm, moist climate. True laterite is characterized by the abundance of aluminum hydroxide and the scarcity of aluminum silicates. Lateritic red loams, such as are seen over large areas in the equatorial forest of the Congo, are often called laterites; but according to Marbut<sup>1</sup> the true laterites in Africa are largely restricted to Usambara, the Cameroon coast and Upper Guinea. They require a very heavy rainfall for their development.

Ferruginous red loams are widely spread over the regions bordering the Congo forest. Small limonite concretions like pebbles may be scattered thickly over the surface, or the same mineral forms large spongy blocks. Yet the red soils are not universal in the Congo, although very characteristic of many forested districts such as the northern Ituri. In some other districts yellow or even gray tints are common. In the Upper Uelle, especially in the country with granite hills, there is a large amount of gray soil, almost blackish.

A soil map does not necessarily show close agreement with a geological map. As Marbut points out, the character of a soil is determined by the parent rock only during the early stages of its development. Later on the climatic forces and native vegetation exercise a dominant influence.

In a heavy equatorial forest like that of the Ituri one is often led to wonder at the relative scarcity of humus, or the general lack of a deep layer of old moldering leaves. Foliage is continually being shed, but

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<sup>1</sup>Shantz and Marbut, 1923, 'Vegetation and Soils of Africa,' pp. 126, 181-190, 214-217, and soil map.

most markedly during any short annual period of drought, as in January at Avakubi. Yet only in very wet spots is it allowed to accumulate, for elsewhere termites swarm to such an extent that the ground may be said to be honeycombed with their workings. Seizing upon everything in the nature of dead vegetation, they remove it at least from the surface of the ground, so that the clayey soil is scarcely concealed from view. An even more extreme condition is observed in the savannas, where fallen leaves or grass are at once enclosed in the earth-walled galleries of termites, and quickly consumed. Annual grass-fires also tend to destroy the humus there.

#### CONCLUSIONS

For our present purpose the geological structure and history of the Congo are of interest mainly in explaining and dating the physical features, especially the position of the rivers and lakes, and the nature and history of the more marked elevations. The latter have an important bearing on the development and distribution of the montane avifauna. The Kivu volcanoes, for example, are shown to be very recent, whereas the ridges that bound the Albertine Rift, like Ruwenzori, may have existed since the Eocene. The depression of the central Congo goes back to the Triassic or earlier, and the ridges bounding it on the north and south are not only of equal antiquity, but they were probably over a thousand feet higher during the Tertiary than at present.

The much greater extension of glaciers on Ruwenzori, during the Pleistocene epoch, suggests that climatic conditions then prevailing in tropical Africa would have rendered the peripheral highlands of the Congo basin particularly suitable for habitation by mountain-loving birds which are now mainly restricted to the Cameroon highlands, those of Benguella, and the mountains of the eastern half of the continent.

The flooding of the Congo in the Triassic had no influence on the present ranges of birds. But the lake believed to have formed again in the Pleistocene may have been a partial barrier between the eastern and western sections of the Lower Guinea forest. It is not impossible that the subspecific differences frequently existing between representatives of the same species in the Cameroon and in the Upper Congo may be due to this segregation.

It is to be noted that in general the broad type of vegetation, whether forest or savanna, is independent of underlying geologic conditions, provided the elevation does not reach 5000 feet. This is shown by the extent of the lowland forest belt, which stretches across the Congo basin

and has an outline quite different from anything on a geologic map. It covers sedimentary and crystalline formations indiscriminately. Even the soil is more a product of the rainfall and vegetation than of the particular rocks which it covers.

CHAPTER III.—CLIMATE OF THE CONGO  
 GENERAL PRINCIPLES

The Congo has a typical equatorial climate, especially if we except for the moment that of the Katanga district, which extends to thirteen and a half degrees south of the equator. Most of the remaining southern

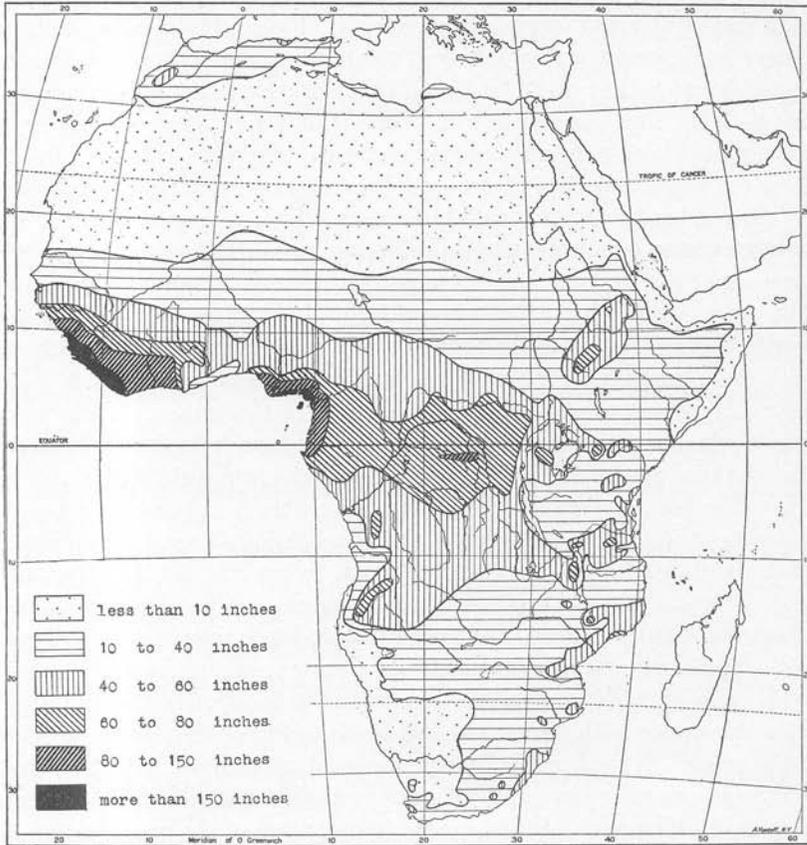


Fig. 9. Total annual rainfall over the African continent. After Kincer, with alterations in the Belgian Congo.

territory lies within eight degrees of the equator, and on its northern edge the Belgian Congo scarcely reaches beyond the fifth parallel. It is quite unnecessary to remark that the climate as a whole is markedly moist and warm. And yet, as is well known, the extremes of heat are

not to be looked for within so short a distance of the equator, where the relatively high percentage of cloudiness and the uniform length of daylight prevent the sun from exerting its greatest heating power. Moreover, although the equator is known to mark one of the rainiest belts on the earth's surface, the spot of heaviest rainfall on the African continent is apparently not in our area, not even on the slopes of Ruwenzori,<sup>1</sup> but at the west base of Mt. Cameroon, about Debundja and Bibundi (412 inches and 403 inches, respectively). Precipitation in the Belgian Congo is, however, amply sufficient to support much the same equatorial belt of forest as that in the lowlands of the Cameroon, and indeed continuous with it. But already at a distance of only four degrees away from the equator, well-marked changes in climate take place which suffice to alter the whole aspect of the country, through its vegetational covering.

No other continent exhibits in so regular a manner as Africa the larger aspects of a true tropical climate, particularly in the way the progress of the sun determines the periods of rains and prevailing winds. The trade-wind belts, which extend from about thirty degrees in both hemispheres almost in to the equator, are not interfered with by chains of high mountains; and the conformation of the land mass is such as to offer a minimum of conflict with the effect of the trades. These blow from the northeast in the northern hemisphere, and from the southeast in the southern, until they encounter the equatorial calm belt, in the latitude where the lower layers of the atmosphere are most continually warmed throughout the year by the sun, so that they exhibit a constant tendency to rise and draw in the cooler trade winds to replace them. The calm belt, doldrum belt, or equatorial cloud ring, as it has been variously called, remains close to the heat equator; and this in turn, because of the predominance of land surface over water area in the north, is apt to lie north of the true terrestrial equator. The location of the equatorial calm belt varies with the season and tends to follow the zenith position of the sun. It is because of the heavy precipitation in this calm belt that the tropical rains are so typically summer rains, especially on the African continent. The term "hivernage," often applied to the rainy season in the French colonies of West Africa, is therefore quite misleading. But the highest temperatures, it must be admitted, are not always experienced in the true summer (i. e., when the sun stands highest in the heavens) because of the cooling effect from evaporation and the shading of the ground by clouds.

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<sup>1</sup>Rainfall data for the Ruwenzori Range are still fragmentary, and precipitation on the mountains may be heavier than indicated on our rainfall map. At Leese in the Semliki Valley, it is said, rain falls almost every day throughout a great part of the year.

It is the relative stagnation of the air, the amount of water vapor it absorbs, and moisture-laden winds from adjacent oceans, which account for the humidity of these low latitudes; any upward movement of the air causes cooling and rains. So the seasons are much better marked by phenomena of precipitation than by the slight changes in temperature. Accordingly, we distinguish the seasons as dry and rainy. At distances of ten to fifteen degrees from the equator there is but a single well-marked rainy season in the year, and a rather long period of drought; but as the equator is approached lesser rainy and dry seasons gradually make themselves felt, until in its immediate neighborhood the year becomes divided into quarters, a condition easy to understand when one remembers that the rains follow the sun, and that the sun crosses the equator twice a year, while approaching each tropic but once. What often happens, however, in the immediate neighborhood of the line, and especially in a moist region like the Congo basin, is that the two periods of drier weather become so shortened that they are scarcely or not at all apparent. Once the equator is crossed, the seasons are reversed, and thus we can distinguish a line of parting of the seasons, which corresponds in a way to the heat equator, yet we may better call it the meteorological equator. While the heat equator, depending on the mean annual temperature, is said to lie, on an average, about seven degrees north of the true equator, the meteorological equator, in West Africa, seems to be in the neighborhood of 5° N. latitude, and in the Cameroon even a little under 3°.<sup>1</sup> In the Congo, the meteorological equator is not far from the geographic one.

In the Ituri district at Avakubi, the slight cessation of rains, sometimes experienced, seemed to coincide better with the northern dry season, coming as it did in January, and yet Avakubi is at only 1° 25' north. The heat equator is displaced to the northward because of the increased extent there of the land mass, which is more readily heated by the sun than the more extended ocean in the south. These conditions have an equally marked, but contrary effect upon the rainfall, and explain why the southern half of the continent is better watered. Their interaction, at any rate, results in the location of the equatorial belt of rains—in our region—very nearly in the zone included by the parallels of four degrees, north and south. In the eastern half of the continent, to be sure, these relations are altered by the increase in elevation of much of the land, so that on the equator the two dry seasons are better marked, and the total precipitation does not suffice for an extension—at the present time, at least—of the equatorial rain forest across East Africa. The

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<sup>1</sup>Hann, 1910, 'Handbuch der Klimatologie,' II, p. 32.

eastern border of the Belgian Congo, because of its altitude, infringes upon this drier eastern area, where even on the equator there are short-grass plains, a condition quite unheard of farther west. And on this eastern border, too, wherever the elevation is sufficient to enter the cloud zone, we find patches of mountain forest, perhaps moister and of

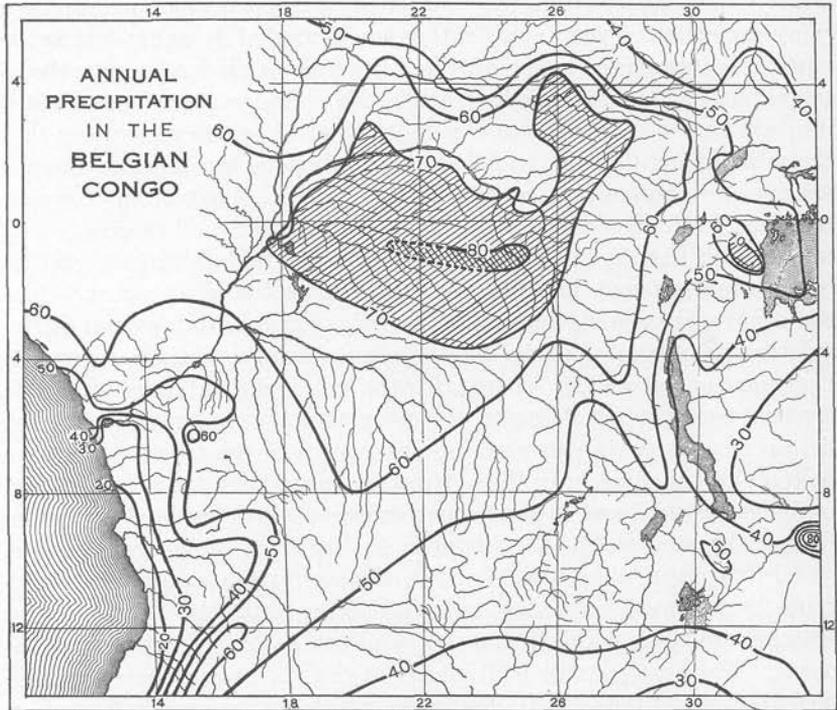


Fig. 10. Total annual rainfall, in inches, in the Belgian Congo and some adjacent countries.

course cooler than the lower rain forest; and of them we shall have much to say.

The prevailing winds of the Congo partake of both northern and southern character. When the sun is in the south, the northeast trades extend their influence into the northeastern portion of the colony, and blow in the northern Uelle district during the dry season. Much of our territory is in the belt of calms or variable winds, but in the south, as along the upper Lualaba, the southeast trades likewise make themselves

felt,<sup>1</sup> especially in the southern dry season, although their direction may be somewhat altered by local conditions. Along the Atlantic coast near the Congo mouth, the prevailing winds, so far as they show any constancy, partake of the nature of monsoons, blowing off the cold Benguella current on to the warmer land, from a west or southwest direction, so that instead of bringing moisture from the ocean, they tend, on account of the unfavorable difference of temperature, to reduce the annual rainfall of the lower Congo region, as compared with the interior. Nevertheless, they do not alter the seasonal distribution of the rains. On the Lower Congo a sea wind has often been described, which becomes a night wind along the cataract region, blowing with special intensity at Manyanga and Vivi from the southwest, mainly in the dry season. During August and September, Pechuël-Lösche noted it as far up as Stanley Pool.

The drier winds of the rainless season have a marked effect on evaporation. The sky, though hazy, still admits a goodly measure of sunshine, and the ground is baked to an extreme, bricklike hardness, in the savanna regions especially. Many of the smaller swamps dry out completely. Where there is shade from forest trees, the effect is less marked.

It has been estimated that the mean annual rainfall for the whole basin of the Congo amounts to about sixty inches. This is found to give a volume of water three times as great as the mean outflow of the Congo River, so that we must assume that of these sixty inches of rainfall, forty are again evaporated, and only about twenty escape eventually to the ocean. This fact helps to explain the copious rains, when so few of the rain-bearing winds can be shown to come directly from the ocean.

#### DETAILS OF CLIMATE IN THE EQUATORIAL LOWLANDS THE SEASONS IN THE CONGO BASIN

In order to make direct comparisons between mean temperatures at the west coast and in the interior, it would be necessary to allow for the influence of altitude, by increasing the figures observed, by 1.4° F. for every five hundred feet. In such a way the coast can be shown to be cooled by the Benguella current; and yet, if we compare the actual temperatures experienced, the means are found to be remarkably uniform, all across the colony.

At Banana the mean annual temperature is 77.9° F.; at Leopoldville, 77.5°; Bolobo, 77.9°; Liranga and Equateurville, 76.8°; Nouvelle

<sup>1</sup>Hann, 1910, 'Handbuch der Klimatologie,' II, p. 84.

Anvers, 78.0°; Mobaye (on the Ubangi at 5° N.), 78.6°; Luluabourg (in the Kasai at 6° S.), 76.5°. All these stations are relatively low, even Luluabourg at only 2050 feet. Of the climate of the elevated portions we shall speak later; but it may be remarked that the annual mean at Elisabethville (about 4059 ft. and 11° 40' S. latitude) is 69.1° F.

Examination of the maximum and minimum temperatures for the year reveals that the extremes are least marked on the equator. At Equateurville they were found to be 94.1° F. and 63.5°; both to the north and the south they become more divergent; at Mobaye, 100.4° and 61°; at Luluabourg, 99.8° and 56.3°.

The variation in monthly means is very slight, amounting to only 9° F. throughout the year at Banana (where July is the coolest month), and 7.6° at Mobaye (where the minimum comes in August). At Equateurville the variation is but 2.5°, and at Luluabourg still less, 1.26°, despite its being farther from the equator. These figures show clearly how greater insolation, when the sun nears the zenith, is prevented by the increased cloudiness and evaporation at the same period. Such slight seasonal variation is apt to be overlooked on account of the more marked diurnal changes in temperature.

The daily range of temperature is about 13.5° F. at Banana, 15.3° in the Cataracts region, 15.6° at Bolobo, and 24.1° at Luluabourg (where the variation between different months was only 1.26°). The thermometer is generally lowest between 5 and 6 A.M., and highest at about 1 P.M., beginning to fall less than an hour later.

So close to the equator the barometer serves less than the thermometer in marking the seasons, and will not even help to predict the weather. Its stability is proverbial. Cyclonic storms are rare in these latitudes, even in the center of the continent; and the pressure of the atmosphere shows only a regular daily oscillation. There are two maxima: 9-10 A.M. and P.M.; and two minima: at 4 A.M. and P.M. The usual variation between 10 A.M. and 4 P.M. is from .10 to .14 inch. One may take it for granted when using an aneroid barometer to determine altitudes.

As has already been remarked, it is the visible moisture that interests us most. Relative humidity is almost always high, even in the dry seasons, though conditions are then unfavorable for its condensation. As Lancaster has shown, this relative humidity does not so greatly exceed that of Belgium, the mean oscillating generally from sixty-two to eighty-four per cent, but it is the difference in temperature that causes the well-marked difference in effects, also the actual amount of water

held in suspension, which is so much higher with a mean temperature of 77° or 78° F., instead of 50° as in Belgium. Certainly the humidity of the lowland Congo forests is most oppressive, particularly during the rainy season. Camping in the forest becomes a most disagreeable experience, unless one takes advantage of some native clearing. Otherwise nothing dries, clothes that have been washed and hung out remain wet almost

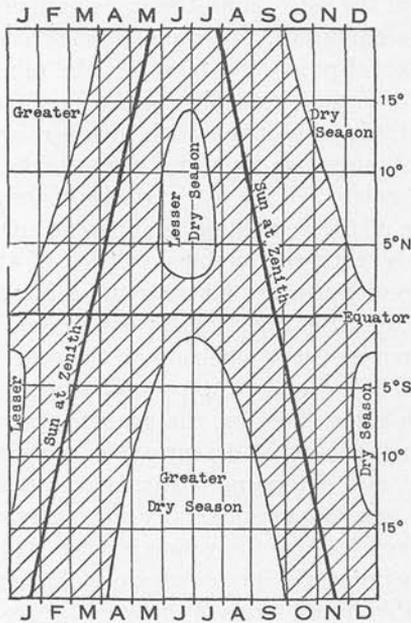


Fig. 11. Diagram of seasonal progress of tropical rains and their dependence on the position of the sun, after de Martonne.

indefinitely, even though no rain falls—but this one is seldom spared. Water-colors will not dry on the paper, unless held directly over a fire, so that sketching, or the drying of skins, becomes out of the question.

Even though one pitches his tent in a large clearing, as always proves far wiser, where short periods of sunshine may be enjoyed almost every day, the evil effects of moisture are not overcome. All leather goods mould, gun-stocks and wooden parts of cameras swell, and even bird-skins take many days to dry, a more serious matter than if the

temperature were not so high. Only direct exposure to the sun, or heating over a fire really dries anything satisfactorily.

The distribution of the rains, which constitute by far the most characteristic feature of the seasons, is best explained with the aid of the instructive diagram by E. de Martonne (Fig 11).<sup>1</sup>

The diagram shows over what parallel the sun is vertical at any given date, and how the rains, under normal circumstances, tend to follow the position of the sun. Since the sun's path crosses the equator twice a year, at the equinoxes, two rainy seasons a year might be expected there. In actual procedure, however, the rains may be so prolonged that the two seasons virtually coalesce, and so on the equator in the upper Congo basin, almost the whole year is rainy. A little farther north and south, at only two or three degrees, the two dry periods begin to make themselves felt, as a few weeks of drought, before their effect on the nature of the vegetation is apparent. One of them, coinciding approximately with the summer solstice of the hemisphere in question, is of lesser importance, for on going a few degrees farther it seems to disappear, and the rains join in one season of wet, while the other dry season extends over as much as half the year.

In the study of bird ecology the periods of rains are of prime importance. Through their effect on the growth of vegetation and the supply of food, whether animal or vegetable, they take the place of summer and winter, and determine particularly the breeding season of many species. The breeding season of any particular species is apt to be that time of year when food for the young is most easily obtainable, and conditions for nesting offer the largest measure of safety. The rains are by no means favorable for all kinds of birds.

Connected closely with the question of reproduction is that of the seasonal plumages which characterize certain birds, most of them species of the grasslands undergoing marked changes of rainfall. Bright nuptial plumages are assumed shortly before the season of nesting, and although this is apt to be during the rainy season, the appearance of the feathers is not caused directly by humidity, for in the Congo savannas many of the whydahs and bishop-birds often begin molting into breeding plumage just about the time of the lesser dry season. Further, it has been noted that these same birds in captivity in colder climates assume the nuptial plumage, as a rule, in the spring; and species from the southern hemisphere (South Africa, for instance) gradually alter their time of molt, when taken to the northern hemisphere, so as to molt in the northern spring.

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<sup>1</sup>1899, *Annales de Geographie*, VIII, p. 84.

In the Congo, at latitudes where the greater dry season lasts for three months or more, the unbroken forest gives way to a predominantly grassy country, or savanna, which is still dotted if not thickly grown up with small trees and bushes, and may have strips of forest along water-courses and depressions which are very like the equatorial forest. The lower Congo flows through such an area, and the climate of the whole

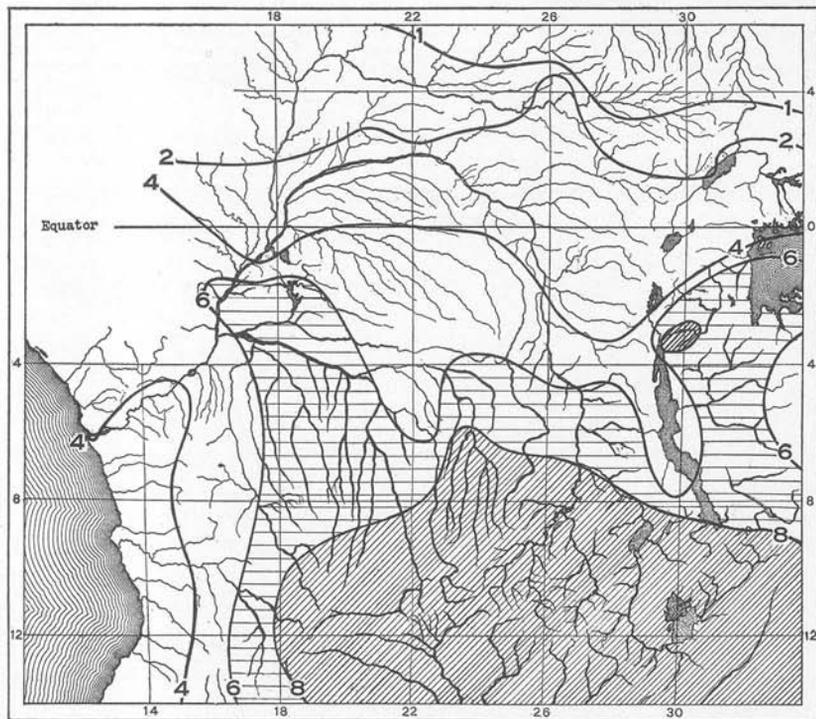


Fig. 12. Rainfall in the Congo during the month of February, in inches.

southern Congo (south of 3–4°) may well be compared with that of the most northern portion, the Ubangi and Uelle regions, even though the dates are reversed. In the Lower Congo the rainy season begins in October and ends in May; but there is a short lesser dry season, for while November and December are the rainiest months, the precipitation decreases in the latter month, and the month of January is comparatively dry. This I have had occasion to note during a month's stay at Boma early in 1915. There was scarcely one real day of rain. From February

to mid-May the rains set in again, falling most copiously at the beginning of April.

During the rainy season the sky at sunrise is usually clouded, between eight and ten o'clock it clears, but between one and two in the afternoon storm clouds appear, and these afternoon rains are accompanied by thunder and lightning. Rain falls generally from two to nine P.M., or later in the night.

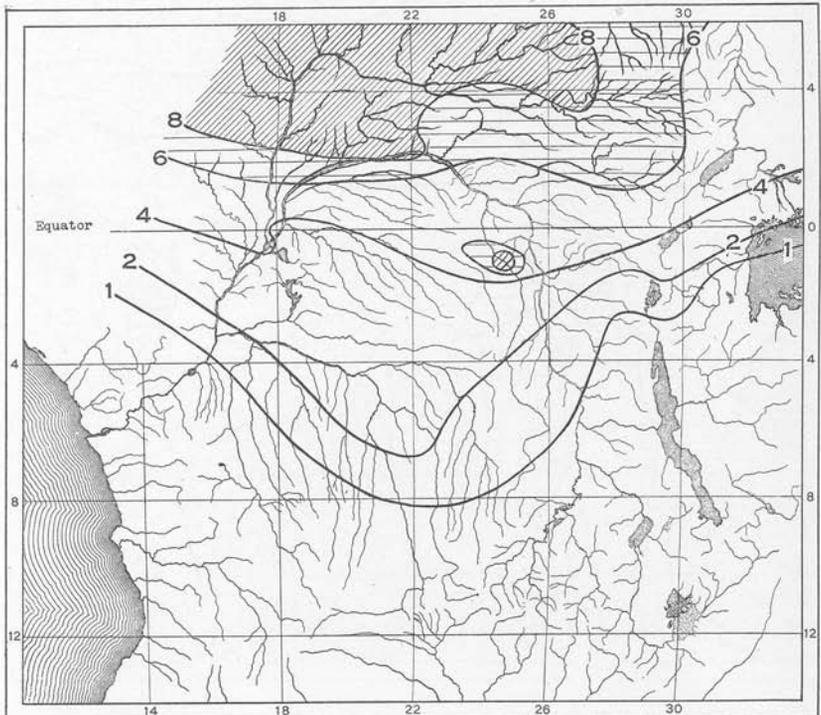


Fig. 13. Rainfall in the Congo during the month of August, in inches.

From June to September is the dry season, as it is across the Kasai district to the Manyema. July is the coolest month, and February the hottest, as a rule, south of the equator, though at Nyangwe the warmest weather comes a little later—from March to May. Near Lusambo in the eastern Kasai the rains begin between the middle of September and the middle of October, lasting until some time in June, with a lesser dry season about February, but scarcely noticeable.

The amount of precipitation, as shown in the following tables, for which the data are borrowed from Knox and other writers, especially from the *Bulletin Agricole du Congo Belge*, is not so much smaller than at many points within the forested equatorial belt; but its seasonal distribution is altered; and this is the reason for its very different effect, in so far as the vegetation is concerned. In the interior of the southern Congo the shorter dry season is less marked than in the Lower Congo. The farther we go from the equator, the longer becomes the principal dry season, until in the Lower Katanga the drought may last four, or even five, months.

The climate of the equatorial rain belt is uniform in comparison. At the former station of Equateurville, near the present Coquilhatville, Lemaire<sup>1</sup> found that there were about 130 rainy days in the year, and though no dry season could be distinguished at all, he divided the year as follows:

Season of greatest heat: Late January through April,  
Month of fewer storms: May,  
Period of fresh breezes: June to August, inclusive,<sup>2</sup>  
Months of average rainfall: September and October,  
Season of heavy rains and storms: November to beginning of January.

Such divisions as these would not of course impress the casual visitor; and I may remark from two years' experience in the Ituri forest, much farther east, that one hardly notices any change in the weather from one month to another, unless he takes actual count of the number of rainy days, or reckons by the level of water in the streams. But even in this case, the larger rivers often come from a distance, and their level may depend much more on the rains in some remote region where they rise, perhaps outside of the forest, than on the territory they afterwards traverse. This is partly true of the Ituri River, which reaches its lowest level in February and March, largely because it drains the northeastern corner of the district, where there is really a dry season beginning in December.

Rains throughout the year are characteristic of the whole region from the Cameroon coast across the lower Ubangi, eastward to the Semliki River and south to Nyangwe, in a belt which supports the enormous rain forest of the central Congo basin. At times it rains on an average every other day, but periods of more than one week without rain are

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<sup>1</sup>Lancaster, 1898, 'Congrès Nat. Hyg. Clim. Méd.,' Bruxelles, II, p. 600.

<sup>2</sup>It rains at this season also; and for July, in 1891 and 1892, the average number of days with rain was eight.

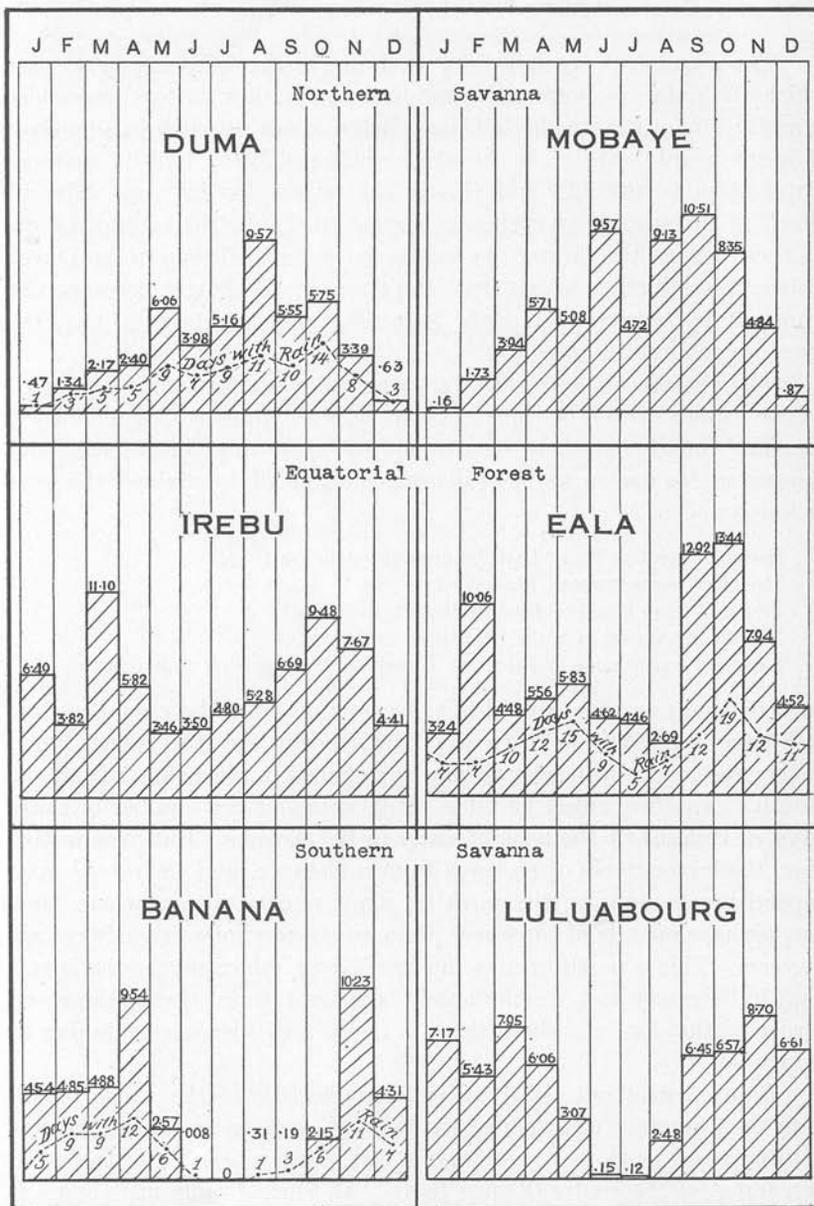


Fig. 14. Diagrams of the rainfall by months, in inches, of the three climatic belts of the Congo lowlands.

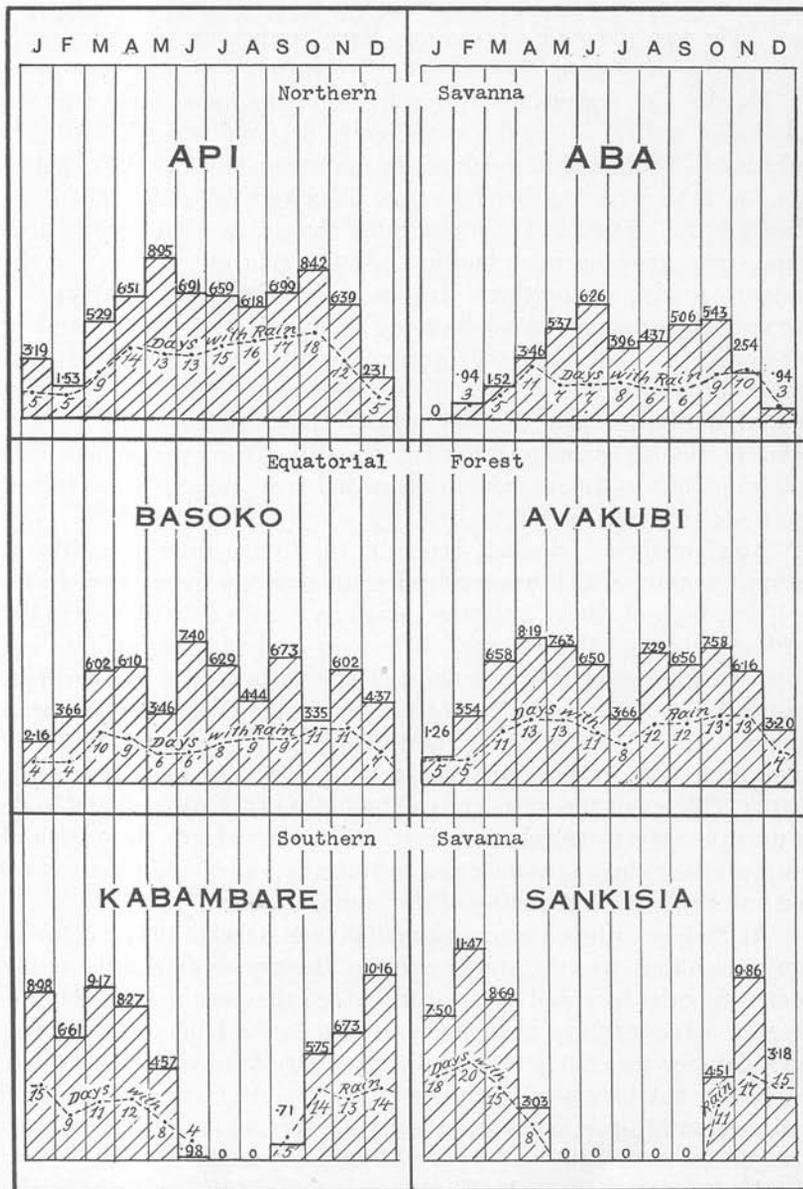


Fig. 15. Diagrams of the rainfall in the three climatic belts of the Congo lowlands.

rare. The two theoretic dry seasons have become merely short spells of lessened precipitation.

But the dry seasons do invade the forest to some extent; in the Ituri forest south of Medje it was noticeably drier underfoot in February and March, 1910; and at Avakubi, in the beginning of 1914, we found that the rains were less frequent from January to March. The dead leaves on the ground in the forest dried enough to make a crunching sound, very annoying when hunting. At this time of year a few of the goatsuckers from the northern savanna invade the forest clearings. It was only then that we found *Scotornis climacurus* at Avakubi; and at this season, too, Bates collected *Caprimulgus inornatus*, another northern species, in the river Ja district of the Cameroon. Near the southern edge of the forest there is a dry period at the opposite time of year. Lukolela, though scarcely more than 1° south of the equator, has little rain from June to August, and in occasional years there is a drought of two months at this period.

North of three and a half degrees in the Congo there is a strip of savanna country which has received scant mention from either Hann or Knox, both of whom treat the Congo as though it hardly extended northward beyond the equator. It is connected with the savannas of Northern Cameroon and Nigeria, and like them it has the northern seasons. This is probably the hottest part of the Congo, for the mean temperature of Mobaye, on the north bank of the Ubangi, is given by Hann as 78.6° F. There are relatively few data for the Upper Uelle district. We spent two years and eight months in this district, and while we made no exact meteorological observations, we did note the periods of rain, and their obvious connections with the development of the vegetation and the periodic activities of the fauna.

At Mobaye, where the annual rainfall is 64.6 inches (99½ days with rain), the driest months are December, January, and February, the rainiest months June and September. Much the same may be said for the rest of the territory stretching eastward to the Lado district. The exact date for the ending of the rains may vary from year to year, but storms are not unknown in the dry months. At Okondo's, south of Niangara, in 1910, we found that the dry weather set in toward the latter part of November, yet on January 13 we were caught in a very heavy thunderstorm on our way to Niangara post. In 1911, at Faradje, the drought began on December 3, and the following year, at the same station, December 1 was noted as marking the end of the rains.

From the beginning of December, therefore, about Faradje, it scarcely ever rains, and the weather offers the sharpest contrast to the

rainy season, which only begins again in March and April. The sky is not of a deep blue, even on the clearest days; and there is usually a perceptible haze, which becomes emphasized by the end of December. For then the grass has had time to dry, and the natives are everywhere setting it afire. They do this partly to drive game in hunting, especially the delicious "Bindi" (*Thryonomys*), and occasionally animals as large as elephants. Sometimes it is burned to clear ground for planting, but I think even more often for the mere pleasure of seeing the countryside cleared of the tall grass that has heretofore clogged the pathways.

Immediately after the fire has swept over an area, the leaves which are still left on the trees drop; but the trees are not killed. Indeed in the rare patches which escape burning the leaves are shed just the same, in early January. The smoke now floating in the air is one of the most characteristic features of the season. It obscures distant views; and the sun as it begins to sink in the late afternoon becomes a coppery red ball upon which one may gaze without discomfort. We did not notice that the heated air rising from the bush fires brought about the formation of cumulus clouds, as has been described in other parts of the continent.

Once the grass has burned off, the sun bakes the ground everywhere to cement-like hardness, where round worm-castings of an earlier season lie like marbles. But up through it the termites still make their way, to build earthen galleries over and consume everything in the way of falling vegetation that is not charred. So here still less humus accumulates than in the forest.

After the termination of the rains, the level of the rivers declines rapidly, there being no vegetation capable of retaining moisture, save perhaps the papyrus; and these swamps gradually lose nearly all their water, and are even invaded at times by the bush fires. Here they do little damage, but when they make their way into the undergrowth of a true gallery forest, the result is different. There the lesser plants are killed, and the lack of lower foliage is noticeable for many months after the rains recommence. The resistance of the present savanna flora to fire is one of its outstanding characters, as is the susceptibility of the forest plants.

Occasionally in March, but especially at the beginning of April, furious thunderstorms preceded by gusty winds herald the approach of the rainy season. But even earlier the trees of the savanna have put forth blossoms and leaves, and before the grass has begun to show its green, orchids of various sorts and colors have thrust up their flowering stalks from underground tubers. The landscape takes on a look of

springtime, and many of the grass-haunting birds, especially *Melocichla mentalis*, take up a new season of song. Rains become of common occurrence, and continue so until the end of June. The month of July offers a short lull. This is the lesser dry season, but it has no particular effect upon the vegetation. The grass is not yet very high, in most cases hardly above the knee, though patches of elephant grass and the old stalks of last year's grass-crop are still troublesome. By September the rains have again increased in frequency, and in October they seem to reach their maximum. Storms are most frequent in the afternoon, so that by traveling only in the morning one is still able to make one's way in comparative comfort about the main roads of the country. Off on the narrower tracks of more remote regions, however, the grass is now so high as to be extremely annoying, and so wet as to keep one damp all the time.

The rains after September are different from those of April and May. Instead of appearing as black clouds low on the horizon, they can be watched in preparation overhead. The morning may be bright, with white clouds scattered in the sky. By noon or early afternoon they grow denser, tending to cover the whole sky. Next, dark shadows appear on their lower edges, spreading, then coalescing, until the part of wisdom is to make rapidly for the nearest village.

The grass-dwelling Ploceidæ are now in their glory. The whydahs (*Coliuspasser*) and bishop-birds (*Pyromelana*) are wearing full nuptial plumage, and their mates are sitting in nests cleverly concealed in the tall grass, over which it has become difficult to see.

Twice I saw hail fall in this region during heavy storms in the latter part of the rainy season. The hailstones were not of unusual dimensions. By the month of November the region has a thoroughly rain-sodden aspect. It has become a sea of tall grass, barring all progress off the pathways, interspersed with bushes and trees, but almost without a flower. The native grains will soon be ready for the harvest, though in such weather they cannot dry. Abruptly the rains cease. The grass turns brown and yellow. Soon it will be ready for burning again. The natives are happy over the prospect of meat to be had when hunting is once more possible.

#### RIVER LEVELS

The rise and fall of the rivers, though dependent on the rains, are carried on to their lower courses with slight retardation. For the student of water birds in Central Africa it possesses a special importance. In the

more equatorial parts of the Congo, aquatic birds are not particularly abundant, some of them skulk in the more wooded or overgrown spots, and those more often seen are apt to be birds of arboreal propensities as well, like herons and ibises. Besides the true tree-ducks, both *Pteronetta* and *Sarkidiornis* can perch in trees, and certain of the birds of prey and kingfishers—according to their feeding habits—may also be classed as water birds. The forest commonly grows right down to the brink of the water. There are no beaches to speak of, and no mud flats or bars when the water is high. So many ducks and waders will have difficulty in feeding.

The level of the streams is of paramount importance to wading or fishing birds. It has been shown that in northeast Africa *Halixætus vocifer* nests at the season when the waters are low and food for the young is most easily obtainable; and in the regions of the Congo I know best, the same is true. The fishing eagle is a resident bird. Birds that nest on beaches or sand bars are more strongly affected. In the northeastern part of the Congo, however, I found that many of the truly aquatic birds did not nest, and were seen only at certain times of year, generally when the rivers were low. I am convinced that they perform regular migrations in accordance with the periodic rise and fall of the rivers north and south of the equator. A journey of only a few hundred miles brings them to watercourses in just the opposite condition from those they have left.

In the regions of well-marked seasons, of course, the rivers will be found swollen toward the end of the greater rainy season, and lowest from the middle to the end of the dry; but streams lying wholly within the equatorial belt of constant rains show comparatively little variation. Such are the Ruki, the Lulonga, the Mongala, and the Itimbiri. Lancaster<sup>1</sup> proposed the simple rule that the farther from the equator is the country drained, the more considerable will be the difference in level. As for the seasons of high water, it would not be difficult to conjecture that the Ubangi reached its maximum height in the latter part of the northern rainy season (at Yakoma on November 1, in fact) or that the Kasai should be in flood at just the opposite season (March–April); but conditions on the middle and lower Congo River are far more complex. Not only does this main stream itself twice cross the equator, but it receives important affluents from both the northern and southern hemispheres. The Lualaba, flowing from the south, naturally brings

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<sup>1</sup>1898, 'Congrès National d'Hygiène et de Climatologie Médicale de la Belgique et du Congo,' Bruxelles, II, p. 312.

about a high level at Stanleyville toward April, and from early August to September, 1909, we found the water there decidedly low. But at Basoko, where the northern influence of the Aruwimi is so important, we first find the balanced state of affairs that is characteristic of the rest of the Congo's course; for this station has two periods of low water: one from late December through January, the other in the second half of June.

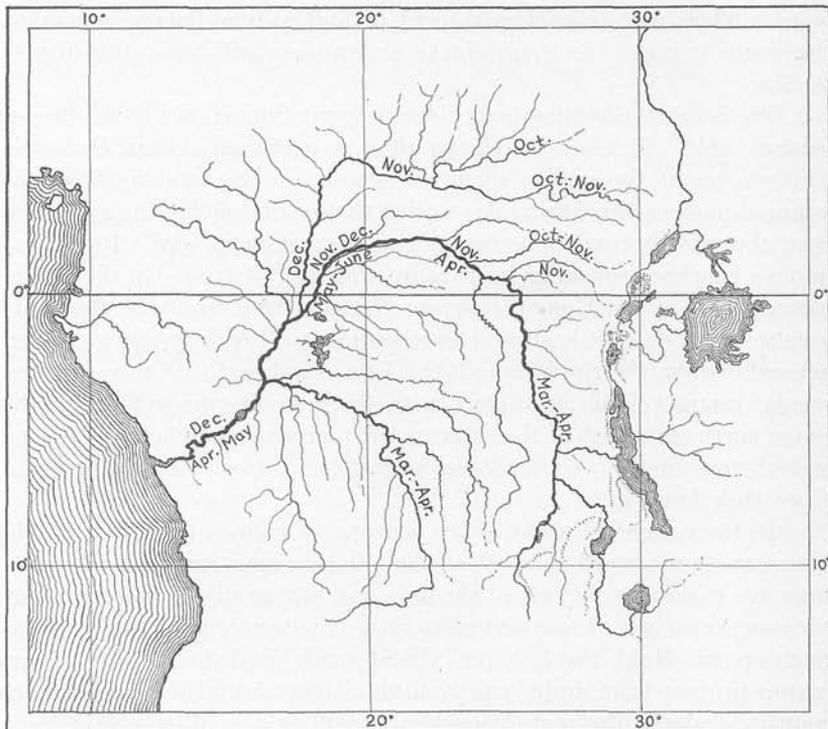


Fig. 16. Sketch-map to show the time of high water on principal rivers of the Congo system.

The intervening periods of high water come to their maxima toward the end of April and again near the first of November. Of these the first is the flooding from the Lualaba and Lomani, the second comes from the Aruwimi.

At Coquilhatville the dates are a little later, especially for the southern waters, so that the high water may be expected about May and from the first week in November to December. Low water occurs in

February and July to August. Because our trip up this part of the stream in 1909 was made in the month of July, and that downstream in December, 1914, I am well acquainted with its aspect under both conditions. At low water many more birds are to be noticed; and the difference is more marked with respect to the numbers of crocodiles and hippos seen—or not seen—for in December, 1914, the water of the Congo was almost on a level with the village streets in much of the Bangala district; and in the whole journey from Stanleyville to Kinshasa just one crocodile was espied, and no hippo.

The Ubangi and Kasai, coming from opposite sides of the line, only emphasize the double nature of the fluctuating Congo, so that at Stanley Pool and on the lower Congo there are still two distinct times of high water (the end of April and the middle of December) as contrasted with two of low (at the middle of March and in July). The rise of April, coming from the southern affluents, is much more pronounced than that of December. That Lang found *Rynchops flavirostris* and *Galachrysis cinerea* breeding on the islands near Zambi in June is connected with the fall of the water level. To take but a single example: the breeding season of *Galachrysis nuchalis* in the Uelle and Ituri districts is absolutely regulated by the level of the streams, since the eggs are laid on isolated rocks in the rivers, which are certain to be covered in the rainy season.

Seasonal fluctuations in the larger rivers of the Congo system are very considerable. The difference in level between high and low water at Stanleyville averages 12 feet, but sometimes reaches 17½ feet. The mean difference at Lukolela is 11⅓ feet, with maximum nearly 15 feet; and at Leopoldville the mean is 11¼ feet, the maximum 18⅓ feet.

At Bangui the Ubangi River regularly rises 22 feet above the low-water mark, and occasionally to 24¼ feet.

To go back to the northeastern region where we spent the most time collecting, we may note the seasonal levels in some of the rivers as follows:

Dungu River at Faradje	} High, July to December, inclusive.
Uelle River at Niangara	
Nepoko River at Bafwabaka	} High, May to December, inclusive.
Ituri River at Avakubi	
	} Lowest, March.

This is of interest with regard to our notes on the seasonal occurrence of snake-birds, cormorants, ducks, and other aquatic birds.

The Ituri and Nepoko first undergo sudden flooding in early May; in the case of the Dungu and Kibali this comes a little later, or sometimes only in July. The high-water level, even in the smaller rivers not on the equator, is often six to ten feet above low water.

## CLIMATE OF THE LOWLAND SAVANNAS OF THE EASTERN CONGO

The Upper Ituri savanna<sup>1</sup> is a relatively narrow band of country along the eastern border of the Ituri district, with such variation in altitude that the climatic conditions are far from uniform. The portion south of Kilo enjoys a true equatorial climate; but at Mahagi the year may still be divided in two parts: one more or less dry, from December to February, inclusive; the other, characterized by copious rains, from the end of February to the end of November. In June or July there is a diminution of rains. It is in October and November that the rains are most frequent. At this time storms are sometimes accompanied by small hailstones.

Because of their altitude and nearness to the forest, certain spots are especially well supplied with moisture. At Kilo, after February, it rains on an average one day in every three, and one may say that there the dry periods do not last more than three weeks. In the eastern part of the plain of the Shari River, especially near the Tinda, rains are frequent throughout the year, because of the vicinity of tall mountains. Near Irumu the dry season is more marked. Descending lower, to Mahagi Port or Kasenyi, along Lake Albert, we find precipitation further lessened, so that the annual rainfall is probably less than 40 inches.<sup>2</sup>

Temperature, too, is dependent upon the altitude, so that while the mean temperature in the middle of the day at 2800 feet near Mahagi Port is 93.2° F., the same observation at Kilo (kraal) at 4455 ft. would vary around 78.8°. The mean of the daily maxima at Kilo is 84.2°, that of the minima 62.6°.

In the elevated zone bordering Lake Albert, the temperature is about the same as this latter case; and rains are frequent all through the year. Misty weather is common at Bogoro. The nights are remarkably cool, the mercury often dropping to 57°, and more rarely even to 53.6°. At the post of Kilo, De Greef once observed a difference of 34° F. in a single day, between six in the morning and noon. It is clear that the climate resembles that of the eastern Uelle, but is cooler, because of increased altitude, and without so long a dry season, being much nearer the equator. At a few of the highest spots there is an undoubted approach to the climate of the humid montane area a little farther south, for at Djugu and on some of the high mountains just west of Lake Albert there are patches of mountain forest.

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<sup>1</sup>Condensed from De Greef, 1916, *Bull. Agric. Congo Belge*, VII, pp. 11-13.

<sup>2</sup>The data in my rainfall table for Mahagi were taken at the White Fathers' Mission, at a considerably greater elevation and farther from the lake.

The floor of the rift valley near Lake Albert, Lake Edward, and in the lower Ruzizi Valley is unusually dry. It seems as though the adjacent elevated rim of the rift captured most of the rains, and north of the Kivu Volcanoes there are dry periods twice in the year. The western and southern shores of Lake Albert are occupied by grasslands with candelabra euphorbias, usually a sign of aridity. The margin of Lake Edward, the upper Semliki Valley, and the Rutshuru Plain are similar in this respect. Yet the floor of the middle Semliki Valley is one of the wettest spots in the region, and is heavily forested. In early February I have walked in four days from the arid shore of Lake Edward, where the drought was extreme and the grass all burned off, along the base of Ruwenzori to the humid forest in the Semliki Valley, where rain clouds gathered nearly every day. The high peaks of Ruwenzori must produce air-currents that bring about frequent rains.

The savannas about Lake Kivu have one relatively dry period from June to August; but are better considered as part of the eastern highland. The lower Ruzizi Valley is more like the country near Lake Edward, and has open grassland with fan-palms and candelabra euphorbias. Only the southern dry season, from June to August, is accentuated.

#### CLIMATE OF THE UPPER KATANGA AND EASTERN HIGHLANDS

The elevated parts of the Belgian Congo, while relatively restricted in area, have a disproportionate importance in the zoögeographic sense, because they break the general uniformity of the territory and bring in climatic elements that either alter the constituents of their fauna and flora, or allow the invasion of different forms from adjoining or even distant regions which they resemble. Accordingly the elevated region in the extreme southeast corner of our territory, known as the Upper Katanga, bears a closer resemblance to the adjoining parts of Rhodesia than it does to the lowlands of the central Congo basin. Its level is mostly above 3200 feet, and there are plateaus exceeding 5000 feet, some spots reaching 5900. Situated between 8° and 13° south latitude, the area has such a relatively temperate climate that efforts have long been made to attract white colonization.

On the elevated plains, between 5000 and 5600 feet, as we learn from Lancaster and from Hann, the nights are cold, the temperature falling often to 37° or even 35.6° F. At lower elevations the extremes of temperature are 46° and 100.4° F. The rains begin in late October or in November, and end with April, giving annually about 47 inches. During this time the sky is mostly overcast, especially in the morning.

Storms are frequent and hail occasional. The dry season is announced by fresh southeast winds, the sky clears, and the nights become cool again.

The long dry season of the Katanga, five months without rain, is one of the outstanding features of the climate, and explains the steppe vegetation of the higher plateaus. In 1912 a meteorological station was established at Elisabethville, altitude 4059 feet. From its data Professor E. Leplae, Director of Agriculture for the Congo, has written a résumé of the climate near Elisabethville, in the *Bulletin Agricole du Congo Belge*, XII, 1921, pp. 5-8, from which I have borrowed the following notes:

The dry season is also the cold season or winter of the Katanga. Agriculture is then only possible with irrigation, and there are sufficient watercourses to make this possible. Two or three crops in a single year can thus be raised.

During the wet season it does not rain daily. In December and January, the wettest months, there is rain twice in three days, on an average, and during the other rainy months only every other day. Showers come mostly toward evening, and hardly last more than one or two hours. Both day and night temperatures are higher during the rainy months. September and October are hottest, when the rains are about to commence. A shaded thermometer then registers 95° to 96.8° F. toward noon, and 46.4° to 55.4° at night. Eight inches below the surface, the soil maintains a temperature between 73.4° and 78.8°. But just above the surface, and this affects plant life directly, it reaches 130° and even 137° F. Daily means of temperature, in the rainy season, vary from 69.8° to 73.4°, in the dry, from 59° to 68°. The annual precipitation, from two years' observation at Elisabethville, was 42.7 inches and 53.5 inches.

In the dry season the temperature at Elisabethville in the middle of the day does not exceed 84.2°, and at night drops to 39.2°, or even 35.6°. In the bottoms of valleys there is often frost, and on the higher plateaus just before sunrise the temperature may go as low as 26.6° or 24.8°. It is easy to see why so few natives inhabit the highlands of the Katanga. In the dry season the winds blow ordinarily from the southeast; during the period of rains intermittently from the opposite direction, the northwest. Sunshine is enjoyed for an average of ten hours daily, during the drought, but cannot be counted on during the humid half of the year.

Inasmuch as Elisabethville is near the border, altitudinally, of what we would consider the tropical life zone, it will be of interest to compare the climatological data for this station with the figures given by Dr. C. Hart Merriam in his 'Laws of Temperature Control,'<sup>1</sup> for the northern limit of the tropical fauna in North America. At the boundary of the tropical zone, says this authority, the sum of the normal mean daily temperatures above 6° C. (43° F.) amounts to 14500° C. (26000° F.). Fortunately, we have the monthly means for Elisabethville, if not the daily, for a period of four consecutive years.<sup>2</sup> These should furnish

<sup>1</sup>1894, *National Geographic Magazine*, VI, p. 237.

<sup>2</sup>1915, *Bull. Agricole Congo Belge*, VI, pp. 116-124; 1916, *idem*, VII, pp. 353-354.

a good basis for comparison with Dr. Merriam's figures. The daily mean for Elisabethville never falls as low as 43° F., so all the temperatures are to be added up. Multiplying the mean for each month by the number of days, and adding the results, we find for the year 1912 a total of 24986° F., indicating that this station is a little beyond the limit of tropical climate.<sup>1</sup>

Figured from the monthly means, the mean annual temperature of Elisabethville for the year 1912 was 68.7° F., or 20.4° C., so that upon the calculations of Hann and Supan, who take the isotherm of 20° C. as the limit of the warm or tropical zone, Elisabethville is found to be just within the border.

At Sankisia, on the northwest border of the upper Katanga, and at only 2150 feet, the Sleeping Sickness Mission led by Dr. Rodhain found 114 rainy days in a year, with a total precipitation of 48 inches. In February there were twenty days with rain; but five months, beginning with May and ending with September, were entirely rainless, whereas the absolute maximum temperature of 105° F. was noted on September 22, and the absolute minimum, 46°, on June 28.<sup>2</sup>

The plateaus extending northward from the upper Katanga along the southwestern side of Lake Tanganyika have a somewhat similar climate, as might be judged from their vegetation. On account of its altitude and the absence of standing water, the plateau of Marungu is cool and healthful. Even during the hottest months the temperature is not oppressive, and on the higher summits it is always cool. E. Bovone,<sup>3</sup> in his report on agriculture and cattle-raising, says that in the month of July a thin sheet of ice often formed during the night on vessels containing water. At this same period of the dry season hoar-frosts are very frequent in the higher situations.

Meteorological observations taken at the station of Mutambala (altitude 4920 feet, 7° 13' S. lat.) from July, 1913 to June, 1915 show the rainfall for a year to be only 31.3 inches, with practically none in June and July, while only 1.22 inches fell in the months of August and September. On the top of the Marungu highland there is no station, but the temperatures are lower, cloudiness more frequent, and the rains more abundant, so that the period of drought is shorter.

<sup>1</sup>Were we, however, to summate the figures in centigrade degrees, we should get a total far below the 14500 given in Merriam's table. There seems indeed to be a grave error in the centigrade half of this table. Instead of adding any actual figures in this scale, Merriam appears to have converted 26000° F. directly to the other scale, without reflecting that this number of degrees above the Fahrenheit zero, in the calculation he was making, is equal to only 7850° centigrade in excess of the zero of the centigrade scale. The latter figure should replace 14500.

Adding up the approximate daily means, as judged from the monthly means for Elisabethville in 1912, we have in centigrade degrees 7448.

<sup>2</sup>J. Rodhain, C. Pons, F. Van den Branden and J. Bequaert, 1913, 'Rapport sur les travaux de la Mission Scientifique du Katanga,' Bruxelles, p. 52.

<sup>3</sup>1914, Bull. Agricole Congo Belge, V, pp. 457-470.

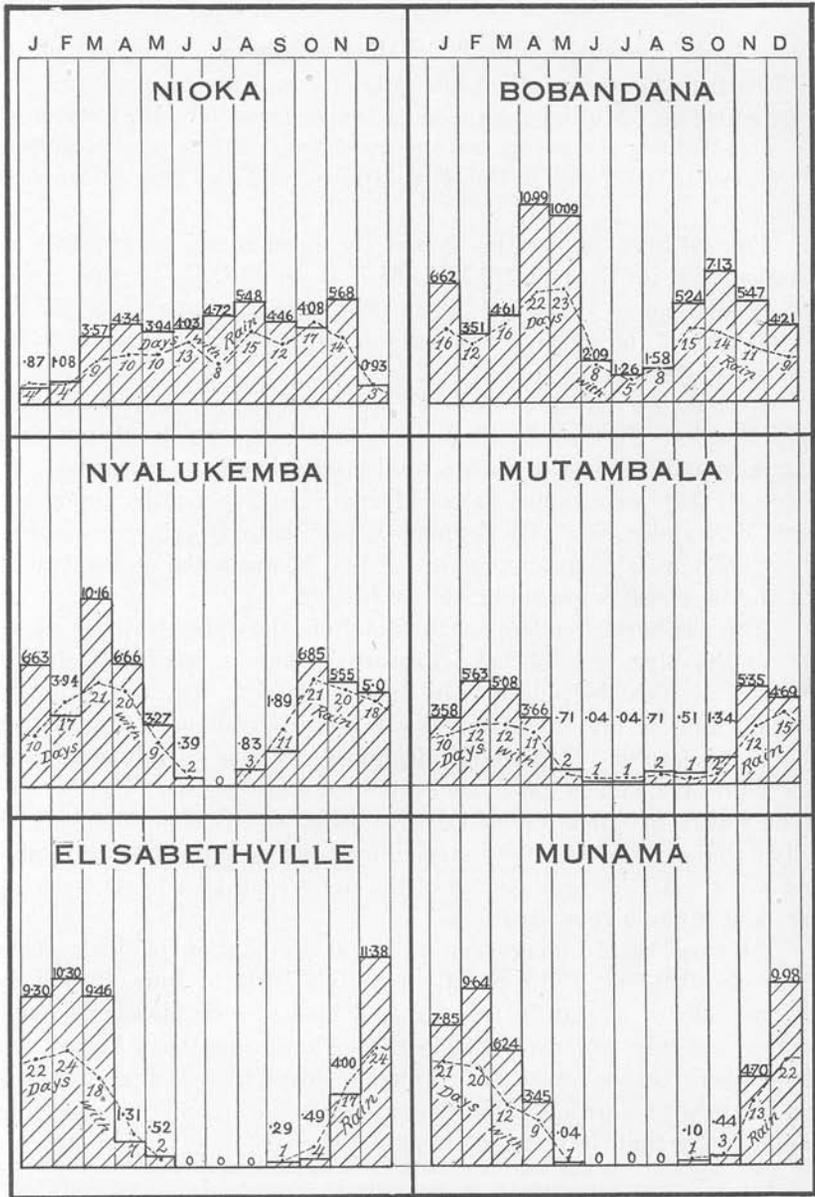


Fig. 17. Diagrams of the rainfall, in inches, of the eastern highlands of the Congo.

In Urundi the climate may fairly be called moderate, everywhere save along the shore of Tanganyika. In the highest parts it is often disagreeably cold and misty. The extreme range at Usumbura on the lake shore in 1912<sup>1</sup> was from 58° to 97° F. At Gitega, altitude about 5250 feet, De Greef<sup>2</sup> gives thermometer readings for two short periods in the dry and rainy seasons, with extremes of 53.6° and 78.8° F. The seasons are clearly defined, and southern in character. The rainy season starts generally toward the 15th of September, or as late as November in the south; and it lasts until May, with some breaks in January. The remainder of the year is dry.

Rainfall records for three mission stations in the interior of Urundi, given in the 'Deutsches Kolonial Lexicon,' Leipzig, 1920, III, p. 287, show that these localities, at elevations of from 4900 to 5700 feet, have 39–41 inches annually.

On these eastern plateaus, passing northward, we enter the equatorial belt of rains, and the climate becomes far more humid than many of the countries to the eastward. Speke and Grant, who remained nearly half a year in Karagwe, near our eastern border, were impressed with the continuous humidity of the region. Bukoba (1° 20' S. on the west shore of Lake Victoria) has an annual precipitation of 68 inches, according to Hann<sup>3</sup>; and the climate to the westward, near the border of Ruanda, is best described in the words of J. A. Grant.<sup>4</sup> "The capital of Karagwe is 1° 40' south of the equator, within a complete belt of vapour the whole year round. Fruitful showers seemed to fall continually. There are no very marked seasons. . . . On the same day, sowing, gathering, and reaping may be seen, and from November to April the fall of rain increases or diminishes according as the sun becomes more or less vertical to our position." "The heaviest rainfall"—added Grant—"comes towards the end of March." From the 17th of that month the rains increased till the climax was reached about April 10. "We had a great number of dull English days, very few bright ones, never an Italian sky, as too many vapours hung about this equatorial region." The elevation was about 5000 feet.

The long forested ridge that extends from northwest of Lake Tanganyika to the region west of Lake Kivu has a climate in most respects similar to that of the forest belt, or cloud belt, on Ruwenzori and on the higher volcanoes of the Kivu group. West of the Ruzizi there is a pro-

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<sup>1</sup>P. Heidke, 1914, *Mitt. aus den Deutschen Schutzg.*, XXVII, p. 103.

<sup>2</sup>1919, *Bull. Agricole Congo Belge*, X, p. 10.

<sup>3</sup>1910, *Handbuch der Klimatologie*, II, p. 164.

<sup>4</sup>1864, 'A Walk Across Africa,' pp. 149, 150.

nounced dry period on the mountains in July, but in general the rains are more abundant than in Marungu, so they support areas of mountain forest and bamboos. A description of the conditions on Ruwenzori and the volcanoes will suffice for general purposes, and further details may be left until we come to discuss the botanical features.

Every traveler who has written about Ruwenzori has remarked on the extreme humidity of its upper slopes. In a mountain range situated at less than one degree from the equator it is not surprising, for such heights have a way of drawing moisture from all the surrounding territory. During the day the action of the sun causes ascending currents up all the slopes, with consequent condensation of moisture beginning as they reach altitudes of 5000 to 6000 feet. This seems to be due to the mountain becoming more rapidly heated by the sun than the plains below, leading to an upward current of air.<sup>1</sup>

In the evening reverse currents are set up, and the cold air from the snow rushes down over the warmer lower slopes. Down all the larger valleys blows a cold wind, which sometimes is almost violent. It may soon die away, as Scott Elliot<sup>2</sup> said, or it may blow all night, and sometimes does not die down till seven or eight in the morning. There is evidence, too, of very powerful winds in the way great numbers of heath trees, near 11,000 and 12,000 feet, have been blown down on the ridges. Their trunks rot very slowly, and lie hidden in the blanket of green moss.

The cloud-ring of Ruwenzori is one of its outstanding features. Practically every morning a belt of cloud is seen at 6000 to 7000 feet, and as this goes drifting up the slopes with the warm currents, more cloud forms below it. The way the vapor condenses at just the lower edge of the mountain forests seems to explain the existence of this belt of vegetation.

When one camps above 12,000 feet the mornings are often wondrously clear, and fine views are had of the peaks. Towards 9 A.M. the clouds begin to drift up the valleys, and soon everything is hidden in fog. From time to time the sun breaks through overhead, but it is rare to see the snowy summits well before late afternoon. Then the whole bank of cloud may disappear, and on the higher slopes the evenings are usually clear and beautiful. Thus it is that distant views of the snows of Ruwenzori are seldom to be had save at daybreak and toward sunset.

Scott Elliot suggested that the moisture for the cloud-ring was drawn from the swamps of Uganda and Lake Victoria, but it is probable that

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<sup>1</sup>Scott Elliot, 1895, *Geogr. Journ.*, London, VI, pp. 308-309.

<sup>2</sup>1895, *idem*, VI, pp. 309, 310.



Fig. 1. Clouds beginning to enfold the snow peaks of Mt. Stanley at 8:40 A.M., only Alexandra Peak still visible. View from Itereré on western side at 13,800 feet.



Fig. 2. Cloud-ring forming at western base of Ruwenzori, 10 A.M., looking north from village of Nganzi at 3750 feet.

much of it comes from the Congo side, and Lake Edward may also furnish a part. It is doubtful whether the actual precipitation on the mountain slopes is much greater than in the lowland forest of the eastern Congo, but the frequent showers are very annoying, and conditions are aggravated by the cold. At 6000 and 7000 feet on the western side the rains are often very copious, but at levels above 10,000 feet they are more of the nature of drizzles. In a pluviometer they might not show much effect. It is the cold fog that is most striking. When the sun breaks through during the day one is warm and happy, as soon as the sun is obscured one shivers. Light falls of snow and hail are frequent at 14,500 feet, but only on the higher peaks does the snow accumulate. If a mountain rises only to 15,000 feet it is generally free from snow.

Evaporation is rapid on the higher slopes of the mountains. Above the heath zone there are always plenty of dry immortelle bushes to make a fire, and lower down the dead branches and twigs broken from the heaths burn readily, even on rainy days.

The moisture that falls as rain or mist on Ruwenzori probably comes from both sides, and is not due to any prevailing wind, but rather to the cooling effect of rising air currents. On the west side the Congo forest, as Wollaston<sup>1</sup> and others have remarked, sends up a broad extension which joins with the mountain forest zone. This is the more humid side, perhaps because the morning sun hardly affects it, and by afternoon the cloud-ring has formed, shading the western slopes during the afternoon.

On the mountain as a whole the rains are so frequent that Scott Elliot did not recognize any dry season in the year. He did not measure the rainfall, but stated<sup>2</sup> that it rained on about forty days out of the 126 he spent on the mountain, whereas different valleys have conditions quite diverse. "The Wimi and Butagu valleys are very wet indeed, while the Mubuku, Yeria and Nyamwamba, as well as the low hills, e.g., about Butanuka and the Salt Lake, are in comparison dry. It is not, however, so much the actual rain as the persistent mist and cloud that makes the climate unpleasant."

But there are certainly times when the climate of Ruwenzori is not so disagreeable, and as the mountain lies virtually on the equator, one might expect two rainy seasons a year. According to Wollaston,<sup>3</sup> the British Museum expedition found the weather in the Mubuku Valley dry and pleasant throughout January, but from then to April they had

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<sup>1</sup>1908, 'From Ruwenzori to the Congo,' pp. 141, 143.

<sup>2</sup>1896, 'A Naturalist in Mid-Africa,' pp. 183, 189, 190.

<sup>3</sup>1908, 'From Ruwenzori to the Congo,' pp. 73-75.

to endure rains, which probably last somewhat longer. A second, more prolonged dry season, they believed came in June and July, possibly early August as well. But this cannot be very clearly marked, for during the twenty-eight days spent by the expedition of the Duke of the Abruzzi at Bujongolo in the Mubuku Valley, June 15 to July 12, 1906, rains, mostly light, were noted on eight days, and hail on another. Not a single day could be listed as entirely clear. At higher levels fogs were even more frequent. Freshfield found very bad weather in November and December.

I can bear witness to the intensely wet weather on the western slopes in November. At 7000 feet in the Butahu Valley we pitched our tents in mud, and could scarcely stir out of camp without being drenched. A sudden change occurred, however, on November 26, 1926, and from that date until January 8, when we left the mountains, there was a spell of comparative drought. The cloud-ring did not vanish; and showers still fell occasionally, but so light as to cause little inconvenience. The slopes below 9000 feet dried out perceptibly, though the moss in the heath zone always remains wet. On February 8, I climbed to 6500 feet near the Luami Valley, and the "dry" season seemed still to persist.

There is little doubt of another diminution in the rains toward July. Toward the end of that month, in 1926, we visited the north end of the range, at Mt. Musandama and the Buamba Pass. The weather there was wholly agreeable, although the higher peaks were hidden in cloud.

Of the range of temperatures at various levels on Ruwenzori only a preliminary notion can be offered, and only a guess as to seasonal variation. Probably it is colder during dry weather. At Nganzi's rest-house, 3830 feet, during relatively dry weather (January 9 to 14), the temperature varied from 59° to 78° F. This village is at the west base, just north of the Butahu River. At Bambumé's village, 4050 feet, just south of the Butahu, it ranged from 62° to 87° (November 9 to 13, a wet period). The maximum of 87° may be a little too high, the thermometer being hung beneath a tent.

Going up the mountain, we found the temperature in the tent at Kalongi, 6900 feet in the Butahu Valley, 56°–82° F. (November 17 to 19, a wet period). Later on, in a grass hut at Kalongi, the thermometer varied from 51°–74° (December 6 to January 1, relatively dry weather).

On the Bugongo Ridge, at 8950 feet, it read 47°–68° F. (November 21–22; November 27–December 3). Higher up on the same ridge at a

spot called Mulungu, 12,000 feet, the readings were 32°–66.5° (November 22–26); but the usual low at night was 36°. At Iteréré, 13,800 feet, temperatures of 33.5°–53.5° were taken at various times on November 23, 25, 26, January 2, 5; but frost formed regularly at night. At 3 P.M. on November 25, when the thermometer registered 53.5° in the shade, it rose to 58.5° if exposed to sun.

I spent two nights on a mountain top at 14,900 feet, just west of Mt. Stanley. There water in our cooking pots froze each night, and the temperature at 1.30 P.M. on January 3 was 38.5° F. The sky was clouded over at the time. The following day, at the foot of a glacier just below Alexandra Peak, at 14,620 feet, the temperature was 39° at 1:05 P.M., with the sky partly clear. Here the temperature appears to fall little below freezing at night, for there was a pond with only thin pieces of ice floating on it. But the diurnal temperature probably does not rise much above 44°.

The climate of the Kivu Volcanoes is closely similar to that of Ruwenzori, with perhaps a little less rainfall and a more important dry period in July and August. I visited them in June, when the rains were still on, and was caught in a heavy hail-storm near the summit of Mt. Mikeno. Some idea of the amount of rain that falls near 11,000 feet may be gained from the record taken by Raddatz.<sup>1</sup> Between November 24 and December 18 rain fell on 15 days, but amounted to only 63.1 mm., or 2.48 inches. At this rate the precipitation for a month would be about 3.1 inches. Since the observations were made in a rainy period, the year's total would scarcely be ten times greater, or 31 inches. This bears out my contention that the amount of rain at high altitudes is not very great. Near the base of the same mountains, at Ruasa, 56¼ inches have been noted in a year.

For comparison with the temperatures taken on Ruwenzori, I can give a few from the Kivu. At Rutshuru, 4190 feet, April 18–27 and May 20–31, 63°–83° F.; on the northwest slope of Mt. Mikeno in forest at 7900 feet, June 23–28, 36.5°–84°; at Kabara camp between Mikeno and Karisimbi, 11,000 feet, June 8–11, 14–20, 32.9°–68°; Lukumi camp, 12,000 feet on Mt. Karisimbi, June 12–14, 33.8°–57.2°. At the summit of Karisimbi, 14,800 feet, at noonday on June 13, the temperature was 40° with sun not visible, no snow on ground.

Although the temperature at 11,000 and 12,000 feet did not fall below 32.9° at 5 feet above the ground, hoar-frosts were of common occurrence at both camps during our visit.

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<sup>1</sup>Mary L. Jobe Akeley, 1929, 'Carl Akeley's Africa,' p. 309.

RAINFALL OF THE BELGIAN CONGO IN INCHES: NORTHERN SAVANNAS

	Yrs.	Lat.	Long.	Alt.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Tot.
Duma <sup>1</sup>	1	3°50'N	18°48'E	1500	.47	1.34	2.17	2.40	6.06	3.98	5.16	9.57	5.55	5.75	3.39	.63	46.4
Mobaye <sup>2</sup>	1 $\frac{8}{12}$	4°22'N	21°10'E	1400	.16	1.73	3.94	5.71	5.08	9.57	4.72	9.13	10.51	8.35	4.84	.87	64.6
Yakoma <sup>3</sup>	$\frac{9}{12}$	4°5' N	22°25'E	1600	—	—	2.14	2.07	7.48	8.15	4.96	8.58	9.88	4.01	6.61	—	56.3*
Api <sup>4</sup>	4	3°43'N	25°27'E	2000	3.19	1.53	5.29	6.51	8.95	6.91	6.59	6.18	6.99	8.42	6.39	2.31	69.2
Uéré <sup>5</sup>	1	4°2'N	25°45'E	2200	.43	3.90	.24	7.13	7.36	7.24	4.76	9.61	10.43	14.92	7.21	.75	73.9
Niagara <sup>6</sup>	1 $\frac{19}{12}$	3°42'N	27°54'E	2330	.64	.51	3.80	5.48	6.44	4.27	3.44	6.06	4.29	7.07	4.67	.82	47.4
Aba <sup>7</sup>	1	3°51'N	30°15'E	3175	0	.94	1.52	3.46	5.37	6.26	3.96	4.37	5.06	5.43	2.54	.94	39.8
Mahagi <sup>8</sup>	6	2°21'N	31°0'E	5200	.13	2.98	2.11	4.88	5.77	3.62	3.87	4.50	8.16	6.38	6.44	1.52	50.3

\*Estimated.

<sup>1</sup>1915, Bulletin Agricole du Congo Belge, VI, p. 128.

<sup>2</sup>Hann, Julius, 1910, 'Handbuch der Klimatologie,' II, p. 82.

<sup>3</sup>Lancaster and Meuleman, 1898, 'Congrès Nat. d'Hygiène et Clim. Méd.,' Bruxelles, II, p. 293-294.

<sup>4</sup>1922, Bulletin Agricole du Congo Belge, XIII, p. 624.

<sup>5</sup>1915, Bulletin Agricole du Congo Belge, VI, p. 128.

<sup>6</sup>1922, Bulletin Agricole du Congo Belge, XIII, p. 624.

<sup>7</sup>1922, Bulletin Agricole du Congo Belge, XIII, p. 623.

<sup>8</sup>1922, Bulletin Agricole du Congo Belge, XIII, p. 622.

Additional data on rainfall in various parts of the Congo will be found in the Bulletin Agricole du Congo Belge, I, 1910, p. 299; V, 1914, p. 419; XV, 1924, pp. 376-385; XVI, 1925, p. 352; XVII, 1926, pp. 275-289; XIX, 1928, p. 399; XX, 1929, pp. 165, 399; XXI, 1930, pp. 551-559, 659-663, 930, 1174.

RAINFALL OF THE BELGIAN CONGO IN INCHES: EQUATORIAL FOREST

	Yrs.	Lat.	Long.	Alt.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Tot.
Ganda-Sundi <sup>9</sup>	4	4°51'S	12°53'E	650	6.18	9.31	8.70	8.38	5.64	0	.007	.17	.29	2.37	8.64	5.16	54.8
Lukolela <sup>10</sup>	1	1° 5'S	17°11'E	1100	3.90	5.71	5.63	3.35	7.01	.71	2.60	.87	3.27	9.57	9.84	9.84	62.3
Irebu <sup>11</sup>	2 $\frac{9}{12}$	0°36'S	17°48'E	1110	6.49	3.82	11.10	5.82	3.46	3.50	4.80	5.28	6.69	9.48	7.67	4.41	72.5
Eala <sup>12</sup>	1	0°	18°22'E	1200	3.24	10.06	4.48	5.56	5.83	4.62	4.46	2.69	12.92	13.44	7.94	5.68	80.9
Nouvelle-Anvers <sup>13</sup>	1 $\frac{10}{12}$	1°36'N	19°9'E	1230	4.09	3.46	4.09	5.55	6.18	4.17	6.29	6.29	6.26	6.61	2.75	9.38	65.1
Musa <sup>14</sup>	1	2°40'N	19°30'E	1400	.77	1.04	0	3.23	1.42	5.56	3.39	11.58	9.67	12.63	4.11	2.84	56.2
Likimi <sup>15</sup>	1	2°50'N	20°30'E	1400	.95	3.23	2.95	10.11	4.46	7.14	8.35	13.34	9.76	7.46	4.90	.68	73.3
Yambata <sup>16</sup>	1	2°26'N	22° 5'E	1300	5.86	1.14	3.55	9.35	6.35	2.78	2.87	12.21	7.10	7.15	6.07	.48	64.9
Dundu-Sana <sup>17</sup>	1	2°55'N	22°25'E	1600	1.89	1.65	2.72	11.21	3.88	3.96	3.31	6.30	7.70	11.82	5.81	.66	60.9
Mobwasa <sup>18</sup>	5	2°38'N	23° 8'E	1600	2.67	3.44	4.26	8.52	7.45	4.85	4.53	7.84	5.55	8.75	6.22	1.34	65.4

<sup>9</sup>1914, Bulletin Agricole du Congo Belge, V, p. 218.

<sup>10</sup>1915, Bulletin Agricole du Congo Belge, VI, p. 126.

<sup>11</sup>Knox, 1911, 'The Climate of the Continent of Africa,' p. 242.

<sup>12</sup>1912, Bulletin Agricole du Congo Belge, III, p. 649.

<sup>13</sup>Knox, 1911, 'The Climate of the Continent of Africa,' p. 242.

<sup>14</sup>1912, Bulletin Agricole du Congo Belge, III, p. 649.

<sup>15</sup>1912, Bulletin Agricole du Congo Belge, III, p. 650.

<sup>16</sup>1912, Bulletin Agricole du Congo Belge, III, p. 650.

<sup>17</sup>1912, Bulletin Agricole du Congo Belge, III, p. 650.

<sup>18</sup>1923, Bulletin Agricole du Congo Belge, XIV, p. 205.

## RAINFALL OF THE BELGIAN CONGO IN INCHES: EQUATORIAL FOREST

	Yrs.	Lat.	Long.	Alt.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Tot.
Barumbu <sup>19</sup>	11	1°14'N	23°32'E	1350	2.66	3.23	4.97	6.87	6.48	6.12	6.29	5.93	7.46	7.10	6.51	4.53	68.1
Basoko <sup>20</sup>	1½/2	1°13'N	23°39'E	1350	2.16	3.66	6.02	6.10	3.46	7.40	6.29	4.44	6.73	3.35	6.02	4.37	60.0
Bomane <sup>21</sup>	2	1°15'N	23°45'E	1350	4.18	2.33	9.28	4.80	8.16	6.81	4.87	3.58	4.51	6.72	6.96	2.73	64.9
Bondo <sup>22</sup>	4	3°48'N	23°47'E	1700	1.57	1.17	2.37	5.00	4.89	4.29	3.72	3.80	6.16	4.81	5.01	1.40	47.1
Moganjo <sup>23</sup>	3	1°20'N	24°20'E	1400	5.05	2.23	3.40	5.90	8.60	2.45	5.53	5.18	6.92	6.57	7.89	1.89	61.6
Yangambi <sup>24</sup>	11	0°45'N	24°34'E	1380	3.61	3.35	5.59	5.72	6.08	4.91	4.36	4.70	7.96	8.13	6.37	3.93	64.7
Gazi <sup>25</sup>	12	1° 6'N	24°33'E	1400	2.65	3.81	4.86	8.25	7.23	5.48	5.74	5.31	8.51	8.36	8.47	4.00	72.6
Buta <sup>26</sup>	2½/2	2°47'N	24°47'E	1476	.82	2.17	4.54	8.08	10.51	5.30	5.40	7.75	6.41	10.01	5.56	1.91	68.4
Opala <sup>27</sup>	4	0°53'S	24°29'E	1400	4.44	5.34	10.00	10.09	4.93	4.43	5.26	9.71	11.25	8.14	9.37	8.25	91.2
Romée <sup>28</sup>	1	0°38'N	24°49'E	1400	6.17	0	3.20	8.84	4.77	6.82	2.38	2.31	2.50	8.94	12.54	2.42	60.8
Avakubi <sup>29</sup>	9	1°20'N	27°34'E	1925	1.26	3.54	6.58	8.19	7.63	6.50	3.66	7.29	6.56	7.58	6.16	3.20	68.1
Nala <sup>30</sup>	1	2°52'N	27°38'E	2500	.27	1.07	5.80	7.74	3.83	11.52	5.83	10.37	8.53	8.83	6.57	.62	70.9

<sup>19</sup>1923, Bulletin Agricole du Congo Belge, XIV, p. 437-438.

<sup>20</sup>Knox, 1911, 'The Climate of the Continent of Africa,' p. 242.

<sup>21</sup>1923, Bulletin Agricole du Congo Belge, XIV, p. 440.

<sup>22</sup>1922, Bulletin Agricole du Congo Belge, XIII, p. 625.

<sup>23</sup>1923, Bulletin Agricole du Congo Belge, XIV, p. 440.

<sup>24</sup>1923, Bulletin Agricole du Congo Belge, XIV, pp. 605-606.

<sup>25</sup>1923, Bulletin Agricole du Congo Belge, XIV, pp. 442-443.

<sup>26</sup>1923, Bulletin Agricole du Congo Belge, XIV, p. 211.

<sup>27</sup>1923, Bulletin Agricole du Congo Belge, XIV, p. 439.

<sup>28</sup>1912, Bulletin Agricole du Congo Belge, III, p. 651.

<sup>29</sup>1923, Bulletin Agricole du Congo Belge, XIV, pp. 208-209.

<sup>30</sup>1922, Bulletin Agricole du Congo Belge, XIII, p. 623.

## RAINFALL OF THE BELGIAN CONGO IN INCHES: SOUTHERN SAVANNAS

	Yrs.	Lat.	Long.	Alt.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Tot.
Banana <sup>31</sup>	6	6° S	12°27'E	6	4.54	4.85	4.88	9.55	2.57	.01	0	.31	.19	2.15	10.22	4.31	43.5
Boma <sup>32</sup>	2	5°51'S	13°6'E	33	2.44	2.12	4.80	6.37	1.39	.06	0	.07	.67	2.39	7.39	7.87	35.5
Vivi <sup>33</sup>	1½ <sub>12</sub>	5°45'S	13°31'E	370	3.62	1.42	5.67	9.09	1.94	0	.03	0	.02	.51	11.33	8.93	42.5
Congo da Lemba <sup>34</sup>	1	5°40'S	13°42'E	1066	.88	.92	6.50	3.76	.72	.03	.08	.03	.43	1.81	11.32	16.75	43.2
Kitobola <sup>35</sup>	6	5°23'S	14°36'E	1540	3.57	4.10	6.69	8.66	3.99	.27	0	.03	.93	4.18	7.71	8.13	48.2
Leopoldville <sup>35</sup>	2½ <sub>12</sub>	4°19'S	15°15'E	1115	6.30	4.88	7.36	7.04	4.29	.55	.02	.04	2.16	5.35	11.49	8.42	57.9
Dolo <sup>37</sup>	1	4°20'S	15°22'E	1150	2.71	3.96	10.86	0	3.24	0	0	.03	.67	4.72	7.80	5.97	39.9
Bolobo <sup>38</sup>	4	2°10'S	16°16'E	1080	5.00	6.97	4.61	7.17	5.63	.39	.04	2.68	3.78	6.54	9.57	10.24	62.6
Luluabourg <sup>39</sup>	2½ <sub>12</sub>	5°56'S	22°18'E	2000	7.17	5.43	7.95	6.06	3.07	.15	.12	2.48	6.45	6.57	8.70	6.61	60.7
Lusambo <sup>40</sup>	10 <sub>12</sub>	4°58'S	23°26'E	1600	8.22	7.51	8.50	5.51	3.92	—	—	2.04	6.14	5.86	8.38	9.84	66.0*
Sankisia <sup>41</sup>	1	9°19'S	25°50'E	2150	7.50	11.47	8.69	3.04	0	0	0	0	0	4.51	9.86	3.18	48.2
Kasongo <sup>42</sup>	1	4°32'S	26°36'E	1800	8.27	4.53	6.69	6.34	5.35	0	0	1.18	1.22	5.28	5.75	5.70	50.3
Kabambare <sup>43</sup>	1	4°41'S	27°44'E	2800	8.98	6.61	9.17	8.27	4.57	.98	0	0	.71	5.75	6.73	10.16	61.9

\*Estimated.

<sup>31</sup>1914, Bulletin Agricole du Congo Belge, V, p. 369.

<sup>32</sup>1912, Bulletin Agricole du Congo Belge, III, p. 648; 1915, Bulletin Agricole du Congo Belge, VI, p. 126.

<sup>33</sup>Knox, 1911, 'The Climate of the Continent of Africa,' p. 242.

<sup>34</sup>1912, Bulletin Agricole du Congo Belge, III, p. 648.

<sup>35</sup>1912, Bulletin Agricole du Congo Belge, III, p. 648; 1915, idem, VI, p. 6.

<sup>36</sup>Knox, 1911, 'The Climate of the Continent of Africa,' p. 242.

<sup>37</sup>1912, Bulletin Agricole du Congo Belge, III, p. 649.

<sup>38</sup>Hann, 1910, 'Handbuch der Klimatologie,' p. 82.

<sup>39</sup>Knox, 1911, 'The Climate of the Continent of Africa,' p. 242.

<sup>40</sup>Knox, 1911, 'The Climate of the Continent of Africa,' p. 242.

<sup>41</sup>Rodhain, J., et al, 1913, 'Rapport sur les Travaux de la Mission Scientifique du Katanga,' Bruxelles, p. 52.

<sup>42</sup>1915, Bulletin Agricole du Congo Belge, VI, p. 127.

<sup>43</sup>1915, Bulletin Agricole du Congo Belge, VI, p. 127.

## RAINFALL OF THE BELGIAN CONGO IN INCHES: EASTERN HIGHLANDS

	Yrs.	Lat.	Long.	Alt.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Tot.
Nioka <sup>44</sup>	2	2° 3'N	30°34'E	5700	.86	1.09	3.51	4.34	3.94	4.02	4.71	5.48	4.46	4.09	5.67	.93	43.1
Fort Portal <sup>45</sup>	5	0°40'N	30°18'E	4800	1.30	3.19	5.75	5.59	5.59	4.09	2.87	4.29	8.03	8.90	5.83	1.97	57.4
Ruasa <sup>46</sup>	1	1°32'S	29°42'E	6068	2.64	3.62	6.91	9.00	8.12	.24	.67	3.11	2.55	8.49	6.42	4.46	56.2
Bobandana <sup>47</sup>	3 $\frac{7}{12}$	1°40'S	29° 2'E	5032	6.59	3.52	4.59	11.0	10.07	2.09	1.27	1.97	5.24	7.12	5.47	4.20	63.1
Kigali <sup>48</sup>	1	1°58'S	30° 3'E	4756	2.73	7.34	5.01	6.72	4.96	.22	.08	.79	3.29	6.92	6.55	3.85	48.4
Nyalukemba <sup>49</sup>	1	2°30'S	28°51'E	5400	6.53	3.94	10.16	6.57	3.27	.39	0	.83	1.89	6.85	5.55	5.00	50.9
Isavi <sup>50</sup>	1	2°33'S	29°46'E	5766	2.95	6.24	4.51	6.74	5.38	.77	.11	1.29	3.55	5.41	7.44	2.48	46.8
Usumbura <sup>51</sup>	1 $\frac{1}{12}$	3°23'S	29°21'E	2624	3.87	8.83	3.28	6.42	2.02	.56	0	0	2.19	5.75	3.54	—	40.1*
Baudouinville <sup>52</sup>	2	7° 3'S	29°43'E	3700	9.98	5.90	7.97	13.19	2.52	0	.04	0	.14	1.67	8.62	17.26	67.3
Mutambala <sup>53</sup>	2	7°13'S	29°45'E	4920	3.53	5.63	5.08	3.66	.73	.04	.04	.69	.53	1.33	5.35	4.69	31.3
Lukafu <sup>54</sup>	1	10°30'S	27°30'E	3280	7.17	9.53	7.09	1.93	.16	0	0	0	.01	1.57	6.89	9.33	43.6
Kambove <sup>55</sup>	6	10°51'S	26°37'E	4500	9.33	8.64	6.41	3.38	.13	0	.01	0	.20	2.93	6.50	10.88	48.4
Elisabethville <sup>56</sup>	4	11°40'S	27°28'E	4059	9.30	10.30	9.46	1.31	.52	0	0	0	.29	.49	4.00	11.38	47.0
Munama <sup>57</sup>	4	11°46'S	27°28'E	4000	7.86	9.64	6.25	3.45	.03	0	0	0	.10	.44	4.70	9.98	42.4

\*Estimated.

<sup>44</sup>1922, Bulletin Agricole du Congo Belge, XIII, p. 621.

<sup>45</sup>Hann, J., 1910, 'Handbuch der Klimatologie,' II, p. 164.

<sup>46</sup>Heidke, P., 1914, Mitteilungen aus den Deutschen Schutzgebieten, pp. 104-105.

<sup>47</sup>Barns, T. A., 1922, 'The Wonderland of the Eastern Congo,' p. 277.

<sup>48</sup>Heidke, P., 1914, Mitteilungen aus den Deutschen Schutzgebieten, pp. 105-106.

<sup>49</sup>Heidke, P., 1914, Mitteilungen aus den Deutschen Schutzgebieten, pp. 102-103.

<sup>50</sup>1911, Bulletin Agricole du Congo Belge, II, p. 559.

<sup>51</sup>1915, Bulletin Agricole du Congo Belge, VI, pp. 130-134.

<sup>52</sup>1915, Bulletin Agricole du Congo Belge, VI, p. 127.

<sup>53</sup>1910, Bulletin Agricole du Congo Belge, I, p. 318.

<sup>54</sup>1915, Bulletin Agricole du Congo Belge, VI, pp. 123-124; 1916, Bulletin Agricole du Congo Belge, VII, pp. 353-354.

## SUMMARY

The climate of any particular locality in the Congo is determined by its position with reference to the equator, its altitude above sea level, and to a smaller degree by proximity to the sea or to high mountains. Within the limits of the Belgian Congo the climate varies from humid tropical to frozen alpine; but while there are a few relatively dry areas, there is nothing approaching a desert.

Temperature alone seems to exert no marked influence on the distribution of animal and plant life until an elevation of 5000 feet is reached. The abundance and seasonal distribution of rains in the lowlands, on the other hand, do affect the distribution of plants and birds.

On mountains above 5000 feet the climate is not only cooler, but often more humid than in adjacent lowlands. Within four degrees of the equator this humidity is especially noticeable. At levels above 11,000 feet the cold and fog are extreme, but the amount of water actually precipitated seems not to be very great.

The resident birds of Africa are responsive to local climatic conditions. The faunal areas which will be recognized differ in the amount and distribution of rains, and sometimes in temperature. In the lowlands of the Congo, however, the climate seems to affect the birds mainly through the vegetation which it determines.

On the higher mountains both temperature and humidity account for the successive floral zones. Such altitudinal plant formations, in turn, harbor their characteristic birds. It is probable that mountain-dwelling birds dislike the heat of the lowlands, while the majority of lowland birds avoid the cold of altitudes above 6000 feet.

The reproduction of indigenous birds is timed so as to take advantage of weather conditions; and finally the migrations of many African species are originated and regulated in response to peculiarities of the local climate.

From all that has been said of the seasonal changes in tropical Africa, it will be seen what varied weather the migrant birds from Europe and Asia are likely to encounter in their winter quarters here. If they stop north of four degrees their winter will be a season of drought, save that many of them arrive in the Uelle district just before the end of the rains or even at the time when they are about at their height. Nearer the equator the weather is more variable, and in the southern Congo the rains are beginning. To what extent the limits of their migrations are determined by the weather it would be interesting to study; but it does seem as though the mere presence of a great forest in western

and central Africa was more a barrier to these northern visitors than the matter of seasonal rains, for many of them go farther south in eastern Africa, where there is little or no forest. Climate affects them most noticeably through its influence upon the vegetation.

CHAPTER IV.—FAUNAL RELATIONS AND SUBDIVISIONS OF THE CONGO

ZOÖLOGICAL DIVISIONS OF AFRICA

Ever since the middle of the last century, when the zoögeography of Africa began to be appreciated, it has been customary to separate the western portion as a special province or subregion. As early as 1853, Schmarda<sup>1</sup> divided the African continent (with the exception of its northern edge, lying within his Mediterranean realm) into three realms (Reich). First was the "Sahara, realm of Melasomes [apparently a group of beetles] and of the Ostrich"; second, "West Africa, realm of the narrow-nosed monkeys and of termites"; third, and last, "High Africa, the realm of ruminants and pachyderms." Madagascar was taken as a distinct realm from the continent and called that of the lemurs.

Schmarda's West Africa was approximately equivalent to the "Upper Guinea" of to-day, but the unexplored nature of all equatorial Africa in his time is amply sufficient to explain the absence of any reference to the larger area later to be annexed to the West Africa of zoögeographers. He clearly appreciated the main peculiarity of this territory, for "the soil and climatic conditions," he said, "recall India and the Sunda region more than they do the adjoining African highland. A prime characteristic is the important forests, alternating with savannas and cultivated lands; the Guinea coast particularly is a vast unbroken forest" (p. 273). His remarks on the characteristic West African mammals are of more worth than those concerning the birds, where he mentioned especially the crowned eagle (*Stephanoaëtus coronatus*), *Musophaga violacea*, *Macrodipteryx africanus* (= *longipennis*), and the genera *Prionops* and *Merops*. The rarity of vultures, upon which he remarked, was much more to the point; and it is only in the appendix (p. 459) that we find some nine species of birds restricted to forested West Africa. They are scattered among a great number of names that are not at all diagnostic.

Two years later, Dr. Pucheran<sup>2</sup> called attention to the same distinct zoölogical region in West Africa under the name "Zone australe du centre de l'Afrique." Hartlaub's conception of West Africa,<sup>3</sup> however, included not only this southern zone of Pucheran, but also a portion of his northern zone of central Africa, where it reached the western coast in Senegambia. Thus, in his classic treatise on the birds of western Africa, Hartlaub considered that West Africa "as a zoological province includes

<sup>1</sup>1853, 'Die Geographische Verbreitung der Thiere,' II, pp. 249-286, 457-475.

<sup>2</sup>1855, 'Esquisse sur la Mammalogie du Continent Africain,' Rev. Mag. Zool., Paris, p. 209.

<sup>3</sup>1857, 'System der Ornithologie Westafrika's,' p. xi.

Senegambia and Guinea in the widest sense of the [latter] word," and he proposed to describe the birds of the coastal regions from 16° north to 16° south, thus overstepping considerably the limits we would now assign to the subregion. At that time, as Hartlaub himself stated, it was only the species of the coastal region that were really known.

P. L. Sclater, in 1875,<sup>1</sup> extended the subdivision of western Africa from the Senegal to the Congo; but Wallace's classical work<sup>2</sup> depicted the West African subregion as stretching eastward "as far as the sources of the upper Nile and the mountains forming the western boundary of the basin of the great lakes. . . Its southern limits are undetermined, but are probably somewhere about the parallel of 11° S. Latitude." This statement was surprisingly accurate, even more so than the plate forming the frontispiece of his volume I, which did not place the inland border far enough east. Wallace's plates do explain how the western subregion is largely encircled by the eastern. The latter is properly shown extending across the Sudan to the Niger bend and the Senegal, separating the forest subregion from the desert. As a boundary between the Ethiopian and Palæarctic regions he chose the tropic of Cancer, only three and one half degrees north of the line which Hartert,<sup>3</sup> judging from Buchanan's collection from Air, adopted as the northern limit of the Ethiopian avifauna in the western Sahara.

Ornithological collections made in the region of Lake Tanganyika prompted Reichenow in 1886<sup>4</sup> to offer a brief criticism of Wallace's divisions. No sharp distinction was shown by the birds, at least, between South Africa and East Africa, which had been considered as separate subregions. The West, on the other hand, was marked by far more important differences. There lived the gray parrot, and the red-and-black weavers (*Malimbus*); a thick exuberant vegetation covered the land, and even where this primeval forest gave place to more open grasslands, the latter were always interrupted by copses and timbered watercourses. The ostrich, the secretary bird, and the multitude of francolins were characteristic only of the eastern and southern region of plains. Bohn-dorff's collections had previously shown how the western bird fauna prevailed as far into central Africa as the land of the Niam-Niam. Now Böhm's material brought it to Lake Tanganyika. Reichenow remarked that the designations western and eastern could better be replaced by "forest fauna" and "steppe fauna." In our opinion Professor Reichenow

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<sup>1</sup>1875, 'On the Present State of Our Knowledge of Geographical Zoology,' Presidential Address delivered to the Biological Section of the British Association, Bristol, August 25.

<sup>2</sup>1876, 'The Geographical Distribution of Animals,' I, pp. 251-313.

<sup>3</sup>1921, *Novitates Zoologicae*, XXVIII, p. 79.

<sup>4</sup>1886, *Journal für Ornithologie*, pp. 396, 397.

himself went a little too far, for he included the Upper Katanga and the whole region of Lake Bangweolo in his western subregion.

Here a word may not be amiss as to how the position of this borderline was determined. In zoölogy, as in botany, it was placed at the extreme limit of distribution of a number of characteristic western forest species. It is not the border of the unbroken rain forest, for in many places these plants and animals range out for 150 to 400 miles, in isolated strips or patches of forest. In coming southward from the Bahr-el-Ghazal, as Wallace tells us (p. 262), Dr. Schweinfurth determined the limits of the subregion at the point where he crossed the watershed between the Nile tributaries and those of the Uelle, in  $4\frac{1}{2}^{\circ}$  N. lat. and  $28\frac{1}{2}^{\circ}$  E. long. He noted a sudden change in the character of the vegetation, which to the southward of this point assumed a West African character. Here also the chimpanzee and gray parrot first appeared, and certain species of plants elsewhere known only in western Africa. Even at the southernmost point of his journey, among the Mangbetu, Schweinfurth had not reached the edge of the uninterrupted forest.

Emin Pasha<sup>1</sup> also discerned the same frontier, and remarked upon the way the line of demarcation inclined from northwest to southeast, extending much farther north in the Azande country of the southern Bahr-el-Ghazal than it did near the upper White Nile or Bahr-el-Jebel.

The rather simple map subsequently presented by Professor Reichenow,<sup>2</sup> with two subregions, may be contrasted with Dr. R. B. Sharpe's,<sup>3</sup> with seven subregions, and two provinces in South Africa. There are two outstanding features of Dr. Sharpe's treatment: first, his emphasis of the break between the two parts of the forest district at Accra, "where the Sudanese Sub-Region breaks through to the coast"; and second, his establishment of a "Victorian or Camaroonian Sub-Region" to include the elevated mountains of central East Africa and the peaks of the Cameroons, which exhibit certain faunal elements in common. The West African area in this map is extended too far to the eastward of Lake Tanganyika, and not far enough into Uganda.

The two subregions of Professor Reichenow were not, however, treated as indivisible. Instead, they comprised no less than thirteen minor districts, of which five made up the western portion. Upper Guinea showed a western and an eastern area. Lower Guinea furnished three such divisions: first, the Cameroon and Gaboon, exclusive of the

<sup>1</sup>1888, 'Emin Pasha in Central Africa,' edited by Schweinfurth, Ratzel, Felkin, and Hartlaub, English translation, pp. 403-406.

<sup>2</sup>1900, 'Die Vögel Afrikas,' I, p. lxxxvi.

<sup>3</sup>1893, *Natural Science*, III, p. 108.

Loango Coast; second, the Lower Congo, with Angola and northern Benguela; third, the Central Lake Region—that part of the West African subregion which bordered on Lakes Victoria, Albert, Edward, and Kivu. In this third area, said Reichenow, the western species occurred together with eastern and northeastern.

The zoölogical richness of this "lake region" of Africa results from the mingling of faunas; within a comparatively short distance one may emerge from the equatorial forest into an East African grassy plateau, or just as suddenly into a cool mountain forest. In 1911, Professor Reichenow published a list of the birds then known from the lake region,<sup>1</sup> enumerating 750 forms, of which 130 were to be regarded as typically West African. About 100 of those remaining, the author admitted, were as typically East African, so the mixture of faunas can easily be appreciated. Instead of including the whole of Reichenow's lake region in West Africa, we find it necessary to draw our boundary directly through it, if we are not to cause a hopeless confusion of faunas. The montane fauna, while having a certain similarity to that of Fernando Po and Mount Cameroon, is far more East African in character than western, though it does contain forms undoubtedly derived from both sides.

The spreading of forest birds from the lowland forest up into the montane forest might be expected on the west side of Ruwenzori; but even Mt. Kenia, much farther east, has forest birds of such evident western affinities as *Lamprolaima olivacea akeleyorum*, *Nigrita canicapilla diabolica*, and *Eurillas latirostris saturata*. On the other hand, such species are always in the minority, even on Ruwenzori.

In the zoögeography of the Congo the limits of the western subregion are of fundamental import. The few parts of our territory not included within it show marked faunal differences which relate them much more closely with the eastern and southern subregion. The latter area, extending in the northwest to Senegal, encloses the forest subregion except along the west coast. The separation of a South African subregion by Wallace has not been justified by subsequent investigations, and has rightly been abandoned by Reichenow and other authorities, although we do find it renewed in a recent work by Dahl.<sup>2</sup> His West African province extends much too far to the southeast, and also to the north, where we find it abutting directly on the desert of Sahara. For vertebrates, at least, the number of East African forms extending across the Sudan to the Niger and Senegal shows this arrangement to be faulty.

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<sup>1</sup>Reichenow, 1911, 'Wiss. Ergeb. D. Zentr.-Afr.-Exp. 1907-8, Mecklenburg,' III, pp. 232-374.

<sup>2</sup>F. Dahl, 1921, 'Grundlagen einer Ökologischen Tiergeographie.'

As characteristic birds of West Africa, Wallace mentioned about twenty-six genera, a much better assortment than that of Schmarada, yet wrongly including *Palæornis* and a few others not at all typical in the light of present knowledge. Reichenow, too, has given a more authoritative list of such "indicators" for the western fauna, composed of thirty-nine genera. From Reichenow's list I have selected the best examples, adding five more to them, as indicated by asterisks.

<i>Tigriornis</i>	<i>Ortholophus</i> (= <i>Tropicranus</i> )	<i>Dyaphorophyia</i>
<i>Pteronetta</i>	* <i>Ceratogymna</i>	<i>Stizorhina</i>
<i>Dryotrionchis</i>	<i>Trachylæmus</i>	<i>Fraseria</i>
<i>Urotriorchis</i>	<i>Gymnobucco</i>	<i>Picathartes</i>
<i>Phasidus</i>	* <i>Melignomon</i>	<i>Pseudochelidon</i>
<i>Himantornis</i>	* <i>Melichneutes</i>	<i>Malimbus</i>
<i>Corythæola</i>	<i>Verreauxia</i>	* <i>Brachycope</i>
<i>Psittacus</i>	<i>Ixonotus</i>	<i>Pholidornis</i>
<i>Myioceyz</i>	<i>Lobotos</i>	<i>Parmoptila</i>
<i>Meropogon</i>	* <i>Stiphornis</i>	<i>Spermospiza</i>

In many cases, species will serve this purpose better than whole genera. Of such West African species the name is legion. Some of them, not included in the foregoing genera, so nearly occupy the whole sub-region, or its forested areas, as to deserve special mention:

<i>Lampribus rara</i>	<i>Pogoniulus erythronotos</i>
<i>Accipiter erythropus</i>	<i>Buccanodon duchaillui</i>
<i>Francolinus lathamii</i>	<i>Campethera permista</i>
<i>Sarothrura pulchra</i>	<i>Campethera caroli</i>
<i>Podica senegalensis</i>	<i>Campethera nivosa</i>
<i>Anomalophrys superciliosus</i>	<i>Smithornis rufolateralis</i>
<i>Calopelia puella</i>	<i>Smithornis sharpei</i>
<i>Turturæna iriditorques</i>	<i>Andropadus curvirostris</i>
<i>Cercococcyx mechowii</i>	<i>Bæopogon indicator</i>
<i>Cercococcyx olivinus</i>	<i>Trichophorus calurus</i>
<i>Chrysococcyx flavigularis</i>	<i>Bleda ezimia</i>
<i>Centropus leucogaster</i>	<i>Bleda syndactyla</i>
<i>Agapornis swinderniana</i>	<i>Nicator chloris</i>
<i>Eurystomus gularis</i>	<i>Cyanograucalus azureus</i>
<i>Halcyon badia</i>	<i>Hylia prasina</i>
<i>Alcedo quadribrachys</i>	<i>Eremomela badiceps</i>
<i>Corythornis leucogaster</i>	<i>Bessonornis cyanocampter</i>
<i>Melittophagus gularis</i>	<i>Neocossyphus poensis</i>
<i>Lophoceros camurus</i>	<i>Geokichla princei</i>
<i>Lophoceros hartlaubi</i>	<i>Trochocercus nitens</i>
<i>Bubo leucostictus</i>	<i>Fraseria ocreata</i>
<i>Chætura sabini</i>	<i>Hirundo nigrita</i>
<i>Pogoniulus scolopaceus</i>	<i>Dicrurus atripennis</i>
<i>Pogoniulus subsulphureus</i>	<i>Laniarius leucorhynchus</i>

*Parus funereus*  
*Oriolus nigripennis*  
*Pæoptera lugubris*  
*Oriolus brachyrhynchus*  
*Onychognathus fulgidus*

*Lamprocolius splendidus*  
*Cinnyris johannæ*  
*Cinnyris superbus*  
*Hyphanturgus aurantius*  
*Nigrita bicolor*

From the extensive information now available as to conditions in the Belgian Congo, we may state that the whole of the colony is to be included in the West African subregion, with the exception of the territory near the shores of Lake Tanganyika and the highlands along the eastern frontier and in the southeast (above 5000 feet within 5 degrees of the equator, or above 3500 feet in the Katanga). Some of these highlands resemble the elevated grasslands of parts of East Africa. Others, where the atmospheric precipitation is greater, are covered with mountain forest or alpine zones which are far more characteristic of the mountains of East Africa, and only paralleled in West Africa on a few highlands in the Cameroon and on Fernando Po.

A very narrow strip of land, immediately along the ocean front, would be recognized by botanists as a distinct coastal area; and since we do find along the beaches and in the estuaries a number of species that do not penetrate farther inland, being either of oceanic habits, or migrants along the seashore, I shall recognize such a coastal subdivision. It is understood that near the mouth of the Congo this consists only of the ocean beach, the mouth of the river, and perhaps also the creeks bordered with mangroves, where not a few of the inland birds are nevertheless to be found encroaching upon the area.

While our territory may thus be cut into two main divisions for zoögeographic purposes, a number of other subdivisions are both possible and advisable, on the basis of minor differences in the fauna, due to differences in climate and consequently in vegetation. From that part of the West African lowlands which is entirely covered with heavy forest are excluded many species of birds, which though they may be western types, are nevertheless found only in grasslands or along rivers and streams with open, not forested, banks. On the other hand, while many forest species have wandered out, or been left, in the gallery woods of the West African savannas, there are nevertheless many forest types of too exacting tastes to content themselves with any forest of such restricted size. It is these peculiarities of bird distribution that justify the further subdivision of the West African part of the Congo territory, for they express the difference between the birds met with in the central Congo forests, and those of the adjoining savanna countries at approximately

equal level above the sea. These differences in the vegetation, as we shall see, are mainly due to the amount of distribution of the rains, but in some places partially also to the agricultural activities of the natives, past and present.

To an even more pronounced degree, the "East African" parts of our territory may be divided into different faunal areas, because of the predominance of mountain forests (sometimes of bamboo, sometimes of dicotyledonous trees in the more humid situations) or short-grass plains in regions where the yearly droughts are more prolonged, or where perhaps the natives themselves have had a hand in altering their lands to serve as farms and pasturage. As the altitude in these eastern regions increases, there are also changes in temperature and humidity which produce altitudinal zones of vegetation that are equivalent to "life zones." A few of the highest mountains reach above the tree line, and bear an alpine vegetation even more weird in aspect than the Paramo of the northern Andes. These areas above the tree line are all of very restricted size, and the birds inhabiting them correspondingly few in species.

After making these avifaunal divisions of the Congo, I attempted to follow them into the adjacent countries and improve upon the maps of Wallace, Reichenow, and Sharpe. The results were published in the *American Naturalist*, LVII, 1923, pp. 106-125. To my great satisfaction they were favorably received, especially by Mr. G. L. Bates<sup>1</sup> and Admiral Lynes,<sup>2</sup> both of whom proposed desirable modifications. Mr. L. Lavauden<sup>3</sup> has found that the northern boundary of the Ethiopian Region is not a straight line along the 20th parallel, but bends strongly southward in the districts east and west of Air. Dr. Joseph Bequaert would call the faunal area of Benguella and Northern Rhodesia the Rhodesian highland district, instead of Angolan, since a large part of Angola lies outside its limits. To me the least satisfactory portion of my map is the South African. Further subdivision seems necessary there, especially in order to call attention to the high veld, the bush-veld, and the patches of cool forest scattered southward from Nyasaland through Gazaland to Natal. Whether the western Cape Province has characteristic birds in sufficient number to make it a distinct district, I am not quite sure.

The difficulty of expressing faunistic relations on a simple map is evident. Further subdivision is always possible; and in dealing with

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<sup>1</sup>1924, *Ibis*, pp. 3-5.

<sup>2</sup>1924, *Ibis*, p. 407, Pl. xiv, map 7; 1925, *idem*, pp. 761-775.

<sup>3</sup>1926, *Revue Française Orn.*, X, pp. 428-439.

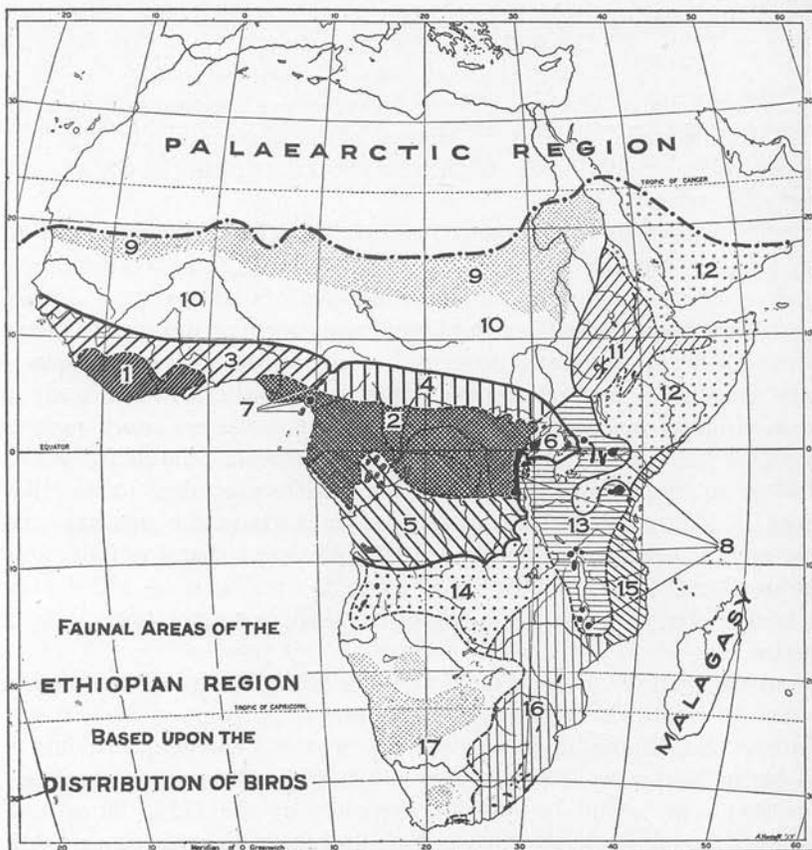


Fig. 18. These subdivisions of the Ethiopian Region are suggested by the ranges of many species and races of birds, and prove rather satisfactory for mammals and some other terrestrial animals.

#### I. WEST AFRICAN SUBREGION

##### A.—Guinean Forest Province

- |                                 |                                 |
|---------------------------------|---------------------------------|
| 1. Upper Guinea Forest District | 2. Lower Guinea Forest District |
|---------------------------------|---------------------------------|

##### B.—Guinean Savanna Province

- |                                  |                                    |
|----------------------------------|------------------------------------|
| 3. Upper Guinea Savanna District | 5. Southern Congo Savanna District |
| 4. Ubangi-Uelle Savanna District | 6. Uganda-Unyoro Savanna District  |

#### II.—EAST AND SOUTH AFRICAN SUBREGION

##### C.—Humid Montane District

- |                              |                             |
|------------------------------|-----------------------------|
| 7. Cameroon Montane District | 8. Eastern Montane District |
|------------------------------|-----------------------------|

##### D.—Sudanese Province

- |                           |                               |
|---------------------------|-------------------------------|
| 9. Sudanese Arid District | 10. Sudanese Savanna District |
|---------------------------|-------------------------------|

##### E.—Northeast African Province

- |                                  |                          |
|----------------------------------|--------------------------|
| 11. Abyssinian Highland District | 12. Somali Arid District |
|----------------------------------|--------------------------|

##### F.—Eastern and Southern Province

- |                                    |                             |
|------------------------------------|-----------------------------|
| 13. East African Highland District | 16. Southwest Veld District |
| 14. Rhodesian Highland District    | 17. Southwest Arid District |
| 15. East African Lowland District  |                             |

special portions of the continent, it is desirable. In treating of the birds of the Congo, for example, I shall distinguish between the forests of the Lower and Upper Congo. But in trying to cover the whole continent this seemed superfluous.

## FAUNAL AREAS AND LIFE ZONES OF THE CONGO

### GENERAL OUTLINES

On the known distribution of birds and mammals in the Congo we have based the following subdivision of the territory into faunal areas. The limits will be more readily appreciated by reference to the map (Fig. 19), and it will be apparent at once how nearly they coincide with the floral areas. We would place the limits of the West African subregion at about the same place as the botanists do, and restrict them slightly more than Reichenow (1900, 'Vögel Afrikas,' I, p. lxxxvi). The areas of mountain forest above 5000-6000 feet, as well as the higher alpine zones, will be considered as belonging to the East African subregion, and likewise the elevated grasslands of the Kivu district, Ruanda, and Urundi, as well as Marungu and the Upper Katanga above 3500 feet elevation.

The remainder of the Belgian Congo falls entirely within the West African subregion, but is divisible into five parts. Of these, the forests of the Lower Congo (especially the Mayombe) form the first; the other forests of the central and eastern regions (below 5000 feet), in so far as they are unbroken by savannas or natural grasslands, the second; the third and fourth being composed of the savannas north and south of the forest, which are separated in a marked degree by the great forest and the highlands to the east of it, while their rainy and dry periods are exactly reversed. In these Guinean savannas a certain number of forest birds are found in the "gallery forests." The northern part of the grasslands which occupy our eastern border, near Lake Albert and the Semliki River, as well as the shores of Lake Edward and the Rutshuru Plain, are reckoned as part of the same faunal area as Uganda and Unyoro, constituting the fifth and last area of our portion of the West African subregion.

The dividing line between this savanna area about Lakes Albert and Edward and the higher grasslands of the Kivu district, although difficult to draw sharply, lies in the neighborhood of Rutshuru. The two districts will be found to have not a few birds in common. However, the Kivu area has much less of West African affinity in its avifauna, and forms rather a part of the East African highland district. The plateaus

of the southeastern Congo, Marungu, and Upper Katanga, are related; but their more southerly position, which influences the seasons so markedly, as well as their faunistic resemblances to the adjacent districts of Rhodesia and Benguela, makes it advisable to distinguish an eighth faunal area, which is but a part of the Rhodesian highland district. In actual position, the humid montane area of the Congo lies between the

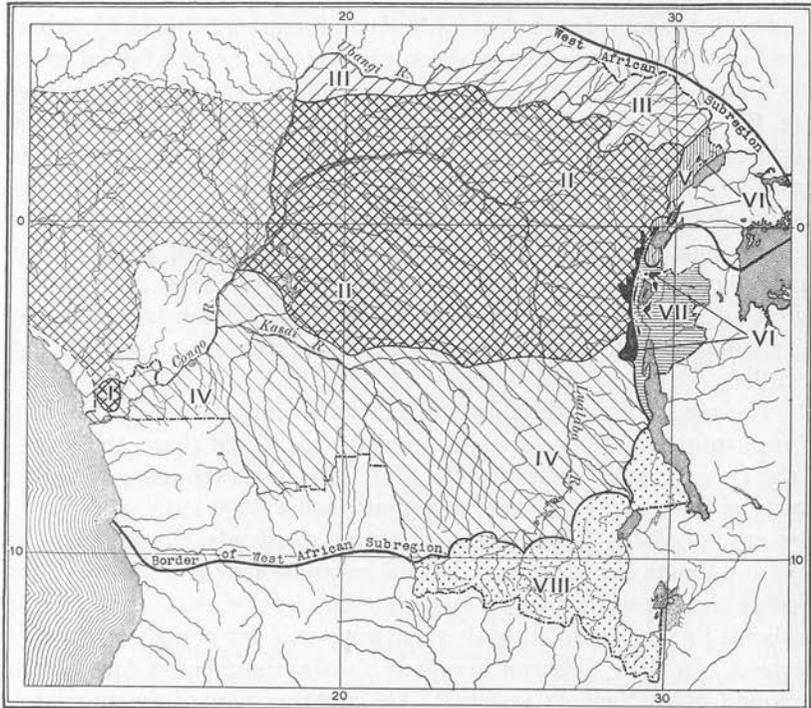


Fig. 19. Principal avifaunal areas of the Belgian Congo. The Roman numerals correspond to those in text.

eastern and western subregions; but in East Africa it is represented by many more isolated forest patches on the mountains.

Limiting ourselves strictly to Belgian territory, we may list the following faunal areas:

- A.—Atlantic Coastal Strip, including the ocean beaches and perhaps the mangrove, near the mouth of the Congo.
- B.—West African Subregion.
  - I. Rain forest of the Lower Congo
  - II. Rain forest of the Upper Congo

- III. Ubangi-Uelle savanna
  - IV. Southern Congo savanna
  - V. Uganda-Unyoro savanna, which enters the eastern border of the Congo near Lake Albert and Lake Edward.
- C.—Eastern and Southern Subregion.
- VI. Humid montane area of Ruwenzori, the Kivu district, and adjacent highlands
  - VII. Grasslands of the Kivu and northern Tanganyika
  - VIII. Plateaus of Marungu and Upper Katanga.

#### ALTITUDINAL DISTRIBUTION

Looking at the country from the point of view of altitudinal life zones, we are impressed with its general uniformity until near the equator an elevation of about 5000 feet is reached, or in the southeast, 3500 feet. In the wetter parts this is the lowest level of montane forests, in the drier parts it is the beginning of highland savannas. Only on the loftiest mountains can other higher zones be delimited. These are at once recognized by their vegetation, and they have characteristic birds and mammals.

Five thousand feet may be taken as the lower limit of the montane area on the Congo side of Ruwenzori and the western Kivu ridge, but the mountain forests do not always come so low. On the Uganda side of Ruwenzori, Scott Elliot<sup>1</sup> stated that the lower level was 7400 feet, while Woosnam<sup>2</sup> gave it as 6500 feet. Both these authors were thinking of the same side of the range, and the difference is to be ascribed to the fact that the forest comes much lower down in the valleys than it does on the more exposed ridges. Its border is decidedly irregular, even where the hand of man has not altered it.

In the Butahu Valley, on the west side of the mountain, it has been claimed, both by Scott Elliot and by Woosnam, that the zones come much lower down. Of course the situation is complicated by the fact that just to the northward there is an arm of the lowland rain forest extending up the slope of the mountain and meeting the montane forest; but this does not fill the Butahu Valley, where the montane forest appears to extend from about 6100 feet to 7500 feet. Above the true mountain forest come successive zones of bamboos, tree heaths, and then the senecio-lobelia zone, which gives way finally to the eternal snows. Varying altitudes have been given for the limits of these zones by travelers who ascended different parts of the mountain, as may be seen from the accompanying table:

<sup>1</sup>1896, 'A Naturalist in Mid-Africa,' pp. 137, 224.

<sup>2</sup>1909, *Trans. Zool. Soc. London*, XIX, pp. 13, 15.

	LOWER BORDER OF				
	FOREST	BAMBOOS	HEATHS	SENECIOS	SNOW
Mubuku Valley (Woosnam) <sup>1</sup>	6500 ft.	8500 ft.	10000 ft.	12500 ft.	14500 ft.
Mubuku Valley (Wollaston) <sup>2</sup>	7000	8500	9500	12500	14500
Butahu Valley (Stuhl- man) <sup>3</sup>	7260	8400	10150	12600	14200
Butahu Valley (Scott Elliot) <sup>4</sup>	6600	7600	8000		
Butahu Valley (Wollaston) <sup>5</sup>		7200	8500		
Butahu Valley (Woosnam) <sup>6</sup>		abt. 6000	abt. 8000	10000	abt. 13300
Northwest slope (Pilette) <sup>7</sup>	6900	7550	10800	12800	14760
"Average levels" (Scott Elliot) <sup>8</sup>	7400	8700	10000		15500

When I first assembled this table I was puzzled by its contradictions, but a visit to the western slopes of Ruwenzori has clarified matters. There is much irregularity in the borders of the vegetational zones. The lower edge of the mountain forest tends to recede on the ridges and to descend in ravines, so that tongues of forest near Bambumé's may reach down to 5000 feet. On some of the adjacent ridges the forest begins only at 7000 feet, where possibly it has been cut back by natives.

On the north side of the Butahu Valley, near the village of Ra-u, one enters the forest at about 6100 feet. Following this line northward across the Lusilubi Valley, I found that it drops perceptibly, and comes down along the Lusilubi to the very base of the mountains at 4500 feet. Near the Biangoro River the lowland forest extends up the slopes and fuses with the mountain forest.

For about twelve miles thereafter there is no grassland on the lower slopes. Close to the Luami River the grass reappears, and on the south side of this river there is a ridge where the mountain forest begins at 6500 feet. Long occupation by natives has doubtless destroyed the

<sup>1</sup>1909, *Trans. Zool. Soc. London*, XIX, pp. 13-23.

<sup>2</sup>1908, 'From Ruwenzori to the Congo,' pp. 278-285.

<sup>3</sup>1894, 'Mit Emin Pasha ins Herz von Afrika,' pp. 304-305.

<sup>4</sup>1896, 'A Naturalist in Mid-Africa,' p. 137.

<sup>5</sup>1908, 'From Ruwenzori to the Congo,' pp. 144-146.

<sup>6</sup>1909, *Trans. Zool. Soc. London*, XIX, p. 15.

<sup>7</sup>1914, 'A Travers l'Afrique Equatoriale,' p. 110.

<sup>8</sup>1896, 'A Naturalist in Mid-Africa,' p. 224.

forest for some distance downward, and the gorge of the Luami is forested down to a much lower level, except where cleared for farming. Northward of the Luami Valley all the lower slopes are grassy, and at the Buamba Pass the mountain forest on the west does not extend below 6900 feet, although it may descend to 5500 feet in ravines not far away.

On the whole, it is true that the mountain forest runs lower along the west side of Ruwenzori than on the east. Grass-fires started by the natives sweep rapidly up the steep sides of the mountains, and this is one of the greatest factors in the recession of the forest margin. The eastern side being drier, they do more damage there. Near Mt. Musandama, on the northeastern slope, there are now places where the grass grows right up to the lower edge of the bamboos. Destruction of the forest assures the disappearance of its most characteristic birds.

The bamboos, on Ruwenzori, are usually mingled with a variety of large trees, but there is a definite zone of bamboos save on some steep rocky slopes. The lower limit of bamboos is at about 7500 feet, I found, in the Butahu Valley, although there are patches of them at 7200 feet near Kalongi. The village owes its name to these bamboos, called "milongi." On the west side of the Buamba Pass, my companion Frank P. Mathews noted bamboos down to 7700 feet.

The upper limit of bamboos on the Bugongo Ridge, between Kalongi and Mt. Stanley, I found to be 9300 feet, but just along the crest of the ridge there are tree heaths here and there down to 8200 feet. So the varying figures given by other visitors are readily explained. The tree heaths often show a tendency to spread downward on ridges, and a more curious aptitude to range upward on ridges into the senecio zone. Just west of Mt. Stanley we entered the lowest extension of the senecio vegetation along a brook at 12,700 feet. Yet patches of heath trees extended up to 13,500 feet in the vicinity, and scattered trees to 13,800 feet.

The snow line on West Ruwenzori is certainly never as low as 14,500 feet. A few lobelias and tree-senecios, together with many immortelle bushes, grow almost up to 15,000 feet, and during my visit there was little snow below 15,200 feet.<sup>1</sup>

For the west side of Ruwenzori, near the Butahu, one may take the following altitudes as the lower margins of the vegetational zones:

- Mountain forest, 6100 feet (but lower in valleys)
- Bamboos, 7500 feet (in patches down to 7200)
- Tree heaths, 9300 feet (on ridges down to 8200)
- Open senecio growth, 12,700 feet (isolated plants grow lower among heaths)

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<sup>1</sup>The readings of my aneroids were corrected with observations by boiling point thermometer at every camp and at the foot of a glacier, so I am convinced that any error in the foregoing figures can scarcely exceed 150 feet.

In the Kivu district native agriculture and grazing appear to have worked havoc with the forest in many places. It is rare to find forests at 5000 feet, but where they do exist they harbor some montane species of birds. These birds are usually wanting in forest areas below 5000 feet, as in the Rutshuru Valley.

On the slopes of the volcanoes the mountain forest may commence at 6500 feet, or only toward 7000. The bamboos are not so well developed as on Ruwenzori, but their lower limit is close to 7500 feet, their upper limit 9600 feet. Tree heaths are never as abundant as on Ruwenzori, but grow between 9000 and 12,800 feet. A far more characteristic tree near these levels is *Hagenia abyssinica*, but it stops at 11,700 feet. The open senecio growth begins at about 12,000 feet, and only dwindles away on the highest summits. About the volcanoes the limits of the plant formations are less regular than on Ruwenzori, and many birds live regularly at higher levels among the hagenias than they do on Ruwenzori, where the tree heaths certainly offer less in the way of food.

Thus far, no attempt seems to have been made to define life zones for vertebrates other than the vegetational zones. Instead of being varied and abundant, as in many parts of the Andes, for instance, the bird fauna of Ruwenzori—despite its significance—is relatively restricted. In 1910, Ogilvie-Grant listed 20 species as peculiar to the Ruwenzori range, and six more which it shared with the Kivu Volcanoes. Since that time all but four of the forms he named have been found elsewhere, either in the Kivu district, or northwest of Baraka. Out of the four forms still restricted to Ruwenzori, scarcely one is more than subspecifically distinct from all allied forms. *Micropus maximus*, for example, is certainly only a race of *M. melba*; *Cinnyris stuhlmanni* is frequently regarded as a race of *C. afer*: and even *Cryptolopha (Seicercus) alpina* is now considered to be a subspecies of *S. umbrovirens*. *Bradypterus mild-breadi* Reichenow, while reported from Ruwenzori alone, is very probably the young of another member of the genus.

Practically all the birds of Ruwenzori are thus found elsewhere in Africa, especially in the neighboring mountains, the Kivu Volcanoes, the mountain forests of Ruanda and Urundi, or on the western Kivu chain. The total number of mountain species known from Congo territory, i. e., mainly restricted to areas above 5000 feet, I find to be about one hundred.

On Ruwenzori, as Woosnam stated, vertebrate animals are relatively scarce above the lower portion of the bamboo zone, though abundant from there down. As for the zones themselves, he says: "These divi-

sions must not be taken as hard and fast lines of difference, for the edges of the zones necessarily merge gradually one into the other. Examples of the characteristic vegetation of one zone may often be seen in the middle of the next, and there is always a difference between the altitudes of the zones as observed in valleys or on exposed ridges. . . . Although only a few of the birds were obtained on the west side, we saw and heard enough to enable us to say that all or nearly all the species which inhabit the east side above 6500 ft. are to be found also on the west." In the majority of cases this has been confirmed by the collections of Schubotz, of Pilette, and of Bequaert, as well as my own.

When we attempt to assign a list of characteristic birds to each of the floral zones, we find that the bamboo zone of Ruwenzori has almost no species which does not occur in the mountain forest just below it. The tree-heath zone, on the other hand, can boast of but one, a sunbird, which does not range either far above or below it. So from the zoölogical viewpoint it is better to unite the first two floral zones of the mountains in a single faunal zone, to be called the mountain forest or subtropical zone. In some areas of mountain forest, bamboos, though less regularly distributed than on Ruwenzori, may form the main constituent. Nevertheless the birds do not differ from those of the ordinary forest zone. Even *Pseudocalyptomena* is not dependent upon bamboos.

Similarly, the heath zone, which might be considered to represent a "temperate" zone in a botanical sense, is here to be included in the alpine life zone, which extends on Ruwenzori from the upper level of the bamboos (9300 ft.) to the lower edge of the snows (15,000 ft.).

Elsewhere than on Ruwenzori, the elevations in Congo territory seldom attain to the alpine zone. Only on the higher Kivu Volcanoes is it to be found again. But on these volcanoes the heath zone is largely replaced by hagenia woods, which are inhabited largely by the birds of the mountain forest zone. The upper limit of the subtropical or mountain forest zone on most of the volcanoes must therefore be raised to at least 11,000 feet, and some of its birds range even higher.

The very small extent of the alpine zone is evidently one of the principal reasons for its restricted avifauna. Without considering the possible effects of inbreeding, we may be sure that the climatic conditions are inimical. This is a borderland where bird life is still possible; and even a short but sudden spell of inclement weather could easily affect the whole alpine area within our limits, decimating or exterminating forms which made their home there. Restocking even from the nearest alpine areas would be problematic at best.

A comparison of life zones as here outlined for equatorial Africa with those of the Andes of Colombia, intensively studied by Dr. F. M. Chapman,<sup>1</sup> shows many points of agreement. A close parallelism might well be expected, when we recall how the various zones result from atmospheric conditions. The subtropical zone, as Dr. Chapman points out (page 136), is dependent upon abundant precipitation, whereas decreasing rainfall and increasing cold are responsible for the changes marking the temperate and Paramo zones. In Colombia, according to Dr. Chapman, the average levels of the zones are roughly as follows:

Tropical	up to 5000 feet
Subtropical	5000 to 9000 feet
Temperate	9000 to 12000 "
Paramo	12000 to 15000 " (snow line).

In the eastern Congo the temperate zone, though represented botanically, is practically without a characteristic bird, the reason being the lack of communication, at such a level, with the northern temperate region. South Africa can scarcely be said to have a "temperate" fauna, unless it is represented by a few sea birds. There are of course a fair number of birds in South Africa which may be regarded as subtropical, since they do not range northward into the hot lowlands of the continent. Some of them, particularly forest-dwellers, as will be shown in Chapters VI and VII, do extend northward in the highlands to Angola, East Africa, and Abyssinia. Consequently the mountain-forest birds of equatorial Africa may be called subtropical. Among birds of grasslands this climatic relation is not so clear.<sup>2</sup>

<sup>1</sup>1917, 'The Distribution of Bird Life in Colombia,' *Bull. Amer. Mus. Nat. Hist.*, XXXVI, pp. 84-93, 136.

<sup>2</sup>Since this report went to press, Mr. W. W. Bowen (1932, *Proc. Acad. Nat. Sci. Philadelphia*, LXXXIV, pp. 260-276) has argued in favor of a primary subdivision of the Ethiopian Region in life zones delimited by isotherms. I still prefer the separation of a West African Subregion on faunal grounds. While temperature is one of the important climatic influences upon bird distribution, I am convinced that the Sudanese avifauna is more closely allied to the birds of the drier parts of eastern and southern Africa than to those of the more humid West African lowlands.

## CHAPTER V.—BOTANICAL REMARKS ON THE FAUNAL DIVISIONS OF THE CONGO

In the present chapter, which lies somewhat beyond my particular field of research and yet is fundamental to it, I have been generously and ably assisted by Dr. Joseph Bequaert, late Associate in Congo Zoölogy at the American Museum, and now of the Harvard University Medical School. He speaks with special authority on plant distribution in the Belgian Congo, for he spent practically the same period there as the American Museum Congo Expedition. Traveling more widely, he made botanical collections in all of the faunal areas I recognize save one, the northern Guinean savanna, where Lang and I spent two and a half years. In 1913–1914, Dr. Bequaert headed a botanical mission to Ruwenzori and the Kivu highlands; and his collections, which comprise some 2000 species of flowering plants, are now being worked out by Professor De Wildeman, Director of the Brussels Botanical Garden.<sup>1</sup> In addition to botanical advice, Dr. Bequaert has also been able to give me substantial help in the outlining of faunal limits in areas which I had not personally visited.

### FACTORS GOVERNING PLANT DISTRIBUTION IN THE CONGO

The distribution of land birds depends primarily upon plant geography. Where the country is sufficiently mountainous, of course, life zones may be established with certain altitudinal contours as boundaries; or, if it is far enough from the equator, isotherms may be used. Yet it does seem, except in the extreme cases, as though the birds were still affected by climate mainly through its influence upon the vegetation. Barometric pressure alone is of little interest, save in the production of winds. These in turn owe much of their influence to changes of temperature and humidity. The effect of temperature is even more immediate upon plants than upon birds. Humidity, or better, rainfall is of the utmost importance, for at equal altitudes it makes all the difference between barren short-grass steppes and luxuriant mountain forests, and these in turn will have avian populations utterly dissimilar.

Professor A. Engler,<sup>2</sup> in outlining the conditions of existence and distribution of the African flora, discussed the climate under two headings: heat and precipitation. After this came the discussion of soils, but he showed to what extent these depend, in tropical countries, upon temperature and moisture. The effect of altitude, it was pointed out,

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<sup>1</sup>E. De Wildeman, 1921–1931, 'Plantæ Bequaertianæ I V 1910, 'Die Pflanzenwelt Afrikas,' I, pp. 871–1010.

depends in ample measure upon the amount of precipitation, so that both tropical and subtropical zones may have dry or humid portions. Upon the basis, then, of climate, altitudinal regions, plant formations, and geographic elements or affinities of the African flora, he divided the continent into four principal floral regions:

- A.—Mediterranean region
- B.—North African-Indian desert region
- C.—African forest and plain region
- D.—Region of southwest Cape Colony

In so far as the Congo is concerned, we are interested here only in the forest and plain region (C), which Engler (pp. 1005–1007) subdivided in four provinces:

- a.—Sudanese parkland province
- b.—Northeast African highland and steppe province
- c.—West African or Guinean forest province
- d.—East and South African woods and steppe province

Taken together, these are almost equivalent to the Ethiopian Region of zoölogists. Although Engler gave no map to show the exact limits of these areas, and even stated that the boundaries are not sharp, it is plain that in the territory of the Belgian Congo we have to do with only the last two provinces (*c* and *d*), and mainly indeed with the West African forest province. Dr. F. Thonner<sup>1</sup> and Dr. Joseph Bequaert<sup>2</sup> have drawn maps to illustrate these subdivisions of Professor Engler. Dr. Bequaert further subdivided the West African province by indicating the extent of equatorial lowland rain forest as opposed to the more open savannas. It will be apparent from this map how little of the Congo lies within the East and South African subprovince—merely the highlands of its eastern border and southeast corner.

Scott Elliot<sup>3</sup> proposed a somewhat different subdivision of tropical Africa:

- A.—Westerly wet region (Niger-Congo drainage especially)
- B.—Easterly wet region (Zambesi and other valleys)
- C.—Central ridge (above 3500 feet)

He emphasized the difference in rainy seasons, but wrongly attributed April-to-October rains to the whole westerly region. Such a classification is unsatisfactory and incomplete.

The best vegetational map of Africa is that by Dr. H. L. Shantz, 1923, in 'The Vegetation and Soils of Africa,' American Geogr. Soc.

<sup>1</sup>1915, 'The Flowering Plants of Africa,' English Edition.

<sup>2</sup>1917, Bull. Amer. Mus. Nat. Hist., XXXVII, pp. 742–744.

<sup>3</sup>1896, 'A Naturalist in Mid-Africa,' pp. 207–226.

Research Series No. 13, by Shantz and Marbut. It errs in showing a strip of mountain forest extending from northern Angola to the vicinity of Noki and Matadi, and in certain details of montane vegetation in the

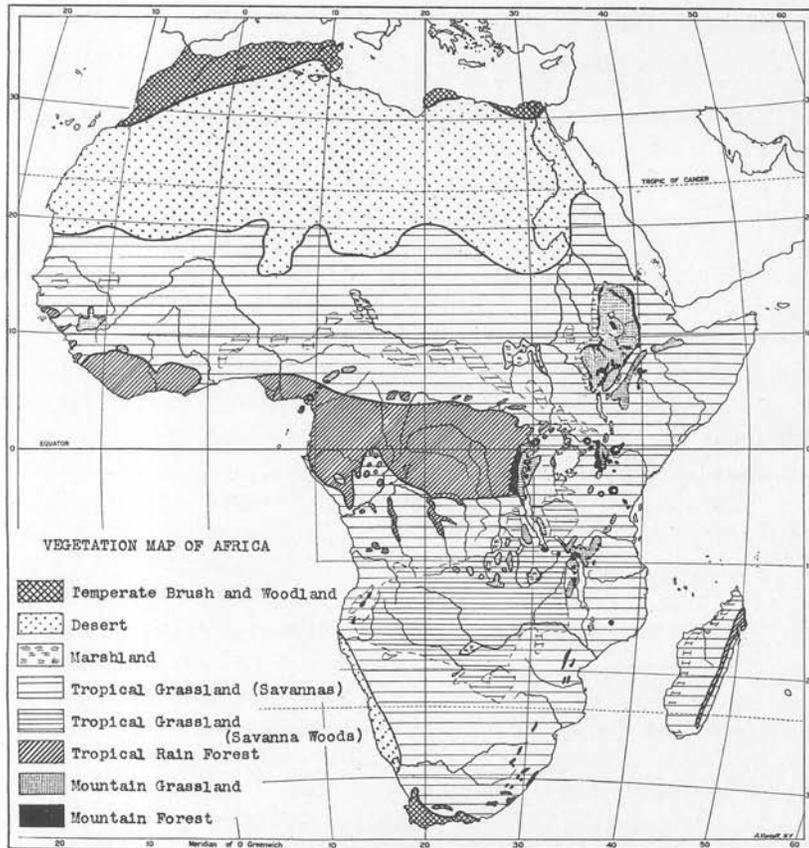


Fig. 20. Map to show main features of African vegetation, after Shantz but somewhat simplified.

eastern Congo. But this work contains a valuable discussion of vegetation types over the whole continent.

It may now be seen that the central botanical feature, in the Congo, is the equatorial forest. It exists because of the extremely moist climate in lowlands close to the equator. "Rain forest," says Schimper,<sup>1</sup> "is

<sup>1</sup>1903, 'Plant-Geography upon a Physiological Basis,' English Edition, p. 260.

evergreen, hygrophilous in character, at least thirty meters high, but usually much taller, rich in thick-stemmed lianes, and in woody as well as herbaceous epiphytes."

A high annual rainfall is by no means the only requisite for a tropical forest. In the Cameroon and Congo, forest occurs only where the rains are almost continuous the year round. Under such conditions a relatively moderate rainfall may suffice. Basoko and Nouvelle Anvers in the Congo have heavy forest, with only 60 and 65 inches of rain annually, but no real dry period.

Konakry in French Guinea has 193 inches, but there are four months (December to March) practically without rain, so along that part of the coast the forests are local and discontinuous. The extensive forests are found in Liberia and the Ivory Coast, where the dry season is all but suppressed.

Brazzaville in the French Congo sometimes receives 78 inches of rain, but the season of drought lasts practically four months, and there is no continuous forest. The balancing of the rainfall and its duration determines the nature of the climate necessary to support the equatorial rain forest of Africa.

Along the coast of Upper Guinea the forest extends in patches northward as far as latitude  $10^{\circ}$ , because of the very heavy rains brought by the southwest monsoon blowing from the ocean during the hot season. In the Lower Congo region at  $6^{\circ}$  south, the cold Benguella current tends to dry the coastal districts. Although a tongue of forest extends southward through the Mayombe, the savannas extend northward in the interior of the Gaboon in a narrowing strip as far as the equator. Farther inland, however, we find the borders of the Congo forest lying for the most part at from three and one half to four degrees north and south of the equator, until on the east they again reach a drier, elevated region which extends across the equator without interruption by a belt of forest.

The difficulty which is found in any attempt to subdivide this botanical province lies in the fact that typical species of forest plants are so often collected far beyond the limits of the unbroken forest, occasionally indeed up to the border line of the province. They extend out in patches of woodland, the so-called gallery forests, which are apt to follow watercourses. The same is true of many forest birds; and yet I do not feel that this is a serious objection, from the practical point of view. For these are not the characteristic or conspicuous species in the savannas. They are the rarer, more unusual things that the collector naturally searches for when he has tired of the commoner savanna fauna or flora.

The line which astonishes and delights the traveler most is that along the edge of the uninterrupted forest. Here comes the most sudden change, whether he is quitting the somber shades of the woodland—as I have twice done after continuous stays of more than a year—and welcomes again the distant views and sunshine, or whether he is entering its spacious solitude for the first time. In the latter case the grasses and the grass birds disappear, and one is entirely enclosed in a new dark-green world, which formerly may have been found only after searching the banks of some of the streams in the savannas. The forest border is strikingly sharp in some regions, truly a green wall, as along its eastern edge near Irumu. In other places the forest throws out a green network enclosing at first isolated patches of high grass. From the high hill of Namambula, northwest of Pawa (northern Ituri), we gazed down upon such a borderland. The grass showed as light yellow-green patches on the eastern side, on the other the dark green was unbroken. In the same way, on coming down the Congo River, in the neighborhood of Yumbi these large tracts of upland grass are more or less isolated at first, but become confluent, and finally there is no more forest worthy of the name.

Although not a word of common usage in English, "savanna" has been adopted in botany as the most suitable term for describing the commonest type of grassland in the tropics: the bush-veld of southern Africa, and the campos of Brazil. Savanna is defined by Warming<sup>1</sup> as a grassland with scattered shrubs and medium-sized trees, or by Schimper<sup>2</sup> as "xerophilous grassland containing isolated trees."

Typical West African plants from the forest, amid the characteristic elements of the Guinean savannas, do extend far out from the edge of the continuous forest; hence the reason for placing the border line of the West African forest province so far out in the north and south. Because of the more general humidity of the regions south of the equator, the border line in Lower Guinea is more distant on that side than to the north of the equator.

Once this boundary has been crossed, not only are the plants of the savanna predominantly of "eastern" types, but likewise the woods which occasionally fringe the watercourses. As regards the mountain forests in the eastern Congo, their constituents, on the whole, are so different from those of the lowland western forest, and so much more common in the mountainous districts of East Africa that the formation, like the higher alpine formations it sometimes encloses, is to be classed as eastern. The

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<sup>1</sup>1909, 'Ecology of Plants,' Oxford, p. 295.

<sup>2</sup>1903, 'Plant-Geography,' p. 162.

affinity is not unnatural in the case of the western Kivu ridge and the Kivu Volcanoes, bordering as they do on the east and southern province; but the position of the Ruwenzori montane region is anomalous, for it is completely encircled by the lower western flora. It must be regarded, I

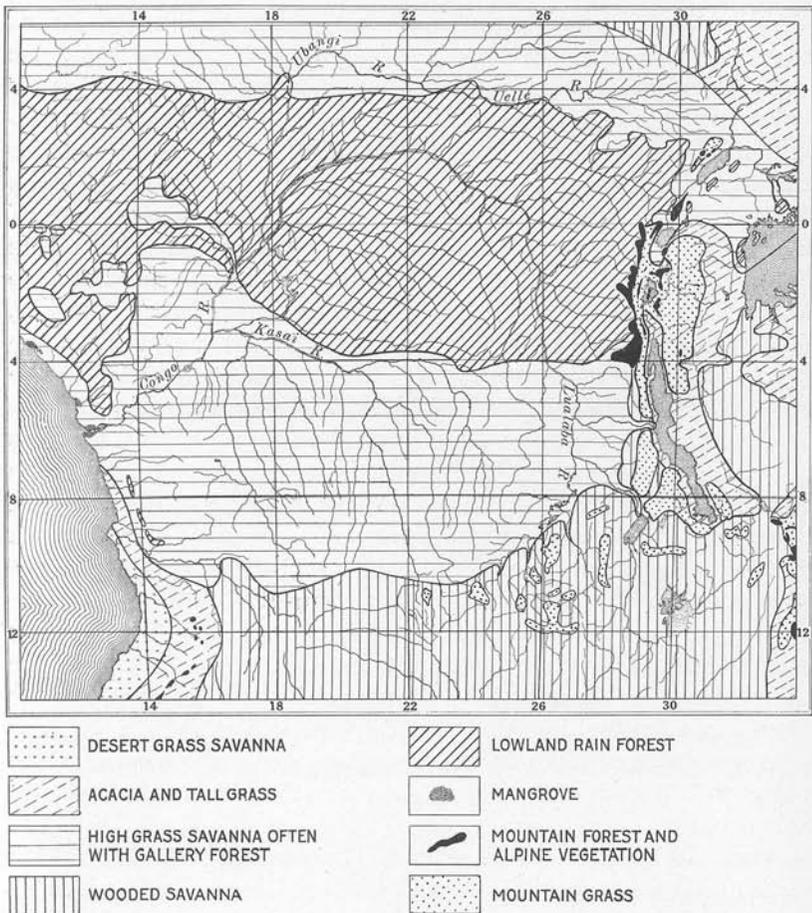


Fig. 21. Vegetation map of the Belgian Congo and adjacent regions.

think, as a remnant of some floral area which was once very much more extensive, and which has a still more detached portion on Mount Cameroon and Clarence Peak. The relationship is also attested to by the birds of the mountains, as was emphasized by Dr. Bowdler Sharpe.

The dissimilarity of the mountain and lowland forests is due to a marked change of climate taking place, as has already been shown, at about 5000 feet, just below the cloud zone, where there is a rapid lowering of temperature, especially at night, and a sudden increase of rainfall and fog. The nature of the forest trees changes, they are not so tall, and include such forms as *Podocarpus* and, higher up, bamboos. Epiphytes, too, are more abundant, ferns, mosses, and lichens drape the trees, and some of the plants are more nearly related to those of temperate regions.

Rapidly increasing cold and changing conditions of sunlight as the mountain is ascended cause the succession of floral zones. On Ruwenzori, said Scott Elliot,<sup>1</sup> "The curious lifting of the cloud at the rate of about 1,000 feet an hour, is, as I have mentioned before, the leading clue to the arrangement of the Floral Zones. The cloud in the morning covers pretty nearly that portion of the mountain which is occupied by the forest and bamboos. Its lower and upper boundary corresponding to the beginning of the forest and the upper limit of the bamboo region. From this it follows at once that the heather region receives the sunlight in the morning, and only at that time, and hence the flora is of a comparatively temperate type. The true forest receives the full heat of the afternoon sun, and this, together with abundant moisture, explains the main features of its plants. The bamboos, on the other hand, receive scarcely any sunlight worth mentioning." Above the bamboos, nocturnal radiation and evaporation are increased, and they must be in part the cause of the curious habit and adaptations of the alpine plants.

#### VEGETATIONAL FEATURES OF THE FAUNAL AREAS AND LIFE ZONES ATLANTIC COASTAL STRIP

The littoral strip is so narrow as to scarcely show on a small scale map of the Congo. Just as botanists would recognize such a division because of the effect of salt water upon the vegetation, so we may allow it to stand because of the many water birds found along the coast, which do not ascend the rivers to any distance. It would comprise therefore only a narrow strip of beach, and that part of the river banks which is occupied by the coastal vegetation, or by plants which owe their presence to the effects of salt in the water, for example: *Ipomœa pes-capræ* on ocean beaches and the mangrove, *Rhizophora Mangle*, in estuaries. These plant associations are not simply characteristic of the western coast of Africa, but may be described as an Atlantic flora, because they are found also on the eastern coast of South America, whereas the east coast of Africa has plants of Indian Ocean type.

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<sup>1</sup>1896, 'A Naturalist in Mid-Africa,' p. 195.



Fig. 22. Creeks of the Congo estuary, viewed from a hill near Banana. Photograph by Herbert Lang.



Fig. 23. Mangrove wood, with a fringe of *Raphia* palms, on the lower Congo River. Photograph by Herbert Lang.

The Congo has but little ocean front, and this consists merely of sandy beaches extending northward from Banana to the Enclave of Cabinda, at first very low, then with a steep bluff back of the beach. Along this shore many waders and marine birds migrate, some of them scarcely to be found elsewhere within our area. The remainder of the coastal area consists of the mangrove formation extending up both sides of the river to a point between Malela and Ponta da Lenha, as shown on the map of the Congo estuary in the Bulletin of The American Museum of Natural History, XL, 1919, p. 15, Map II.

The plant formation includes many other species besides the famous *Rhizophora Mangle*; among the most conspicuous are *Avicennia nitida*, *Conocarpus erectus*, *Laguncularia racemosa*, and *Dalbergia ecastophyllum*.<sup>1</sup>

The name mangrove is applied by Schimper to the whole. "In creeks and lagoons, where the movements of the sea and air are weaker, it [the belt of shore within the reach of the tide] is covered by woodland that is sometimes more shrub-like or bush-like, sometimes forest-like, and is termed *mangrove* or *tidal woodland*. It differs from all inland-formations as regards both its flora and its ecology."<sup>2</sup> As one passes in front of these mangroves of the lower Congo River they give the impression of a real forest, for they reach a height of 80 feet and a diameter of 2 feet, and the beauty of their border is enhanced by graceful *raphia* palms. No epiphytes grow on the mangroves, though a large leafy parasite (*Loranthus*) has been found on them. Some of the forest birds inhabit the mangroves, but in general the bird fauna is less varied than in the other kinds of lowland forest.

#### THE WEST AFRICAN SUBREGION

In Schimper's work, 'Plant-Geography upon a Physiological Basis' (English edition, 1903), the geographical treatment of the West African division is fragmentary and inadequate. He speaks of the Upper Congo as an upland savanna, which is true only in part. Even that of Professor Engler, in 'Die Pflanzenwelt Afrikas,' I, 1910, scattered between pages 623 and 681, treats rather more of the taxonomic and structural features of the flora than it does of its regional distribution. We feel it advisable therefore to describe briefly the general aspects of the vegetation of our faunal subdivisions, inasmuch as this condition is so intimately bound to the distribution of the birds, and has in most cases a clearly causal relation. The western forest province of Engler, which nearly coincides

<sup>1</sup>The family relationships of plants mentioned in this chapter will be found readily in J. C. Willis, 1925, 'Dictionary of the Flowering Plants and Ferns,' 5th Edition.

<sup>2</sup>Schimper, 1903, 'Plant-Geography,' p. 395.

with our western faunal subregion, is so called because of the predominance of forest. There is only one break in the vast forests which extend from Sierra Leone to Ruwenzori; this comes in the region of Togo and Dahomey, and is to be attributed directly to the low annual rainfall in the country just east of the Gold Coast Colony. Nevertheless, in the western portion (known as Upper Guinea) there is hardly more than one plant family, the Rapataceæ, which is not found in Lower Guinea; and this family is known also from tropical America. Uniformity is the outstanding trait of the forest country, and so it is rather difficult to draw a definite line anywhere separating the forest of the Upper Congo from that of the Cameroon and the Gaboon. It does seem that the Mayombe forest may be kept separate from that of the Upper Congo, for it is an isolated southward extension of the Gaboon forest, and more intimately connected with the Cameroon than with the Upper Congo. Whether the line of division should come in the neighborhood of the Ubangi River, or farther west in the Cameroon, is a question as yet unsettled.

Not a few botanists believe that this Congo forest must once have been much more extensive, covering the whole of the area we now include within the forest province and extending across East Africa. Some assert that the climate of Africa is still becoming drier, and the forest shrinking. The invasion of the savanna formation, nowadays, is favored by the agriculture of the natives, who cut down the forest around its borders. Then, after they have abandoned the fields, grasses and other savanna plants overrun them. Reconquest by the forest is hindered by the custom of burning annually any grass-grown space, fire having a fatal effect upon any forest plants which have taken hold in the meantime, whereas the savanna plants, because of their adaptation to drought, lose only the drying foliage which still clings to them, and make good the loss as soon as the rains begin.

The forest "galleries," which may thus be regarded as the remnants of a more extended forest, are able to maintain themselves in savanna surroundings partly by the heavy precipitation during the rainy portion of the year, and likewise through the moisture conserved throughout the year in the soil of the lower situations they affect.

Just as we find slight differences between the birds of the Mayombe forest and of the Upper Congo forest, so there are botanical differences which will justify a separation. But it is to be remembered that the Mayombe is only a southward extension of Engler's Gaboon and Spanish Guinea subprovince, and that every one of the botanical and faunal divi-

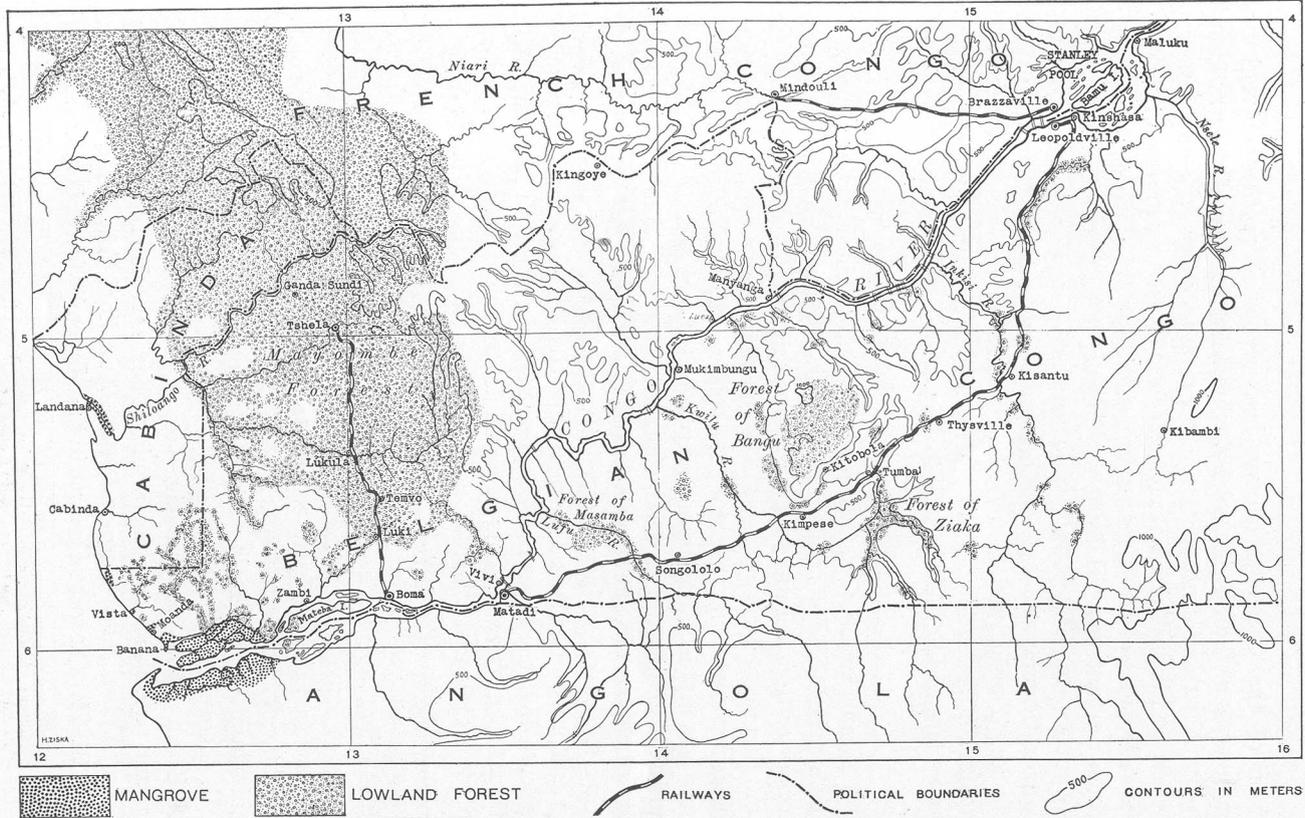


Fig. 24. Forest Map of the Lower Congo, after Egger, Verscheuren, Bequaert, and others.

sions of the Congo which we here recognize reaches beyond the boundaries of the Belgian colony. Similarly the type of country found in the Kivu and Katanga is more extensive in eastern and southern Africa, and is anything but characteristic of the Congo as a whole.

The parts of the West African subregion lying within the Congo which are not covered by dense forests, I have called the Guinean savannas: the Ubangi-Uelle and southern Congo savannas, and the Uganda-Unyoro savanna, extending to the countries for which it is named. The differences between these areas are due partly to their separation by the forest, and partly to their proximity, respectively, to the Sudan, to East Africa, and to Angola.

#### Rain Forests of the Lower Congo

A considerable forest covers the region of the Mayombe, north of Boma, where Engler's Gaboon and Spanish Guinea subprovince enters Congo territory. In its broad features this forest does not differ much from that of the Upper Congo. The genera of trees composing the primitive forest are largely the same; the species are often different. There is more geographic variation in the trees of tropical Africa—Dr. Bequaert tells me—than in the herbaceous plants of the same region. The extent of virgin forest in the Lower Congo is often exaggerated. Count de Briey<sup>1</sup> has called attention to the devastation already caused by native agriculture, and from the report of the Mission Forestière Verschueren<sup>2</sup> we learn that the finest forest is found only in northern Mayombe. In this unbroken forest, among the multiple species of larger forest trees, are noted: a camwood (*Pterocarpus*), a large *Sarcocephalus*, *Milletia Laurentii* and *Milletia versicolor*, *Coula edulis*, *Pentaclethra macrophylla*, *Chlorophora excelsa*, a "mahogany," and many others useful for timber, of which only the native names are given. As an example of the size of the crowns of some of these trees, it may be mentioned that de Briey measured one (a "Linga") by its shadow, and found it to cover 69,700 sq. ft. In volume V of the same Bulletin, 1914, pp. 214–246, will be found other photographs of vegetation and climatological data for the Mayombe, by J. Claessens.<sup>3</sup>

South of the river Lubuzi the forest becomes interrupted by clearings and patches of savanna, forming a border region the extent of which is also emphasized by Bequaert, 1920, Rev. Zool. Afr., VIII, Sup. Bot., pp. B. 21–24. The second growth in the Mayombe forest is characterized

<sup>1</sup>1912, Bull. Agricole du Congo Belge, III, pp. 806–827.

<sup>2</sup>1914, Bulletin Agricole du Congo Belge, V, pp. 47–72, with a vegetational map.

<sup>3</sup>The 'Manuel des Essences forestières du Congo Belge,' by Professor C. Vermoesen, published by the Belgian Colonial Ministry in 1923, deals especially with the forest trees of the Mayombe.



Fig. 25. Forest of Mayombe as seen from a hill near Ganda Sundi.

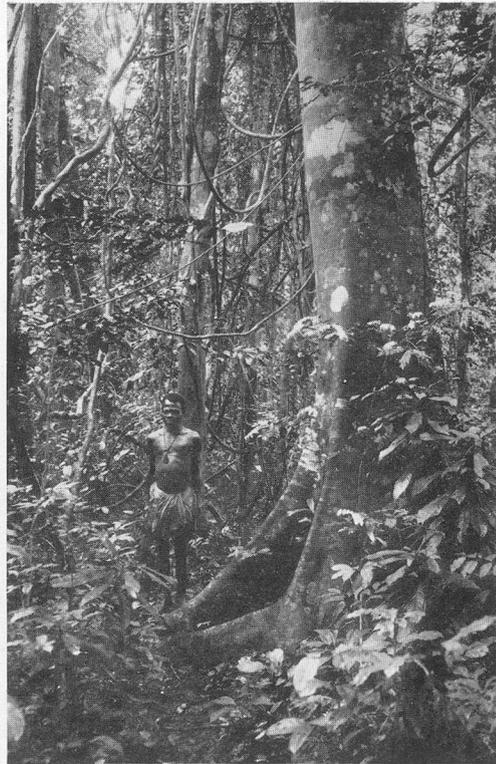


Fig. 26. Undergrowth in virgin forest near Ganda Sundi.

by the same trees as in the Upper Congo: oil-palms, parasol trees (*Musanga Smithii*), and silk-cotton or kapok trees (*Ceiba*). In the secondary woods of the Mayombe the pineapple has now run wild.

The remainder of the Lower Congo has few areas which could be described as rain forest, though patches of a sort of open, second-growth forest, harboring not a few forest birds, are fairly common. The only real forest areas which Verschueren was able to investigate, outside of the Mayombe, were the forest of Masamba (northeast of Congo da Lemba), that of Bangu (northwest of Kitobola), and that of Ziaka (south of Tumba on the Congo Railroad). Many interesting forest birds could no doubt be found in these small areas.

In some countries with tropical rain forest, it has been said, fruit-eating birds and monkeys migrate with the ripening of fruit from one district to another. In the forest of the Upper Congo, I failed to observe anything of the sort, save in the case of one fruit-bat and possibly a glossy starling. Count de Briey<sup>1</sup> remarks on the season of flowering for the trees of the Mayombe forest:

For the forest there is no period of repose at all marked. Flowering seasons succeed and interdigitate with each other so that the vault of foliage preserves always the same appearance. At most one could only point out the presence of a larger number of trees in flower towards the beginning of the rains.

Each species, moreover, shows the greatest caprice in this regard; except for four or five of them it would really not be possible to assign any fixed season for blooming.

Frequently, over several kilometers' distance, one meets trees of one or another species covered with ripening fruit, then a little farther on the ground will be strewn with its flowers just formed. If the spots are farther apart, and the altitude a little different, the space between flowering seasons may be five or six months.

Many species of trees blossom twice a year. It is possible then to find flowers and fruit at all times of year.

### Rain Forests of the Upper Congo<sup>2</sup>

It will be difficult to give an adequate description of these forests, which impressed Stanley so forcibly when he first traversed them. Unless one has seen a tropical forest somewhere, they cannot be visualized—I think—until one stands in the shade of the mighty trees. Professor Reichenow, though he had visited the Cameroon, seems not to have realized their importance in excluding most of the savanna birds. The distribution of the bateleur eagle, like so many other wide-ranging African birds, is given in his 'Vögel Afrikas' as the whole Ethiopian Region.

<sup>1</sup>1912. Bull. Agricole du Congo Belge, III, p. 816.

<sup>2</sup>A description of the botanical features by Dr. J. Bequaert will be found in *Agronomie Tropicale*, 1913, pp. 5-25.



Fig. 27. A small clearing in the Mayombe forest near Ganda Sundi, with an oil-palm and young parasol trees.



Fig. 28. Road from Ndalú to Ganda Sundi, in the Mayombe forest. Chopping favors the second-growth elements.

Statements like this, common not alone in Professor Reichenow's works, are apt to astonish the ornithologist who makes a stay of any length in the central Congo. Years may go by without his seeing a bateleur, a typical vulture, a coly,<sup>1</sup> a bustard, courser, sand-grouse, or horned guinea-fowl. Many species of birds extend their range all around this forest, yet are never seen within its limits, because conditions are most unfavorable to their ways of life.

The limits of this forest area, in so far as we know it to-day, are indicated in our map, Fig. 21. I have relied not alone upon personal knowl-



Fig. 29. The Congo River in the forest belt, as seen from Maberu, just above Lukolela.

edge and the experience of Mr. Herbert Lang, but have drawn upon the fund of information gathered by Dr. J. Bequaert, during his extensive botanical explorations from the Lower Congo to Ruwenzori, the Kivu district, and the Katanga. Additional data were received from Commandant Maurice Siffer, an officer of many years' activity in the Congo, and Commissaire de District in the Ituri during our stay in the Congo; from Mr. E. Torday, well known for his ethnological researches in the Kasai, as well as from Dr. H. L. Shantz and Mr. H. C. Raven, who

<sup>1</sup>The record from Yambuya, in Reichenow, 1902, '*Vögel Afrikas*,' II, p. 204, is erroneous.

together made botanical and zoölogical collections for the United States National Museum in the Katanga and Urundi districts in 1920, besides descending the Lualaba to the point where it enters the forest. Published works and maps of Professor A. Chevalier and Professor Engler have also been utilized.<sup>1</sup>

The outline of the forest, as here given, is to be taken as the limit of continuous forest, unbroken, that is, by anything more than the clearings of man, the courses of rivers, and occasional areas of swamp which cannot support forest trees. It is to be understood that in the savannas to the north and especially to the south one may find strips of genuine forest vegetation along watercourses, or at intervals patches of forest which cannot well be represented on a small scale map. Otherwise such areas would not be included in the western subregion.

We are unable to subdivide this portion of the forest into lesser zoölogical or botanical areas, and yet of course there are local variations of many kinds. The central portions may be slightly different from the peripheral ones, as indicated by the distribution of certain birds. Tree-ferns, for instance, we found to be wanting in the central Ituri, though we observed them on the northern and eastern edges of the same forest, and they are also reported from the southern border of the Congo forest. In the same way *Pandanus* is less common in the middle of the forest than around its borders.

There are, however, in every part three main types of forest, distinct but everywhere intermingled, according to conditions of topography and native occupation. We may call them (1) Primary or virgin forest of the uplands; (2) Inundated forest; (3) Secondary forest or second growth.

#### PRIMARY FOREST

The primitive covering of all but the wettest lowlands consists of rain forest; but it is surprising, in some regions with a dense native population, how little of it is left untouched. The plants that compose it are roughly of three sorts: trees, epiphytes (including lianas), and undergrowth (the latter mainly low bushes and herbaceous plants). Each of these is found to contribute about one-third of the species. Although there are intermediates, small trees hardly reaching above the undergrowth, or plants that grow both on the ground and as epiphytes, each group has its characteristic forms. The forest trees are almost always extremely mixed as to species, and of different sizes, so there is no continuous level of forest top. Viewed from above, as from a hill, the upper

<sup>1</sup>Compare also Dr. J. Mildbraed, 1923, 'Das Regenwaldgebiet im äquatorialen Afrika,' Notizblatt Botanischen Gartens u. Museums Berlin-Dahlem, VIII, No. 78, pp. 574-599.



Fig. 30. Lowland forest at Lukolela, with lianas and a large *Chlorophora* tree.



Fig. 31. Boles of trees and heavy lianas in forest near Poko, Uelle district. Photograph by Herbert Lang.

surface of the forest, far from a uniform green, presents a mosaic of shades, varied here and there by the sparkling crown of some tree in flower. The irregular skyline of the forest as viewed along a river bank, for example, is due to the diverse height and habit of all these many kinds of trees.

The equatorial forest of the Congo is not the inextricable tangle which many travelers suggest. Along borders or near watercourses, perhaps, but once a way is found through this outer barrier, one finds oneself in a gloomy forest, where the giant trunks rise like columns in a majestic tabernacle. Progress is scarcely hindered save by old logs and rotting boughs on the ground, and the many lianas stretching in all directions. The ground may be muddy, covered with dead wood and decaying leaves; but in most cases a carpet of vegetation will scarcely be apparent, the canopy of foliage casting too much shade. To say that no ray of sunshine enters, or that a perpetual twilight reigns, is an exaggeration. I have hunted and watched the birds of these forests, over long periods, in the undergrowth and on the highest boughs, and can testify that by a little manoeuvring I could always get glimpses of sky. Sunshine filters to the ground, causing the dewdrops on the underbrush to flash in its radiance. The foliage here is of a dark-green shade, very different from that of savanna plants. On dark or rainy days, of course, and they are not rare, the forest presents a much more dreary picture, but one can always see well enough to identify the small birds that flit through the lower growth in bands, and even the little brown babblers among the dead leaves on the ground. A shot at any bird in the tree-tops with a 12-bore gun was always a gamble; the big gray pigeons (*Columba uncinata*) were not always to be located despite their prolonged cooing, and when fired at sitting would often escape unharmed. For the vault of foliage borne aloft by the great trees might be 100 to 150 feet above the ground. Many of the trees put out large plank-buttresses at their base, certainly a source of stability; but this is by no means a universal characteristic.

About the post of Penge (Ituri), Bequaert estimated the number of species of forest trees as from 50 to 70. The genera and families to which they belong are likewise very diverse, but more of them belong to the Leguminosæ than to any other group. The climate renders thick layers of cork in the bark unnecessary, and more or less smooth trunks are common, often light in color, and perhaps because of pale lichen growing on them, showing whitish against the dark foliage.

To enumerate the characteristic species only of forest trees would be a task for a botanist, and I shall content myself with mentioning a very



Fig. 32. Forest with tree-ferns between Rungu and Nala, southern Uelle district. Photograph by Herbert Lang.



Fig. 33. Oil-palms in the forest between Pawa and Isiro, on the southern border of the Uelle district. Photograph by Herbert Lang.

few of the commonest, such as the wide-ranging *Chlorophora excelsa* (Moraceæ); *Ceiba pentandra* (Bombacaceæ), the giant silk-cotton; *Cynometra Alexandri* (Leguminosæ), with small stiff leaves and white pea-like flowers; a species of *Pterocarpus* (Leguminosæ) which supplies the camwood beloved of the natives; *Treculia africana* (Moraceæ) with a large fruit like that of a bread-tree; several large species of *Ficus*, *Macrolobium Dewevrei* (Leguminosæ), the "mambao" of the Ituri, where it is one of the most abundant of the large trees and may form nearly pure stands. An occasional *Dracæna*, perhaps forty yards high, surprises one with its unusual foliage, but is by no means a common sight.

According to reliable descriptions of other equatorial rain forests, especially in Java and Brazil, the Congo forest is less dense and luxuriant, especially its undergrowth. Certainly the restricted number of palms in the unbroken forest of the Congo is a striking deficiency, especially because the family is so typical of the tropics.

In any event the naturalist freshly transported from Europe feels completely lost amid the extraordinary diversity. Seldom does any particular tree build an extensive formation. Families and genera mingle pell-mell, till we have the characteristic situation in a tropical rain forest, where even a few examples of any one species may be difficult to locate.

The more conspicuous epiphytes are mainly orchids (which do not often flower), pteridophytes (ferns, *Selaginella*, *Lycopodium*), *Ficus*, a few Araceæ, Begoniaceæ, Piperaceæ, and one stringy drooping cactaceous plant (*Rhipsalis*). Large cabbage-like "elk-horn" ferns adhere to the upper parts of the tall trunks. Numbers of mosses, liverworts, and lichens also grow on the trees. Epiphytes are less abundant, both as to individuals and species, in the lowland rain forest than in the lower mountain forests, where the humidity increases, as a result of the low-hanging clouds that bathe them daily.

We used to gather the green moss hanging in the undergrowth, to dry it for use in stuffing our bird and small mammal skins. In the Ituri forest we found it most abundant in narrow ravines where there was no sun, but a continually humid atmosphere. Streamers of *Usnea* lichen, in this forest, hang from boughs high up in trees where there is little or no foliage.

The lianas vary in form from thin cylindrical stems slung cable-like and taut between the trees to flattened fasciated bands a foot across, hanging more loosely in festoons, or climbing in corkscrews toward the vault of foliage far above. What manner of plants they may be the



Fig. 34. Forest floor in the northern Ituri district, with clumps of marantaceous plants in left center. Photograph by Herbert Lang.



Fig. 35. Inundated forest in southern Uelle district, showing stilt roots of *Uapaca* trees. Photograph by Herbert Lang.

lay traveler would be loath to guess; never do they exhibit their flowers, it would seem, and their leaves are mostly far up out of range of sight. Only the climbing rattan-palms (*Calamus* and *Laccosperma*) are really frank in showing their banners, if we except a thorny creeper very close to *Acacia*, with finely pinnate leaf, from which the nests of weavers and sunbirds are sometimes found suspended in the forest.

Few truly parasitic plants are found in the rain forest except *Loranthus*, which is represented by many species. These plants form dense tufts of dark-green foliage on the boughs of other trees, and bear clusters of red tubular flowers which are frequently visited by sunbirds, and occasionally also by the small penduline titmouse, *Anthoscopus flavifrons*. True mistletoe (*Viscum*) also grows in the Congo forest, albeit far less abundantly.

Impenetrable thickets are usually a sign that the forest has been tampered with. The undergrowth in virgin forest is not apt to be dense. By following the game paths worn by elephants and buffalo one is able to travel in almost any direction. A caravan of porters, with boxes on their backs, can make its way anywhere in this forest, except in inundated regions.

A conspicuous bush in the Ituri forest is the large-leaved *Alchornea floribunda* (Euphorbiaceæ) from the root of which natives prepare an intoxicating drink known as "yandu." Another very common element of the undergrowth has leaves with a little ant-pocket at the base, *Scaphopetalum Thonneri*.

Besides young trees, bushes, and creepers, the underbrush of the rain forest contains a small number of herbaceous plants, likewise a few broad-leaved Gramineæ which one would hardly recognize as grasses. The commonest is *Streptogyne crinita*, and another, *Leptaspis cochleata*, is also common in the Ituri. These grasses are almost never seen in flower, and in a general way they resemble, in diminutive form, the zingiberaceous *Aframomum*. There is also a small species of bamboo, *Atractocarpa olyrififormis* Franchet, growing on the ground in deep-shaded forest. Sedges are usually found in the second growth only, but one very peculiar, broad-leaved genus, *Mapania*, grows in the Ituri forest. Some of the most characteristic herbaceous plants of the undergrowth still await mention. These are ubiquitous lily-like plants of the families Marantaceæ and Zingiberaceæ, especially *Aframomum*, with pointed leaves arranged in alternate series along a green stem, and a red-skinned fruit projecting from the ground at a little distance. No less abundant are the phryniums, with large oval leaves borne singly on a long smooth



Fig. 36. View in Ituri forest from a hillside near Babeyru, showing part of a clearing for a placer gold mine. Photograph by Herbert Lang.



Fig. 37. Forest brook near Niapu in southern Uelle district. Photograph by Herbert Lang.

stem. The latter form broad patches in the virgin forest, and one with purplish under leaf-surface, *Phrynium confertum*, is especially likely to attract attention.

Notwithstanding the protection against wind which the forest must provide, great trees are sometimes uprooted and overturned, dragging down others with which they have become interlaced, and a slight sunny gap is opened where numbers of bushes and small trees soon spring up.

In many places where the shade is not too dense one encounters tracts of the giant *Sarcophrynium Arnoldianum* (Marantaceæ), with its broad stiff leaves, borne on tough springy stems six to eight feet long. They were aptly called "tuiles végétales" by Brother Gillet on account of their use for roofing.

#### INUNDATED FOREST

Any part of the forest which remains flooded long enough to interfere with the growth of the usual forest trees develops certain peculiarities. Trees with stilt or prop roots, many of them belonging to the genus *Uapaca*, and growing to a height of seventy-five to eighty feet, are very characteristic. In general the trees may be said to represent fewer species than in the normal forest; but lianas are more diverse, including *Entada scandens*, *Vitex Staudtii* (hollow, inhabited by small red ants), *Landolphia florida* and various other rubber-vines, rattan-palms (*Calamus*, *Oncocalamus*, *Eremospatha*, and most common of all, *Ancistrophyllum secundiflorum*). Such liana-like palms commonly possess leaf-stems ending in tendrils armed with sharp hooks. In the inundated forest grow the Marantaceæ and Zingiberaceæ, the latter represented by *Costus* and *Aframomum*.

Along the banks of forested rivers there is usually a fringe of high trees overhanging the water, and in the lower-lying situations a smaller bushy growth, covered with creepers. Many plants of the inundated regions occur there also, and in addition a number of conspicuous creepers, such as *Mussænda* (Rubiaceæ) with brightly colored pink or yellow bracts (really one of the sepals enlarged). The screw-pine (*Pandanus*) grows occasionally, and rattan-palms very often, along the streams in the forest, the special abode of copal trees (*Copaifera*), moderate in size, with peculiar "bijugate" leaves.

Of the truly aquatic plants one might mention *Ipomæa reptans* with purplish-red flowers and hollow, air-filled stems, floating out from the shore. *Jussieua repens* (Onagraceæ) also floats, both its swollen roots and stems being slightly inflated with air. Despite the general lack of



Fig. 38. Rapids of the Aruwimi River at Panga, seen from the right bank. Photograph by Herbert Lang.



Fig. 39. View up the forested River Lindi, District of Stanleyville, seen from a clearing near Bengamisa. Photograph by Herbert Lang.

grasses, there may be occasional patches of a stout *Pennisetum* lying in part upon the water, and in sheltered spots drifts the lettuce-like *Pistia stratiotes*. *Papyrus* grows but seldom within the forest area, and in my experience forms no large masses there. Water lilies of the family *Nymphæaceæ* are almost entirely absent. On rocks in the rivers, which are exposed only at low water, cling the *Podostemonaceæ*, extremely similar in appearance to mosses or liverworts, except when they flower. These supply food, as we have found, for some of the ducks, a family of birds which is nevertheless poorly represented in the region of the forest.

The view along a forest-bordered river is nearly always monotonous, the continual border of green, dull and dark at a little distance, giving way only occasionally to a gap occupied by an almost invisible village, or a brown patch indicating a fresh clearing. It is true that closer attention, especially in the early part of the rainy season, when many of the trees are flowering or putting forth new leaves, will reveal a really surprising variety of tints, from reddish and yellow through all shades of green, to trees covered with small white blossoms. But the daily repetition of the scene causes its effect soon to be lost on the beholder, or often the glare of the sun puts it to naught.

#### SECONDARY FOREST

The importance of old native clearings in the African forest, and the relation of secondary forest to some species of birds, has received almost no attention, save from Mr. G. L. Bates in his observations on the birds of the southern Cameroon. The native population is so dense in parts of the forested Cameroon, Gaboon, and Congo, notably along certain of the rivers, that the virgin forests have been devastated over wide areas. Not that forest of a sort has disappeared—we have all heard enough about the rate of growth in tropical clearings. However, the plants which grow up so rapidly in these places are not the same by any means as those composing virgin forest. And the birds which frequent this new vegetation are in a large part distinct from those of the original forest.

A newcomer to the Congo, going up the Aruwimi River, would describe it as bordered everywhere with the densest of primeval forests. The same traveler, after a year or two in the truly virgin growth of parts of the Ituri, would be disappointed in returning down the Aruwimi (I speak of the part between Bomili and Banalia especially) to find how much of the forest, especially that around the villages where he would camp at night, was merely tall secondary growth. This leads one to

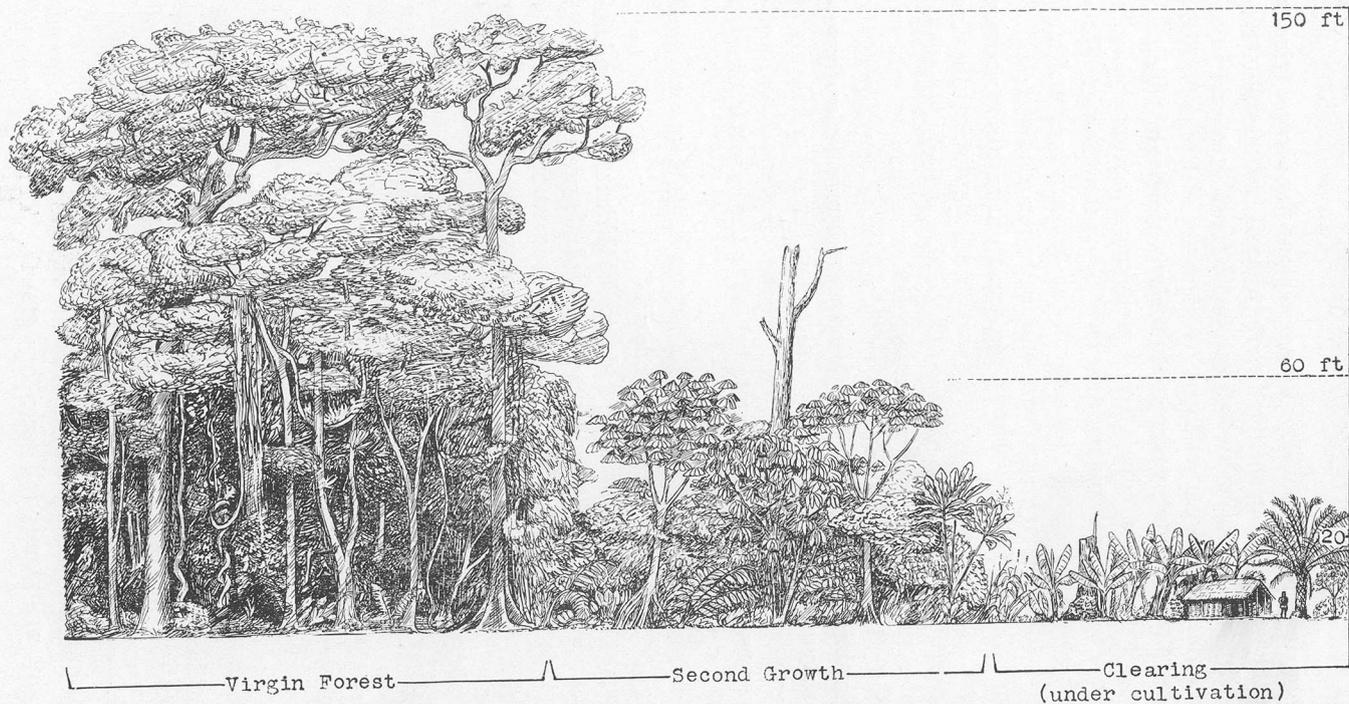


Fig. 40. Sketch to illustrate the succession of lowland forest vegetation after clearing by natives. Before the tall trees of the original forest can reestablish themselves there is a period of occupation by dense undergrowth and special second-growth trees, which reach only a moderate height.

wonder how long it takes to restore a clearing in the forest to its original condition. Remembering that there are two generations of trees at least, first a quick growing light-wood set, and then the slower growing hardwoods, I am inclined to estimate the minimum period of complete reforestation at about eighty years.

The nature of the second growth is remarkably uniform all across Lower Guinea. The arborescent species are not numerous. Their growth is often luxuriant, as is that of the underbrush. In lower-lying situations second growth naturally resembles inundated forest, and so we shall consider that of drier spots. The most characteristic tree of this formation is doubtless the parasol tree (*Musanga Smithii*) which stands on prop roots containing considerable water, and often forms small groves. They are frequented by many birds, including the plantain-eaters, which are very fond of the fruit. Parasol trees commonly attain a height of fifty feet, and another of the typical second-growth trees, *Spathodea nilotica*, is scarcely taller, bearing large and brilliant red flowers, thereby attracting many sunbirds when in bloom. The silk-cotton tree (*Ceiba pentandrum*) is likewise to be regarded rather as a tree of secondary formations, though it is frequently the largest of the trees along river banks, equalling the tallest forest trees in height, and having extremely wide buttresses at the base. These trees are at times entirely bare of leaves, but different trees shed their foliage at quite diverse seasons, and also come into fruit irregularly in the same way. These three trees attain their height rapidly. *Musanga Smithii* has one of the lightest woods known, and such a tree probably reaches full size in about twenty years.

In the abandoned plantations of the Ituri there frequently springs up a spiny acacia-like tree of no great size, *Dichrostachys nutans*. Twenty-four feet is about its maximum size, and the fruit forms bunches of contorted pods. The tree has a remarkable distribution, for it is found also in savannas practically throughout Africa.

Some other small trees and large bushes typical of secondary forest are *Vernonia conferta*, bearing tufts of enormous leaves at its apex,<sup>1</sup> *Myrianthus arboreus*, a bush or tree with little stilt roots at its base, and *Trema guineensis*, a small tree. A number of creeping or climbing plants are equally widespread in the secondary growth. *Trachyphrynium Liebrechtsianum* is a stiff-stemmed member of the Marantaceæ, climbing into the undergrowth, and helping in the formation of the densest thickets; *Mikania scandens* is a climbing composite which winds over the bushes; *Olyra latifolia* a climbing grass with broad leaves which

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<sup>1</sup>Figured in Engler, 1910, 'Pflanzenwelt Afrikas,' I, p. 744.

reaches a height of twenty feet; *Scleria Barteri* a climbing sedge attaining eighteen to twenty feet. *Selaginella scandens* and *Gleichenia linearis*, a climbing fern, add grace to this type of vegetation, which is responsible in so large a measure for the density of the old village and plantation sites, known in the eastern Congo as "matongo" (in the language of the Arabisés, or at Lukolela as "munga" (in the language of the Bobangi). Herbaceous plants are far more abundant than in virgin forest. The lower growth may include a small number of sedges and grasses, even some of the genus *Panicum*, and at times there are thickets composed wholly of elephant grass, *Pennisetum Benthami*. But *Aframomum*, melastomaceous and marantaceous plants are more in evidence, because of their large leaves. I am not sure that the great tracts of *Sarcophrynium Arnoldianum* growing locally in the forest, the large oval leaves of which serve so generally as shingles on houses, are not the signs of land which has almost reverted to primitive forest.

Finally, it is no surprise to find in many of these old clearings vestiges of cultivation in the shape of sterile banana plants, manioc bushes, and a few other domestic plants. In the region of the Nepoko River, as in some other parts of the Congo, veritable groves of oil-palms are scattered in the second-growth forest.

#### INHABITED CLEARINGS

The situation in which the white resident in the Congo forest is apt to spend most of his time is an altogether artificial product, the clearing. Its flora to a considerable degree is introduced or cultivated. Nevertheless, it attracts certain of the native birds, some of them species otherwise scarce in the forested districts. Of course a number of the original trees are left standing in any Congo clearing, because a little shade does no harm to the growing crops, and the felling of the trees, with simple native tools, is a serious task for the male population. At first the prostrate trunks and branches lie in hopeless confusion. Some of the latter are cut off and burned, but an abundant supply of fire-wood always lies close at hand.

In many districts oil-palms grace the villages. They have not, as a rule, been planted intentionally, but are a sign of long human occupation, and may have grown up in a secondary forest, to be spared when the less valuable trees were again sacrificed to agriculture.

The staple foods in the forest are plantains and manioc; and they make up the bulk of native plantations, except in districts where mountain rice (a variety of *Oryza sativa* which does not need irrigation)

has been introduced, usually within recent years, by the Bangwana or Arabisés of the Province Orientale. Indian corn grows luxuriantly in the clearings of the forest. Native bark-cloth is made from the bast of several indigenous species of *Ficus*, and small groves of these trees are not infrequently planted by the natives near their huts. Peeling the bark does not kill the tree, which proceeds to grow another covering, and this in turn may serve to clothe a savage. In the meantime these cultivated trees are apt to produce crops of "wild" figs, small, round and berry-like, which are of no value as food save for bats and birds. The canna, of which a variety with dark-red flowers frequently blooms about the native villages of the Ituri, is a good sunbird plant, and more showy cultivated kinds may be seen around the abodes of Europeans. Fruit trees, mostly of exotic origin, are planted in all government posts, providing food which the native birds do not always disdain; and large groves of coffee, cacao, or of rubber form an artificial wood that also attracts a few of them.

The age and extent of a clearing are apt to be indicated by the amount of grass to be seen in it. With long continued human encouragement, this element, so foreign to the forest belt, may gain such an ascendancy that a pseudo-savanna environment is established. Fields of *Imperata* or of a tall *Panicum* may be seen in places, or thickets of the cannelike *Pennisetum purpureum*. The largest clearing of this sort that I know of is at Stanleyville, on the right bank of the river. There are many other settlements along the upper Congo where similar conditions will be noted. This favors the immigration of a few savanna birds along the course of the river.

## Guinean Savannas

### GENERAL CHARACTERISTICS

The northern and southern Guinean savannas are so similar that their general botanical features may best be taken up together. Their main characteristic is the predominance of grass. In some parts there are but few bushes or trees; still, such areas are of restricted size, and the grasses then very high. More usually the grasslands are dotted with bushes, trees, or palms. Along the watercourses they are often intersected, or entirely enclosed, by strips of forest. Areas of elephant grass are more or less local, and more common in the parts that border on the rain forest.

It is extremely difficult to describe the different types of savanna, and to trace their geographic distribution on a map. Many sorts are

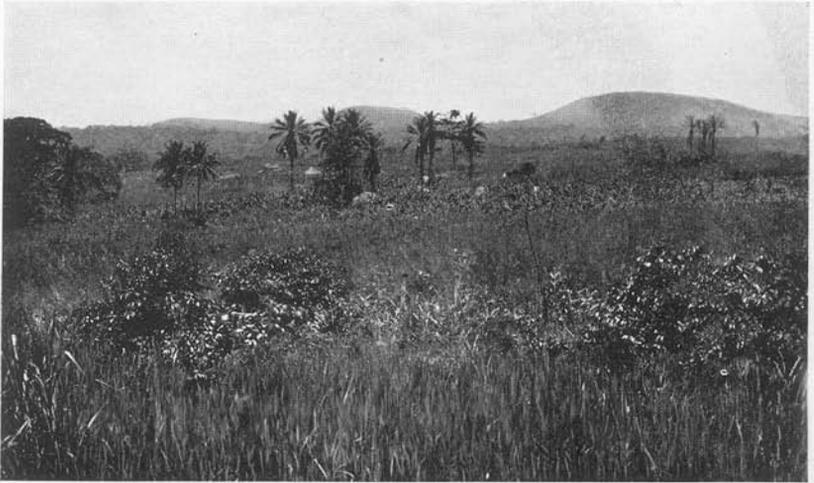


Fig. 41. View northward from Pawa, northern Ituri district, over a high-grass savanna. Ironstone hills in distance. Photograph by Herbert Lang.

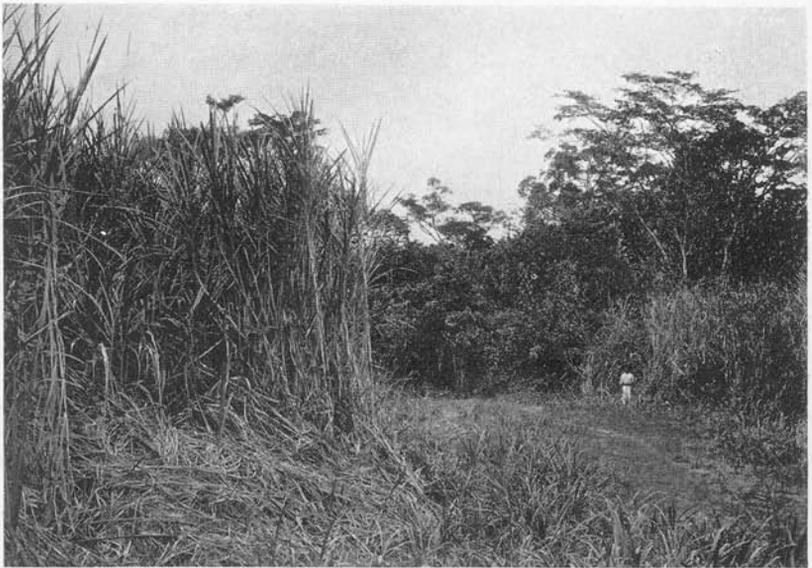


Fig. 42. One of the first tracts of elephant grass on the northern margin of the Ituri forest between Medje and Pawa. Photograph by Herbert Lang.



Fig. 43. Bush-grown savanna near Nabere, between Dungu and Faradje, Upper Uelle district. Photograph by Herbert Lang.



Fig. 44. Open savanna north of Nzoro (Vankerckhovenville) in Upper Uelle. Path worn by white rhinoceroses. Photograph by Herbert Lang.

usually represented in the same region, depending on local conditions of soil or drainage. *Imperata cylindrica*, a relatively low grass, without stalk,<sup>1</sup> often forming open fields, seems to favor a sandy soil; *Pennisetum purpureum*<sup>2</sup> a deep clayey one. But the commonest genera of grasses in these savannas are *Andropogon* and *Panicum*, generally intermediate in size between the two preceding. All these grasses show a definite annual growth in relation to the rains, though this is least marked in *Imperata*. Their full height is reached toward the end of the rains, after which they dry rapidly, and over large areas are burned off. All the plants of the savanna are well adapted to resist drought during a long dry season, and the majority of them are able to undergo periodic burning without very serious effects. Many of the bushes and trees, indeed, have thick corky bark. The fire in its passage sears them to such an extent that the foliage immediately wilts and is soon shed, but the leaf- and flower-buds are not destroyed. It may be only a few weeks later that the whole little tree bursts into bloom, and with the first rains the leaves unfold, giving a verdant air of spring to the country, before the grass has put forth more than a few green sprouts.

In addition to the grass, other herbaceous plants are very numerous. They usually flower at the end of the dry season or at the beginning of the rains, before they are smothered by the grass. Many are the orchids that send up their flowering shoots in February and March, in the Uelle district, well before there is any rain. None of them seems to be visited by sunbirds, though the latter are to be seen about the small trees then beginning to flower. Among the other herbaceous plants the Leguminosæ are well represented; there are also composites such as *Vernonia*, and Melastomaceæ. A number of winding plants are able to raise themselves with the grass, and so can flower later in the season, among them species of *Vigna* and *Dolichos* (Leguminosæ), and a few Convolvulaceæ. Some taller herbs also have showy blossoms, such as a wild *Sesamum* with bright purple flowers attractive to sunbirds (seen by Bequaert at Nyangwe), *Crotalaria*, and *Tephrosia*.

The shrubs and smaller trees of the savanna are largely species of exceptionally wide distribution. A good example is *Anona senegalensis*, which occurs in both the northern and southern savannas of the Congo. *Hymenocardia*, *Gardenia*, *Dombeya*, *Zizyphus*, *Sarcocephalus*, *Erythrina*, *Gymnosporia*, *Strychnos*, and *Bauhinia* are other typical genera. Their rough corky bark is in contrast with the smooth coverings of forest

<sup>1</sup>Widely known as "suli" in the Uelle, "nsonia" at Kisantu, and "nyazi" in the Manyema, and preferred to all others for roofing.

<sup>2</sup>Also known as *P. Benthami*.



Fig. 45. Flowers of sugar-bush (*Protea madiensis*) from country north of Faradje, Upper Uelle. Photograph by Herbert Lang.



Fig. 46. *Erythrina* tree in blossom, standing in a patch of *Imperata cylindrica* (grass), in Upper Uelle. Photograph by Herbert Lang.

trees. They shed their leaves annually, whether or not fire comes near them.

The "sugar-bushes," of the curious family Proteaceæ, are typical of southern and eastern Africa, and poorly represented in the Congo savannas. One small species is said to occur in the Lower Congo; and the large *Protea madiensis*, with showy white flowers, known among the Belgians as the "tulipier" or tulip tree, is found on the northeastern border of the Uelle. In South Africa the sugar-bushes are favorites with the sunbirds on account of the quantity of nectar they secrete; but I did not notice anything of the sort in the Uelle. In the Upper Katanga district, which is so much more southern in character, six or seven species of sugar-bush are known to occur.

As for the larger trees of the savanna districts, it may be said that they are more locally distributed than the bushes and shrubs. On this basis attempts have been made to classify the different sorts of savanna, and to indicate their geographic extent. But although any savanna owes much of its character to the bigger trees, the scheme has not proved successful. Everywhere the variation is too pronounced. Borassus palms are found in many parts of tropical Africa, yet are markedly local in the Belgian Congo. The relative scarcity of palms in Africa has already been mentioned. Up to the present only some fifteen species of palms have been reported from the territory of the Congo, whereas several hundred are known in Malaysia and in tropical America. Still, most of the palms in the Congo form a marked feature of the vegetation, either because of their size, or by growing together in numbers. We may cite, for instance, the fringe of *Raphia* palms on the banks of the Congo estuary, the groves of *Elæis guineensis* in certain parts of the southern Uelle, the Kasai, and the Lower Katanga, or the forests of *Borassus* along the banks of the upper Lualaba, just as *Hyphæne guineensis* (the "false Borassus") grows commonly along the lower Congo.

The baobab (*Adansonia digitata*) is common in the Lower Congo and about Stanley Pool, but unknown elsewhere in the Congo, though occurring in East Africa and on the Zambesi. Its giant trunk, for the storage of water, is justly famous. The measurement by Pechuel-Lösche of a baobab at Ambrizette, a little south of the mouth of the Congo, with a trunk eighty-nine feet in girth may here be cited. *Kigelia*, the "sausage tree," is represented through all the Congo savannas, preferably in spots fairly well watered. *Lophira alata* (Ochnaceæ) is a fair-sized tree with tufts of long glossy leaves, which forms groves in the northern half of the Uelle district. The bulk of the larger savanna trees



Fig. 47. Swamp north of Nzoro, Upper Uelle, with marantaceous plants (*Clinogyne*) and wild date palms (*Phoenix reclinata*). Photograph by Herbert Lang.



Fig. 48. Grassy meadow in a shallow depression near Yakuluku, northern Uelle. A granitic hill in distant background. Photograph by Herbert Lang.

belong to the Leguminosæ, and in many places acacias are the commonest of them, the species being very numerous. Flat-topped acacias shading a short-grass plain are, however, not a common sight in the Congo, and anything but characteristic of the savannas we are now describing. Some may be rather flattened, but the extreme form is more usual in the highlands of eastern Africa, and may be seen along the eastern Congo border.

The savannas owe their existence to a dry season lasting always more than two months. During the opposite season they are copiously wetted, and the lower-lying situations are apt to become marshy.

#### PAPYRUS SWAMPS

Extensive growths of *Cyperus Papyrus*, though practically unknown in the forest, are widely distributed over the savanna region, wherever the water becomes more or less stagnant in the swamps. In the Uelle district, for instance, we found them common in the northeastern section and almost entirely lacking in the Mangbetu country. On the Lualaba there are also enormous stretches of papyrus, in the marshes of the Lake Kisale region, where *Balæniceps* is at home; and at Boma, on the lower Congo, it fills some rather large marshes. These harbor some characteristic birds, especially reed-warblers and rails, as well as many swimming birds where there is open water.

Papyrus swamps commonly have deep mud and water between the rhizomes that support the tufts of stalks, but sometimes the papyrus floats. In the region between Faradje and Yakuluku, Lang went hunting in one such swamp where hippos dived and swam directly under the plants on which he stood. In the vicinity of Faradje the papyrus swamps often follow long, winding bottom-lands for miles, with hardly a perceptible stream of open water traversing them. In the rainy season one may wade knee-deep in muck and foul water, stumbling over the rootstocks, where in the months of January and February one could pass dry-shod. The greatest height this noble sedge attains in the Upper Uelle is about fifteen feet. During the drought brush-fires may pass through the swamps, leaving only the charred stalks; but whether burned or not the papyrus puts up a fresh green growth at the return of wet weather.

At other spots and for reasons I cannot give, unless they depend upon the more complete filling of the depression with alluvial soil, open grassy swales are found just where one might have expected papyrus or gallery forest. About them grow wild date palms (*Phoenix reclinata*) and often patches of marantaceous plants related to *Phrynium*.



Fig. 49. Papyrus swamp along Duru River, Upper Uelle district, with wild date palms at left. Photograph by Herbert Lang.



Fig. 50. Elephant trail through a papyrus swamp near the source of the Duru River, Upper Uelle. Photograph by Herbert Lang.



Fig. 51. Eastern bank of the Lualaba River, south of Kabalo, showing savanna with groves of *Borassus* palms.

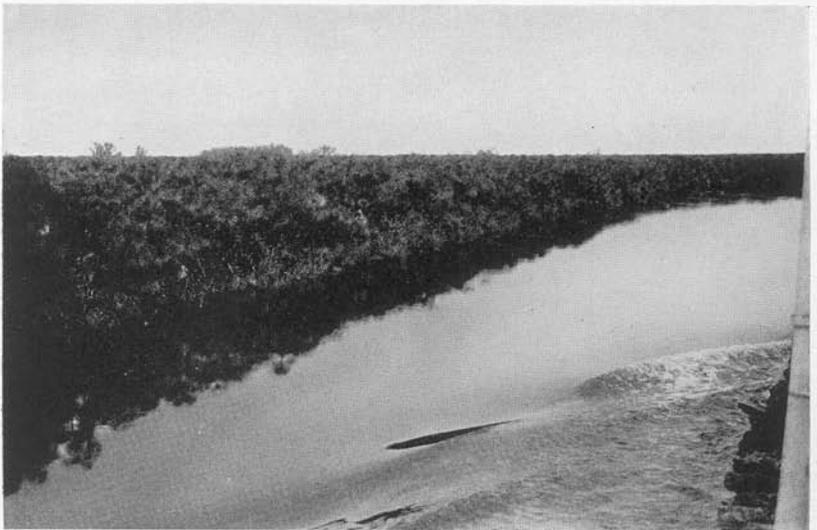


Fig. 52. Papyrus in Lake Kisale, the "sudd" region of the Lualaba River.

The greatest area of papyrus swamp in the Congo is along the Lualaba River, in the neighborhood of Lakes Kabamba, Kisale, and Upemba. Though on a smaller scale, it resembles the sudd region of the Upper White Nile. The swamp area of the Lualaba and the shallow lakes within it must occupy nearly 2000 square miles, of which the greater part is covered with a luxuriant floating growth of papyrus. The ambatch tree (*Herminiera Elaphroxylon*) with swollen trunk is conspicuous, and bears large yellow flowers. A few other trees and palms grow here and there, especially along the margins of the meandering river, where there is sometimes a muddy natural levee. On this the natives plant maize.

Numbers of aquatic birds, especially openbill storks, herons, aningas, gray pelicans, ducks, and skimmers, live about the open water. This is the only district of the Congo where the whale-head stork is known to dwell.

#### BOGS OF THE NEPOKO DISTRICT

Along the affluents of the rivers Gada<sup>1</sup> and Maika on the region of the Nepoko (northern Ituri) there are curious quaking bogs, known in the region as digadig or dig-dig.<sup>2</sup> They have the appearance of level open meadows, from 200 to 600 yards wide, and follow the course of some stream inconspicuous or hidden in the woods that border both sides of the bog. Thus while crossing on one of the narrow native causeways, one can often see for half a mile or more upward and downward, until the view is closed in by a curve in the valley. There are only a few small trees or stunted *raphia* palms, at most, growing in the middle of the bog; and the herbage, composed mainly of sedges and fine grasses, is only knee-high, or a little longer and denser where the natives have not cut it to be burned for salt. In many spots there is much *Sphagnum* moss.

The surface of the quagmire, composed of the matted roots of this vegetation, floating on the underlying body of thin mud or water, is often so solid as to move but little beneath one's weight. At times it rolls annoyingly when walked upon, if indeed the water does not rise to one's calf. Sometimes a lavender-colored lotus grows in spots of open mud and water; and because they are amazingly deep, these must be carefully avoided.

The sedge already referred to as furnishing the native salt—quite an industry in this region—is a *Cyperus*, growing only about two feet high. In the “digadig” which I visited to the eastward of Pawa there was no papyrus, though it was said to exist at the headwaters of some of

<sup>1</sup>This is not the River Gada of the Mangbetu country (Uelle).

<sup>2</sup>Compare Junker, 1891, 'Reisen in Afrika,' III, p. 95.

the streams, and to be even better for the making of salt. In a smaller bog near Ibambi, I did see a quantity of papyrus growing, but it seemed curiously stunted in size, as compared with that of Faradje. In the northern Uelle, thirty miles east of Yakuluku, Lang visited other floating bogs, some with low sedges, and some with papyrus.

#### WOODED WATERCOURSES

Thus far we have not described the forest galleries, those strips of woodland of which Junker has given so good a diagram, with trees masking some small brook, whose course they follow through the grassland. They are so much like the true forest in places that they scarcely need further description; more often, however, it would be better to compare them with secondary forest of the equatorial belt. In still other cases they



Fig. 53. Diagrammatic section across a "gallery forest," after Junker.

have more character of their own, dense growths of *Pandanus*, or trees seldom found in the real rain forest, just as they harbor, in addition to the true forest forms, certain species of birds which extend for a thousand miles or more along this borderland, living in small woods amid the savanna, yet never going into the equatorial forest. In some of the gallery forests about Niangara and Dungu, patches of *Sarcophrynium* were encountered in moist places and seemed to be the special retreat of *Ptyrticus turdinus*. In other places in that region *Raphia* palms are met with along the borders of wooded streams and swamps, their gigantic leaf-stalks making up for the lack of a trunk. The stalks are widely used in native architecture, and often miscalled bamboos. Many of the birds of the forested strips in savanna are not those of virgin forest, but such as would only be found in the Ituri in clearings or rather open second growth.

The gallery forest formations in the north would appear to be especially important in the neighborhood of Doruma, if we can judge from some of the species of birds and of plants which have been collected there. In the immediate neighborhood of Faradje we found the forest fauna but poorly represented; and yet at two days' march eastward toward Aba there is a large and remarkable patch of forest which harbors not only the squirrels and some duikers of the true forest, but even chimpanzees, and naturally enough a number of forest birds we saw nowhere else in the region. But even here *Bubo lacteus* and *Bycanistes subcylindricus*, which lived in this forest, are to be noted not as true forest birds, but species of the woods beyond its borders.

In the southern savanna the extension of isolated portions of the forest along timbered watercourses would seem to be even more pronounced. A number of forest birds, such as *Cercococcyx mechowii*, were first discovered in northern Angola; and so typical a forest hornbill as *Ceratogymna atrata* has been taken more than 9° south of the equator, at Kinda in the Lulua district. The Kasai River, from Kwamouth up to the mouth of the Sankuru, is said to be lacking in woods along its banks,<sup>1</sup> and consequently has far more water birds on its sand-banks and islands than has the main stream of the upper Congo. The Sankuru has the forest coming down to the water's edge, yet the country between the Sankuru and Lukenye, Mr. Torday assured me, has large areas of grassland. Above Lusambo, on the left bank of the Lubilash, at 5° south, Hinde tells of marching through an extensive forest. These conditions in the interior of the southern Guinean savanna are to be explained through the cooler, moister climate of Africa south of the equator, a result of the increasing narrowness of its land mass.

Most of the large native bamboos of the Congo are restricted to the mountainous region. In many places along the Congo River there are dense patches of introduced bamboos which have been planted or have escaped from cultivation, but I did not note that they had any ornithological interest. Likewise in the case of a native lowland bamboo of quite a different habit, forming rather dry open patches in the savanna or at the edge of gallery forest, we were unable to find any birds that were at all concerned with it. This bamboo was found by us in the Uelle district, a few miles south of Nzoro, and also near the village of Matafa, a Logo chief, southeast of Faradje. The species is doubtless *Oxytenanthera abyssinica*, and I believe it to be the same as that reported by Schubotz as growing in thickets from Loka to Lado,<sup>2</sup> and perhaps that

<sup>1</sup>Compare Capt. S. L. Hinde, 1895, *Geographical Journal*, V, p. 426, and figures.

<sup>2</sup>Adolf-Friedrich, Herzog zu Mecklenburg, 1912, 'Vom Kongo zum Niger und Nil,' II, p. 84.



Fig. 54. Bare slope of one of the larger granitic hills near Aba, eastern border of Upper Uelle district. Photograph by Herbert Lang.



Fig. 55. Savanna woods near Garamba, northeastern border of the Upper Uelle, in April. Photograph by Herbert Lang.

which Schweinfurth found growing abundantly at places in the Bahr-el-Ghazal Province.

#### HILLS OF THE NILE BORDER

On the whole the topography of these two savanna areas is almost as monotonous as that of the equatorial forest belt. Both the Uelle and the Kasai districts, for the most part, are merely undulating, from 1500 to 3000 feet in altitude, with no mountains of importance. There are, however, rocky eminences in the Lower Congo, especially near Matadi, and in the Uelle, particularly towards the northeastern border, which have considerable zoölogical and botanical interest. These are the hills of granite, gneiss, and other old rocks which have been dwelt upon in the chapter on geology. So monotonous is most of the savanna scenery that the gray bulk of one of these massive rocks on the skyline, though many miles off, and out of my way, never failed to arouse a longing to pay it a visit.

After climbing many of them, in the neighborhood of Matadi, Pawa, Dungu, Garamba, Nzoro, and especially Aba, I can declare emphatically that their zoölogical interest does not vary in proportion to altitude—very few are 1000 feet higher than the surrounding country—but in proportion to the amount of bare rock, and its steepness. It is this physical condition which provides the retreats and nesting sites desired by so many creatures of the "rock community," foremost among which come the hyraxes. Rabbits, squirrels, a mongoose, a baboon, and bats make up the remainder of the mammalian group. The rock-dwelling birds are more numerous still, and will be considered in another chapter.

The flora too is greatly influenced by the amount of rock exposed, for this produces xerophilous conditions which are very striking. Except for occasional rock pools there is nothing to preserve the water which falls. Even where soil accumulates around the bases of plants, it is shallow and cannot be kept moist. As a result there are spots where the plants take on the appearance of desert vegetation. Let us glance at conditions on the hills near Aba. Aloes, which are scarce in the lower savanna, here become the most ordinary growth. They occupy the stretches of smooth rock where grass cannot grow, and with them are tangles of a leafless light-green plant (*Sarcostemma*), with smooth cylindrical stems, branching at right angles, and bearing during the dry season terminal tufts of small white flowers which betray them as members of the milkweed family (*Asclepiadaceæ*). The aloes bear their red flowers on a central stalk during the rains. Mosses of course are prac-

tically absent, lichens more abundant; but the cactus-like euphorbias are rarer than one would expect; we saw only one patch of good size at Aba. In shady or moist situations, generally on the lower slopes, grows a handsome wild banana, *Musa Schweinfurthi*, the fruit of which has large seeds, scattered perhaps through the agency of the baboons.

Mt. Baginze, on the northern boundary of the Uelle district near Yakuluku, was visited by Dr. Schweinfurth, who gave the following account of its botanical features.

Before actually setting foot upon Baginze we had still to make an ascent through a fine forest, but in due time we reached the mountain and made our encampment close beneath the perpendicular wall of the western flank. The halting-place was upon the edge of a deep ravine. . .

The first few steps that I took were quite enough to convince me of the entire accordance of the flora with that of the Abyssinian highlands. Masses of brilliant aloes, with their scarlet and yellow blossoms, grew luxuriantly upon the slopes of gneiss; the intervals between them were overspread with a mossy carpet of *Selaginella rupestris*, whilst clusters of blue lobelia reared themselves like violets, only of a brighter hue, from the surface of the soil. Here and there, in singular contrast to the tender foliage of the shady hollows, lending moreover a new and striking character to the vegetation, I found, cropping up from amidst the rocks, the thick fleshy leaves of that remarkable orchid, the *Eulophia*: and on the still higher declivities I met with yet another true representative of the Abyssinian flora in a new species of *Hymenodictyon*, a dwarf tree of the class of the Rubiaceæ, which in some form or other appear to embrace at least a tenth of all the plants of Africa in these regions.

Wherever one of the bright bubbling streams was seen, like a shining thread upon the grey monotony of the rocks, there I was pretty sure to find the Ensete, or wild African plantain. This is a plant which is never seen below an altitude of 3000 feet above the sea. It was now to be observed in every stage of its growth, sometimes being small like the head of a cabbage, and sometimes running out to a length of twenty feet with its fruit attached to a short thick stem in the form of an onion. The tender leaves were marked with a midrib of purple-red. It struck me that here in the wilderness this plant, which has become so common a favourite in our greenhouses, is distinguished by a much shorter leaf-stem and by a more compact appearance than it bears in its cultivated form when its growth is spreading and graceful. Not unfrequently the Ensete of the mountains bore a striking resemblance to young specimens of the *Musa sapientium*, though it exceeded it in the number of the leaves it bore, there being occasionally as many as forty on a single plant. I found it here in full bloom, but without any prospect of fruit; it differs from the other representatives of its class by losing its leaves at the time of its flowering, and then has the appearance of an elongated onion on a shaft some six or eight feet in length, on the top of which rests a compact truss of bloom.

I turned towards the northern declivity, which slanted in almost an unbroken line from the summit to the base. At first my view was necessarily circumscribed, and it was only after a good deal of clambering and by a very circuitous route along rugged places, overhung with bushes, and across fissures full of water, that I succeeded in finding the correct path. . . . The highest point of the ridge I found to be at the



Fig. 56. Baobab trees near Zambi, with lower Congo River in background. Photograph by Herbert Lang.



Fig. 57. Palms (*Hyphaene guineensis*) in open grassland near Zambi, on lower Congo. Photograph by Herbert Lang.



Fig. 58. Hills in grassy savanna near Boma, Lower Congo.



Fig. 59. Slopes of Bangu Plateau near Kitobola in Cataracts district. Courtesy of the Department of Agriculture, Belgian Colonial Office.



Fig. 60. Savanna near Marchal, in Cataracts district.



Fig. 61. Charlesville on the Kasai River, in one of the more wooded parts of Kasai district, seen from an airplane. Photograph by S. A. B. E. P. A.

south of the summit, and thence I had a magnificent prospect, being able to see for fifty or sixty miles in an east and northeast direction. Not far short of a hundred different mountain-peaks were visible, and of these I took measurements of the angles between the more important, which I subsequently combined with the angles which I had already observed. I also made a drawing of the entire panorama around me.

There was an entire absence of large trees everywhere, and the higher regions of the mountain bore but a very scanty vegetation. Contented, however, with the few botanical discoveries that the toilsome trip had yielded, I began to think of returning. It had taken me four hours to make the ascent of the mountain, but being now aware of the correct path, a single hour was all I spent in getting back to our encampment.<sup>1</sup>



Fig. 62. Small savanna area with many *Borassus* palms just south of Lukolela, middle Congo River.

I am sure that conditions of somewhat this nature may be found in the southern savanna, especially near the Lukuga River, the Hakanson Mountains, and on the southern border of the Kasai district. Certainly the rougher eminences in the "Monts de Cristal" have a good deal in common with those of the Upper Uelle. At a few hours' march from Matadi there are two high granite hills; but I was disappointed with the few hill birds I found there, although there were hyaxes of a light-gray color, matching the light-gray lichen which covered the darker rock in exposed places. Old nests of *Hirundo abyssinica* also were found. There were aloes, and a spiky *Sansevieria* (perhaps *S. cylindrica*) which we had

<sup>1</sup>Schweinfurth, 1874, 'The Heart of Africa,' II, pp. 214-218. English translation.

not found in the Uelle. The hyraxes, judging from signs beneath the rocks, come down on the hills quite close to the town of Matadi, and on an overhanging cliff along the river there was a large colony of nesting swifts (*Micropus affinis*).

#### SAVANNAS OF THE LOWER CONGO

On my way down the Congo River, as we came out of the forest at Bolobo, and tarried a few hours there and at Kwamouth and Kunzulu, I was impressed with the strong resemblance of this savanna to that of the Uelle. Many of the shrubs looked just different enough to represent other species of the same genera, and the birds were no more different. In many cases the species were the same, and still more often their notes were quite alike. Toward evening the hoarse cries of *Pternistis cranchii* recalled *Francolinus icterorhynchus*. The grass was beginning to grow, for it was now nearly the fourth week in December, and looking at the molting widow-birds (*Coliuspasser macroura*), and listening to the gay chorus of bush-shrikes and warblers, especially *Melocichla mentalis* and *Cisticola lateralis*, I could easily imagine myself back in the Uelle in the month of May. At Kunzulu there were dense tree growths in places; and about Leopoldville and Kinshasa one finds rather open woods which explain, I think, the many forest birds that have been collected there. Below Matadi, the number of shrubs and small trees in the savanna is smaller, although a sort of gallery forest often fills the gullies. The country back of Boma is decidedly hilly, relatively barren in some parts. It seemed to me that the grass was more inclined to form tussocks, and there was one small grass with a well-defined bulb. The bulbs would be turned up in numbers in cultivating the fields and were continually eaten by the bare-throated francolins. I could not decide how much the poverty of the bird fauna near Boma was to be attributed to the proximity of the town that served as the capital of the Congo. It is likely at the root of the scarcity of the indigenous guinea-fowl, *Numida meleagris marchei*, of which I could only find a single small flock during several weeks of searching.

#### SAVANNA WOODS

In trying to make out the exact limits of rain forest and savanna we found that accounts of vegetation in books of travel confused, more than aided us. What an author would call forest depended mostly on the regions in which he had traveled previously. But it is surprising when anyone familiar with the central Congo rain forest speaks of forest in the

Upper Katanga. What he means as a rule is an open woodland formation that Schimper has called savanna forest<sup>1</sup> and Engler steppe forest.<sup>2</sup> Still less rainfall is required than by the usual savanna, and the grass beneath the trees is fine and fairly short. It is common at levels of 3500 to 5000 feet in the Upper Katanga. We found considerable patches of it along the Congo-Sudan boundary in the neighborhood of Garamba. Engler's description of this formation in Unyamwezi would apply to it as found on both the northern and southern borders of the Congo, except that his dimensions for the trees are too small.

Erect trees, 7-12 meters high with stems 3-4 centimeters thick, form the prevailing type; Leguminosæ with pinnate leaves, which are termed "myombo," are dominant and sometimes pure; thus in Unyamwezi *Berlinia Eminii* occurs extensively, but species of *Acacia*, *Sterculia*, *Terminalia*, and *Kigelia* as well. There is little underwood, the shrubs and small trees of *Anona*, *Combretum*, and others are so scattered that traveling through the myombo-forests is in no way impeded. Succulent plants are rare, only here and there is an Aloe or a candelabra-like *Euphorbia*; but numerous herbs cover the ground.

My own description of the savanna woods of the northeastern Uelle, taken from my field catalogue of birds (May 5, 1912) is a rather summary treatment: "About the spot marked 'Garamba' on the map, the ordinary savanna vegetation is distinctly different from that about Faradje. Many of the commonest trees are of other species and the grass is in general shorter and finer. A few miles to the north (close to Sudanese territory) patches of open woods begin, irregular in shape and extent, composed of trees that attain a height of sixty to seventy feet, and resemble slightly in shape and in color of bark the American white oaks. Of course they have no relationship with the oaks. The large trees are mainly of two species: one leguminous, with large pinnate leaves and big brown seed-pods, ten inches (25 cm.) long; the other has a more oaklike leaf, or a large oval one, but the flowers are small and yellow, superficially not unlike those of a *Berberis*. The ground beneath the trees is comparatively free of underbrush, but covered with grass, which must grow four or five feet high before the end of the rainy season. Such groves of woods, though often intercepted by stretches of the ordinary bush savanna, spread away into the Sudan; nor do they only follow watercourses, like the gallery forest south of Faradje. Near Garamba, more often than not, the marshes are open and grassy, of the type our Azande trackers call *nduwili*, though there is also some papyrus."

The regions was inhabited by the derby eland; but I did not find it so well populated with birds as localities fifty miles farther south. We

<sup>1</sup>1903, 'Plant-Geography,' pp. 260, 358.

<sup>2</sup>1895, 'Die Pflanzenwelt Ost-Afrikas und der Nachbargebiete,' Deutsch Ost-Afrika, V, p. 62.

had now approached the line which appears to mark the edge of the West African flora and fauna; but it was as though many of the species of the Guinean savanna had become scarce, without their place being taken by any appreciable number of truly Sudanese or East African species.

#### Uganda-Unyoro Savanna

A part of eastern Africa north and west of Lake Victoria is included by botanists in the forest province because of the presence of so many typical western plants, and because there are not only gallery forests, but also larger wooded areas like the Budongo and Mabira forests, similar to the Congo rain forests. Rubber-bearing lianas (*Landolphia*), the West African rubber tree (*Kibatalia elastica*), and the bark-cloth fig (*Ficus Schimperii*) are all found in Uganda; and the large forest trees are closely related to those of the Congo, belonging to the same genera or even species. Whereas the forest elements are so typically West African, and include marantaceous plants in the forest undergrowth, there is at the same time a considerable invasion of East African plants in the more open savannas. Yet the elephant grass so abundant throughout Uganda is a western rather than an eastern plant. Papyrus swamps are numerous.

One could easily point out a close parallelism between plant and bird distribution in Uganda. In the pages to follow, it will readily be seen how many species of the western birds of the dense forest push eastward into Uganda. The cases where they are known to differ subspecifically are constantly increasing, especially through the work of Dr. V. G. L. van Someren in Uganda. Further, the admixture of eastern species is very marked, many of them coming to the border of the Ituri forest near Kilo and Beni, though not found in the northern Guinean savanna. It is questionable, at best, whether we have a right to include the south-east base of Ruwenzori in the western subregion, so that the montane region of that range is not so completely isolated from the lower level of the eastern subregion as may appear from my map.

Similarly that part of the Congo into which the Uganda-Unyoro savanna projects, especially the shore of Lake Albert and the Lendu Plateau rising just to the west, has a number of species of birds which would be reckoned as East African. The lake shore is relatively dry, a grassy savanna dotted with trees and a few *Borassus* palms, as well as candelabra euphorbias. Reed-beds of *Phragmites* often extend into the water of the lake. The lower Semliki Valley has much the same vegetation.

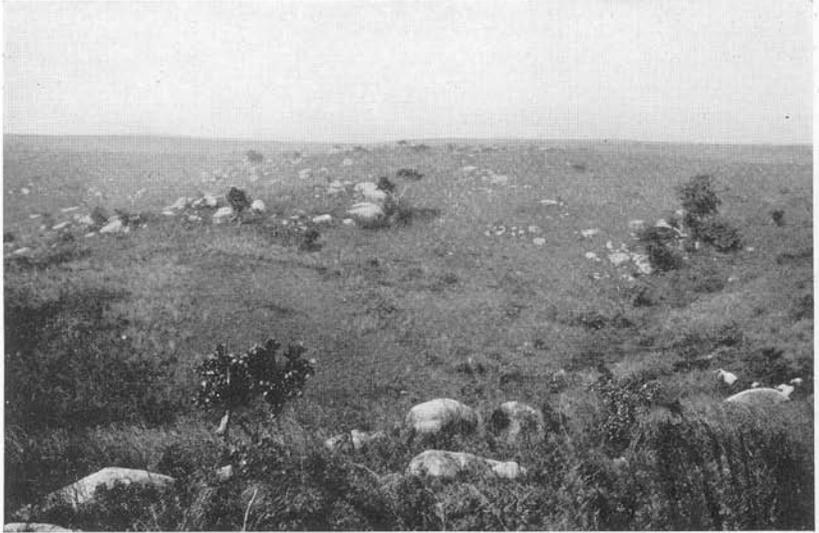


Fig. 63. Savanna on the Lendu Plateau, north of Nioka, northeastern Ituri district. Altitude 5800 feet.



Fig. 64. Granite outcrop on summit of a hill six miles northeast of Nioka, Lendu Plateau.

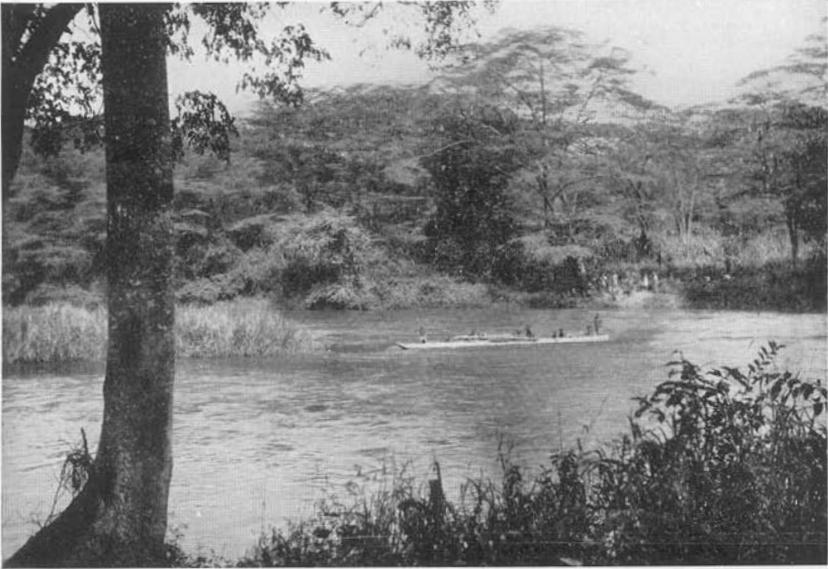


Fig. 65. The Semliki River near the old post of Beni. Photograph by Dr. J. C. Phillips.

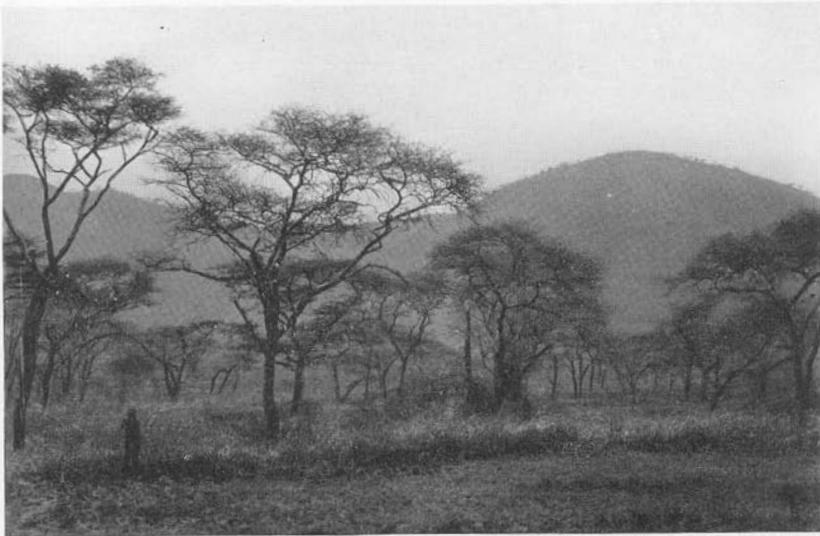


Fig. 66. Open acacia woods at southern base of Ruwenzori, near Kasindi.

The steep escarpment immediately to the west is largely grass-covered, with bushes and small trees in many of the ravines. Here we again saw a large sugar-bush like that of the northeastern Uelle. The Lendu Plateau is largely grassy, with relatively few trees except *Erythrina*. Near Bogoro, at the southern end of this plateau, there is said to be a native bamboo of a height of twenty-four to twenty-seven feet, forming dense clumps in the grassland. These bamboos flower so seldom that determination of the species is well-nigh impossible; yet it seems quite likely that this is the same as that found in the eastern Uelle and Lado Enclave. Emin likewise mentioned bamboos as growing on the heights along the west of Lake Albert.

Above 5000 feet on the Lendu Plateau and on the higher mountains along its eastern edge there are sometimes patches of mountain forest. Mt. Aboro is said to be well wooded, and in the valley of the Nizi River close to Djugu there is a splendid forest with a number of montane birds. These wooded areas are not part of the Uganda-Unyoro savanna district, but really a part of the humid montane area better developed to the southward.

At lower levels towards Irumu there is an extensive high-grass savanna, with some elephant grass, which ends abruptly at the eastern margin of the Ituri forest. To the southward the grassland extends to the hilly region near Boga and the northwest base of Ruwenzori.

Separated from the plains near Lake Albert by a stretch of rain forest, the old post of Beni stands in a grassy plain traversed by the upper Semliki. The elevation is not great, about 3000 feet, and yet there are many species of birds which one would not find in the Guinean savannas of the Congo (e. g., *Balearica regulorum* and *Nectarinia kilimensis*), intruders from eastern Africa.

This is a southern extension of the Uganda-Unyoro savanna into Congo territory, which surrounds Lake Edward and reaches up the Rutshuru Valley. Scott Elliot<sup>1</sup> regarded it as the meeting place of the eastern and western floras, and it must be admitted that in places the aspect of the vegetation is decidedly eastern.

Close to the margin of the forest the grass is high, and some of it is elephant grass, which is particularly tall and dense along the southwest base of Ruwenzori. Near Beni there are groups of *Borassus* palms. The middle of the plains of the upper Semliki and of the lower Rutshuru has lower, finer grasses (including *Themeda triandra*), with acacia trees and large euphorbias. North of Lake Edward there are open woods of large

<sup>1</sup>1895, Proc. Zool. Soc. London, p. 342.



Fig. 67. Southwestern shore of Lake Edward, with western escarpment of Albertine Rift. Photograph by Dr. J. C. Phillips.



Fig. 68. Looking up the lower Rutshuru River from near Kabare. Photograph by Dr. J. C. Phillips.

acacias with grass beneath, and at Kasindi as well as in the Rutshuru Plain there are dense patches of scrub in which two or three arborescent species of euphorbia take a major part.

Here and there in the lowland savannas near Irumu, Boga, and Rutshuru are patches of heavy forest, sometimes following the courses of rivers, such as the upper Loya, and the Rutshuru River near the post of Rutshuru. On the eastern edge of the Rutshuru Plain there is also a lowland forest which extends up into the mountains, and there takes on a montane aspect.

As a result of the marked variations in altitude and rainfall in this region, the Uganda-Unyoro savanna in Congo territory is extremely diversified, and merges gradually above 5000 feet with the montane types of vegetation.



Fig. 69. Diagrammatic view of eastern escarpment of the Rutshuru Valley, at about  $1^{\circ}$  S. latitude. An area of lowland forest on the eastern side of the valley extends up the gorge of the Ivui, where it meets a patch of mountain forest. Most of the surrounding country is grassy. These conditions are the result of local rainfall, altered somewhat by native farming.

#### EAST AND SOUTH AFRICAN SUBREGION

##### Humid Montane Areas and Alpine Zone

In discussing topography, climate, and faunal areas, I have already mentioned the highland forests which are found in many parts of the eastern Congo above 5000 feet. At times elevations exceeding that level will be found covered with grasslands or scrub; but where there is forest it takes on a humid montane character, and is inhabited by mountain birds. Even when forest is lacking there are usually many plants not occurring in the warmer lowlands. To describe the features of these highland areas, it seems best to take up first the outstanding example.

#### THE RUWENZORI RANGE

The whole western and southern base of the range is tropical, lying between 3000 and 4000 feet. The slopes just above 5000 feet may be called the "subtropical" or "lower montane" area. On Kilimanjaro, Sjöstedt has called it the "culture-zone," because its fertile lower parts

are cultivated by the natives, just as they are on Ruwenzori. It may be due partly to this agency that the lower limit of mountain forest is so variable on the western side of Ruwenzori, where at one place it extends down to the lowland forest, and at many others is restricted to the area above 6000 feet. On the eastern slope of Ruwenzori the forest does not commence until an altitude of 6500 to 7000 feet is reached. But its character is then much the same on both sides.



Fig. 70. Fording the Butahu River where it issues from Ruwenzori into the Semliki Plain.

The zones of vegetation as the mountain is ascended may be classified according to Schimper's system.<sup>1</sup> His three "regions" or zones of vegetation are:

1. Basal (like neighboring lowlands)
2. Montane (more hygrophilous, less thermophilous)
3. Alpine (under influence of general mountain climate)

Ruwenzori is so close to the equator and so isolated that the resemblances of the higher zones to higher latitudes is minimized, and the alpine zone,<sup>2</sup> although possessing some elements with near allies in north-

<sup>1</sup>1903, 'Plant-Geography,' p. 702.

<sup>2</sup>Because of the many differences from the alpine regions of more northern continents, especially the lack of pronounced winter and summer, it has been objected that the highest floral zone near the equator should not be called alpine, but better the paramo zone, from the name given to it in northern Andes.

ern regions, is nevertheless of an aspect which cannot be matched in temperate or cold latitudes.

The two upper floral divisions of Schimper can be further subdivided on Ruwenzori, for the humid montane zone is composed of a

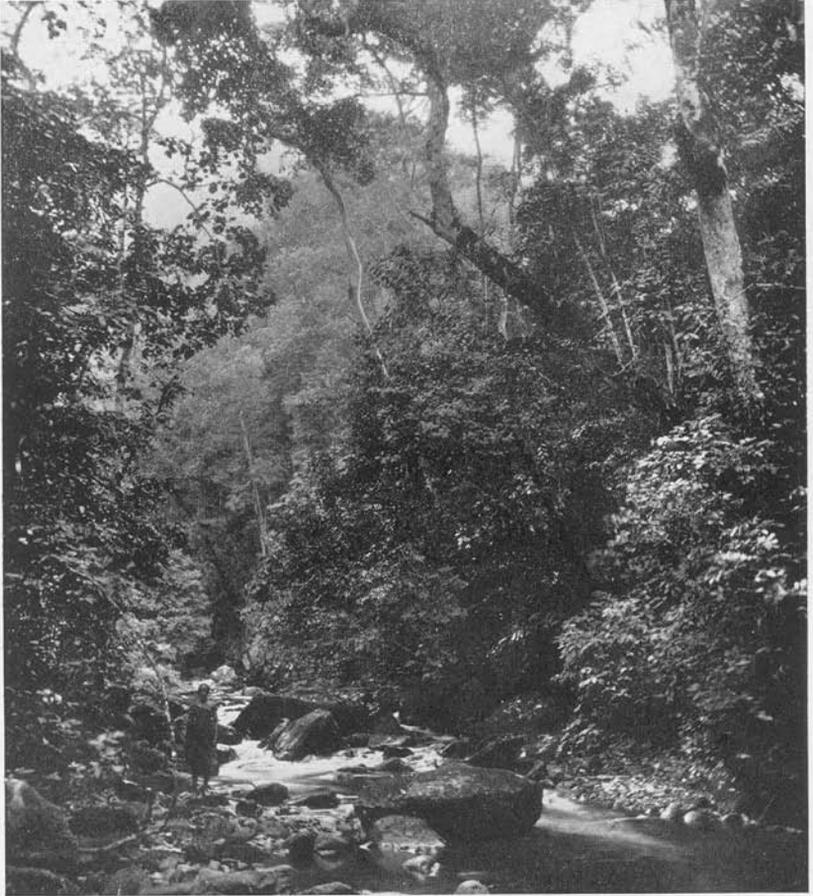


Fig. 71. Lowland forest on the Bungulu brook where it flows from the west base of Ruwenzori into the wooded part of the Semliki Plain.

forest belt and a higher bamboo belt. Above these the alpine zone begins, where the flora is intensely modified through the lowered temperature and increased evaporation. First, there is a belt of tree heaths, which may be regarded as a temperate formation, *Erica arborea* being also found in the

Mediterranean region. Above the tree heaths is the most picturesque zone of all, that of the giant groundsels and lobelias, which Scott Elliot states, with some exaggeration, made him think "of Pterodactyls and Plesiosaurs." A few hundred feet below snow line the senecios and lobelias cease, and the last flowering plants are a rush and a grass.

For a short description of the more typical plants occurring at these different altitudes of eastern Ruwenzori, we may turn to the notes by Wollaston, in the paper on the botanical collections of the British Ruwenzori Expedition.<sup>1</sup>

From 3000 to 4000 feet.—Between Lake Ruisamba (=Lake George) and the mountains there is a park country with grass and acacias, of eastern nature, although the West African *Spathodea nilotica* here grows in ravines.

4000 to 5000 feet.—A good deal of native cultivation, with elephant grass the most important feature, *Erythrina tomentosa*, a small red-flowered tree, growing amidst it.

5000 to 6000 feet.—Cultivation and elephant grass still continue, but a few small patches of forest fill the bottom of the valley (Mubuku R.).

6000 to 7000 feet.—Banana culture and elephant grass cease at 6000 feet. Now comes a zone of shrubs, with *Acanthus arboreus* and its mauve flowers conspicuous. The first of the tree lobelias (*L. Giberroa*) appears in open sunny places. *Dracænas* grow beside the streams, and wild bananas in shady places extend beyond 7000 feet. Cultivation of millet and colocasia stops at 7000 feet.

7000 to 8000 feet.—Between these elevations the biggest forest on the east side is found. A large *Dombeya* is very noticeable, and a *Podocarpus* is the finest tree, though not numerous. A *Begonia* climbs on the trunks, and tree-ferns stand in shady and moist places.

8000 to 9000 feet.—Slopes become steeper (Mubuku Valley) and forest thins out somewhat. There are small tree heaths (*Erica arborea*) and *Podocarpus* immediately below the bamboos (*Arundinaria alpina*) which begin at about 8500 feet on the eastern side, and 7000 feet in the western Butahu Valley.

9000 to 10,000 feet.—The bamboos continue to 10,000 feet, but at about 9500 feet the big tree heaths begin, their branches draped with a gray lichen. Terrestrial orchids, a bushy *Impatiens*, numerous ferns and a *Helichrysum* are noted at this level. *Rubus Doggettii* grows at 10,000 feet.

10,000 to 11,000 feet.—Mosses abundant, cushioning the tree heaths and fallen logs. More tree lobelias and a yellow-flowered tree hypericum appear now; *Viola abyssinica* also occurs, and at 11,000 feet the widespread northern "chickweed," *Cerastium vulgare*.

11,000 to 12,000 feet.—Immortelles (*Helichrysum*), tree lobelias, tree heaths, and tree senecios are the most conspicuous features. *Rubus runssorensis* is fairly abundant, and *Sedum ruwenzoriense* grows.

12,000 to 15,000 feet.—Tree heaths cease about 12,500 feet, but senecios (*S. adnivalis*) continue in some places to above 14,000 feet. *Lobelia Wollastoni* appears at 12,500 feet and grows nearly to the snow line, *Lobelia Deckenii* stops at 13,000 feet.

<sup>1</sup>Rendle, Baker, and Moore, 1908, Journ. Linn. Soc. London, Botany, XXXVIII, pp. 228-279. Pls. XVI-XIX. These are reprinted in abbreviated form in Wollaston's "From Ruwenzori to the Congo," 1908, App. A, pp. 278-285.

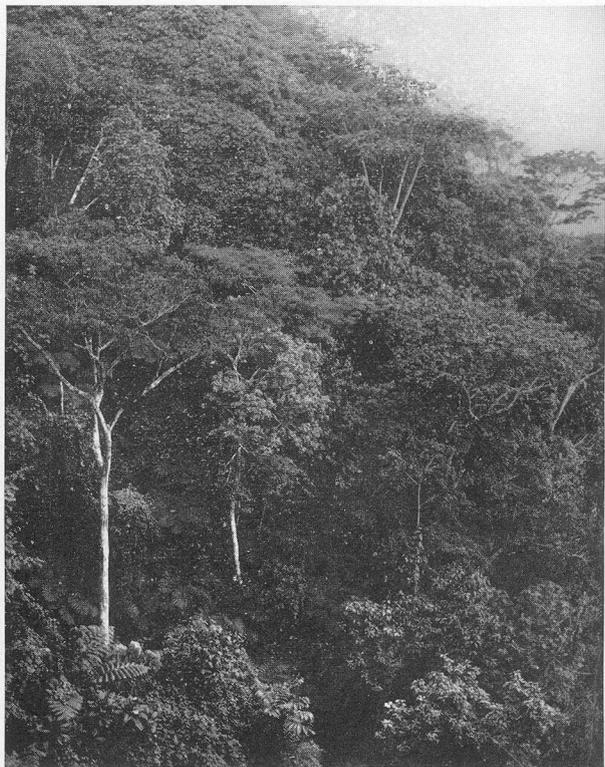


Fig. 72. Mountain forest at 6500 feet on the west slope of Ruwenzori, above Pakihoma.



Fig. 73. Mountain forest at 6900 feet near Kalongi, Butahu Valley, Ruwenzori.

In this region the immortelles form bushes, sometimes four or five feet high; there are a number of other plants growing up to 13,000 feet, an *Alchemilla* and an *Arabis* at 14,000 feet, and a rush (*Luzula Johnstoni*), a grass (*Poa glacialis*), and mosses almost to the permanent snow.

The same zones as here described for the Mubuku Valley extend around to the western slopes. Scott Elliot, Wollaston, and Woosnam all agreed that the respective zones descend somewhat lower in the valley of the Butahu on the western side; yet Stuhlmann's figures, of a much earlier date,<sup>1</sup> do not bear this out. He did find scattered bamboos in the Butahu Valley at a level of only 7000 feet, but there was forest from 7200 to 8300 feet, and then bamboos again up to 10,050 feet. The lowest tree heaths invaded the bamboos, and the highest, according to Stuhlmann's calculations, reached 12,500 feet. Above this are found the same lobelias, giant groundsel, and immortelles as on the eastern side. Stuhlmann estimated the lower level of the snow to lie at 14,100 feet, but he did not reach it, and his figure was about a thousand feet too low.

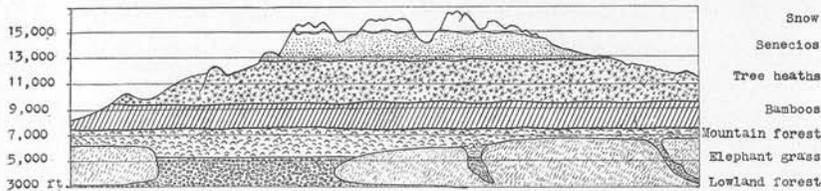


Fig. 74. Diagram of vegetational zones on western side of Ruwenzori. The vertical scale is greatly exaggerated.

The statement of Woosnam that all the floral zones came lower in the Butahu Valley is not substantiated. In following the same route as Dr. Stuhlmann I found that his altitudes were substantially correct. Except in the valleys the forest began at about 6100 feet, the lowest bamboos were in patches at 7200 feet, but the bamboo belt really began at 7500 feet. The tree-heath zone replaced the bamboos at 9300 feet, though some heath trees grew much farther down along a ridge. The lower limit of the Senecio zone was 12,700 feet, but some of the heaths spread upward to 13,800 feet.<sup>2</sup> The snow line I would place at 15,200 feet.

On the northwestern slope of the range, reaching upward toward Mt. Emin, Pilette<sup>3</sup> found the levels of the various floral zones essentially

<sup>1</sup>1894, 'Mit Emin Pascha ins Herz von Afrika,' pp. 300-305.

<sup>2</sup>A few heaths or bamboos with very slender stalks may be seen below the limits given here, and other plants of the upper zones may grow sporadically in stream-beds at relatively low levels. These are of no importance in delimiting zones of vegetation.

<sup>3</sup>1914, 'A Travers l'Afrique Equatoriale,' p. 110.



Fig. 75. Tree-ferns (*Cyathea Sellæ*) in a ravine at 6700 feet in Butahu Valley.



Fig. 76. *Lobelia Giberroa*, at 6900 feet near Kalongi, Butahu Valley.

similar, but the forest starts higher up. His estimate of the snow line seems too low.

Forest	from	6900 feet
Bamboos		7550 "
Tree heaths		10,800 "
Lobelias		12,800 "
Snow		14,760 "

The narrowness of the forest belt here corresponds with an observation by Woosnam<sup>1</sup> on the northeast side. "On a clear day when the cloud rests upon the higher part of the ridge, leaving that part below 10,000 feet exposed, an instructive view can be obtained from Fort Portal. The forest belt appears as a well-defined dark band running the length of the ridge without a break, but diminishing in breadth toward the north end until, at the point where it disappears over the ridge, it is only a narrow strip about one hundred yards wide and a good deal mixed with bamboo."

The diagram of Ruwenzori which De Wildeman<sup>2</sup> constructed upon the data of Pilette and the Ruwenzori Expedition is therefore not an east-west section, but rather one from southeast to northwest, with an interval of many miles.

The junction of the mountain forest with the lowland forest of the Semliki on the western slope, as reported by Stuhlmann and by Wollaston, was confirmed by Bequaert. In February, 1927, I made a point of visiting the spot, and found the connection to be ten or twelve miles wide. In this stretch there is no grassland on the lower slopes, the fusion of the two kinds of forest being complete. If lowland forest birds cared to make their way up into the mountain forest, here would be an excellent route. But the relative scarcity of such species in the mountain forest shows that they do not take advantage of it, doubtless because the cold is distasteful.

A list of characteristic plants growing at the various levels on the west side of Ruwenzori would be too long for our present purpose. Only a few can be mentioned briefly.

*Acanthus arboreus*, a large bush with prickly leaves and purplish-pink flowers, is abundant along the base, but scarcely grows above 6200 feet. Just below the edge of the mountain forest there is usually a dense growth of elephant grass (*Pennisetum purpureum*), with scattered trees, especially *Erythrina* and *Albizzia*. On the native farms are grown maize, beans, millet (*Eleusine*), and taro (*Colocasia*), but plantains do not fruit well above 6400 feet. Some white potatoes are grown at Kalongi, the

<sup>1</sup>1909, Trans. Zool. Soc. London, XIX, p. 16.

<sup>2</sup>1921, Revue Générale de la Colonie Belge, p. 20.



Fig. 77. Bamboos (*Arundinaria alpina*) on west slope of Ruwenzori, at 7900 feet.



Fig. 78. Thick moss-beds in the heath zone of west Ruwenzori, at 12,000 feet.

highest village in the Butahu Valley, 6900 feet, and castor-oil plants near the huts grow into small trees.

Old fields within the mountain forest belt are apt to be grown over with nearly pure tangles of bracken (*Pteridium aquilinum*), six or seven feet in height, and these ferny patches occasionally stretch up to 7500 feet.

The mountain forest on Ruwenzori is not remarkable for the size of the trees, and the undergrowth is usually very dense. Up to 6400 feet there is a large species of *Aframomum*. Some of the characteristic trees are *Dracæna afromontana*, *Ficus butaguensis*, *Pittosporum fragrantissimum*, *Croton butaguensis*, *Dombeya Goetzenii*, *Schefflera acutifoliolata*, *Psychotria ficoidea*, and two species of *Olea*. In ravines and other moist spots there is an abundance of tree-ferns (*Cyathea Sellæ*), in open glades the tall *Lobelia Giberroa*, and here and there a wild banana with enormous leaves. Creepers and epiphytes abound, and one sees a little blue violet (*Viola abyssinica*), buttercups (*Ranunculus*), *Plantago palmata*, balsams (*Impatiens*), but no clovers.

Above 7500 feet bamboos (*Arundinaria alpina*) become an important element of the forest, often forming nearly pure stands. Some of them reach a height of forty feet, and the thickest stalk I measured had a circumference of 27 cm., or 10.6 inches. Many more trees are scattered among the bamboos on Ruwenzori than on Mt. Kenia. Large yews (*Podocarpus milanjanus*) and *Dombeya* trees grow here, laden in November with masses of white flowers. When the bamboos grow thickly there are few herbaceous plants, but a jack-in-the-pulpit (*Arisæma ruwenzoricum*), a balsam (*Impatiens apiculata*), *Geranium simense*, a climbing *Begonia*, *Thunbergia alata*, and two species of *Galium* grow in this zone. Occasionally one sees a large white immortelle, or a tall blackberry bush with black fruit.

The change from bamboos to heaths at 9300 feet is decidedly abrupt, although scattered heaths do extend downward a thousand feet, and heath bushes are occasionally seen on the western slopes as low as 6500 feet. In explanation it may be added that there are a number of species of heaths, distinguishable only to a botanist, and belonging to two genera, *Erica* and *Philippia*. All have narrow leaves and small flowers, so that their superficial aspect often suggests juniper bushes. Others grow to a height of twenty-five feet, with stout bare trunks and a heavy drapery of beard-lichen. The ground is covered almost everywhere with a thick carpet of wet mosses, including *Sphagnum*, and clumps of moss and liverworts adorn many of the heath trees. No less than twenty-



Fig. 79. Tree heaths (*Philippia*) in the upper Mubuku Valley, east Ruwenzori  
Photograph by Vittorio Sella. Copyright, National Geographic Society.



Fig. 80. Lower edge of the Senecio zone west of Mt. Stanley, at 12,800 feet. *Senecio adnivalis*, tree heaths, and a carpet of *Alchemilla*.

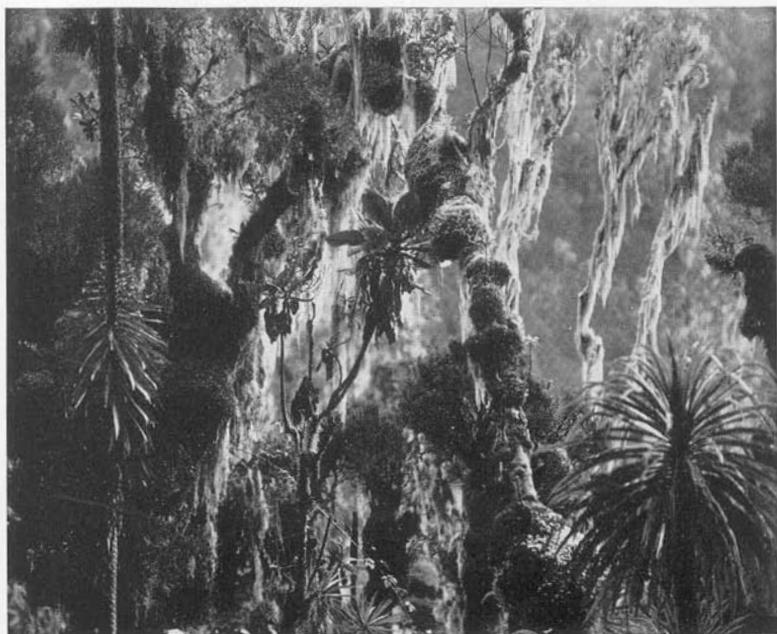


Fig. 81. Vegetation in the upper heath zone at Bujongolo, east Ruwenzori with *Lobelia Stuhlmanni*. Photograph by A. J. Klein.



Fig. 82. *Senecio adnivalis* and *Lobelia Wollastoni* at 13,000 feet, west of Mt. Stanley.



Fig. 83. *Lobelia Deckenii* in the Bujuku Valley, east Ruwenzori. Photograph by Vittorio Sella. Copyright, National Geographic Society.



Fig. 84. View up the western side of Mt. Stanley from Itereré, 13,800 feet.

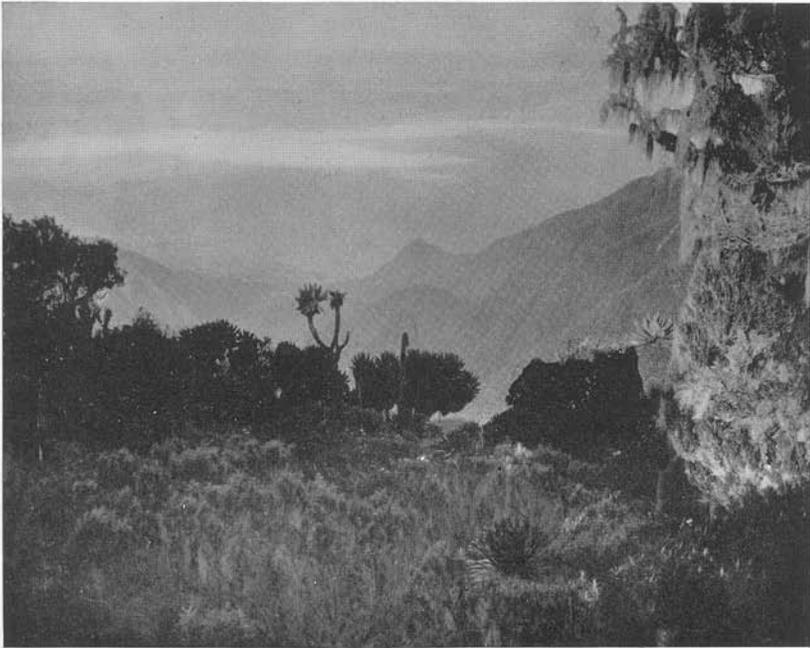


Fig. 85. View from Itereré, down the Butahu Valley to the Semliki Plain.

eight species of mosses have been found in the heath zone of Ruwenzori, and the wet carpet they form is often two feet or more in thickness. Where the dead heath trunks lie in a tangled mass they become hidden under the moss, and the unwary visitor may fall through up to his neck.

Among the heaths there are a few other trees, small examples of *Podocarpus*, *Agauria* (suggesting rhododendrons by their broad leaves), *Mæsa*, *Cornus Volkensii*, and *Rapanea*. At one spot near 11,400 feet we found a patch of *Hagenia* trees, but these are rare on Ruwenzori. At 10,000 feet grew a patch of low tree-ferns (*Alsophila Mildbraedii*), and above 10,800 feet there is a *Lobelia* with a long woody stem surmounted by spiky tufts of leaves (*L. Stuhlmanni*). The first arborescent senecios were met at 11,300 feet, growing here and there amid the heaths. A blackberry already mentioned (*Rubus runsorensis*), *Vaccinium Stanleyi*, and a *Mimulopsis*, are bushes occurring in this zone. Few herbaceous plants can compete with the ubiquitous mosses, yet one sees spikes of pink orchids, an *Impatiens* with scarlet flowers, and a sprawling *Peucedanum*.

Although a few lobelias and senecios grow amid the heath formation, the change to the typical groundsel or senecio formation is abrupt, and may take place as low as 12,800 feet. There one steps out onto a springy carpet of *Alchemilla*, and walks freely between the arborescent groundsel, which are mainly *Senecio adnivalis*. Above 14,000 feet grows *Senecio Erici-Rosenii*, with under surface of leaves fuzzy-white, and its trunk usually concealed by adhering dead leaves. The torch-lobelias are mainly *Lobelia Wollastoni*, the stouter *L. Deckenii* being confined to boggy spots in valleys.

Almost everywhere grow patches of woody bushes of *Helichrysum Stuhlmanni* with straw-white flowers, and the tussocks of *Carex runsoroensis* are abundant. A rush (*Luzula Johnstoni*) is common, and there are a few low grasses. Green moss often forms a thin carpet beneath the tree groundsel and immortal bushes. Between 13,000 and 14,000 feet tall bushes of *Hypericum Bequaerti*, with numerous orange-scarlet flowers of almost the size and shape of tulips, mingle with the tree groundsel, as do scattered clumps of tree heath. The magnificent Dartmouth sunbird, so common at this level, occasionally visits the *Hypericum* flowers, but is seen most frequently clinging to the flower-spikes of *Lobelia Wollastoni* or perching on the senecios.

The genus *Alchemilla* appears to be represented by several species differing in the size and form of leaf. As one ascends above 14,000 feet only a small-leaved species persists, and at 14,700 feet this virtually disappears. The torch-lobelias, too, are scarce above 14,500 feet, though



Fig. 86. *Senecio Erics-Rosenii* and *Helichrysum Stuhlmanni* at 14,500 feet, west of Mt. Stanley, Ruwenzori.



Fig. 87. Alexandra Peak and one of its glaciers, seen from the west at 14,900 feet.

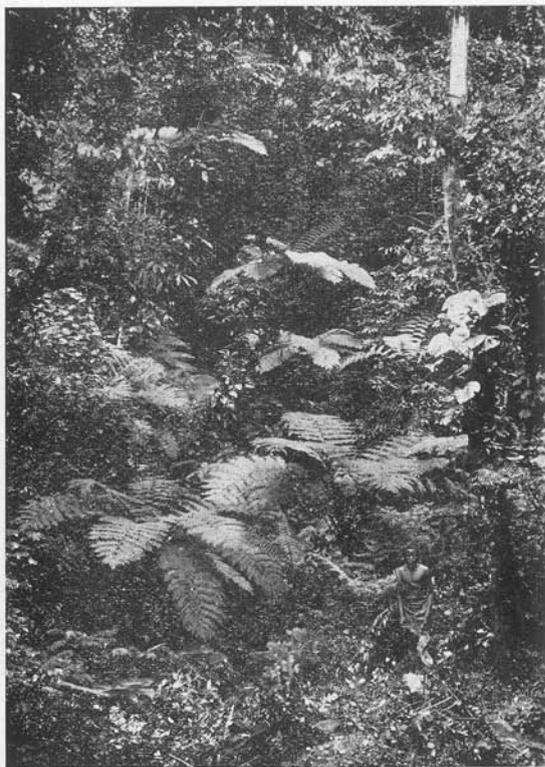


Fig. 88. Tree-ferns in lowland forest at 3900 feet, along the Kahindo brook, on eastern side of Rutshuru Valley.



Fig. 89. Mountain forest at 5300 feet in highland just east of Rutshuru Valley, near Ivui River.

*Senecio Ericsi-Rosenii* grows up to 14,800 feet, and the immortelle bushes reach 15,000 feet at least. Finally at 15,200 little is left besides blackish lichen encrusting the rocks.

#### THE KIVU VOLCANOES

Although their vegetational zones correspond in a way with those of Ruwenzori, the volcanoes differ in several respects. The lower mountain forest is less extensive than on Ruwenzori, and while the bamboos flourish on the central and eastern volcanoes, they are wanting on the active western cones. The heath zone is poorly developed and, on the central group especially, is largely replaced by an association in which *Hagenia abyssinica* is the dominant tree. The *Senecio* zone, on Mikeno and Karisimbi at least, is rather similar to that of Ruwenzori. The very summits of these two highest peaks are nearly bare of vegetation.

With regard to the species of plants, there are similar differences. Some kinds which are rare or wanting on Ruwenzori are abundant about the Kivu Volcanoes; for example, the clovers, lacking on Ruwenzori, and the *Hagenia* tree, which is so scarce there. At the base of Mt. Mikeno there are three species of clover, *Trifolium usambarense* being the most common.

In many places recent lava-flows have destroyed the former vegetation, and only gradually can the normal conditions be restored. The lava fields are very extensive in the vicinity of Mt. Niragongo and Mt. Namlagira, and another one of somewhat earlier date lies to the north of Mt. Muhavura. Moreover, the whole east slope of Muhavura is barren of forest, as though the lava there had not yet weathered sufficiently.

Mention has already been made of the varying level at which mountain forest begins in the Kivu district. Lulenga, for example, at 6000 feet near the northwest base of Mikeno, is in a grassland, with forest beginning at 7000 feet, and bamboos from 7600 feet to 9700 feet. Going up the western slope of Mikeno, we first met the bamboos at 7500 feet, and saw them last at 9600 feet. Here the bamboos are never so large or so numerous as on Ruwenzori, and are still more mixed with trees.

The southern base of Karisimbi is said to have a better-developed bamboo growth, and a strip of bamboos extends from there to the so-called "Bugoe" forest, on the highlands northeast of Lake Kivu. Yet bamboos are entirely wanting on Niragongo and Namlagira.

On Mikeno the *Hagenia* trees appear in some numbers amid the bamboos at 8400 feet, and from 9600 to 11,700 feet they form a mag-

*Senecio Erics-Rosenii* grows up to 14,800 feet, and the immortelle bushes reach 15,000 feet at least. Finally at 15,200 little is left besides blackish lichen encrusting the rocks.

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Fig. 90. The eastern group of Kivu Volcanoes, seen from Rutshuru. From left to right: Muhavura, Gahinga, and Sabinyo.

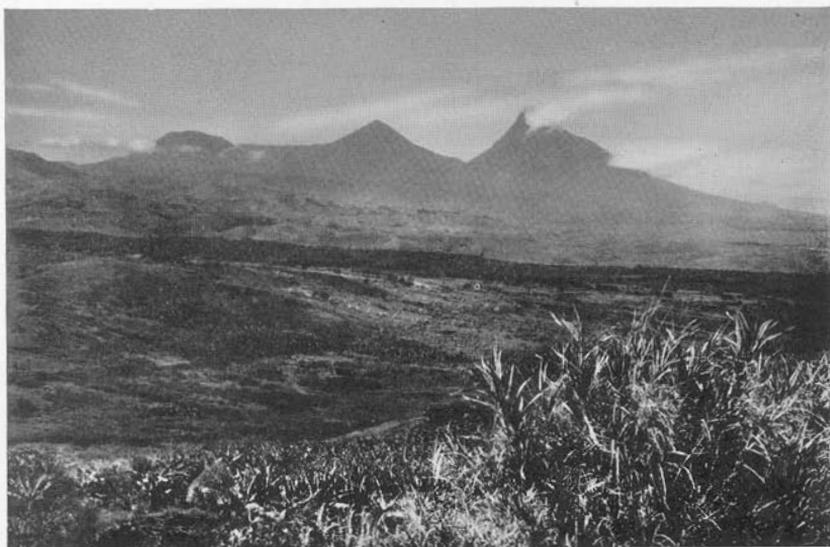


Fig. 91. The central group of Kivu Volcanoes, seen from Rutshuru. From left to right: Visoke, Karisimbi, and Mikenno.

nificent open forest, with a luxuriant growth of wild celery (*Anthriscus silvestris*), sorrel (*Rumex nepalensis*), herbaceous senecios, and nettles (*Fleurya* and *Pilea*) beneath them. The *Hagenias* bear quantities of ferns and mosses, and are often draped with lichen. The bases of their massive trunks sometimes have a circumference of twenty feet. Here there are a few other trees; but I saw no *Podocarpus*, and need only mention an *Agauria*, providing food for *Ruwenzorornis*, and *Hypericum lanceolatum*, which becomes the dominant tree between 11,700 and 11,900 feet, on both Karisimbi and Mikeno.

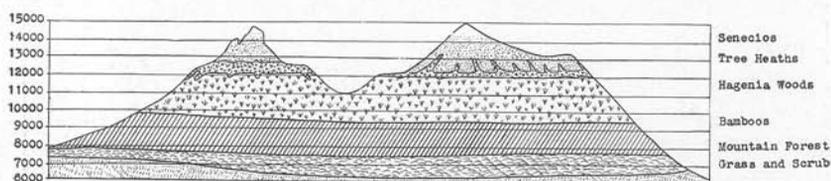


Fig. 92. Vegetational zones on western slopes of Mt. Mikeno (left) and Mt. Karisimbi (right) in the central group of Kivu Volcanoes. Their summits are nearly barren save for moss and lichen.

Tree heaths are found on these two peaks around 12,000 feet, but do not form a well-defined zone; and a heavy moss-carpet like that of Ruwenzori is wanting. *Philippia johnstonii* attains a height of thirty feet, while a species of *Ericinella* forms bushes a little farther up. The Senecio zone is well developed on Mikeno and Karisimbi, and there grow *Senecio adnivalis* and *S. Ericsi-Rosenii*, *Lobelia Wollastoni* and *L. karissimbensis*. *Alchemilla cinerea* carpets the ground, and there are patches of herbaceous immortelles with white and pinkish flowers, but no woody bushes as on Ruwenzori.

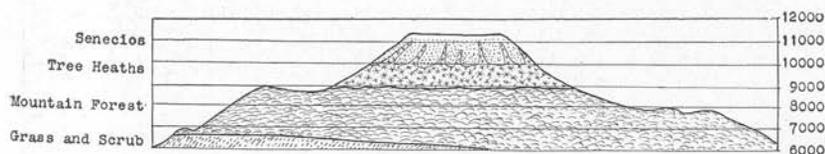


Fig. 93. Vegetational zones on eastern side of Mt. Niragongo. A bamboo zone is lacking, and the summit is bare lava, with only a few tufts of grass.

Snow and hail often fall on the summits of Mikeno and Karisimbi, so there is little vegetation there. At about 12,000 feet Karisimbi has



Fig. 94. Bamboos (*Arundinaria alpina*) on southwest slope of Mt. Mikeno, 8400 feet.



Fig. 95. Mountain forest on southeast slope of Mt. Niragongo, 7800 feet.

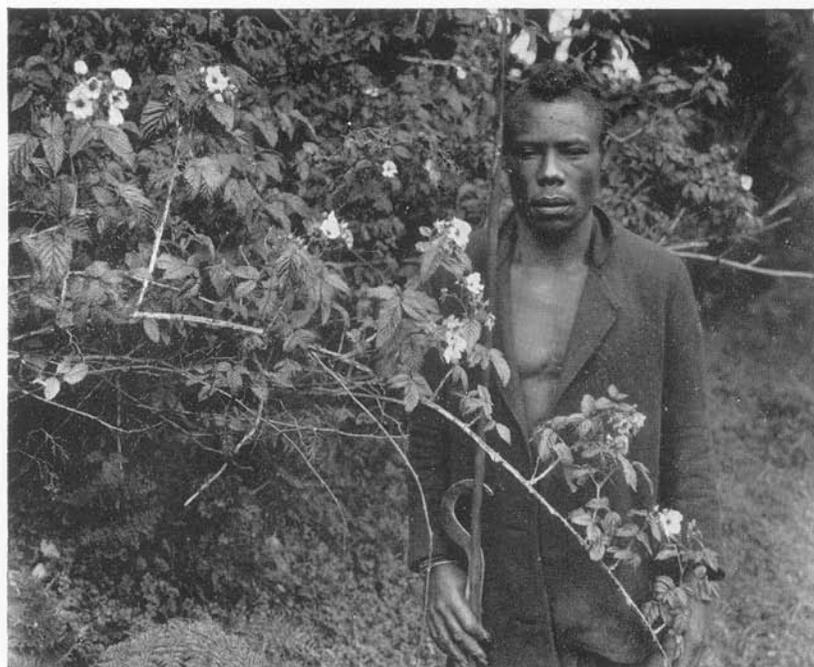


Fig. 96. Blackberry bush (*Rubus runsorensis*) on Mt. Karisimbi, 12,000 feet.



Fig. 97. Red clover (*Trifolium*) on Mt. Mikeno, 8500 feet.



Fig. 98. Clearing in *Hagenia* woods at 11,000 feet in saddle between Mts. Karisimbi and Mikeno. Karisimbi in background.

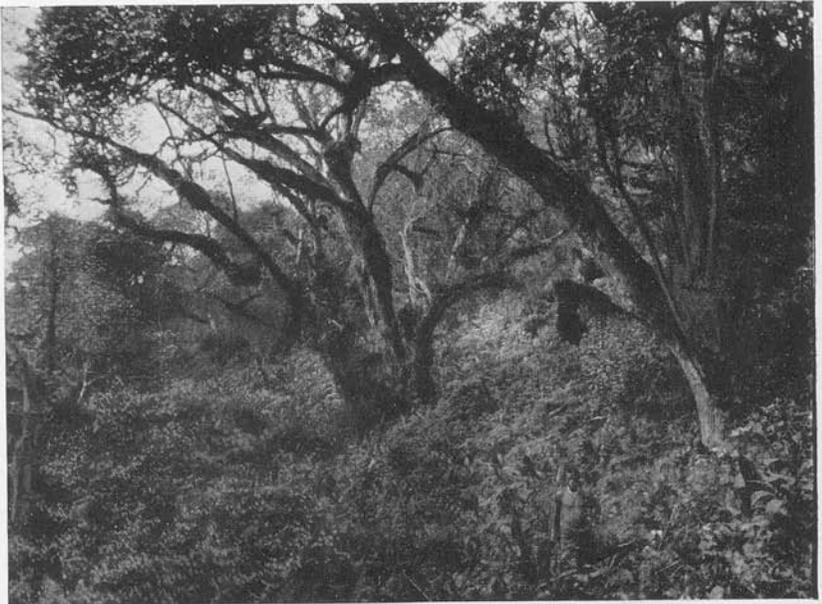


Fig. 99. *Hagenia* woods on Mt. Karisimbi, 11,500 feet.

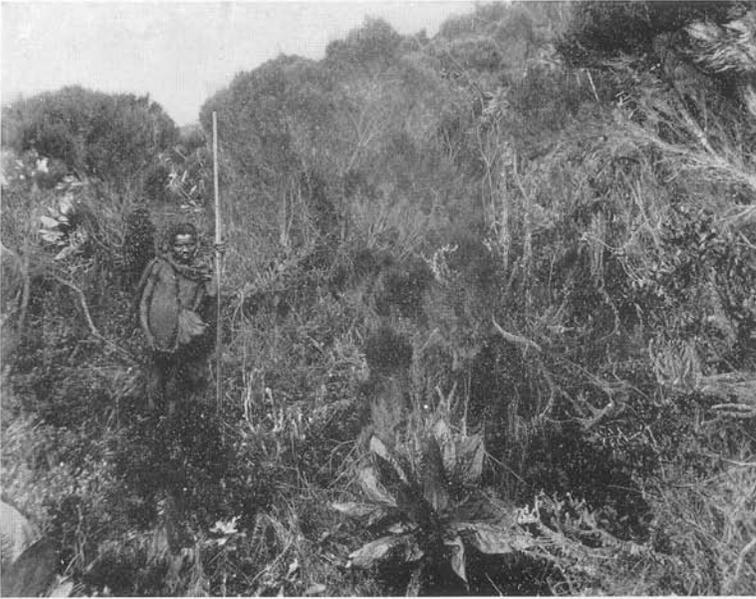


Fig. 100. Heath zone on Mt. Niragongo, 10,000 feet. *Erica arborea* and *Philippia Johnstonii*.



Fig. 101. Large heaths on Mt. Mikeno, 12,500 feet.



Fig. 102. *Lobelia karissimbensis* in a gully on Mt. Karisimbi at 12,500 feet.

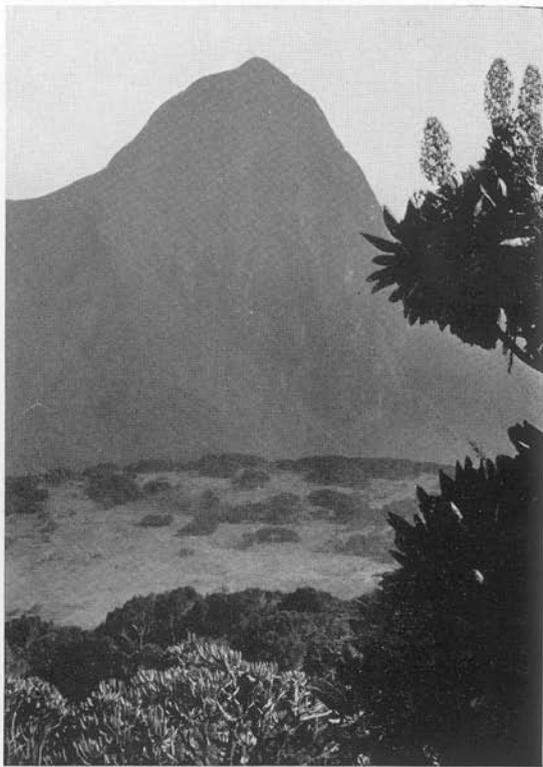


Fig. 103. Mt. Mikeno seen from upper slopes of Karisimbi. *Senecio adnivalis* flowering in right foreground, and dark clumps of heath-trees (*Philippia Johnstonii*) in middle distance at 12,000 feet.

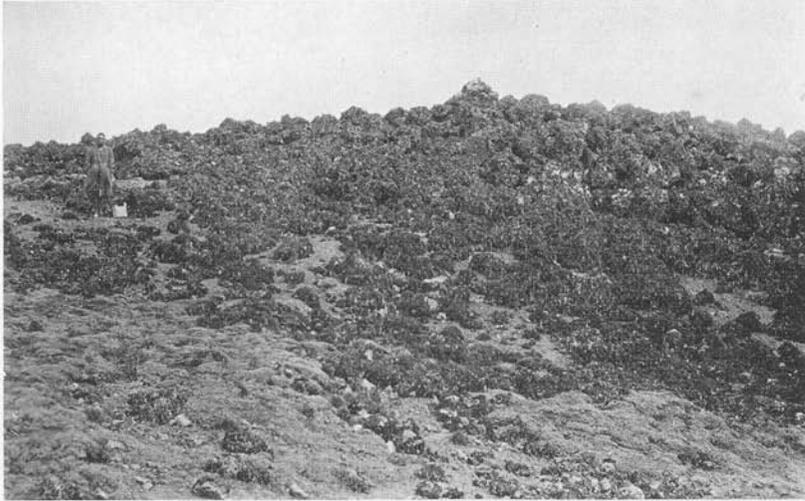


Fig. 104. The barren summit of Mt. Karisimbi, at nearly 15,000 feet. On the lava boulders grows a lichen, *Gyrophora alpina*.



Fig. 105. Senecios on Mt. Karisimbi, 13,500 feet. Here *S. Erics-Rosenii* and *S. adnivalis* grow mixed.

some boggy meadows marking old craters, and these are largely overgrown with sedges.

Our ascent of Niragongo was made from Kibati, in a tall-grass savanna with *Erythrina* and other small trees, southeast of the mountain. At 6800 feet we entered scrubby woods, and soon were climbing through a rather fine mountain forest with large trees. Toward 8300 feet there was rough lava covered with scrub, and near there we began to see *Hypericum* trees. The first heath bush was at 8600 feet, and a few small *Podocarpus* trees grew at 9000 feet. No bamboos were seen on the mountain.

The heath zone is better marked on Niragongo. At 9200 feet heath bushes are numerous, and from 9500 to 10,700 feet heaths predominate, many growing to small trees. In the lower heath zone there are trees of *Myrica salicifolia*, and above 10,000 feet arborescent senecios of small stature stand amid the heaths. At 10,900 feet the lava becomes nearly bare, with a few small heath bushes and immortelles, while close to the rim of the crater (11,370 feet) there are only a few tufts of dead grass.

Namlagira, the newest and most active of the volcanoes, has no heavy forest or bamboos. It rises from an extensive lava field where a young scrubby growth is becoming established. First the rough blocks become coated with gray lichen, then come mosses and ferns, sorrels (*Rumex maderensis*), *Hibiscus gossypinus*, and a succulent *Kalanchoë*. On some of the older lava fields in the Kivu there grows a splendid *Kniphofia*, with scarlet flowers at the top, yellow ones below. It is constantly visited by sunbirds. Eventually a low woody vegetation appears, entwined with creepers; and as the lava weathers, it will eventually provide soil for the plants that occur on the older volcanoes.

The vegetation of four of the more important peaks has also been investigated by Dr. Mildbraed,<sup>1</sup> the botanist who accompanied the Duke of Mecklenburg. He stated that Sabinyo, while far more deeply eroded, has somewhat the same predominance of bamboos in the forest zone as Karisimbi, though they are not so tall and grow in denser clumps. Above them is a more typical heath formation than on Karisimbi, containing *Erica arborea* and *Philippia Johnstonii*. Muhavura, on its western side, is much like Sabinyo, but the vegetation of its eastern slope seems to have been largely destroyed by a rather recent flow of lava, upon which stable conditions have not yet become established.

*Senecio adnivalis* and *Lobelia Wollastoni*, as Mildbraed says, are restricted to Ruwenzori and the Kivu Volcanoes. *Lobelia Giberroa*, how-

<sup>1</sup>1914, 'Wiss. Erg. D. Zentr.-Afr. Exp. Mecklenburg,' II, Botanik, pp. 636-650.

ever, which grows much lower down in the montane region, has a far wider range, from Abyssinia to Kilimanjaro, Ruwenzori, and even the mountains north of Lake Nyasa. To-day there are wide intervals where the latter species cannot grow. An explanation based on the carrying of the seeds by birds does not suffice to show why the alpine species have a smaller area of dispersal than those of the lower montane region. A change in the climate, on the other hand, involving the lowering of the floral zones, will best cover just this aspect of the problem.

#### OTHER MOUNTAIN FORESTS

It seems very probable that much more of the highlands about Lake Kivu and in Ruanda and Urundi was originally forested, and that natives cleared large areas because of their fertility. The forests remaining are usually at high levels, especially along the upraised margins of the Albertine Rift.

The Bugoie and Rugege forests are of montane type, and shelter birds of that character. According to Morteihan<sup>1</sup> the forests of the eastern Kivu region (apart from those of the volcanoes) are located as follows:

- 1.—For fifty kilometers along the northeast side of Lake Kivu, and fifteen kilometers wide, containing very many bamboos (Bugoie).
- 2.—A second forest with bamboo at some of the higher spots, beginning south of Lubengera, on the easternmost corner of the lake, extends into Urundi (Rugege).
- 3.—A third forest in Urundi, south of Gitega, also with considerable bamboo.

Among the trees taking part in the formation of these forests the most important are *Olea hochstette ri* (wild olive), *Sideroxylon Adolphi-Friederici* (Sapotaceæ), *Macaranga kilimandscharica* (Euphorbiaceæ), *Podocarpus usambarensis* (Taxaceæ), and *Hagenia abyssinica* (Rosaceæ). Tall, light-colored trunks sometimes stand out so as to be visible for miles; but these patches are only remnants of extensive forests, which must once have spread much more widely over the highlands of eastern Africa, but which have suffered at the hands of the natives. Much of the mountain grassland, thinks Dr. Shantz,<sup>2</sup> would probably revert to forest, were it not for the constant burning and grazing.

In parts of Ruanda, violets, water-ress, and other apparently northern plants occur; there are tree heaths too in a few isolated places. But a large part of this populous territory has now steppe, or better, mountain-grass vegetation.

Along the eastern escarpment of the rift the remnants of mountain forest can be followed northward almost to Lake Edward. Bamboos

<sup>1</sup>1921, Bull. Agricole Congo Belge, XII, pp. 449-451, with map.

<sup>2</sup>1922, Geographical Review, XII, p. 340.



Fig. 106. Rugege Forest, southeast of Lake Kivu, 6500 feet. Photograph by Rudolf Grauer.

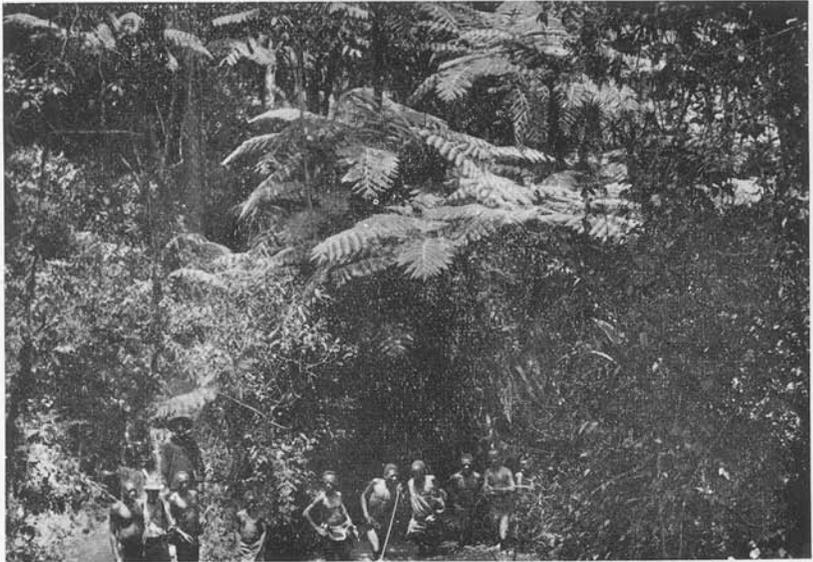


Fig. 107. Tree-ferns in mountain forest northwest of Lake Tanganyika, 6500 feet. Photograph by Rudolf Grauer.



Fig. 108. The west shore of Kwidjwi Island, Lake Kivu. Photograph by Rudolf Grauer.

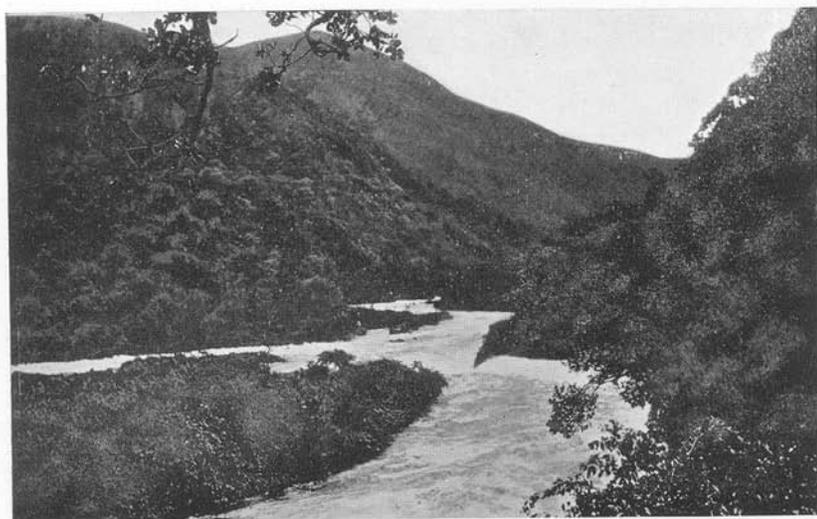


Fig. 109. The upper Ruzizi River near Nya Lukemba. Courtesy of the Department of Agriculture, Belgian Colonial Office.

cover the highest ridges near Behungi in British Ruanda, though the lower mountain forest is all but obliterated. North of Kigezi there is also dense forest on the mountains, the Kayonsa forest of Uganda foresters, but it is mainly east of the Congo boundary. A continuation of it descends into the eastern side of the Rutshuru Valley.

The shores of Lake Kivu are steep and without extensive marsh formations. On its islands there is a mixture of grassland with dense tangled woodland where few of the trees are markedly tall. The largest of the islands is Kwidjwi, twenty-four miles long, rising at one point 2600 feet above the level of the lake. On this mountainous portion, beginning at 800 feet above the shore, grows a mountain forest, in which Mildbraed cites as the largest trees: *Parinarium Mildbraedii* (Rosaceæ), *Chrysophyllum longipes* (Sapotaceæ). *Strombosia Schefflerii* (Oleaceæ) is very abundant, and *Grewia Mildbraedii* (Tiliaceæ) as well as *Carapa grandiflora* (Meliaceæ) rather common. In the undergrowth a *Dracæna* is conspicuous, and flowering herbaceous plants grow luxuriantly. Along brooks are many stately tree-ferns, reaching a height of twenty-six feet, with fronds more than nine feet long. The most elevated portion of Kwidjwi is still below the level of the tree-heath zone of the other Kivu Mountains, and the large heaths which are to be seen, *Ericinella manni*, grow far down along the lower edge of the montane region.

Along the western margin of the rift, as a glance at the orographic map will show, there is a chain of highlands extending from the southwest side of Lake Tanganyika to the northwest shore of Lake Albert. South of 4° 30' the rainfall is greatly reduced, and Marungu has only very small areas that resemble mountain forest.

From the mountains northwest of Baraka to the highlands northwest of Lake Edward there is a nearly continuous chain of mountains clothed in many places with mountain forest or bamboos. For practically this whole distance the altitude is at least 6500 feet, and in four sections it rises to 8000 and 10,000 feet.

A. Pilette<sup>1</sup> called these the Mitumba Mountains, considering them as a northwest extension of the Mitumbas in the southeast Congo. I prefer to call them the Western Kivu Range. Rudolf Grauer collected many birds on the forested highlands northwest of Baraka, at 6500 feet, and he has kindly sent me many photographs showing typical mountain forest there. This is the locality which he called "Urwald westlich von Tanganyika."

From Luvungi in the Ruzizi Valley I made a hasty trip to the high ridge on the west. At Lemera, 5000 feet, the vegetation was grassy with

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<sup>1</sup>1914, 'A Travers l'Afrique Equatoriale,' p. 32.



very few trees, and the lower eastern slopes of the mountains were similar. Although mountain forest extended down in gullies to about 6900 feet, it was often wanting on the ridges up to 7500 feet. The bamboos began at 7600 feet, and covered the whole summit of the ridge, except where there were open grassy patches and a few tree heaths. The highest summit in this vicinity was called Kandashomwa, with an elevation of 9900 feet.

Later, my friends Messrs. Rockefeller and Murphy crossed the ridge and descended the western slope to Itula. They report that below the bamboos there was a belt of mountain forest, then a stretch of mountain grass, and finally more mountain forest near 6500 feet, which soon merged with the lowland rain forest to the westward.

On the higher ridges west of Lake Kivu there are mountain forest and bamboos, but a strip of mountain grassland on the western slope is apparently the usual condition. Dr. Bequaert, who has crossed the range in the neighborhood of Masisi ( $1^{\circ}$  S. lat.), did not find tree heaths. He tells me also that there is a great difference in the elevation at which the mountain forest begins on the two sides of the ridge. On the west it merges gradually with the equatorial or lowland rain forests at an elevation of about 5000 feet. But on the east it exists only at a higher level, about 6600 feet, which may be due in part to the diminishing precipitation. Bequaert is inclined to believe that the natives along the east side have cut the forest off to till the ground, because some small isolated patches of woodland still remain.

Once the high-lying, subtropical forest is entered, the marantaceous plants disappear from the undergrowth, and the trees composing the forest are entirely changed. Among them is now a remarkable tree, *Sakersia* (family Melastomaceæ), ten meters in height with dense clusters of purplish-red flowers. Near Masisi at least, *Podocarpus* is wanting. Tree-ferns (*Cyathea*) become very common, and the undergrowth usually contains tall herbaceous Acanthaceæ, one of them *Mimulopsis arborescens*, semiligneous at the base, growing fourteen feet high. Epiphytes are much more abundant than in the lowland forest, and include ferns, orchids, the lobeliaceous *Streptocarpus*, many species of *Lycopodium*, and begonias. Among the ground plants may be noted *Plantago palmata* (the genus is Holarctic, and widespread in the high mountains of eastern Africa), and a cress (*Nasturtium*).

Just northwest of Lake Kivu, where Pilette<sup>1</sup> described the mountains as forming at least four parallel ridges, there seems to be a good deal of

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<sup>1</sup>1914, 'A Travers l'Afrique Equatoriale,' p. 325.



Fig. 111. Grassy lower slopes of mountains west of Ruzizi River, looking southward from an altitude of 7000 feet.



Fig. 112. View northward from the summit of Mt. Kandashomwa, 9900 feet, west of the Ruzizi River. Isolated tree heaths are draped with *Usnea* lichen.

grassland and park savanna, especially near the small "Mokoto" lakes, Ndalala and Luenge. West of them elephant grass flourishes widely, and Pilette's photograph of the bank of the river Loso shows it in a dense growth. At higher levels, about Ndalala, the mountains are wooded.

Southwest of Lake Edward, in the vicinity of Luofu, the country is relatively low and almost entirely covered with savanna and patches of bracken. But along the western side of Lake Edward the general level is from 7000 to 8300 feet, with at least one mountain mass called Tshabirimu rising to about 10,000 feet. Above 7500 feet bamboos are widespread, but the lower mountain forest seems to have been badly mutilated by native charcoal-burners. In many places its former existence is suggested by areas of bracken and scrub. At other points the road traverses good patches of mountain forest, and there are some large *Podocarpus* trees.

Just northwest of Lake Edward, at a place called Mulu, there is a small mountain crowned with bamboo and encircled by forest. Gorillas have been killed here, but it seems to be the most northern place where they occur on the western Kivu Ridge.<sup>1</sup> Now the mountains become lower and more grass-covered, only 4000 feet high near the new post of Beni. Then to the north comes a stretch of lowland forest.

As the western escarpment rises again in the neighborhood of Lake Albert it is grass-covered, and in many places the savanna vegetation prevails as high as 6000 feet. Locally, however, conditions permit of a luxuriant mountain forest, or at least a forest with many montane birds. For at least ten miles north from Djugu there is an area of forest at altitudes of 5000 to 5500 feet, through which flows the Nizi River. It has very large trees, with considerable drapery of epiphytes and beard-lichen. There are few aframomums in the undergrowth, no phryniums; but the underbrush is dense; and parts of the forest have evidently suffered at the hands of natives. I did not see any tree-ferns, and palms are wanting.

According to Commandant Siffer and Mr. E. F. Lumen, there are also considerable forests on some of the higher mountains overlooking Lake Albert near 2° N. latitude. These have sometimes been called the massif of Loguma. The highest is Mt. Aboro, 8040 feet, which is said to have a forest about three miles in diameter. There are also bamboos, I was told, on some of the highest summits.

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<sup>1</sup>Neither do they occur on Ruwenzori. *Gorilla g. beringei*, the eastern race, inhabits suitable places on the western Kivu Ridge south to the highlands near Baraka, and has also been obtained near Wakale at about 3000 feet. It also makes its home on the older volcanoes of the Kivu group. See H. J. Coolidge, Jr., 1929, *Memoirs Mus. Comp. Zool.*, Cambridge, L, No. 4, pp. 295-381.



Fig. 113. Highlands northwest of Lake Edward at 7900 feet, looking southward. Mt. Tshabirimu in the distance, at right.



Fig. 114. Rest-house in the mountain forest at Mulu, 8100 feet, northwest of Lake Edward.



Fig. 115. Grassy plateau of Urundi at Rusoka. Photograph by Dr. H. L. Shantz.



Fig. 116. West bank of the lower Ruzizi River, with *Hyphæne ventricosa*. Photograph by Rudolf Grauer.

Near Djugu we collected mountain birds such as *Heterotrogon vittatus*, *Campethera tenuiolæma*, *Phyllastrephus flavostriatus*, *Coracina graueri*, *Apalis pulchra*, *Cinnyris reichenowi*, and *Poliospiza striolata*. So these forests have a montane avifauna, and merit further study.

#### Grasslands of the Kivu Plateau

The majority of mountain birds prefer forests, and disappear from areas where these are destroyed. Their place is taken for the most part by birds which also live in lowland savannas, but there are some savanna birds that are limited to highlands. On the whole, the birds of the northern shores of Lake Tanganyika do not differ very markedly from those of the grassy plateaus, although the latter are largely above 5000 feet.

In the Kivu area the savannas are far more extensive than the mountain forests. Wherever they are dotted with bushes and trees they are well supplied with birds, but sometimes at levels of 5000 to 6500 feet woody plants are scarce. There one sees relatively few birds. Such is often the case along the lower slopes of the western Kivu Ridge, as well as near Luofu, and on its northern extension, west of the upper Semliki River. The southern shores of Lake Kivu, like the southern portion of Kwidjwi Island, have strikingly open grasslands.

For a brief description of the provinces of Ruanda and Urundi we may turn again to Mortehan's article<sup>1</sup>:

The slopes near large rivers are covered with trees, generally acacias, three or four meters high, a sparse growth shading short, fine grass. This makes them typical savannas.

The rest of Urundi and of Ruanda, outside a few ravines of the mountains that separate the plain of the Ruzizi from the higher plateau, where rare patches of bamboo remain from a forest practically non-existent, and without counting groves of palms in the plain of the Ruzizi and along the shore of Tanganyika, is absolutely wanting, one might say, in tree growth. Only from time to time, on the site of a former village, one meets a few *Dracænas* or wild figs, the last traces of some vanished kraal, or here and there a tree or isolated copse, which no one must touch. These are the "Imana," or sacred trees; the "Bigbaro" groves planted on the location of past royal residences; and lastly the "Misezero," small woods preserved about the royal burial places.

With the exception of the forest regions, Urundi and Ruanda constitute a country of pasture. The value of the different parts is variable, and they may be classed as follows:

The best [pastures] are found in Ruanda, in the savanna regions. They have a fine herbage, short, and dense, where the grasses are mingled with numerous leguminous plants (especially a sort of clover).

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<sup>1</sup>1921, Bull. Agricole Congo Belge. XII, pp. 449-451.

Next come the regions of the center and the east of Ruanda, where the forage is still short, and includes always a fairly large proportion of Leguminosæ.

The grazing lands seem not so good in Urundi; they are covered principally with high grasses, rather tough. These are especially Andropogons, varied here and there with a tuft of *Pennisetum* or *Panicum maximum*.

Finally, in the east of Ruanda, are found pastures of but medium quality. The grass is choked by a bush vegetation, consisting of thorny Leguminosæ in the main, to which cling morning-glories, and of large and abundant ferns, doubtless *Pteris aquilina*.

As photographs show, the Kivu grass-country is everywhere of a rolling or very hilly configuration. The more important grasses on the highland of Urundi are listed by Dr. H. L. Shantz.<sup>1</sup> They include *Hyparrhenia filipendula*, a *Trichopteryx*, *Sporobolus pyramidalis*, and *Themeda triandra*.

Extensive papyrus growths, says Mildbraed,<sup>2</sup> are characteristic of the larger valleys in Ruanda. The richest swamp of the sort was at the western end of Lake Mohasi, where the papyrus was supplemented by beds of another sedge, *Cladium Mariscus*, small bushes, ferns, and other herbaceous plants.

#### Upper Katanga and Marungu

The distinctness of the Upper Katanga in a phytogeographic sense from the Lower Katanga, the Manyema, and Kasai has been amply demonstrated by Bequaert.<sup>3</sup> He discussed this, among other floristic divisions of the colony, and gave a map to show the line of separation, which extends from near Albertville on Lake Tanganyika, southwest to Kiambi on the Luvua, thence to Bukama, and passes a little to the north of Kafakumba and Dilolo. In reality it marks the boundary between the "forest province" (or West African Subregion) and the "steppe province" (Eastern and Southern Subregion), a line which almost reaches the coast of Angola at Novo Redondo but bends northward until it ends near Ambriz. In the Katanga it follows the 3500 foot contour, and reaches up the valleys of the rivers somewhat farther perhaps than indicated on my map. Much the same line is continued by the 5000 foot contour nearer the equator in the eastern Congo, decrease in latitude naturally raising the line of demarcation.

The Upper Katanga includes several high plateaus, especially the Kundelungu (west of Lake Moero, over 6000 feet at the highest point), and the Bianco (highest point 5600 feet, between Bukama and Kambove).

<sup>1</sup>1923, 'Vegetation and Soils of Africa,' part I, pp. 67-68.

<sup>2</sup>1914, 'Wiss. Erg. Deutsch. Zentr.-Afr. Exp. 1907-8, Mecklenburg,' II, p. 615.

<sup>3</sup>1912, 'Handel. XVI Vlaamsch Natuur en Geneesk. Congres. Leuven,' pp. 148-170, map on p. 156.



Fig. 117. Northeastern shore of Lake Tanganyika in the vicinity of Nyanza.  
Photograph by Dr. H. L. Shantz.



Fig. 118. Western shore of Lake Tanganyika, just south of Albertville.

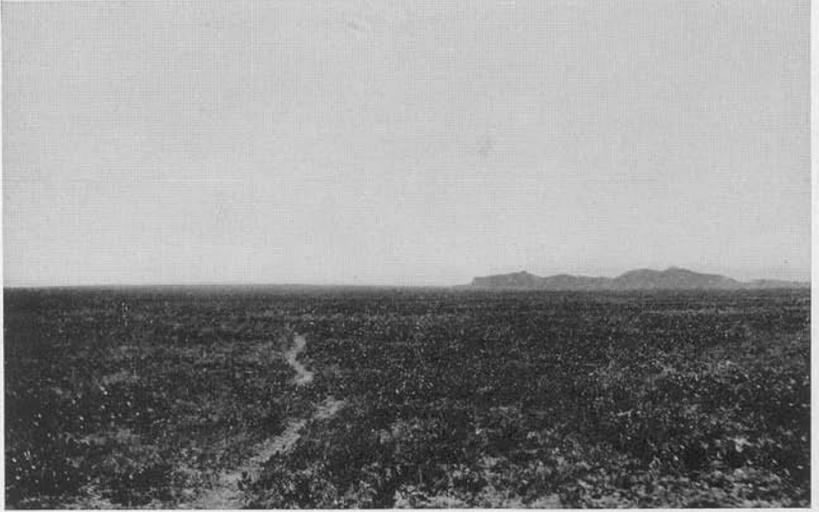


Fig. 119. Level top of the plateau north of Kapiri, Upper Katanga. Courtesy of Department of Agriculture, Belgian Colonial Office.



Fig. 120. Savanna in river valley near Kapiri, with edge of plateau in background. Courtesy of Department of Agriculture, Belgian Colonial Office.

The approach to the plateaus from the north is relatively abrupt; at their northern tips lie rugged mountains, and deep valleys are cut by the Luvua, Lufira, and Lualaba. But toward the south they slope gradually away, the Congo-Zambesi watershed showing slight undulation, and the highest levels along it only about 4700 feet.

The lower river valleys in the north of the area have considerable forest of a western character with lianas and even epiphytes. But the two principal types of plant formation in the Upper Katanga are an open savanna wood, covering most of the area, and short grass steppe on the highest plateaus. Instead of finding any differences between the Upper Katanga and Northern Rhodesia, Bequaert pointed out the negligible effect of the Congo-Zambesi watershed at this point, and the agreement between adjacent regions of the Katanga and Rhodesia. Neave's description<sup>1</sup> may be interpreted in the same way, notwithstanding his emphasis upon the very different lowlands along the Loangwa River.

In the savanna woods of the Upper Katanga the trees are so large and numerous that from a distance the country looks forested, as it has so frequently been called by travelers. Yet the trees are far enough apart to allow of a continuous carpet of grass, relatively short, about fifteen inches high. As in all the other savannas, the aspect varies, the trees may be still more widely spaced or growing in copses, their graceful form and the short grass giving the impression of a true park country. A good example of this is the plain at the south end of Lake Moero.

Observations on the retreating shore-line of Lake Albert led J. E. S. Moore<sup>2</sup> to see in such park lands an evidence of the gradual drying up of tracts of land once under water, which are first colonized by very hardy species of plants, beginning with candelabra euphorbias, and then occupied by acacias and other trees, until the area is entirely overgrown.

In his 'Notes sur la Flore du Katanga,' part 2, Professor De Wilde-man<sup>3</sup> gives a number of photographs showing the character of the open woods of the Katanga. I do not care to follow Schimper in calling them "savanna forest," for they seem hardly different enough from the ordinary savanna of Africa to be called forest. They are inhabited by birds not at all of true forest-dwelling kinds.

Engler has called it "Baumsteppe," a term which we cannot use if we limit steppe to mean grassland without trees. I propose to call the formation a "savanna wood." Here trees are a prominent feature, the

<sup>1</sup>1910, *Geographical Journal*, XXXV, pp. 132-144, with 8 photos of landscapes.

<sup>2</sup>1903, 'The Tanganyika Problem,' pp. 107-119.

<sup>3</sup>1913, *Annales de la Société Scientifique de Bruxelles*, XXXVII, pp. 5-82, Pls. 1-vi.



Fig. 121. Open grassy meadow or "dembo" near Elisabethville, Katanga. Note bushy vegetation on the termite hill at right.



Fig. 122. Savanna woods near Elisabethville, Katanga. The dominant trees are species of *Brachystegia*.

larger ones grow about sixty-five feet high, with a diameter of fifteen inches. *Afrormosia angolensis*, the "mubanga," is said to reach forty feet in height. When not in flower or fruit, they all look strangely alike, particularly the leguminous trees; yet the species are remarkably numerous and the genera very diverse. Those predominating are: *Parinari* (Rosaceæ), *Brachystegia* (Leguminosæ, as are the six following), *Berlinia*, *Cassia*, *Afrormosia*, *Dalbergia*, *Pterocarpus*, *Lonchocarpus*, *Canthium lanciflorum* (Rubiaceæ), *Monotes* (Dipterocarpaceæ), *Vitex* (Verbenaceæ).

According to Neave,<sup>1</sup> native agriculture offers a serious menace to the savanna woods of the Upper Katanga. In the more populous parts it is difficult to find woodland which has not suffered at some time. For purposes of cultivation the natives avoid the low-lying grass-covered areas near streams, locally known as "dembos," because of the necessity of drainage, and confine their farming to the higher, less fertile parts which are wooded. Trees are cut down over large areas, to be burned and used as fertilizer, whereas the area of land actually under cultivation is relatively small.

It is in the Upper Katanga that the strongest resemblances to southern Africa are seen, and so a number of species of sugar-bushes (Proteaceæ) are met with. Some grow to a height of eight and one-half feet, and the flowers are said at times to exceed eight inches in diameter. Cactus-shaped euphorbias are very common in the Upper Katanga, growing usually around the base of large termite hills that often attain twenty or twenty-five feet in height. With them grows a spiky *Sansevieria*, and Professor De Wildeman<sup>2</sup> gave a list of plants found on these mounds. These even include trees, a *Bauhinia* and a *Phytolacca*. The woods are occasionally interrupted, we are told, by hills on which the vegetation is scant or stunted, because of the presence of copper ores unfavorable to the growth of trees as well as of most other plants. Along the northern slopes of the Katanga plateau there are patches of a small bamboo with solid stem, probably an *Oxytenanthera*. Elephant grass (*Pennisetum purpureum*), though recorded from Lukafu, is not abundant in the Upper Katanga.

The more one climbs upward on the slopes that limit the elevated parts of the Katanga, such as the Kundelungu and the Bianco (also called Manika, as is the northern part of Marungu), the smaller the patches of savanna woods become, until on the tops of these two plateaus woods are

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<sup>1</sup>1910, *Geographical Journal*, XXXV, p. 137.

<sup>2</sup>1913, *Annales de la Société Scientifique de Bruxelles*, XXXVII, pp. 31, 32.

no longer in evidence, save in fringes along streams. Here at levels of 5300 feet, despite the general lack of natives or cattle, there are often no trees or large bushes, only short grasses and herbaceous or semiligneous plants. Among these may be cited *Philippia* (Ericaceæ). In this steppe, at the season of flowering, there appear members of the Liliaceæ and allied monocotyledons, Leguminosæ, Labiatæ, Scrophulariaceæ, and Compositæ. Among the last-named are many species of immortelles (*Helichrysum*), a genus represented in all the elevated regions of central Africa.

Springs are numerous, and in the depressions around them and in the gullies which their overflow cuts in the grassy plains grow tree-ferns, cycads, a few bushes, and a liliaceous plant (*Kniphofia*) bearing a spike-like raceme of reddish-orange flowers. In other places, according to Neave, there are patches of dense forest about the source or along the course of a stream. Seldom more than a few acres in extent, they are formed of tall trees of great girth, entwined by creepers. On the highland of Benguella such wooded areas are known as "fountain bush." They have yielded a number of mountain forest birds, and so in the Katanga it would seem that they deserve further attention from ornithologists.

Along this southern boundary of the Congo basin one might expect rugged hills of the sort found in the northeast, near the Lado district. But they are few, and not high.

The plateau of Marungu, on its upper levels, is likewise characterized by the general lack of arborescent vegetation. It has been described at some length by Bovone.<sup>1</sup> The more level northern part, called "Manika" by the natives, is also known as Lower Marungu, for its altitude varies from 4900 to 5600 feet, whereas the more southerly Upper Marungu is a very broken country, and the highest points reach 9000 feet, the valleys not less than 5900 feet. In this elevated grassland, trees are usually so rare that one sees scarcely more than the wild fig trees planted by the natives in their villages. It is toward the east that the high country becomes most treeless.

In July the thermometer in Upper Marungu sometimes drops below the freezing point; so manioc and bananas do not thrive, and the principal native cultures are maize, beans, and sweet potatoes. Wheat has been introduced by the White Fathers. The grasses do not exceed twenty-four inches in height as a rule, though occasionally there are andropogons of five or six feet. Here, also, the grass is burned annually by the natives, in order to expose the freshly sprouting grass for their

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<sup>1</sup>1914, Bulletin Agricole du Congo Belge, V, pp. 457-470.



Fig. 123. Highland savanna at source of the Kipale River, Marungu. Courtesy of the Department of Agriculture, Belgian Colonial Office.



Fig. 124. Granite hill in Lulua district, south of Katolo. Photograph by F. Overlaet.

herds. In the Lower Marungu the grass averages higher, and there is even elephant grass in some of the lower valleys.

Messrs. Rockefeller and Murphy, who collected birds in Marungu, tell me that the lower area of savanna woods extends southward along the lake shore, and then westward again just north of the Rhodesian border. The word Marungu denotes highlands with no trees, and above 5500 feet one finds no savanna woods. In a very few spots in the highlands, as at Ketendwe (6150 feet), there are woods along some of the streams and neighboring hillsides. At Kasangala (7050 feet) they found an absolutely treeless country, except for a thin fringe of scrubby trees bordering a small river.

Consequently there are few mountain forest birds in Marungu, in contrast to the mountains north of Lake Nyasa or those northwest of Lake Tanganyika. The lack of dense woods on the Marungu highland is a barrier to the distribution of many montane birds.

#### SUMMARY

The faunal areas as well as the altitudinal life zones which we base upon the distribution of birds in the Congo are characterized by distinct types of plant associations. Across the rainy equatorial belt stretches a mighty rain forest, an important part of the African "Hylæa," from which grasses are all but excluded. North and south of it are savanna districts, where the tall grass is mingled with bushes and small trees, many of them West African in character. Along the eastern border of the Congo are grasslands, often of more eastern type; and on many of the mountains near the equator a very different sort of forest, subtropical in nature, at levels where the cloud-ring envelops them. Where the mountains rise above 10,000 feet, the alpine plants take on a most striking appearance, without a parallel at lower levels.

Other highlands, where the rainfall is of less abundance, and especially those plateaus more than four degrees from the equator, are covered by mountain grasslands with relatively little woody vegetation. In the southeastern corner of our territory, more than seven degrees south of the equator, the short-grass formation occupies only the higher levels, the greater part of the plateaus being overgrown with an open woodland formation, differing markedly from the rain forest by an abundance of grass beneath the trees, and by the smaller size of its timber.

Vegetational differences go very far in determining the present-day distribution of birds, which have marked preferences for certain types of

plant formations. The equatorial forest is a chosen retreat for many, and a serious barrier to those which require grassland.

We must assume that vegetation in the past varied with climatic changes, and that the lowland forest, at some time during the Tertiary, was more extensive, reaching even to northeast Africa and the east coast. Likewise, the mountain forests were probably larger and more confluent in the Pleistocene, when the glaciers of Ruwenzori came so much lower. At that time they may have existed along the northern and southern borders of the Congo basin.

CHAPTER VI.—BIRD DISTRIBUTION IN THE CONGO AND ITS  
ECOLOGICAL ASPECTS

GENERAL OUTLINES

The study of the geographic distribution of Congo birds must lead us inevitably to consider their ecology. It will not suffice simply to draw life zones at certain elevations, for the first real change due to altitude can be observed only at nearly 5000 feet; and less than one-tenth of the Congo bird fauna lives exclusively above that level. On the other hand, the lowland fauna shows many peculiarities of distribution, and while in the main these are dependent upon vegetation, sharp lines between the faunal areas are not at all easy to draw. We shall still feel called upon to explain why some species occupy two or more distinct faunal areas, when another may be restricted to one area or only a section of it.

The most fundamental distinction in Africa, ecologically, is that between the forest and grass-dwelling faunas. This is partly a question of food, although there can be no doubt that the condition of light and shade enter equally into it. Professor E. H. Eaton<sup>1</sup> finds something of the sort among birds of eastern North America, and mentions the larger eyes of forest-loving species; but the distinction must be more pronounced in equatorial Africa. I have often watched the African pied wagtail running about at mid-day, snapping at insects, darting out into the glare of the tropic sun, and retreating as hastily again into the shade of some welcome bush or hut. A captive white stork was equally unwilling to expose itself. These, however, are not forest birds. In the case of *Colinus striatus*, *Coturnix delegorqueti*, and a few other birds which are constantly exposed to the sun, I have noticed that there is black pigment about the skull or in the tissues covering the brain. Some of the small waxbills have dark-pigmented skin over the head, serving a purpose similar to that of the blackish skin in terns of the genus *Gygis*, where the plumage is white and translucent.

Once in a while, in the posts of the forest region, forest birds find themselves unwittingly in one of the houses. I do not know how they come there, for they may be species one does not see in the cleared space round about. But they invariably exhibit one unexpected trait: they will not come down from beneath the shade of the roof and face the sunshine outside. They perch in the darkest place just below the rafters, or fly back and forth beneath the roof, as did a black bush-shrike (*Laniarius leucorhynchus*) at Niangara. The European who called my

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<sup>1</sup>1914, 'Birds of New York,' II, p. 6.

attention to it was lying ill with fever; and his remarks at first made me fear he might be delirious, though soon they were verified. Later on, at Avakubi, I saw a forest bulbul (*Bleda syndactyla*) in the same awkward position. Dr. Christy secured a specimen of *Francolinus squamatus* in a house in a village of the eastern Ituri district.

On mountains, as in the lowlands, many birds are only at home in woods and disappear when the trees are thinned out. They seem to

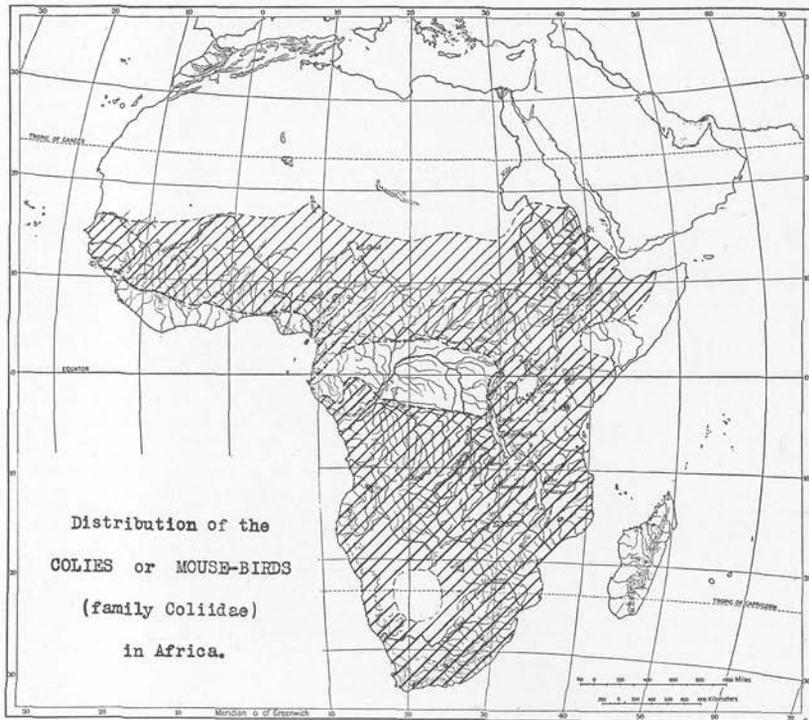


Fig. 125. Map to show how the wide-ranging colies shun the greater part of the forest areas in Upper and Lower Guinea.

prefer the cooler climate, and to avoid the lowlands; but lowered temperature is not in itself sufficient. They must have forest as well. A smaller number of mountain birds live in open spots, which they prefer to woods.

In many cases the inveterate preference shown by many birds for a forest or for a grass environment is simple to understand. It is only natural that birds of granivorous diet, and with striking adaptations in the

form of the bill for dealing with seeds of the savanna grasses, should shun the equatorial forest, where grasses which would suit their taste are almost unknown, except in a few clearings. There, as in grassy spots along the margins of rivers, we do find seed-eating birds, members possibly of invading parties, ever appearing in clearings and second growth. It is not to be supposed of course that a fringilline bill is an

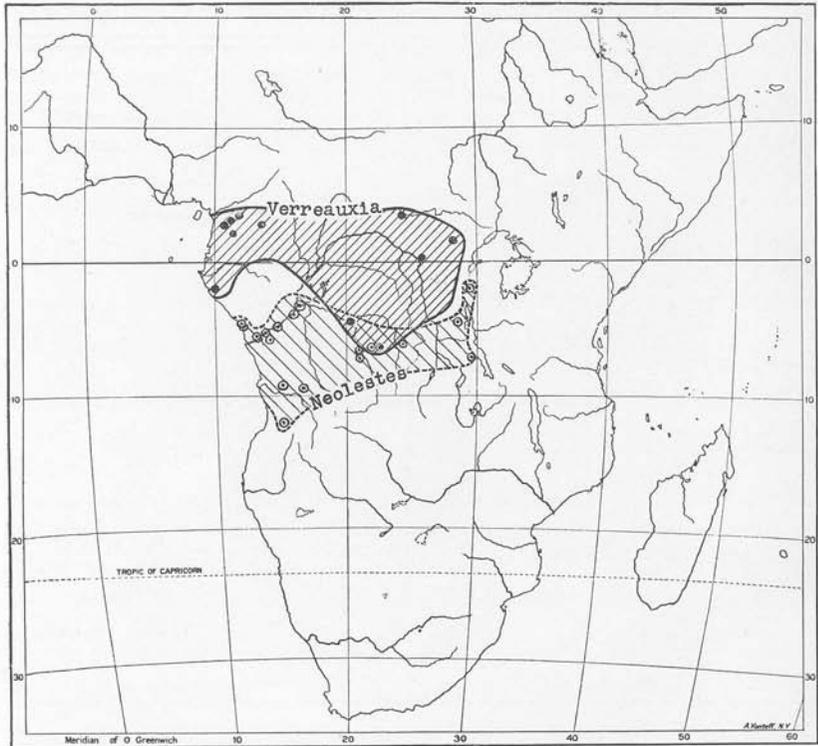


Fig. 126. Ranges of a Lower Guinea forest bird, the piculet *Verreauxia africana*, and of a savanna-dwelling bulbul, *Neolestes torquatus*, of the southern Congo. Their ranges seem to overlap in the Kasai district because of the heavy gallery forests.

infallible mark of a granivorous diet. Many species of the ploceid genus *Malimbus* are typical dwellers in the forest, and completely insectivorous, notwithstanding their stout beaks.

That fruit-eating birds like the turacos should be common in forest seems natural enough. But why should the colies, then, which are typically frugivorous, prefer the savannas to such a degree that they are

found in forest regions of the Congo only where there has been extensive clearing along its border? Sometimes we find whole families, such as the flamingos, bustards, sand-grouse, hemipodes, cranes, wrynecks, hoopoes, oxpeckers, and larks exhibiting a distaste for the entire region of rain forest. The same dislike is shown by certain genera in other families, and at times by individual species.

It is almost impossible to name any families wholly confined to the rain forests of the western subregion unless we recognize the Picathartidæ as a family, or take groups such as the Picumnidæ and Artamidæ, each of which is represented in Africa by a single forest-loving species. The African pittas, which are sylvan enough in habits, extend beyond the western forests into those of the southeastern quarter of the continent. The Pycnonotidæ as a whole are rather firmly attached to forests, although the typical genus is not.

Just as lions are found only in regions where the population of hoofed animals is sufficient to furnish them a livelihood, so the oxpeckers (*Buphagus*) are mainly restricted to the grasslands of Africa, where they can follow the big game on whose ticks they feed so largely. In the rain forest large mammals are much harder to locate or follow.

The lack of vultures in the Congo forest (with the exception of *Gypohierax*) is not surprising if we reflect upon the difficulty they would have in finding carrion in a district where the hyena and jackal disdain its search. *Gypohierax*, which may be regarded as a vulture, takes a dead fish, when it can be found, from the riverside, but owes its successful occupation of the forest clearings to its subsistence upon the fruit of the oil-palm. A comparison of distributional maps of *Elæis guineensis* and this generalized vulture is illuminating because of the way both ranges coincide.

For many birds suitable nesting sites are limited—one of the reasons, perhaps, why pelicans are local. Some of the swallows and swifts are rarely seen except in the neighborhood of rocky precipices; and thorn trees are a necessity for not a few of the true weaver-birds. *Textor cucullatus*, which has been introduced on the island of Haiti, is mainly confined, Dr. W. L. Abbott tells me, to the situations which most resemble an African park landscape, and offer acacias of much the same type. But it also nests on palms near houses, as it does in Africa.

Such behavior is determined not only by the evident necessities of food and of nesting requirements, but also by certain instinctive and hereditary likes and dislikes, which determine the type of environment or vegetation the birds will seek out and inhabit. Otherwise many birds

could no doubt subsist under a variety of conditions. There is nothing novel in such a view; it is one of the fundamentals of bird distribution, and intimately linked, no doubt, with the "homing instinct" so strongly exhibited by all migratory birds. We may, as a matter of convenience, delimit faunal areas and life zones, inasmuch as there are certain associations of birds often extending over large areas; but let us not forget that



Fig. 127. Distribution of *Bessonornis caffra*, a robin-chat ranging from sea level at Cape Town to the highlands of eastern equatorial Africa, where it lives only above 5000 feet, in the relatively small areas shown in black.

the border lines of such divisions are certain, in places, to be vague or diffuse.

Just as no two species of birds are exactly alike in all details of habits and food, so no two species, in the case of free-ranging continental forms, have areas of distribution which exactly coincide. The conclusion I would draw is that each species must be studied by itself, after which it may often be included in some general scheme that will enable us to

view in a not too unnatural perspective the wider aspects of bird distribution.

It is clear that the dispersal of birds in the Congo is not determined by impassable physical barriers, but by climate, and especially by rainfall. Climatic factors, save perhaps the cold of the mountains, act upon birds through the vegetation. Watercourses also are a necessity to many kinds of birds; and still others are partly governed in their wanderings by the availability of nesting sites, such as trees of certain kinds or rocky cliffs, in default of which some are beginning to take to houses. Otherwise, we may say that the principal plant associations have corresponding bird communities—as they were called by Eaton—and so the intimate connection between phytogeography and distributional ornithology is established.

It may be pointed out that the different subdivisions of the human races in Africa are similarly distributed. The agricultural Bantu peoples occupy southern and central Africa up to the northern edge of the equatorial forest. To the north of the forest are found the true Negro tribes. In the forests roam the Pygmies, gaining their living from the chase, perhaps the remnant of an earlier population of the continent. The penetration of the pastoral Hamites from the northeast has followed the highlands of east central Africa, where the short grass and fewer tsetse flies make possible the raising of the cattle to which they are so strongly attached. And finally, European colonization has been most successful in the cooler or drier parts of the continent.

It seems certain that the equatorial forest of Africa has been in the past one of the most stable environments. As long as the climate of the earth has been anything like the present, the equator must have been marked, as a result of air currents and humidity, by a warm, moist belt which would favor arborescent vegetation. If there were periods, such as the Miocene is assumed to have been, of more uniform mild climate over the earth's crust, then it is likely that the width of the forest girdle was greatly enlarged. If, on the other hand, changes of climate were to be attributed to migration of the poles, or continents, these movements would doubtless be so slow that the equatorial forest of the continent would shift gradually, taking its fauna, for the most part, along with it. And even though the climate of Africa is, as some claim, now growing progressively drier, and the desert areas are encroaching upon the savannas, it will apparently only result in a diminution of the size of its equatorial forest, without any further effect upon the forest fauna than a limitation in its numbers, or the isolation of certain parts in disconnected

portions of the forest. As far as birds are concerned the interchange between forest and savanna faunas would appear to be very slight. Along the gallery forests some species make their way far out into the savanna areas, but on the whole keeping strictly to the densest woods. The invaders from the savannas may find clearings suited to their needs. They do not seem fitted to establish themselves in the primeval forest; and were it not for the activity of man, no doubt the gradual change to second growth and finally virgin forest would eventually drive them back to the forest border, whence they evidently have come.

The botanical uniformity of the forest, from the west coast inland to the region of the great lakes, has been commented upon by Mildbraed; and it is well known that this is paralleled by the uniformity of the vertebrate fauna. When I read the admirable notes by Mr. G. L. Bates on the birds of the southern Cameroon, I am struck with their close resemblance, both in a systematic and an ecological way, to those of the Ituri forest. It is only in the relation of the birds to the native population and the names given them by the blacks, that the difference becomes marked. To be sure, there are often subspecific differences in the birds, and a few which do not extend all across the broad region of forest.

Just as William Beebe<sup>1</sup> has called attention to the distinctness of the birds inhabiting second growth and those of virgin forest in South America, so Mr. Bates had already remarked upon the special avifauna of second growth in the Cameroon, conditions I have confirmed in the Upper Congo. An ornithologist in a museum, receiving specimens of *Francolinus squamatus squamatus* from many widely separated localities in the West African rain forest, might naturally conclude that this was a francolin of virgin forest, represented in neighboring parts of the continent by allied races. The collector in western Africa soon finds that *F. s. squamatus* is only to be sought in the tangled thickets that border the clearings, or in the older second growth, and not in the forest proper. The forest francolins are *Francolinus lathamii* and *Acentrortyx nahani*. Both are somewhat aberrant, and one might say that no typical francolins live in the rain forest.

Besides a preference for feeding at certain levels in the forest trees, or on the ground beneath them, other forest birds may be further segregated because of their fondness for watercourses. On the whole it may be asserted that water birds are relatively scarce, even along the banks of the larger rivers that traverse the densely forested districts. Only at the seasons of low water do sandy or muddy margins or bars offer themselves

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<sup>1</sup>1917, 'Tropical Wild Life in British Guiana,' pp. 60-67.

as feeding grounds. Consequently, the numbers of large water birds are not to be compared with those to be seen along the rivers of the drier regions of the continent. Also the species are fewer. The spur-winged goose, saddle-billed stork, spoonbill, and pelican seldom show themselves on the forested rivers. *Hagedashia hagedash*, *Galachrysis nuchalis*, and *Megaceryle maxima* do somehow breed there; and the snake-bird, the small cormorant, egrets, and the cattle heron are present at least during part of the year. *Scopus umbretta* nests along some of the larger forested rivers, but is not common.

Extended open swamps or very broad rivers in forested regions occasionally attract water birds which are otherwise scarce in the forest. Near Nouvelle Anvers the marabou stork is said to be established and to breed, though in the Ituri forest I did not find it at any season. More elusive are the water birds which are restricted to the deep shade of the rain forests, and of which we shall speak later. We shall now consider the bird communities found in the various faunal areas within our limits, according to the following plan:

A.—ATLANTIC COAST

B.—WEST AFRICAN SUBREGION

I, II.—Forests

Virgin forest: three levels

Second growth: two levels

Clearings: two levels

Forest swamps and watercourses

Edges of the forest

III, IV, V.—Lowland Savannas

Dry savannas of Uelle

Cultivated fields of Uelle

Southern Congo savanna

Uganda-Unyoro savanna

Watercourses in savannas

Grassy marshes

Papyrus swamps

Gallery forests

Rocky hills

C.—EAST AFRICAN SUBREGION

VI.—Humid montane areas

Mountain forest zone

Alpine zone

VII.—Grassy highlands of the eastern Congo

VIII.—Marungu and Upper Katanga plateaus

## BIRDS OF THE COASTAL STRIP

The species which best characterize this narrow western border of our territory are those exclusively of the ocean or the ocean beaches. The southern savanna fauna makes a northward extension along the coast, reaching to Cape Lopez and the Gaboon River; but the forest fauna is well represented at no great distance inland. The aquatic birds in the lagoons along the Gaboon coast, as on the lower Congo, are mostly of species which are found also on bodies of water inland.

With the exception of migrants, especially from far north, the coastal birds are not numerous. So close to the equator large breeding colonies of sea birds are not to be found; and the islands in the Gulf of Guinea have but few pelagic birds to send as visitors to the mouth of the Congo. Neither have observers been abundant for this region, though fortunately a little farther north, at Landana, the German Loango Expedition, as well as the French collectors, Lucan and Petit, have rendered the fauna better known.

My observations of the birds at the mouth of the Congo were limited to what I could see from steamers, on arriving and sailing from Banana. Toward the 20th of June the Cape gannet is abundant off the coast of the French Congo, and a few were seen close to Banana Point. The night before we reached the mouth of the Congo, a Wilson's petrel flew on board. They had been following us all down the coast, and I have since seen these petrels inside Banana Point. At this season, too, there are flocks of terns, many of them probably *Sterna balænarum*. While Lang was at Banana, in early September, he noted that every evening several hundred terns made their way to roost on Shark Point, across the entrance of the river. In late April I noted *Sterna sandwicensis* well within the mouth of the river.

As soon as one rounds Banana Point, the black-and-white vulture (*Gypohierax angolensis*) becomes the most conspicuous bird. About the coconut palms of the settlement, numbers of palm swifts dart to and fro. From this point the inland fauna begins to predominate, even among the aquatic birds. Most of those one meets on the way up to Boma are by no means species limited to the coast.

Leaving the mouth of the river again on January 30, I saw very little of marine birds. No gulls were seen in this vicinity; but at such a season a few large terns (*Sterna maxima albididorsalis*) are continually noted standing on the buoys and floats at anchorages.

Down the west coast travel a number of migrant shore birds: plovers, the turnstone, tatlars, the sanderling, and curlews. We shall

not consider them here in detail, because exact records for many of them are still to be wished for from the twenty-five miles of ocean front belonging to the Belgian colony. A list of those which certainly will be found to occur is given in the chapter on migration.

The Tubinares are but poorly represented, for in addition to *Oceanites* only two small petrels, the "Cape pigeon" (*Daption*), and two shearwaters are really to be expected. The frigate bird is certainly rare at the Congo mouth. The red-billed tropic-bird (*Phaëthon æthereus*) has been reported, but probably erroneously; and the Ascension Island tropic-bird (*P. lepturus ascensionis*) may perhaps be looked for. Large cormorants are noted on the lower course of the river, such as are seen inland only on the great lakes. *Phalacrocorax carbo lucidus* and *P. capensis* both seem to come this far north on the west coast. So, too, may the black oyster-catcher of South Africa, *Hæmatopus mouquini*, but perhaps only as a wanderer.

Of the smaller skuas, both *Stercorarius parasiticus* and *S. pomarinus* are to be expected along this part of the coast, though precise records from the Congo are still wanting. No gulls have as yet been reported from the Congo mouth, nor are any likely to be at all common. Marsh terns occur, but the only specimen thus far collected about Banana was identified as *Chlidonias nigra*. In the nearby Gaboon, Ansoerge found breeding examples of *Sterna albifrons*, not different enough from the typical subspecies of Europe to be named. These, too, must wander to the Congo.

The common tern (*Sterna hirundo*) migrates down the West Coast, and some individuals even stay in South Africa during the northern summer. *Sterna paradisæa*, while rarer, may be expected as a migrant off shore. The Sandwich tern has been taken at Banana, where it passes on its travels. The Damara tern (*Sterna balænarum*), resident on the southwest coast of Africa, is as small as the least tern, more similar in pattern to *S. hirundo*, but with a black bill. It occurs as far north as Landana.

Instead of being a winter visitant from the western hemisphere, the royal tern of the west coast of Africa is a resident subspecies, *S. maxima albididorsalis* Hartert. The Congo estuary is nearly at its southern limit, though there are one or two records from Angola and Benguella. The largest of the terns, the Caspian, has been reported from the Gaboon coast, where it is only a migrant, but it breeds also in South Africa. The noddy (*Anous stolidus*) has once been reported from the Congo, but usually stays farther north on the west coast.

Of such birds of the Atlantic coast a few, like the smaller terns and the shore birds, may venture a short way up the larger rivers. But, for

the most part, the species seen along the banks of these streams, even at tidewater and where the bank is fringed with mangrove, are the same that frequent the rivers many hundreds of miles inland. Consequently, although the mangrove is typical among coastal plant formations, one may hesitate to include it within the coastal strip I have outlined for the study of bird distribution.

A word or two will not be amiss concerning the birds of the mangrove. From a boat on the river—or one of its ramifying creeks—the banks often seem to be forested; yet the fringe of tall *Rhizophora* trees is relatively narrow and extends little beyond the reach of the highest tides. Back of this, on the Congo, one comes again into savanna vegetation. The illusion of forest is heightened perhaps by some of the birds seen along the bank. The dark-blue swallow of the forest rivers (*Hirundo nigrita*) is there, sunbirds (*Anthreptes gabonicus* and *A. aurantium*), a black-and-white hornbill (*Bycanistes sharpii*), gray parrots, a rufous roller (*Eurystomus afer*), and forest-loving kingfishers (*Alcedo quadibrachys guentheri* and *Halcyon malimbica*), in addition to *Ceryle rudis* and *Megaceryle maxima*. *Gypohierax angolensis* is ubiquitous.

The innumerable froglike fishes (*Periophthalmus papilio*)—according to Sjöstedt's observations in the Cameroon<sup>1</sup>—hopping along the edges of the mud banks at low tide, furnish much of the food of the herons, hammer head (*Scopus*), snake-bird, and the larger kingfishers. On the Shiloango River, a finfoot is found swimming among the mangrove roots. It is a form of *Podica senegalensis*, and perhaps will be found near Banana. Sjöstedt believed he saw *Himantornis hæmatopus* in the mangrove near Ekundu, Cameroon; and Lang is convinced that he too, saw a large brown rail in the mangrove close to Banana. A vivid description of the bird life of the mangrove region at Kissangé, on the Lower Congo, is given in Johnston's 'The River Congo,' 1884, pp. 31-39. Most observers would, however, find the inland rain forest more abundantly stocked with birds than this ill-smelling mangrove swamp.

On the islands just above the mangrove district live more water birds, such as pelicans and Egyptian geese, but these again are such as would be encountered on broader inland streams of the savanna areas. There too, nests the African skimmer (*Rynchops flavirostris*) and the pearl-gray pratincole (*Galachrysis cinerea*), but both these species are found on the upper Congo River at the time of low water, and on many other rivers of western Africa.

We must conclude that a coastal area need only be recognized for the birds of the ocean and its beaches. The mangrove fauna is only a

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<sup>1</sup>1895, K. Svenska Vet. Akad. Handl., Stockh., XXVII, No. 1, p. 14.

slight modification of the usual fresh-water bird community, with a small proportion of forest species added. *Anthreptes gabonicus* is perhaps restricted to mangroves.

#### LOWLAND RAIN FORESTS

(I and II of Faunal Map)

From the forested district in the Lower Congo, 199 species of birds are known, and a considerable number still to be expected. The species from the Mayombe, for the most part, are the same as those in the Upper Congo forests. Only the following are mainly restricted, within our limits, to the Lower Congo; and some of them have near relatives in the more easterly forests.

*Turacus macrorhynchus verreauxi*  
*Turacus persa persa*  
*Gymnobucco calvus congicus*  
*Pitta angolensis angolensis*  
*Atimastillas falckensteini*  
*Illadopsis cleaveri batesi*  
*Anthreptes fraseri cameroonensis*

In about thirty cases, the species are represented by distinct races in the Mayombe and in the eastern Congo forest. Only a few examples need be given:

*Francolinus l. lathamii* and *schubotzi*  
*Halcyon m. malimbica* and *prenticei*  
*Bycanistes s. sharpii* and *duboisi*  
*Tricholæma hirsutum flavipunctatum* and *ansorgii*  
*Bleda eximia notata* and *ugandæ*  
*Bleda syndactyla ogowensis* and *woosnami*  
*Illadopsis f. fulvescens* and *ugandæ*  
*Alethe c. castanea* and *woosnami*  
*Erythrocerus m. mcallii* and *congicus*  
*Psalidoprocne n. nitens* and *centralis*  
*Dryoscopus a. angolensis* and *nandensis*  
*Malimbus m. malimbicus* and *crassirostris*

Being much less familiar with the forest of the Mayombe, I shall describe ecological conditions especially in the Ituri forest. Mr. Bates' accounts of birds in the Cameroon forest indicate that as we go westward subspecies and some species may change, but the ecological relations are virtually unaltered. The birds of the Ituri forest, I found, might be said to occupy three levels. There are those living on or near the ground, those of the tops of the trees, and an intermediate arboreal group, keeping low enough down to be in dense shade.

## VIRGIN FOREST: GROUND AND LOWER UNDERGROWTH

The forest birds living near the ground are among the most difficult to observe. With the exception of the guinea-fowl, they can scarcely be said to flock. Their colors are often protective, their manners of the shyest; and were it not for their voices one might often overlook them completely. The natives of some parts are expert at trapping them, and this proved to be the best way to secure specimens.

The characteristic species are not numerous. For the Upper Congo forests the following list is typical.<sup>1</sup>

<i>Phasidus niger</i>	<i>Neocossyphus poensis præpectoralis</i>
<i>Guttera plumifera schubotzi</i>	<i>Alethe castanea woosnami</i>
<i>Acentrorityx nahani</i>	<i>Alethe poliocephala carruthersi</i>
<i>Francolinus lathamii schubotzi</i>	<i>Tychædon collsi collsi</i>
<i>Calopelia puella brehmeri</i>	<i>Geokichla princei camaronensis</i>
<i>Centropus leucogaster</i>	<i>Dyaphorophyia tonsa</i>
<i>Caprimulgus batesi</i>	<i>Dyaphorophyia castanea</i>
<i>Bleda eximia ugandæ</i>	<i>Dyaphorophyia jamesoni</i>
<i>Bleda syndactyla woosnami</i>	<i>Dyaphorophyia graueri</i>
<i>Illadopsis fulvescens ugandæ</i>	<i>Trochocercus nigromitratus</i>
<i>Illadopsis rufipennis</i>	<i>Fraseria cinerascens</i>
<i>Sheppardia cyornithopsis lopezi</i>	<i>Nigrila bicolor brunnescens</i>
<i>Stiphornis erythrothorax mabiræ</i>	<i>Spermospiza poliogenys</i>
<i>Neocossyphus rufus gabunensis</i>	

Not all birds in the foregoing list are terrestrial, in fact few, if any, are entirely so. The guinea-fowl will sometimes take refuge in trees, and *Calopelia* is frequently heard cooing from some elevated perch, though it feeds on the ground. A very few, *Dyaphorophyia* especially, are not actually seen down on the ground; and I doubt whether any species, save the gallinaceous birds and goatsucker, really nest on the ground. The gallinaceous species are at least partially insectivorous, the dove less so, but the remaining birds are almost without exception insect-feeders. A number of stomachs of *Spermospiza poliogenys* were examined, and soft seeds were found in all, as well as insect-remains in three. *Nigrila bicolor* seems to live largely on small insects and caterpillars. The scarcity of small seed-eating birds is not remarkable, for there are few grass or similar seeds in the lower vegetation.

Among the ground birds, particularly the thrushes and the bulbuls, are several which are most in evidence at spots where driver ants are on the move. Probably at such times the birds become a little less shy, and

<sup>1</sup>In all the lists of birds included with the present chapter, whenever there is any doubt as to the subspecies in question, or in the case that two geographic races may occur within the area discussed, only the binomial name of the species is given. A more complete discussion of the subspecies will always be found in the systematic part of this report.

when they have gathered thus along some forest path, conditions are much more favorable for watching them. In the rain forests along the west coast, Du Chaillu long ago noticed the attraction of the doryline ants for *Alethe castanea*; and Reichenow<sup>1</sup> and Sjöstedt,<sup>2</sup> on the Cameroon coast, have remarked upon a number of small birds, as well as a lizard, *Mabuya raddoni* (Gray), which prey upon the ants. Boyd Alexander<sup>3</sup> on Fernando Po, and G. L. Bates,<sup>4</sup> in the interior of southern Cameroon, have added to the history of this peculiar chapter in bird behavior, which is matched of course in tropical America by birds of very different families, with the neotropical representatives of the driver ants.

The bird species concerned, in the lowland forests of the eastern Congo, are mainly members of three genera: *Alethe* and *Neocossyphus*, among the Turdidæ, and *Bleda*, in the Pycnonotidæ. Each of these happens to be represented by two species, so that we saw there a half dozen "ant birds." That some other species, as of *Illadopsis*, or *Shepardia*, may share this habit, I am not yet inclined to deny.

The following incident is characteristic. Coming to a spot along a forest road one morning where a horde of driver ants was crossing the road in several columns, we noted that there were also birds on hand, and stopped to watch the proceedings. Besides a half-dozen small brown thrushes (mostly *Alethe castanea woosnami*, and one or two *Alethe poliocephala carruthersi*) there were also two larger rufous *Neocossyphus rufus gabunensis*, one *N. poensis præpectoralis*, and one rufous-tailed *Bleda syndactyla woosnami*. It was evident that the birds had been attracted by the ants, and they seemed especially concerned with a spot where these choleric insects had spread out widely on the path. Here I might correct the impression one is likely to form that the driver ants continually swarm over large areas of ground. In the case of the African forms, at least, nothing is more characteristic than the way they move in long winding columns, seldom climbing up into the undergrowth. Further, they are sensitive to sunlight, and cannot safely cross a sunny road on a clear day, except beneath the shelter of an earthen gallery.

The ant birds likewise keep to the shelter of the forest. The alethes were most in evidence, fitting back and forth across the path, occasionally darting down among the ants, and perching in the bushes bordering the way. *Alethe castanea* has a habit of fitting its wings slightly, when perched, like our American bluebird. From time to time one of the

<sup>1</sup>1875, Journ. f. Orn., p. 29.

<sup>2</sup>1895, K. Svenska Vet. Akad. Handl. Stockh., (2) XXVII, No. 1, p. 109; 1897, Bihang Svensk. Akad. Handl., XXIII, part 4, No. 2, p. 14.

<sup>3</sup>1903, Ibis, p. 377.

<sup>4</sup>1908, Ibis, pp. 128-129.

*Neocossyphus* would fly out of the undergrowth, sometimes alighting on the ground amid the ants. These thrushes are extraordinarily shy, and it was only after a long wait that I managed to secure one of them for my collection.

What are the birds seeking? It cannot be the adult ants, for these are generally eaten in small numbers, if at all. Nor is it their young, for more often than not the ants are carrying no pupæ; and the circumstance has nothing to do with the presence or absence of birds. Can it then be the victims—insects and the like—which are being transported by the ants? Surely there ought to be easier ways than this to procure the same food; yet the three ant-heads found in one thrush's stomach might well have come there in that way. Seizing some coveted morsel, we may surmise, the bird found that several ants had buried their jaws in it. Their bodies, at any rate, were plucked off before it was eaten. Doubtless a further advantage is to be seen in the driving by the ants of insects and other small animals from their retreats, rendering them an easy prey to the ant-followers.

The food of the "ant birds," according to many examinations of stomachs, consists mainly of insects and their larvæ, with a few small amphibians. Only in one case did I find a full meal made from driver ants; this was an immature *Neocossyphus poensis*. Perhaps experience would have made it wiser. Another species of *Alethe*, *A. poliophrys*, which lives in the mountain forest of Ruwenzori, was described by Woosnam<sup>1</sup> as being similarly fond of attacking columns of driver ants. This I have recently observed for myself, and I found that *Bessonornis archeri* and *Pogonocichla stellata* do the same.

In South and Central America the marching columns of army-ants of the genus *Eciton* are likewise attended by birds. In Guiana Schomburgh<sup>2</sup> noted particularly the birds we now call *Formicarius colma* (Gmelin) and *Pithys leucops* Vieillot. H. W. Bates<sup>3</sup> also mentioned flocks of plain-colored ant-thrushes that accompanied these ants; and in Nicaragua, besides the ant-thrushes, according to Belt,<sup>4</sup> trogons, "creepers," and other birds capture the insects stirred up by the ecitons. For northeastern Brazil, Meerwarth<sup>5</sup> gave as the most characteristic birds associated with the ants, *Phlegopsis nigromaculata* (Lafresnaye) and *Pyriglena atra* (Swainson), both formicariids, and the cuckoo

<sup>1</sup>1910, Trans. Zool. Soc. London, XIX, p. 374.

<sup>2</sup>1848, 'Reisen in Britisch Guiana,' II, p. 287; 1923, idem, English translation by Walter E. Roth, II, p. 228.

<sup>3</sup>1863, 'Naturalist on the River Amazons,' II, p. 357.

<sup>4</sup>1874, 'Naturalist in Nicaragua,' p. 20.

<sup>5</sup>1904, 'Globus, LXXXVI, p. 314.

*Neomorphus geoffroyi* (Temminck). On the island of Trinidad the Beebes<sup>1</sup> note, in addition to "ant-birds," woodhewers, anis, and fly-catchers, especially *Myiodynastes maculatus* (Müller); but I cannot help thinking that there has sometimes been a confusion between ordinary foraging flocks of birds and those especially attracted by driver ants.

VIRGIN FOREST: LOWER PARTS OF TREES

Edible seeds or fruits at this level are almost entirely wanting. Consequently the birds which pass their lives here, with the exception of a few raptorial species, are all insectivorous, not excepting those with apparently granivorous beaks, such as the weavers of the genus *Malimbus*.

Notwithstanding their variety, as will be seen from the list to follow, the birds of the intermediate levels in the true forest are anything but conspicuous; and the newcomer, though a trained ornithologist, will find himself easily overlooking some of them. Well do I remember my first month's experience, in the forest between Stanleyville and Avakubi, before I had learned how to find the typical small birds of the middle level of the vegetation. Few of them did I see at that time, a failure which may be ascribed in part to their retiring nature, the difficulty of following them in their haunts, and in part also to their habit of forming wandering flocks, so that they are not to be observed scattered uniformly through the forest.

<i>Urotiorchis macrourus batesi</i>	<i>Phyllastrephus xavieri</i>
<i>Astur castanilius</i>	<i>Phyllastrephus icterinus</i>
<i>Astur toussenelii canescens</i>	<i>Phyllastrephus albigularis</i>
<i>Accipiter erythropus zenkeri</i>	<i>Nicator chloris</i>
<i>Cercococcyx mechowii</i>	<i>Lobotos oriolinus</i>
<i>Cercococcyx olivinus</i>	<i>Macrosphenus concolor</i>
<i>Turacus schültzei emini</i>	<i>Hylia prasina</i>
<i>Halcyon badia</i>	<i>Camaroptera chloronota toroensis</i>
<i>Lophoceros hartlaubi granti</i>	<i>Apalis rufogularis nigrescens</i>
<i>Tropicranus albocristatus cassini</i>	<i>Sylvietta denti</i>
<i>Glaucidium tephronotum</i>	<i>Alseonax flavipes</i>
<i>Bubo leucostictus</i>	<i>Parisoma griseigulare</i>
<i>Strix woodfordii nuchalis</i>	<i>Smithornis rufolateralis</i>
<i>Apaloderma narina brachyurum</i>	<i>Andropadus curvirostris</i>
<i>Apaloderma æquatoriale</i>	<i>Andropadus gracilis</i>
<i>Buccanodon duchaillui duchaillui</i>	<i>Eurillas latirostris eugenia</i>
<i>Tricholæma hirsutum ansorgii</i>	<i>Stelgidillas g. gracilirostris</i>
<i>Indicator maculatus stictithorax</i>	<i>Bæzopogon clamans</i>
<i>Campethera caroli</i>	<i>Trichophorus chloronotus</i>
<i>Campethera nivosa herberti</i>	<i>Trichophorus calurus</i>

<sup>1</sup>C. W. and M. B. Beebe, 1910, 'Our Search for a Wilderness,' pp. 49-50.

<i>Megabyas flammulatus æquatorialis</i>	<i>Cyanomitra obscura</i>
<i>Trochocercus nitens nitens</i>	<i>Cyanomitra cyanolaema</i>
<i>Tchitreca rufocinerea batesi</i>	<i>Malimbus nitens microrhynchus</i>
<i>Tchitreca smithii ignea</i>	<i>Malimbus coronatus</i>
<i>Stizorhina fraseri vulpina</i>	<i>Malimbus malimbicus crassirostris</i>
<i>Dicrurus atripennis</i>	<i>Parmoptila jamesoni</i>
<i>Dryoscopus senegalensis</i>	<i>Pholidornis rushiæ denti</i>
<i>Anthreptes axillaris</i>	

Life in the forest seems to render birds as well as mammals much shyer than those of more open country. It should be remembered that often they can be seen only at a distance where many of the plains creatures would immediately take to flight. To their natural timidity must be added the pronounced liking of the forest birds for clear weather and shafts of sunshine. One may go into the forest, therefore, on a dark rainy day and hear little or nothing of its feathered populace. But by choosing a bright clear morning, or the afternoon of one of such days—none too common at most seasons—which does not close with a down-pour, one's search will probably be better rewarded. It is more or less a matter of chance, for one may walk some time through woods practically deserted before meeting one of those heterogeneous, wandering companies of birds, so typical of the forest habitat. But here it is that the widest variety of the small birds of the dense forest is to be observed. Some acquaintance with the habits of such a flock will be necessary to enable one to follow it and take stock of its members.

In North America our migrating wood warblers are sociable birds, feeding during the daytime in loose flocks, each bird looking after its own provender, and yet not losing track of its fellows. In winter again, our chickadee, downy woodpecker, nuthatch, and creeper adopt much the same tactics. Birds of the open grass countries of Africa have generally more individualistic dispositions. Seed-eating species may congregate in large flocks, which are apt to be composed of a single species or a few related ones. It is only as we approach the savanna woods (see pages 237, 262) that we again find a parallel to the insectivorous mixed bird parties of the equatorial rain forest.

Many of us have discovered this habit independently. Dr. E. Stresemann<sup>1</sup> has summarized what was known of it in the various tropical countries. In Africa particularly, G. L. Bates, Boyd Alexander, and Swynnerton have written about it, and to theirs I shall add my own account, composed nineteen years ago in the Ituri forest. There is no more constant feature of forest bird life in Africa than the gathering

<sup>1</sup>1917, Verhandl. Orn. Ges. Bayern, XIII, pp. 127-151.

of many different species to form parties, which travel loosely and leisurely along, very often taking some definite direction, each bird occupying itself according to its proper propensities, some skulking along on or near the ground, others hopping and flitting through the undergrowth, while some of their comrades scour the foliage of the lower branches of the taller trees, dense tangles of hanging vines, or climb up the trunks and limbs, getting ants and other insects from the bark. Such a flock may contain as many as forty or fifty individuals, but it is by no means easy to count or identify all of them. It is plain that they are following a common course, not always straight.

Some of the recruits are to be counted as ground-dwelling forms. They are not the most characteristic, and in many cases they do not persistently follow the others. More of the species are those of the "second story" or intermediate level. A full list would not be easy to draw up, for many birds are only occasionally seen in such company, and could not be included without hesitation. Fortunately it is a simpler matter to enumerate those which most commonly compose such an association, at least for the central Ituri forest.

The most regular members are a white-bearded bulbul, *Trichophorus calurus*, and two duller species of the same family, *Phyllastrephus icterinus* and *P. xavieri*. These seek their food among the leafy boughs, though the first-named will occasionally climb almost like a woodpecker. Two plain-colored *Illadopsis* are also common, loving the lower growth and dense tangles. So, too, is the wattled flycatcher, *Dyaphorophyia castanea*, uttering its hoarse croaking notes, or taking short noisy flights. There is the abundant green sunbird, *Cyanomitra obscura*, and the straight-billed *Anthreptes axillaris*. The latter shows little concern for the reputation of its family, and is not at all attracted by flowers, but hops about amid the foliage, in the tops of the undergrowth, or the lower boughs of the higher trees. Two paradise flycatchers, *Tchitrea r. batesi* and *T. s. ignea*, neither with long rectrices, are next in order, and a stockier bird, *Stizorhina fraseri vulpina*, of the same family. There may be a silent little green woodpecker, *Campethera nivosa*, climbing up the smaller trees where it feeds upon ants, or a larger brown-cheeked *Campethera caroli*, or perhaps a glossy black drongo, *Dicrurus atripennis*, whose presence is betrayed by its explosive but hardly musical sounds. Several species of Ploceidæ are occasionally encountered; one of them, the small brownish *Parmoptila jamesoni*, with scarlet forehead, being a member of the waxbill subfamily, whereas the others belong mainly to the genus *Malimbus*, *M. nitens* and *malimbicus* the most numerous. Still another weaver finch, shyer and more terrestrial, is *Spermospiza poliogenys*.

Among the remaining species, *Alethe poliocephala carruthersi* and *A. castanea woosnami*, two dull-colored thrushes, and *Bleda syndactyla woosnami* and *B. eximia ugandæ*, green-and-yellow bulbuls, are rather difficult to observe amid the vegetation, though not rare. *Dyaphorophyia jamesoni* often announces its presence low down in the underbrush by loud, sputtering wing-beats. *Trochocercus nilens*, a flycatcher with a close resemblance to *Tchitrea*, is much scarcer. The piculet (*Verreauxia africana*) we saw only in old second-growth woods. Both species of *Nicator* will sometimes be found in these bird parties. But they are apt to stay behind in their own particular spot while the others move on, as is true likewise of *Bessonornis cyanocampter bartteloti*, generally found only in second-growth woods, and of *Laniarius leucorhynchus*, *Phyllanthus a. bohndorffi*, and *Macrosphenus flavicans*.

Associated with the birds, one often finds a squirrel or two, of a medium-sized species, *Funisciurus anerythrus anerythrus* (Thomas), which has a loud birdlike call itself. Whether or not they form an integral part of the coterie seems to me an open question. In the case of another smaller squirrel of the forest undergrowth, *Tamiscus emini emini* (Stuhlmann), it is certain that only by accident do they find themselves among such a group of birds.

None of the birds usually making up these parties, it will be remarked, is especially noted as a singer. In truth the notes heard from them are rather subdued, mostly twittering or chirping sounds, and some harsh or nasal. The loud "peep!" of *Trichophorus calurus*, and its attempt at song, mingling with the short nasal notes, as of distrust, emitted by the slender-billed *Phyllastrephus*, are the most characteristic; and it is they that first attract one's attention to the flock. *Bleda syndactyla woosnami*, besides jarring and clucking noises, produces occasionally a sweeter series of descending notes like the word "cheer." The paradise flycatchers of the forest have call-notes, "zree-zree," like those of *Tchitrea viridis*, the species of the clearings, but not its sweeter song. *Stizorhina* utters protracted, but almost painful, whistled notes. In short, melody is really heard only when they happen to fall in with one of those shy little thrushes, *Tychaëdon collsi*, which haunt the lower bushes and give from time to time a prolonged warbling song, so delicious that it charmed me more than any other bird I have heard, at home or abroad.

In the southern Cameroon, Bates<sup>1</sup> has observed exactly the same sort of bird parties. The short list he gave includes some of the same species, or their geographic representatives:

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<sup>1</sup>1905, *Ibis*, p. 462; 1930, 'Handbook of the Birds of West Africa,' p. xvi.

<i>Dicrurus atripennis</i>	<i>Malimbus</i> , various species
<i>Criniger</i> (= <i>Trichophorus</i> ) <i>calurus</i>	Woodpeckers
<i>Bleda tricolor</i> (= <i>Phyllastrephus icterinus</i> )	One or more squirrels
<i>Anthreptes fraseri</i>	

Each party in the Cameroon forest, he tells us, includes individuals of from three to ten species. Many other forest birds, besides those listed above, are seen in them; but certain of the strictly forest-dwelling species, living in the undergrowth and among the dead leaves, are not often included.

The difficulty in observing these mixed parties is that they are ever in movement, and are apt to elude one in the thickness of the forest. For a few moments they may become almost silent, and to keep them in sight, especially if a shot has been fired, requires urgent attention. It is well to watch the general direction of their progress, and to try by a running detour to post oneself a little ahead of them. Then they may be looked over quietly as they come up. Another shot may change their course somewhat, but the flock tends to keep together, even when disturbed.

There is no season when these hunting parties are not in vogue. They are by no means associations of young or non-breeding birds. In this forested belt of the Congo many species of birds breed at all times of the year. Just how they combine their social propensities with attentions to nest and young remains to be investigated—certainly many birds with enlarged sexual organs are to be found in the flocks. According to Stresemann, birds actually nesting withdraw from the flock, a view still open to question.

Newton and Pycraft both concluded that such sociable habits of birds, especially in Europe, were founded upon mutual aid in seeking food. Swynnerton<sup>1</sup> held a somewhat similar view, that the birds were engaged in a sort of coöperative hunt, or drive. But Marshall<sup>2</sup> had earlier inferred that their object was to band together against the attacks of enemies such as birds of prey; and it seems that the theory of protection, toward which Stresemann himself inclines, dates back to H. W. Bates,<sup>3</sup> who observed the same habits among the forest birds of central South America. Whatever the cause, there can be no doubt as to the reality of the flocking instinct among many small insectivorous insects in tropical forests. It is not to be denied that the impulse may be due to a combination of advantages. On one occasion in the Ituri,

<sup>1</sup>1915, *Ibis*, pp. 346-354.

<sup>2</sup>1900, *Ibis*, p. 222.

<sup>3</sup>1863, 'The Naturalist on the River Amazons,' II, pp. 333-336. For the course of a bird-party in Guiana, see E. M. Nicholson, 1932, 'The Art of Bird-Watching,' pp. 72-75.

hearing a vigorous scolding and commotion among such a bird party, I approached the spot where some of the small birds had been darting down close to the ground, and there coiled amid the leaves I found a large rhinoceros viper, *Bitis nasicornis*. But birds are ever ready to mob snakes and owls, whether or not their young are in danger.

Rhinos and other big game undoubtedly gain a measure of protection from the accompanying *Buphagus*, yet the reason for the association will be seen at once in the food habits of the bird. Under modern conditions, at least, elephants and buffaloes are often exposed to danger by the conspicuous cattle herons which follow them. Yet here again, it is through the assistance of the giant mammals in scaring up grasshoppers that the herons are attracted. For the same reason, says Heuglin,<sup>1</sup> *Merops nubicus* accompanies cattle, and has been seen in the Sudan riding on the back of a stork (*Sphenorhynchus abdimii*) in spite of the fact that they were thus competing for food. Swynnerton's account of the ground hornbill and a starling, *Creatophora carunculata*, hunting together, is comparable. What other reason can be assigned for the hornbill, *Tropicranus*, so often following bands of monkeys? Either the monkeys scare out insects for the birds, or else the birds catch bits of fruit which are let fall. The monkeys of the Congo forest are also accompanied by a large squirrel, *Protoxerus stangeri centricola* (Thomas), perhaps for a similar advantage. In my judgment the theory of coöperative hunting is not yet to be abandoned; and Neave, I find, also declared himself in its favor.

An extreme case of mixed flocking, where there can be no doubt as to the purpose, is that of the birds which assemble when the savanna grass is fired. Raptores, bee-eaters, swifts, swallows, and others of different orders are then attracted by the insects fleeing the conflagration. In a way the passage of a flock of birds through the undergrowth, or of a swarm of driver ants on the march, can be compared with the effect of an advancing fire upon the insect population. These diverse instances of bird behavior exhibit a common advantage in the driving of insect prey from its cover.

#### VIRGIN FOREST: TREE TOPS

The species living in the upper half of the forest trees, or for the most part above twenty yards from the ground, form a group by themselves. Some of them to be sure do visit the ground occasionally; the raptors darting down upon their prey, or eating it on the ground, as

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<sup>1</sup>1860, 'Ornithologie Nordost-Afrikas, I,' p. 201.

*Stephanoaëtus coronatus* does. The green pigeon comes at times to eat earth; and the hornbills perhaps to gather soil with which part of the wall is made, closing the entrance of their nests. Nevertheless these birds pass almost all their time in the tree tops. Swifts of the genus *Chætura* are here included because they feed above the trees, though the search for a suitable hollow trunk may bring them lower down to nest.

<i>Aviceda cuculoïdes batesi</i>	<i>Chætura</i> , three species
<i>Hieraaëtus africanus</i>	<i>Neafrapus crassini</i>
<i>Stephanoaëtus coronatus</i>	<i>Pogoniulus erythronotos</i>
<i>Dryotriorchis spectabilis batesi</i>	<i>Trachylæmus purpuratus</i>
<i>Astur melanoleucus</i>	<i>Gymnobucco sladeni</i>
<i>Columba unicincta</i>	<i>Melignotheres exilis exilis</i>
<i>Turturæna iriditorques</i>	<i>Melichneutes robustus</i>
<i>Vinago calva calva</i>	<i>Polipicus elliotii</i>
<i>Pachycoccyx validus</i>	<i>Mesopicos xantholophus</i>
<i>Cuculus solitarius</i>	<i>Ixonotus guttatus</i>
<i>Cuculus clamosus gabonensis</i>	<i>Cyanograucalus azureus</i>
<i>Chrysococcyx cupreus intermedius</i>	<i>Apalis nigriceps collaris</i>
<i>Chrysococcyx flavigularis</i>	<i>Artomyias fuliginosa</i>
<i>Corythæola cristata</i>	<i>Batis ituriensis</i>
<i>Agapornis swinderniana zenkeri</i>	<i>Fraseria ocreata ocreata</i>
<i>Poicephalus gulielmi gulielmi</i>	<i>Chlorophoneus bocagei jacksoni</i>
<i>Psittacus erithacus erithacus</i>	<i>Sigmodus rufiventris mentalis</i>
<i>Eurystomus gularis neglectus</i>	<i>Parus funereus</i>
<i>Halcyon malimbica prenticei</i>	<i>Oriolus nigripennis</i>
<i>Melittophagus gularis australis</i>	<i>Oriolus brachyrhynchus lætior</i>
<i>Lophoceros camurus camurus</i>	<i>Onychognathus fulgidus hartlaubii</i>
<i>Bycanistes sharpii duboisi</i>	<i>Lamprocolius purpureiceps</i>
<i>Bycanistes albotibialis</i>	<i>Anthreptes tephrolæma</i>
<i>Ceratogymna atrata</i>	<i>Melanopteryx tricolor interscapularis</i>
<i>Scoptelus castaneiceps brunneiceps</i>	<i>Malimbus rubricollis centralis</i>
<i>Bubo poënsis poënsis</i>	<i>Malimbus erythrogaster</i>

Among these birds will be noted a larger proportion of fruit-eaters than in the lists of lower-level birds. More fruit no doubt is borne on the higher, better-lighted parts of the forest trees. The total lack of Fringillidæ in the primeval forest should not be overlooked, nor the rarity of Ploceidæ in the present environment. *Malimbus rubricollis* has the unexpected trait of climbing like a nuthatch.

Boyd Alexander,<sup>1</sup> whose wide experience in collecting African birds would naturally lend weight to his opinion, has held that the birds of forest tree tops are brightly colored, and those of the floor of the forest always very dull in hue. Comparison of the present lists will offer but

<sup>1</sup>1907, 'From the Niger to the Nile,' II, p. 314.

little support to his thesis. I find the ground dove, *Calopelia*, quite as beautifully dressed as *Turturæna*, and more so than *Columba unicincta*. *Corythæola* is less brilliant than *Turacus*, and the hornbills and honey-guides are not famous for color. The golden cuckoos, orioles, and starlings are left as the only instances of brightly colored birds which cannot be matched in the lower undergrowth. Yet they are almost compensated for, in my opinion, by the blue-spotted guinea-fowls, the orange-chested *Stiphornis*, and *Dyaphorophyia graueri*. Alexander argued that the sunlight induced the brilliant colors of birds, but I feel that the facts do not warrant his assumption. Applying this idea still further, we might expect the most brilliant species in places most brilliantly illuminated, which is far from being the case. The prevailing sandy brown of birds in a desert is too well known.

A great many naturalists, of course, have argued that desert-coloration is the direct effect of aridity, but their case is not proved. Selection is a better explanation, but the whole question is not yet settled.

In the forest, ground birds may have greater need of concealing coloration than those of the tree tops. But there are also family tendencies in color. Pittas are usually of bright hues, timaliids commonly wear browns, and forest bulbuls favor greens. Heredity outweighs direct climatic influence, and has probably been molded by natural selection. Slight mutations are evidently the best material for selection.

#### SECOND GROWTH WOODS: NEAR THE GROUND

The difference between these woods and the first stand of forest has already been described. Just as the plants differ, so do many of the birds. The question is naturally suggested as to where these species lived before man had made the present inroads upon the forest. My answer is simple. There always were small areas in the forest, of the nature of second growth, places where a number of trees had been felled by a wind-storm, and where a denser secondary bush-growth had sprung up. In other spots along rivers the elephants and buffaloes are wont to trample down the vegetation, forming swamps in which they stamp and wallow. The first vegetation to invade these is of the nature of secondary woods. Again, changes in the course of rivers would have similar results; and it is in places such as these, even to-day, that one will come across the same species that haunt the secondary forest and thickets bordering villages.

The list of characteristic species in the lower half of the ordinary second growth, or within about twenty-five feet of the ground, is not a

long one. It has a few significant names, birds which one might think, from the mere list of localities in which they have been taken, to be restricted to the dense virgin forest. In reality they are not found there.

<i>Francolinus squamatus squamatus</i>	<i>Macrosphenus flavicans</i>
<i>Sarothrura elegans reichenovi</i>	<i>Bathmedonia rufa vulpina</i>
<i>Tympanistria tympanistria fraseri</i>	<i>Camaroptera brevicaudata tincta</i>
<i>Ceuthmochares æreus intermedius</i>	<i>Camaroptera superciliaris pulchra</i>
<i>Myioceyx lecontei</i>	<i>Sylvietta virens</i>
<i>Melittophagus mülleri mülleri</i>	<i>Bessonornis cyanocampter bartteloti</i>
<i>Pogoniulus leucolaima leucolaima</i>	<i>Erythropygia leucophrys ruficauda</i>
<i>Pogoniulus subsulphureus ituriensis</i>	<i>Pedilorhynchus comitatus stuhlmanni</i>
<i>Verreauxia africana</i>	<i>Erythrocerus mcallii congicus</i>
<i>Pitta reichenow<sup>1</sup></i>	<i>Tchitrea viridis speciosa</i>
<i>Eurillas virens virens</i>	<i>Laniarius leucorhynchus</i>
<i>Atimastillas flavicollis</i>	<i>Anthreptes collaris hypodilus</i>
<i>Atimastillas simplex</i>	<i>Nigrita fusconota fusconota</i>
<i>Nicator vireo</i>	<i>Nigrita luteifrons</i>
<i>Campephaga quisqualina martini</i>	<i>Hypargos nitidulus schlegeli</i>

#### SECOND GROWTH WOODS: IN THE LARGER TREES

The bird fauna of the secondary woods is better divided into two levels than into three. Above the dense thickets rise a variable number of tall trees, remnants of the earlier forest, which it was not necessary to cut down in its entirety. After a few years these are added to by the rapid-growing *Musanga* and *Spathodea*. If there are dead trees as well, they serve as perches for many large birds, and house colonies of brown barbets.

<i>Kaupifalco monogrammicus</i>	<i>Bæopogon indicator</i>
<i>Accipiter erythropus zenkeri</i>	<i>Eremomela badiceps badiceps</i>
<i>Streptopelia semitorquata</i>	<i>Parisoma plumbeum plumbeum</i>
<i>Vinago calva calva</i>	<i>Bias musicus musicus</i>
<i>Chrysococcyx klaasi</i>	<i>Fraseria ocreata ocreata</i>
<i>Eurystomus afer</i>	<i>Erannornis longicauda teresita</i>
<i>Aerops albicollis (migrant)</i>	<i>Hirundo senegalensis senegalensis</i>
<i>Lophoceros fasciatus</i>	<i>Dicrurus modestus coracinus</i>
<i>Scopelus castaneiceps brunneiceps</i>	<i>Pæoptera lugubris major</i>
<i>Pogoniulus scolopaceus flavisquamatus</i>	<i>Lamprocolius splendidus splendidus</i>
<i>Heliobucco bonapartei</i>	<i>Melanopteryx mazwelli</i>
<i>Campephaga permista permista</i>	<i>Nigrita canicapilla canicapilla</i>

To draw a sharp line between the birds of these different plant formations and their varying levels is of course not so simple as it may seem on paper. Just as the secondary forest will regain its primitive condition by

<sup>1</sup>From the little I was able to learn of its habits, I am inclined to think that the Congo pitta (*P. reichenowii*) should be included in this list. Our native hunters secured it in second growth, but it may also occur in virgin forest.

imperceptible gradations, so its bird fauna will gradually be altered and eliminated. Yet, by classifying the forest birds in these various categories, we gain an impression of the way so many species co-exist in one region where environmental conditions are nevertheless relatively uniform. Further, the second growth itself is only a state of transition between the true clearing (next to be discussed) and the primary forest.

#### CLEARINGS IN THE RAIN FOREST

Inasmuch as the birds of the clearings consist so largely of what might be considered invaders from the Guinean savannas, they are anything but typical of the forest area. They are, for the most part, common in the vicinity of native villages and government posts, and sure to be met by the traveler. One trenchant difference between the vegetation in recent or occupied clearings and old second growth is the presence of certain grasses in the former. It has a far-reaching effect upon the bird population, which now includes one or two true grass warblers, and a far larger number of Estrildinæ.

The division into ground- and tree-haunting species is artificial, and will not bear critical examination in all cases. It is useful only as an indication of the kind of spots where the species are usually encountered.

#### GROUND AND GRASS BIRDS

*Bubulcus ibis* (transient)  
*Sphenorhynchus abdimii* (transient)  
*Anomalophrys superciliosus* (transient)  
*Turtur afer afer*  
*Cosmetornis vexillarius* (transient)  
*Motacilla aguimp vidua*  
*Prinia mistacea*  
*Burnesia leucopogon reichenowi*  
*Burnesia bairdii bairdii*  
*Cisticola anonyma*  
*Psalidoprocne nitens centralis*  
*Psalidoprocne chalybea*  
*Pomatorhynchus australis frater*  
*Amblyospiza albifrons saturata*  
*Quelea erythrops*  
*Spermestes cucullata cucullata*  
*Spermestes poënsis*  
*Spermospiza ruficapilla*  
*Pirenestes ostrinus rothschildi*  
*Estrilda astrild occidentalis*  
*Estrilda belpoda*  
*Estrilda nonnula*  
*Estrilda atricapilla atricapilla*  
*Serinus mozambicus barbatus*

#### ARBOREAL BIRDS

*Gypohierax angolensis*  
*Gymnogenys typicus*  
*Milvus ægyptius parasitus* (transient)  
*Lophia tus occipitalis*  
*Machærhamphus alcinus anderssoni*  
*Chrysococcyx caprius*  
*Halcyon senegalensis*  
*Ispidina picta picta*  
*Cypsiurus parvus*  
*Pycnonotus tricolor*  
*Turdus libonyanus centralis*  
*Platysteira cyanea nyansæ*  
*Erannornis longicauda teresita*  
*Tchirea viridis speciosa*  
*Hirundo semirufa gordonii*  
*Corvus albus*  
*Chalcomitra rubescens*  
*Cinnyris chloropygius*  
*Cinnyris johannæ*  
*Textor cucullatus bohndorffi*  
*Melanopteryx nigerrimus*  
*Hyphanturgus nigricollis nigricollis*  
*Amauresthes fringilloides*  
*Passer griseus ugandæ*

Some of the migrants from Eurasia are conspicuous in forest clearings at the proper seasons, being concentrated, as it were, by the relatively few spots where they feel at ease in the forest area. Among the ground-loving species, we might have included the white stork, the black-winged pratincole, and a number of small shore birds, as well as the tree pipit. Two shrikes, the gray flycatcher, and the roller of Europe are more arboreal in habits.

A short sketch of bird-life in a clearing of the Upper Congo forest cannot be omitted. A former giant of the forest becomes the village palaver tree; and because no chattering band of monkeys ever raids its lofty boughs, it becomes the metropolis of the village weaver-birds, especially *Textor cucullatus* and *Melanopteryx nigerrimus*, occasionally *Melanopteryx maxwelli* and other rarer species. These joyous camp-followers keep up an unceasing din during clear weather as the males cling upside down at their doorways, playing at weaving, or come flying from the palms and banana fields nearby, with strips of foliage or whole green leaves, to do really earnest work on their nests. Their young are sometimes stolen by the hawk *Gymnogenys*, and are frequently gathered by the villagers for food. If there were any oil-palms when the forest was cleared, they probably have been left, and are also favorites with the weavers, providing nesting sites, nest material, and even an oily component of their ration. If not too close to the houses, the palms will also attract *Gypohierax*.

In the nearby plantations two crops are sure to be growing: plantains and manioc. The fruit of the plantains is always cut green, before any plantain-eater would think of eating it; and manioc is scarcely of interest to the birds, unless occasionally francolins or crested guinea-fowl peck at its roots. Small weaver-finches and colies (at the forest border) sometimes nest in the bunches of green bananas and plantains, and many sunbirds come to probe the flowers of the same plants. Another crop of more interest to the granivorous birds is mountain rice. Doves and occasionally francolins (*Francolinus squamatus*) eat it; but it is the Ploceidæ that cause the gravest ravages, so that it is sometimes necessary to post boys as sentinels to save the ripening grain. Flocks may come of *Textor cucullatus*, *Amauresthes fringilloides*, and *Spermestes poënsis*, but *Pirenestes ostrinus rothschildi* appears in smaller numbers, and the beautiful little weaver-finch, *Hypargos nitidulus schlegeli*, which, for want of a scientific name, I used to call in my notes the "rice-bird," is a regular visitor to the fields when the grain is ripening. Instead of clinging to the heads, this last species feeds on the ground, evidently on the fallen grains, and when alarmed, darts swiftly into a neighboring thicket.

Maize is raided by the larger weavers at times; but sweet potatoes, in the forest, were not found to suffer from the attentions of any birds. Few fruit trees will the Congo black man take the trouble to plant. But around the posts of the European, new ones are continually being tried. Mangoes, guavas, and papayas are now widespread. The first-named can boast of little preference on the part of Congo birds, although the dense foliage tempts them to nest in the trees. Guavas are pecked open by bulbuls and barbets (and carried off by the epaulet-bats), and an over-ripe papaya left on the tree will also draw admirers, particularly near the border region of the forest, where colies have invaded the clearings.

Agricultural stations in the Congo forest all have their groves of rubber trees. The first species to be planted were *Kibatalia elastica* and *Manihot Glaziovii*. The flowers on the first of these, though small, are visited by sunbirds, and the pappus of the seed-pods is used by some birds to line their nests. The second-named, or Ceará rubber tree, at the time of its flowering is a rendezvous for many kinds of sunbirds, and they somehow manage to swallow enough of its latex to coagulate into small balls of rubber in their stomachs. More recently *Hevea brasiliensis* has been widely planted, but I have never noted any sunbirds as coming regularly to it.

The fruit of fig trees, whether planted by the natives for their bark, or starting naturally as epiphytes on other trees, are relished by *Eidolon helvum*, a large fruit bat; and among the birds, bulbuls, barbets, and love-birds (*Agapornis swinderniana*) like them best. Francolins may pick them up from the ground.

Despite the markedly omnivorous propensities of the village-dwelling Congo native, which may have explained his very recent cannibalism, there are a few birds which prosper directly alongside mankind, for the most part unmolested. Some of these are found nowhere in the dense forest area except about villages. I refer particularly to *Passer griseus* and *Motacilla aquimp vidua*. The first is a true sparrow, in voice and in habits, but it never becomes numerous enough to be an annoyance. The wagtail is more familiar and lovable. It has a sweet ringing song, of which it is not sparing; and its nest is placed in plantains or other vegetation near the village, or even in grass thatch on the huts. During the day it runs about on the open ground of village squares or verandahs, darting at flying insects with open bill, an audible click announcing each of its successes.

After the first glimmer of daybreak has appeared, the earliest of the village birds to announce the new day is apt to be the common

*Pycnonotus tricolor*. Without either beauty or song to endear it, the bulbul's chirrup is often a welcome sound, earning for it a host of native names like "Natshókoro" (Mangbetu) and "Kwótolo" (Azande) which closely imitate its voice. It does little injury to any fruit except guavas, and few residents of the Congo would dispute their rights to these with the birds.

While we were traveling the long forest road which led from Stanleyville to Avakubi, one of the best indications that we were approaching a village, and perhaps the end of a day's march, was the sight of the lighter green banana foliage, and the small black swallows flitting about over these half-open spots. The swallows were of two kinds, but I think that *Psolidoprocne nitens centralis* was more common than *P. chalybea*. The reason why they are so often seen around villages is partly to be found in their nesting habits. These saw-winged swallows dig small tunnels in earthen banks, sometimes along the banks of streams. In the area we are considering, I think they are more apt to be in the sides of pits left when clay has been dug from some termite hill to plaster the walls of the houses. Such excavations are commonly three or four feet deep, and serve as receptacles for refuse.

Almost every Congo village keeps chickens, variegated in color and of mongrel breed, for the native does not know the advantage of selection. The fowls must forage for themselves, and are merely provided with a safe roosting place for the night. Here and there muscovy ducks are bred which were introduced long ago from South America. No African bird has been truly domesticated by these blacks. Gray parrots are taken from their nests and reared, their red tail-feathers being plucked for use as adornments, now and then a young guinea-fowl may be raised to maturity, and a few chiefs in the savanna districts have kept domestic pigeons. In the Lower Congo, small singing birds, especially serins and weaver-finches, are often trapped and kept in cages; but this seems due to the influence of the European bird-trade.

#### FOREST SWAMPS AND WATERCOURSES

Despite the fact that a number of Ethiopian water birds of the savanna areas also occur along the larger rivers of the forest belt, the more shaded watercourses and smaller swamps in the forest have an aquatic bird fauna of their own, with a number of very peculiar forms. Little has thus far been learned of their life histories, especially with regard to nesting.

<i>Tigriornis leucolopha</i>	<i>Canirallus oculus</i>
<i>Lampribus rara</i>	<i>Sarothrura pulchra centralis</i>
<i>Lampribus olivacea cupreipennis</i> <sup>1</sup>	<i>Podica senegalensis</i>
<i>Pteronetta hartlaubii</i>	<i>Alcedo quadribrachys guentheri</i>
<i>Himantornis hæmatopus whitesidei</i> <sup>1</sup>	<i>Corythornis leucogaster leopoldi</i>

Moreover there are a few passerine species fond of leafy boughs or dead stumps along forested river banks, if not indeed restricted to them. In the Ituri we noted invariably in such situations: *Apalis goslingi*, *Aleonax cassini*, *Hirundo nigrita*, *Anthreptes aurantium*.

On the lower Aruwimi and near Stanleyville, we saw *Meropogon breweri* only along lightly wooded river banks. *Merops malimbicus* likewise appears to prefer the neighborhood of water. The lapwing *Xiphidiopterus albiceps* is found along the banks of forested rivers like the upper Congo and many streams of West Africa. To the southward it appears, however, to extend far beyond the limits of the rain forest. The weaver, *Brachycope anomala*, does not stray from river banks; and along the Congo three other species seem firmly attached to the same situation: *Nectarinia congensis*, *Sitagra melanocephala duboisi*, and *Sitagra monacha*. The African wood-swallow, *Pseudochelidon eurystomina*, nests in colonies in sand-bars along the forested course of the Congo and lower Ubangi.

#### EDGES OF THE FOREST

In the region near Medje (northern Ituri) we observed and collected a number of birds which we did not find again either in the savannas of the Uelle or in the denser forest farther south. Though apparently inhabiting clearings and second growth, or more rarely true forest, they are scarcely to be classed with the other forest birds, because none of them is known to range across the forest belt from north to south. Instead, they follow the northern border of the forest in a narrow band, often extending from the Cameroon to Uganda, and sometimes southward along the eastern edge of the Congo forest, or in places along its southern margin.

*Cerchneis tinnunculus rufescens*  
*Phæniculus bollei jacksoni*  
*Glaucidium tephronotum*  
*Chlorophoneus multicolor*  
*Laniarius lühderi*  
*Fiscus mackinnoni*  
*Anthoscopus flavifrons*  
*Zosterops stenocricotus*  
*Phormoplectes preussi*

<sup>1</sup>I am in some doubt as to the habits of *Lampribus olivacea* and *Himantornis*. Both of them probably wander into the woods far from water.

*Cerchneis t. rufescens* and the European kestrel are considered races of one species because they appear to intergrade through northeast Africa. The dark form of the northern Ituri, however, seems to range westward to Nigeria and perhaps the French Sudan. In Congo territory we found it very local, and I have met with it only at Bafwabaka and Medje, in the northern Ituri district, and near the valleys of the Semliki and Ruzizi rivers, in the eastern borderland.

*Glaucidium tephronotum* (of which I consider *pycrafti* a race) is known only from Medje and Niapu, on the northern edge of the Congo forest, from Lukolela on its southern edge, and from Bitye in the Cameroon. During a long stay at Avakubi, in the central Ituri, I could find no trace of this pygmy owl.

One of the most characteristic sounds in the brush of the Mabudu country, where the transition occurs between savanna and forest, is a prolonged, hollow "kaw." A cautious approach may reveal its author as a bush-shrike, *Laniarius lühderi*, which was discovered by Reichenow near the Cameroon River, and which ranges eastward to Mt. Elgon, and then southward through the Kivu district. It shuns the denser forests, for I did not see or hear it south of the Nepoko River, near Medje, nor did it occur north of Niangara, even in forest galleries.

Very similar to Lühder's bush shrike in its distribution is *Fiscus mackinnoni*; but as one might suppose from its generic position, the present species is less a bird of thickets, and more apt to be found perching in clearings.

Among the Ploceidæ there are a few species behaving more like nuthatches than one might expect from the shape of their bills. *Malimbus rubricollis* and *Phormoplectes preussi* are the best examples. The latter species was found by us not only in the country from Medje north to Niangara, but also along the eastern edge of the forest toward Beni. It is known to extend westward to the base of Mt. Cameroon, and reappears in the Mayombe forest. Generally it is seen climbing about on the bark of trees bordering upon clearings, and its diet is largely made up of insects.

In the eastern edge of the Congo forest there are other birds which are not found in its central region. Some of the species are represented along the northern or southern edges of the forest, and some extend eastward in forest patches across Uganda. Among the best examples are:

<i>Guttera edouardi seth-smithi</i>	<i>Phyllastrephus lorenzi</i>
<i>Columba albinucha</i>	<i>Campephaga petiti</i>
<i>Bycanistes subcylindricus</i>	<i>Apalis jacksoni</i>
<i>Phaeniculus bollei jacksoni</i>	<i>Seicercus budongoensis</i>
<i>Colius striatus</i> (in clearings)	<i>Hyliota australis slatini</i>
<i>Smithornis sharpei eurylæmus</i>	<i>Chlorophoneus multicolor</i>
<i>Chlorocichla lætissima</i>	<i>Dryoscopus angolensis nandensis</i>
<i>Arizelocichla kakamegæ</i>	<i>Zosterops stenocricotus toroensis</i>
<i>Prosporphocichla scandens orientalis</i>	<i>Melanopteryx aureomucha</i>
<i>Phyllastrephus hypochloris</i>	<i>Phormoplectes dorsomacu latus</i>

None of these is truly of montane distribution, but *Chlorocichla lætissima* and *Dryoscopus angolensis* range up to 5500 feet. *Phormoplectes preussi* is found in the eastern section of this forest, and also *P. dorsomaculatus*, but the latter may be restricted to levels of about 4000 feet.

Whether the southern edge of the forest is similarly provided with birds of borderland distribution is not yet clear. It seems more likely that there they will occur rather in the patches of heavy forest more or less isolated from the main area.

#### SAVANNAS OF THE WESTERN SUBREGION

(III, IV, and V of Faunal Map)

##### UBANGI-UELLE SAVANNA

The Guinean savannas form a transition between the forests of the West African subregion and the more grassy countries of the Sudan and East and South Africa. The Uganda-Unyoro savanna has a stronger admixture of eastern birds, along with many true western forest species. So if we were to take a list of the whole number of forms occurring in any of these savanna areas, it would be extremely confusing. We should be at a loss to know why such typical plains birds as bustards and oxpeckers are found in the very same districts as blue-spotted guinea fowl and many typical species of forest babblers, bulbuls, and sunbirds. Why do we find in the neighborhood of Niangara (Uelle district) five species of plantain-eaters: two characteristic of the grass countries to the north, and one restricted to the forest border and "galleries," as well as the two common species of the deep forest in the Ituri? The answer can be had by examining the nature of these savannas in the Congo, and studying the fauna of each component part. The presence of so many forest species is then seen to result from the extension of strips of "gallery forest" far out into the grasslands. In the Azande or "Niam-Niam" country these extend out to the very limit we have set for the West

African subregion. For the best examples of the savanna fauna, then, we shall naturally look away from wooded watercourses to the grass and scrub environment.

As one crosses the Uelle savanna from south to north, gradual changes in the fauna are encountered, such as would not be noticed in following the edge of the forest from east to west. Many of the grassland birds do not approach the area of unbroken forest, and so are restricted to the northern part of this savanna (area III). Such species are apt to be more characteristic of the Sudan than of our territory. Conversely, species more agreeable to savanna near the forest are apt to extend less into the Sudan. *Cinnyris bouvieri* is an excellent example of a bird restricted to a narrow fringe of savannas just on the border of the forest. *Lagonosticta nigricollis*, in contrast, is a Sudanese form, coming but a little way over the border of the Congo.

Intimate acquaintance with the fauna of this part of Africa gives one an impression of a number of overlapping parallel bands, running from the White Nile to northern Cameroon or farther west, and bounded on the south by the outline of the rain forest. As one crosses the different bands, new species gradually appear, and some old ones drop from sight, so that this faunal area seems far less homogeneous than the equatorial forest. No doubt the same peculiarity may be noted in the southern Guinean savanna, but the "bands" will be found wider, more irregular, and the admixture of forest birds more pronounced.

A list of all the birds inhabiting the savannas in the Uelle district would be too long, as I shall mention only those which are especially characteristic of this faunal area, and of which few occur in the east or south of the Congo, unless represented there by a different race.

CHARACTERISTIC BIRDS OF THE DRY BUSHY SAVANNAS IN THE UELLE DISTRICT

<i>Necrosyrtes monachus monachus</i>	<i>Coracias abyssinicus</i>
<i>Melierax metabates metabates</i>	<i>Melittophagus pusillus ocularis</i>
<i>Astur badius sphenurus</i>	<i>Dicrocercus hirundineus heuglini</i>
<i>Aviceda cuculoides cuculoïdes</i>	<i>Merops nubicus</i>
<i>Butastur rufipennis</i>	<i>Bucorvus abyssinicus</i>
<i>Buteo auguralis</i>	<i>Phaeniculus purpureus niloticus</i>
<i>Aquila rapax raptor</i>	<i>Upupa epops somalensis</i>
<i>Numida meleagris major</i>	<i>Otus leucotis leucotis</i>
<i>Francolinus icterorhynchus dybowskii</i>	<i>Scotornis climacurus sclateri</i>
<i>Neotis cafra denhami</i>	<i>Macrodipteryx longipennis</i>
<i>Afribyx senegallus senegallus</i>	<i>Colinus striatus leucophthalmus</i>
<i>Streptopelia vinacea barbaru</i>	<i>Lybius guifsobalito</i>
<i>Agapornis pullaria pullaria</i>	<i>Lybius vieilloti vieilloti</i>

CHARACTERISTIC BIRDS OF THE DRY BUSHY SAVANNAS IN THE UELLE DISTRICT  
(Continued)

<i>Lybius leucocephalus leucocephalus</i>	<i>Salpornis spilonota emini</i>
<i>Campethera punctuligera balia</i>	<i>Oriolus auratus auratus</i>
<i>Yungipicus obsoletus obsoletus</i>	<i>Lamprocolius chalybæus emini</i>
<i>Mirafra fischeri cranbrookii</i>	<i>Lamprocolius chloropterus chloropterus</i>
<i>Anthus leucophrys zenkeri</i>	<i>Zosterops senegalensis superciliosus</i>
<i>Campephaga phænicea</i>	<i>Anthreptes longuemarei haussarum</i>
<i>Turdoides plebejus cinereus</i>	<i>Hedydipna platura platura</i>
<i>Eremomela elegans canescens</i>	<i>Chalcomitra senegalensis acic</i>
<i>Heliolais erythroptera jodoptera</i>	<i>Cinnyris osea decorsei</i>
<i>Cisticola lateralis antinorii</i>	<i>Cinnyris coccinigaster</i>
<i>Pentholæa albifrons clericalis</i>	<i>Sitagra atrogularis atrogularis</i>
<i>Bradornis pallidus pallidus</i>	<i>Clytospiza monteiri</i>
<i>Tchitrea viridis viridis</i>	<i>Pytilia phænicoptera emini</i>
<i>Psalidoprocne mangbettorum</i>	<i>Lagonosticta rara rara</i>
<i>Nilaus afer camerunensis</i>	<i>Lagonosticta rufopicta lateritia</i>
<i>Malacoctonus poliocephalus catharoxanthus</i>	<i>Uræginthus bengalus ugandæ</i>
<i>Enneactonus gubernator gubernator</i>	<i>Poliospiza gularis elgonensis</i>
<i>Corvinella corvina affinis</i>	<i>Emberiza cabanisi cabanisi</i>
<i>Prionops plumatus concinnatus</i>	<i>Emberiza affinis affinis</i>

This list gives no idea of the total population. It cannot be subdivided according to the height at which the species customarily live. The trees are not tall, and many, if not most of the grass birds betake themselves to their boughs at times. All the Palæartic migrants have purposely been omitted from this list, for the sake of brevity, though most of them do exhibit distinct preference for certain types of environment.

The clearing of ground for agriculture here makes for less change in the landscape than it does in the forest region. In general, too, it makes less difference to the birds. Certain species of the Uelle which are more fond of the open spots in the wild savanna are naturally attracted to cultivated fields. Among these may be mentioned:

<i>Turnix sylvatica lepurana</i>	<i>Stigmatopelia senegalensis æquatorialis</i>
<i>Turnix nana</i>	<i>Streptopelia vinacea barbaru</i>
<i>Coturnix delegorguei delegorguei</i>	<i>Bucorvus abyssinicus</i>
<i>Numida meleagris major</i>	<i>Mirafra fischeri cranbrookii</i>
<i>Francolinus icterorhynchus dybowskii</i>	<i>Anthus leucophrys zenkeri</i>
<i>Lissotis melanogaster</i>	<i>Uræginthus bengalus ugandæ</i>
<i>Afrilyx senegallus senegallus</i>	<i>Vidua macroura</i>

Ripening grain, of course, attracts a much larger number of weaver-birds; and to guard against them, watchers have often to be posted in the durra and rice fields. Fruit and shade trees, planted near houses, attract other birds, especially *Pycnonotus tricolor minor*, *Colius striatus*

*leucophthalmus*, and several barbets. Palm-swifts come to nest in palms or in the grass thatch of houses, whereas *Passer griseus* and *Motacilla aquimp vidua*, just as in the forest clearings, are familiar village birds.

Mixed bird parties, comparable to those of the Congo rain forests, are anything but typical of the Guinean savannas. Birds may assemble in numbers to feed, especially if they are seed-eaters, or when attracted by a swarm of flying termites. But the mysterious bond that would urge them to travel in company is lacking, save in rare instances. One of these notable exceptions was observed by us in the northeastern Uelle district. Near Garamba especially, though not in the tall savanna woods, *Salpornis spilonota emini* and *Hyliota flavigaster flavigaster* would seldom be encountered alone. Their constant companion was a small yellowish warbler, *Eremomela elegans canescens*, which itself forms companies of four to six individuals, searching foliage diligently for insects and their larvæ, and continually repeating a short, hoarse, call-note. Associated with them would be a family of the blue-backed *Hyliota*, and two or three creepers, *Salpornis*. The two latter species seemed to have concluded a perpetual alliance, so constantly were they found in each other's society. With them might go a few short-tailed warblers, *Sylvietta brachyura dilutior*, or black titmice, *Parus niger purpurascens*.

The association is a frequent and instructive sight. The company progresses through the bush in one direction, the different members seeking food each in its own way. The little yellow warbler is seconded in its investigation of the leaves by the *Hyliota*, more of a warbler in habits than a flycatcher, and practically noiseless. The silent creeper wends its way up the rough-barked trunks of the stunted trees, beginning below, or wanders out on their branches, often clinging to the under side of a bough like a nuthatch, which it also parallels in the lack of pointed rectrices. *Sylvietta brachyura* combines both methods, peering everywhere, climbing occasionally like the creeper. Sometimes it emits a low hoarse call, or a pleasant warbling song. The search is continuous; one by one the beaters progress to fresh trees and bushes, the creeper distinguishing itself on the wing by having the most undulating motion, where none are strong fliers. It ought to be added that never was a drongo to be seen in this association, although *Dicrurus adsimilis divaricatus* is a common bird of the region. Such an association would offer a temptation, rather than protection, were any small bird-eating hawk to come upon it. Perhaps an instinctive companionship is about all that it suggests.

The affinity shown between the northern and southern savannas of the Congo is rather pronounced, and illustrates the communication which

is possible around the eastern edge of the forest, and by crossing over the forest, especially between the Cameroon and the middle Congo. Of 144 forms which could be listed as characteristic of the upland savanna in the Ubangi-Uelle faunal area, 36 are not racially different from their representatives in the southern Guinean savanna, whereas about 50 others are represented there by other forms of the same species. Only 58 are not thus represented, but some of them have related forms somewhat farther south in Africa, sometimes in the Katanga district of the Congo. The exact figures will vary of course with the taxonomic treatment of the forms. A higher proportion of forms in common would be found if we were to count the whole avifauna of the Uelle with that of the Kasai, for instance, because so many species of the gallery forests, and so many of the aquatic birds, would be identical.

The resemblance between the Ubangi-Uelle savanna and that of the eastern Congo border, adjacent to Uganda, is scarcely closer.

#### SOUTHERN CONGO SAVANNA

The concentric nature of distribution around the Congo forest will be developed in another chapter, with special examples. It will suffice to say that when there is a subspecific difference between the members of a species inhabiting both northern and southern Guinean savannas, the southern form is rather apt to be the one occurring on the eastern border of the Congo forest, north, at least, to Lake Kivu. If there is any faunal line of division in the lowland savannas near Ruwenzori, it is the belt of forest across the Semliki Valley; but apparently the Kivu highlands present a more effective barrier.

The southern Congo savanna (area IV) has nevertheless many subspecies and certain species which have not been collected in any other area of the Congo. Only the distinct species will be listed here.

<i>Balæniceps rex</i>	<i>Platysteira albifrons</i>
<i>Charadrius forbesi</i>	<i>Chlorophoneus gutturalis</i>
<i>Anthus pallidiventris</i>	<i>Lamprocolius nitens</i>
<i>Sylvietta rufigenis</i>	<i>Chalcomitra fuliginosa</i>
<i>Calamonastes cinereus</i>	<i>Textor collaris</i>
<i>Neolestes torquatus</i>	<i>Lagonosticta landanz</i>
<i>Cichladusa ruficauda</i>	<i>Estrilda nigriloris</i>
<i>Bessonornis natalensis</i>	<i>Hypochoera nigerrima</i>
<i>Batis minulla</i>	<i>Fringillaria impetuani</i>

*Balæniceps* is not a southern type, but happens to find a suitable home on the Lualaba. *Charadrius forbesi* is also better known north of

the Cameroon. *Sylvietta rufigenis* may well be conspecific with *S. ruficapilla*. *Neolestes torquatus* extends slightly beyond the eastern limits of the area, but is too characteristic to be omitted.

Not a few forms which are widespread in the Kasai extend also to the Upper Katanga and Marungu, because of the savanna vegetation, despite a somewhat cooler climate and more marked dry season. Future collecting near the Angolan border may be expected to enlarge the foregoing list.

#### UGANDA-UNYORO SAVANNA

When I visited this section of the Congo in 1926 and 1927, I was able to judge of the difference between its avifauna and that of the Uelle. As expected, there was a marked divergence in the birds of grasslands, rivers, and lakes, while the birds of lowland forest patches were more alike. The following species have been found in the Congo section of the Uganda-Unyoro savanna, but neither in the northern nor the southern Guinean savanna, though some occur in the Kivu highland savanna, or the Rhodesian highland.

<i>Torgos tracheliotus</i>	<i>Cisticola carruthersi</i>
<i>Circætus pectoralis</i>	<i>Cisticola robusta nuchalis</i>
<i>Circus ranivorus</i>	<i>Cichladusa guttata guttata</i>
<i>Francolinus levaillantii kikuyuensis</i>	<i>Chloropeta gracilirostris</i>
<i>Porphyrio madagascariensis</i>	<i>Riparia paludicola ducis</i>
<i>Gallinula chloropus brachyptera</i>	<i>Psalidoprocne albiceps</i>
<i>Balearica regulorum gibbericeps</i>	<i>Laniarius barbarus mufumbiri</i>
<i>Stephanibyx coronatus</i>	<i>Fiscus excubitorius</i>
<i>Hydrocolæus cirrocephalus</i>	<i>Nectarinia erythroceria</i>
<i>Gelochelidon nilotica nilotica</i>	<i>Nectarinia pulchella lucidipectus</i>
<i>Streptopelia decipiens shelleyi</i>	<i>Sitagra pelzelni pelzelni</i>
<i>Poicephalus meyeri saturatus</i>	<i>Sitagra intermedia intermedia</i>
<i>Merops superciliosus</i> (migrant)	<i>Sitagra dimidiata</i>
<i>Rhinopomastus cyanomelas schalowi</i>	<i>Xanthophilus castanops</i>
<i>Urocolius macrourus griseogularis</i>	<i>Pyromelana franciscana franciscana</i>
<i>Tricholæma lacrymosum</i>	<i>Pyromelana orix nigrifrons</i>
<i>Thripas namaquus intermedius</i>	<i>Colius passer eques</i>
<i>Mirafra albicauda</i>	<i>Nesocharis ansorgei</i>
<i>Mirafra africana ruwenzoria</i>	<i>Estrilda roseicrissa</i>
<i>Anthus brachyurus leggei</i>	<i>Estrilda rhodopyga centralis</i>
<i>Apalis flavida æquatorialis</i>	<i>Hypochera orientalis</i>
<i>Cisticola woosnami woosnami</i>	<i>Serinus sulphuratus shelleyi</i>

While this list is made up largely of birds with an East African distribution, it must be remembered that in the area under consideration they live side by side with birds of equally western type.

## AQUATIC BIRDS OF THE SAVANNA AREAS

In neither the New nor the Old World does the humid belt close to the equator exhibit the profusion or the variety of large water birds that one finds farther to the north and south. Flamingos and pelicans are more subtropical, not to mention ducks and geese, which attain such a development in the temperate and colder zones. Many of the larger aquatic birds, moreover, which one sees on the rivers of the African forest belt seldom or never nest there. The savanna districts immediately north and south of the forest are somewhat richer in aquatic birds, and at a few points where wide rivers offer good fishing grounds more of them congregate at certain seasons. Such places are Wissmann Pool on the lower Kasai, Stanley Pool on the Congo, and the region of Lake Kisale on the Lualaba. On the east of the forest, large water birds are still commoner, partly because of the proximity of the lakes, among which Lake Edward would appear to have the most cormorants, pelicans, and spoonbills. Some of the smaller highland lakes in Ruanda are well supplied with ducks.

Large aquatic birds are more abundant in southeast Congoland, according to Sir Harry Johnston,<sup>1</sup> than anywhere in the west or the north. The abundance of storks, herons, flamingos, pelicans, cranes, ibises, geese, and ducks, at the south end of Lake Tanganyika he called almost fabulous. Captain Hinde had described the grassy flats along the lower Luapula as being literally covered with flocks of spur-winged geese. On the broader reaches of the Kasai, Grenfell had also noted the abundance of pelicans, darters, herons, storks, spur-winged geese, ducks, skimmers, fishing vultures, and kites. Likewise on the Mfini River, in October, the same missionary explorer wrote of pelicans, herons, sacred ibis, "crowned cranes,"<sup>2</sup> and other water birds; but arriving at Lake Leopold he found conditions changed, and the birds very few.<sup>3</sup> This is but another illustration of the difference between forest and savanna environments, as affecting even the water birds.

I did not see pelicans on any river in the forest belt, except along the Congo River below Coquilhatville. Spoonbills are of course rarer in the West African subregion. In the Upper Uelle district, during a two years' stay, we saw no egret of any species, but they are not quite so scarce on some rivers within the forest area.

The whale-headed stork being so particular in its choice of haunts, perhaps it is not surprising that it should be lacking on Lakes Edward,

<sup>1</sup>1908, 'George Grenfell and the Congo,' I, p. 321.

<sup>2</sup>No specimen of *Balearica* seems to be known from that region.

<sup>3</sup>Johnston, 1908, 'George Grenfell and the Congo,' I, pp. 153, 167, 169.

Kivu, and Tanganyika. The marshes of the upper Lualaba, however, furnish a more acceptable habitat, and there it was first obtained in 1909 near Lake Kisale. There is little likelihood of its turning up in the wide stretch of country between this spot and the Kagera River, west of Lake Victoria, or indeed anywhere else in Congo territory except the north end of Lake Albert.

The Uelle district, though largely savanna, is not rich in aquatic birds. The following list of those to be seen on the Uelle, Dungu, and Kibali rivers, exclusive of a few migrants from Eurasia, will do little more than impress one with the relative poverty of the fauna.

<i>Phalacrocorax africanus africanus</i>	<i>Plectropterus gambensis gambensis</i> (rather scarce)
<i>Anhinga rufa rufa</i>	
<i>Nycticorax leuconotus</i>	<i>Halizetus vocifer</i>
<i>Butorides striatus atricapillus</i>	<i>Pandion halizetus halizetus</i>
<i>Bubulcus ibis</i>	<i>Limnocorax flavirostra</i>
<i>Ardea melanocephala</i>	<i>Porphyryla alleni</i>
<i>Ardea goliath</i> (rare)	<i>Charadrius marginatus pallidus</i> (rare)
<i>Pyrrherodia purpurea purpurea</i>	<i>Hoplopterus spinosus</i> (rare)
<i>Scopus umbretta</i>	<i>Himantopus himantopus</i> (rare)
<i>Dissoura episcopus microscelis</i>	<i>Pluvianus ægyptius</i>
<i>Ephippiorhynchus senegalensis</i> (rare)	<i>Galachrysia nuchalis marcheii</i>
<i>Anastomus lamelligerus lamelligerus</i>	<i>Ectidnemus senegalensis</i>
<i>Threskiornis æthiopicus</i> (rare)	<i>Actophilornis africanus</i>
<i>Hagedashia hagedash nilotica</i>	<i>Corythornis cristata cristata</i>
<i>Nettapus auritus</i> (rare)	<i>Ceryle rudis rudis</i>
<i>Sarkidiornis melanotos</i>	<i>Megaceryle maxima</i>
	<i>Scotopelia peli peli</i> (rare)

The kingfishers and birds of prey listed above are not water birds under the strictest interpretation; but they do live along the rivers, and take their food from the water. A bee-eater, *Melittophagus bullocki frenatus*, is also very characteristic of the rivers.

The facts of distribution in the Congo do not support the opinion of Boyd Alexander,<sup>1</sup> earlier expressed by Professor Reichenow,<sup>2</sup> that rivers serve as highways for the dispersal of many species of birds. With certain water birds it may be true; but otherwise the kind of country away from the river banks has a more direct influence. Among passerine birds a few, like *Nectarinia congensis*, *Brachycope anomala*, and *Hirundo nigrita*, are always found along forested rivers, yet even they cannot make their abode far beyond the edges of the equatorial forest. On the whole, then, the direction of the rivers cannot be said to determine the distribution of birds.

<sup>1</sup>1907, 'From the Niger to the Nile,' II, pp. 21-22.

<sup>2</sup>1874, Correspondenzblatt Afr. Gesellsch., No. 10, p. 176.

The Lualaba enters the forest near Kasongo and the fauna along its banks is completely altered, the savanna fauna only penetrating into clearings afforded by human activities, as it often does when there is no river highway. Again, near Yumbi, the Congo emerges again into the savanna, and the forest fauna can only follow its course where patches of forest offer a safe shelter. So the influence of vegetation is preponderant. Similarly the Semliki, the Lomani, the Uelle, and the Ubangi pass from savanna to forest, with the same change of fauna; and other rivers of smaller size furnish innumerable instances of like nature.

#### BIRDS OF GRASSY MARSHES IN THE UELLE

Other water birds, of course, instead of seeking open river banks, are found skulking in marshes. Many of the low, wet spots in the Uelle district are forested, and harbor a few aquatic species. Other situations, especially to the northeast, are filled with papyrus; but there are also occasional grassy marshes, where rails and snipe will be found. Among the marsh birds to be noted are the following:

<i>Izobrychus minutus payesii</i>	<i>Schænicola brevirostris</i>
<i>Ardeirallus sturmi</i>	<i>Cisticola galactotes nyansæ</i>
<i>Crecopsis egregia</i>	<i>Cisticola natalensis valida</i>
<i>Sarothrura böhmi böhmi</i>	<i>Antichromus minutus</i>
<i>Sarothrura lugens</i>	<i>Amblyospiza albifrons saturata</i>
<i>Sarothrura rufa elizabethæ</i>	<i>Coliuspasser macroura macroura</i>
<i>Limnecorax flavirostra</i>	<i>Pirenestes ostrinus maximus</i>
<i>Capella media</i> (migrant)	<i>Paludipasser locustella uelensis</i>
<i>Capella gallinago gallinago</i> (migrant)	<i>Estrilda paludicola paludicola</i>
<i>Capella nigripennis</i>	<i>Nesocharis capistrata</i>
<i>Budytes feldegg feldegg</i> (migrant)	

#### BIRDS OF PAPYRUS SWAMPS

Swamps with papyrus commonly contain more water than the grassy marshes, and the cover they offer is higher, so that some of the swamp-loving species shun them. Yet they do have a few birds peculiar to them. To collect any specimens one is obliged to flounder about, often knee- or waist-deep in black ooze and water, jumping from one clump of the giant sedge to another, and tripping over its stout rhizomes beneath the water. The papyrus does not take fire so readily as grass, even when the swamp dries in the rainless months, so it then provides roosting quarters for a number of birds—several common species of weavers, and some bulbuls as well.

During the day, and especially in the morning, some very curious bird notes issue from the papyrus swamps. There are the guttural

calls, with almost metallic resonance, of *Calamornis rufescens nilotica*, a large gray-brown reed-warbler; and the prolonged series of chirruping sounds, mingled with loud, explosive wing-beats, which reveal the presence of two other warblers of the genus *Bradypterus*: *B. carpalis carpalis* and *B. brachypterus centralis*. The "papyrus birds," as I used to call them in my notes, are extremely difficult to see. One breaks a way into the thicket of papyrus, and the disturbance imposes a sudden silence upon the birds. Only patient waiting and watching in the depths of the tangle will bring success. Meantime one is apt to come across some small gray-brown bats, *Nycteris pallida*, which have been hanging from the feathery tufts of the papyrus, and flit erratically away ahead of the disturber.

The association of two species of *Bradypterus* is to be seen in many other localities. From the swamps of the Sezibwa River, in Uganda, Dr. van Someren has described<sup>1</sup> a dark form, *B. yokanæ*, which is not more than subspecifically distinct from my *carpalis*. *B. brachypterus centralis* probably lives in the same swamps with it, inasmuch as it is known from several localities in North Kavirondo.

In the Kivu region, at increased elevation, *B. graueri* replaces *carpalis*, but *B. brachypterus centralis* still occurs there. In the Cameroon, at Ankonolinga, just on the northern edge of the forest, Bates has found another large species, *Bradypterus grandis*, sharing its habitat with a race of *B. brachypterus*. In the Uelle I saw neither species of *Bradypterus* outside a dense growth of papyrus, although other mountain-dwelling members of the genus have different habits.

At Faradje *Calamornis r. nilotica* appeared likewise to be attached to the papyrus. Nearer the forest border, however, there are extensive growths of elephant grass, in which the same species of reed-warbler proves to be at home. I heard its unmistakable calls among such canes on the hills near Nzoro, and collected specimens at Pawa, on the northern edge of the Ituri basin. At Stanleyville, again, I found a *Calamornis* which was satisfied with some coarse grass along a creek; but those about Boma were restricted to papyrus. There I could find no *Bradypterus* keeping them company. In the Semliki Valley a large *Calamornis* is abundant in the elephant grass.

The other birds of the papyrus, in the northeastern Uelle, are not always so particular as to the vegetation. Picking their way gingerly, with continual low clucks, and occasionally a curious froglike note, families of the slaty-black rail, *Limnocorax*, pass by at short range;

<sup>1</sup>1919, Bull. Brit. Orn. Club, XL, p. 21.

and if there are a few trees near the border of the marsh, one may hear the cheery notes of a smaller rail, *Sarothrura pulchra*. I seldom saw the Palæarctic reed-warblers, which migrate to central Africa, dwelling in the papyrus. A yellow-and-black weaver, *Sitagra tænioptera*, frequently hands it nest to the papyrus, especially where it fronts on a good stream of water; while *Alseonax infulatus*, a dark brown flycatcher with light belly, is typical of small quiet ponds bordered by this type of vegetation. Least bitterns, also, may be included among the inhabitants of these swamps.

The greatest area of papyrus in the Congo is along the Lualaba near Lake Kisale. Here the lakes and broad streams are the resort of unusual numbers of water-fowl: small cormorants, anhingas, gray pelicans, herons, open-bill storks, white-faced tree-ducks, pygmy geese, spur-winged geese, and comb-ducks; as well as fishing eagles and black-and-white vultures. The whale-head stork is rarely visible from passing steamers. My friend J. De Riemaecker tells me that he made five trips through the region by boat before seeing his first whale-heads.

The small birds living in the papyrus are less well known, because few collectors have given them any attention. As usual there are black-headed weavers, swamp Cisticolas (*galactotes*), and brown flycatchers (*Alseonax infulatus*). During the few stops made by the steamer I listened for the calls of *Bradypterus*, but heard none. Neither did I hear the voice of *Calamornis rufescens*, although I obtained a smaller species of *Calamornis*, apparently *leptorhyncha*. Along a canal in the papyrus I was surprised to see a forest kingfisher, *Alcedo q. guentheri*. The smaller *Corythornis cristata* is of course common. These great swamps deserve further investigation, especially as to their small passerine birds.

#### BIRDS OF GALLERY FORESTS IN THE UELLE

Extensions of the forest vegetation into the savanna areas, as might be expected, carry a part of the forest fauna with them. It must still be noted that many of the forms which appear the most sylvan in the detached "galleries" are only birds of secondary forest when in the rain forest area. Once the primeval growth is entered they are wanting. It must not be supposed that the savanna districts are entirely without their own forms which frequent such woods as they find. A short list can be given for the Uelle savanna area, of species of this nature, birds of gallery forest, yet not occurring in the continuous equatorial belt, or only near its borders.

<i>Guttera edouardi seth-smithi</i>	<i>Turdoides tenebrosus</i>
<i>Turacus leucolophus</i>	<i>Apalis flavida flavitorquata</i>
<i>Musophaga rossæ rossæ</i>	<i>Drymocichla incana</i>
<i>Bycanistes subcylindricus</i>	<i>Eminia lepida</i>
<i>Scotopelia bouvieri</i>	<i>Cisticola erythrops sylvia</i>
<i>Caprimulgus nigriscapularis</i>	<i>Bessonornis niveicapilla</i>
<i>Caprimulgus inornatus</i>	<i>Dryoscopus gambensis malzacii</i>
<i>Melignotheres minor riggenbachi</i>	<i>Stilbopsar torquatus</i>
<i>Prosporphocichla scandens orientalis</i>	<i>Cinnyricinclus leucogaster leucogaster</i>
<i>Illadopsis puveli strenuipes</i>	<i>Cyanomitra verticalis viridisplendens</i>

To this list might be added a few which are subspecifically distinct from forms living in the true forest area:

<i>Cuculus clamosus jacksoni</i>
<i>Apaloderma narina narina</i>
<i>Heliobucco bonapartei intermedius</i>
<i>Pirenestes ostrinus ostrinus</i>

Many of the above species have a seemingly irregular distribution over large areas of the African continent, easily explained when their ecological preferences are taken into account.

Among the birds which Reichenow chose as indicators of the extent of the western subregion near Lake Victoria, the gray parrot seems<sup>1</sup> more reliable than *Musophaga rossæ*. This plantain-eater, though West African beyond a doubt, is not so truly a forest species as some others of its family. Its being found on the east shore of Lake Victoria can be better understood when we recall its marked preference for gallery forest, and its total absence from the center of the Ituri forest. We first observed the species on the Congo between Stanley Pool and Kwamouth, and during our next sixteen months in the forest it was not to be seen. Only when we had left the Ituri behind, and had come out into the savannas near the Uelle River, did we again find *Musophaga rossæ*. Its voice is very characteristic, and in returning through the Congo forest I was again able to verify its complete absence not only by sight but by ear. It also lives in patches of forest along the eastern Congo border, and in the Kasai district.

*Guttera edouardi seth-smithi* is a tufted guinea-fowl usually spoken of as a typical forest form, because it is known in Uganda only from the heaviest forests, and has also been collected along the eastern border of the Ituri forest. But when we enter the unbroken Congo forest, the very distinct *Guttera plumifera* replaces it. Similarly, Bates, in the southern Cameroon forest, found only *Guttera plumifera*. In short, I did not see

<sup>1</sup>According to Meinertzhagen, 1919, *Ibis*, p. 386, the gray parrot is extending into Kenya Colony.

any evidence of the existence of *seth-smithi* far within the line of unbroken forest; and I consider the various forms of *G. edouardi* as inhabitants only of the border regions of the forest, especially because they extend through Southeast Africa to Natal. *G. e. schoutedeni* occupies the gallery forests of the southern Congo.

Among the remaining species listed there are several, such as *Bycanistes subcylindricus*, *Caprimulgus nigriscapularis*, *Prosporphocichla scandens*, and *Turdinus puveli*, which have a narrow, drawn-out range, extending east and west, paralleling the rain-forest belt which lies just to the south. *Caprimulgus nigriscapularis* is an extreme example, ranging from Portuguese Guinea to Kenya Colony, across fifty degrees of longitude. From north to south, in the Upper Uelle district, I doubt if the narrow area it inhabits covers much more than one degree of latitude, or seventy miles.

A few other species of like distribution I have omitted from the above list, because they do not live in gallery forest. Such birds are likewise restricted to a narrow band along the southern edge of the Uelle savanna. *Cinnyris bowieri* has already been mentioned. We found it only in the grasslands of the Mabudu and Mangbetu countries, bordering directly on the forest. It seems to occupy the same position on the southern edge of the forest, in the Manyema and in the Gaboon. *Cinnyris coccinigaster* inhabits the northern savanna, extending from Upper Guinea to the eastern Uelle, but in such an extremely narrow belt that we met the species nowhere save at Niangara and Nzoro. It was totally absent at Faradje and northward. This sunbird has been reported from the southern border of the forest in the vicinity of the Lower Congo. A further example is *Petrochelidon preussi*, a swallow I found in the Uelle savanna, but which had hitherto been collected only on the Sanaga River (Cameroon). Bates has since found it in Nigeria.

For the gallery forests of the southern Guinean savanna, I am unable to give a corresponding list of peculiar species, partly because of my lack of familiarity with the region, and partly because the forest fauna seems to extend out much farther to the southward. About twelve of the forms listed as typical of gallery forests in the north are nevertheless represented in the southern Congo by the same or closely allied forms, and I regard it probable that they live in similar situations there.

Species which inhabit the gallery forests of the Uelle district and found commonly also in the Upper Congo forest are as follows:

<i>Hagedashia hagedash nilotica</i>	<i>Campethera caroli</i>
<i>Pteronetta hartlaubii</i>	<i>Mesopicos xantholophus</i>
<i>Kaupifalco monogrammicus</i>	<i>Eurillas virens virens</i>
<i>Francolinus squamatus squamatus</i>	<i>Stelgidillas gracilirostris</i>
<i>Sarothrura pulchra centralis</i>	<i>Bæopogon indicator chlorosaturatus</i>
<i>Tympanistria tympanistria fraseri</i>	<i>Thescelocichla leucopleura</i>
<i>Turturæna iriditorques</i>	<i>Atimastillas simplex</i>
<i>Columba unicolor</i>	<i>Nicator chloris</i>
<i>Vinago calva</i>	<i>Phyllanthus atripennis bohndorffi</i>
<i>Pachyoccyx validus</i>	<i>Camaroptera brevicaudata</i>
<i>Cuculus solitarius</i>	<i>Apalis goslingi</i>
<i>Chrysococcyx cupreus</i>	<i>Burnesia bairdii bairdii</i>
<i>Ceuthmochares æreus intermedius</i>	<i>Pedilorrhynchus comitatus stuhlmanni</i>
<i>Turacus schütlii emini</i>	<i>Parisoma plumbeum plumbeum</i>
<i>Corythæola cristata</i>	<i>Megabyas flammulatus æquatorialis</i>
<i>Psittacus erithacus erithacus</i>	<i>Erannornis longicauda teresita</i>
<i>Eurystomus afer</i>	<i>Stizorhina fraseri vulpina</i>
<i>Halcyon senegalensis senegalensis</i>	<i>Tchagra australis</i>
<i>Halcyon malimbica prenticei</i>	<i>Sigmodus rufiventris mentalis</i>
<i>Alcedo quadribrachys guentheri</i>	<i>Oriolus nigripennis</i>
<i>Lophoceros camurus camurus</i>	<i>Lamprocolius splendidus splendidus</i>
<i>Lophoceros fasciatus</i>	<i>Anthreptes collaris hypodilus</i>
<i>Bycanistes sharpii duboisi</i>	<i>Cyanomitra obscura</i>
<i>Ceratogymna atrata</i>	<i>Chalcomitra rubescens</i>
<i>Strix woodfordi nuchalis</i>	<i>Cinnyris chloropygius orphogaster</i>
<i>Chætura ussheri sharpei</i>	<i>Hyphanturgus nigricollis nigricollis</i>
<i>Pogoniulus leucolaima leucolaima</i>	<i>Spermospiza ruficapilla</i>
<i>Tricholæma hirsutum ansorgii</i>	<i>Hypargos nitidulus schlegeli</i>
<i>Campethera permista</i>	

Of these fifty-seven species, twenty-four are inhabitants of virgin forest in the Ituri (see page 216). The others, though they occur in that faunal area, are all birds of second growth, clearings, or watercourses.

#### BIRDS OF ROCKY HILLS IN THE UELLE

Mention has already been made in the chapters on geology and botany to the numerous hills in the Upper Uelle, and to their special interest with regard to birds. It is true that the hills near Aba do form an extension from the mountainous ridge along the western side of the Albertine depression. But the birds which frequent these elevations are not of the true mountain fauna, such as one would find on Ruwenzori, or even on the highland west of Lake Albert. They are simply rock-loving birds which are scarce or unknown in the central Congo basin, although they do stretch westward to northern Nigeria, and some to Senegambia, wherever they find conditions suitable. It is not high altitudes that are sought, for while at Aba they may live at elevations close to 4000 feet, the same species sometimes occur at sea-level near the

west coast, provided they have rocky cliffs, while a few have taken to nesting on large buildings or fortifications.

Boyd Alexander<sup>1</sup> dwelt very properly upon the peculiarity of this rock-loving fauna, which he encountered at so many points from northern Nigeria to the headwaters of the Uelle. On the bare gray rocks squat gray nightjars (*Caprimulgus trimaculatus*), so protectively colored as to escape detection at a few yards, until they take wing. In the low tangled plants skulk little brown grass-warblers (*Cisticola emini petrophila*) found only on hills. Against the steeper cliffs brown rock-martins (*Ptyonoprogne rufigula*) plaster their cup-shaped nests, and under overhanging rocks the streaked *Hirundo abyssinica* builds its flask-shaped abode, from which *Micropus caffer* may oust it before its brood is reared. The sweet song of a rock-thrush (*Thamnozœa cinnamomeiventris*) rings out from the steepest precipices.

In addition to the birds, there are certain mammals which frequent the same hills, but are not found in the lowlands of the Congo savanna, namely, a dark-coated hyrax (*Procavia lopezi*), a mongoose of somewhat similar color (*Helogale hirtula robusta*), and a lighter brown squirrel (*Heliosciurus multicolor gambensis*). Perhaps the rabbit of the north-eastern Uelle is more fond of these elevated spots than of the savanna in general. Many species of bats profit by the shelter afforded in crevices and caves in the rock. Bands of baboons (*Papio doguera*) also haunt the bare eminences, which offer secure lookouts.

No doubt it is partly the xerophilous vegetation on such hills which pleases the birds and partly the nesting-sites the rocks afford. To a slight extent, also, these are birds of the Sudan which invade the Congo at this point, finding local conditions similar enough for their wants. Some of them, like *Cerchneis alopec*, come as migrants in the dry season, and do not nest. Yet during a stay of more than two years we never saw this large kestrel at any spot away from the hills.

The following is a list of species which I found to be typical of this hill environment, and almost if not entirely lacking in the neighboring lowlands:

<i>Cerchneis alopec</i> (migrant)	<i>Cercomela familiaris omoënsis</i>
<i>Ptilopachus petrosus emini</i>	<i>Monticola saxatilis</i> (migrant)
<i>Caprimulgus trimaculatus tristigma</i>	<i>Alseonax minimus pumilus</i> (taken once)
<i>Micropus affinis affinis</i>	<i>Alseonax gambagæ</i>
<i>Micropus caffer streubelii</i>	<i>Ptyonoprogne rufigula rufigula</i>
<i>Heliocorys modesta bucolica</i>	<i>Hirundo abyssinica unitatis</i>
<i>Cisticola emini petrophila</i>	<i>Fringillaria tahapisi goslingi</i>
<i>Thamnozœa cinnamomeiventris subrifipennis</i>	

<sup>1</sup>1907, 'From the Niger to the Nile,' II, pp. 307-309.

All but *Cerchneis alopec* and *Monticola saxatilis* are presumed to breed there. *Fringillaria t. goslingi* does nest, in December, and withdraws to the north during the rains. At least I did not find it there in July.

The occurrence of *Micropus caffer streubelii* must be largely governed by that of swallows building flask-shaped nests. These it takes over, either by force, or after the builders have vacated them. A re-lining with feathers by the swifts makes it ready for their occupancy. The fondness of *Hirundo abyssinica* for overhanging rocks on which to plaster its "cliff-swallow" nursery is therefore reflected in the presence of the small white-rumped swifts, which are only seldom seen away from such hills.

The southern Congo savanna has probably fewer hills, yet where they exist they must support a similar small bird fauna of peculiar tastes. On the lower Congo I saw *Micropus affinis*, *Cercomela familiaris falkensteini*, and *Hirundo abyssinica unitatis*, all frequenting rough hills. The swallows there have taken to nesting frequently on the side of houses or beneath verandahs. They could be seen thus at the American Consulate in Boma, and Mr. Harry McBride told me that their nests were taken possession of by swifts. *Micropus affinis* builds its own nest of grass and feathers. A few of the other rock birds of the Uelle have representative forms in the southern savanna, *Fringillaria t. tahapisi*, for example, recalling *F. t. goslingi* in habits; and perhaps other hill birds are there which do not occur in the north.

In the grasslands of the eastern Congo border some species of the foregoing list are known to occur, and their habits and preferences are there the same. Few of them ascend the high mountains. *Caprimulgus trimaculatus* lives here and there on hills with bare rocks, near Nioka, Beni, and Kasindi, but not above 5000 feet on the southern end of Ruwenzori. *Thamnolæa cinnamomeiventris* has been recorded from Beni, but not on Ruwenzori, *Ptyonoprogne rufigula* ascends Ruwenzori only to 7000 feet, and *Fringillaria tahapisi* keeps to its southern base.

Why are these rock-loving birds seldom or never found in the lowland forest region? The hills in the forest belt, though equally high, do not show the same cliffs and boulders, because the trees not only mask them, but by the action of their roots and the moisture in the soil, cause them to disintegrate at a much more rapid rate. Sites which might serve for the nesting of such species as *Hirundo abyssinica* and *Micropus affinis* have therefore long ago been destroyed. *Micropus caffer streubelii* was shot at Avakubi only once. *Hirundo abyssinica* is not unadaptable;

and I have seen it at Coquilhatville and Irebu on the Congo, within the forest belt. Finally, the rock goatsucker, *Caprimulgus trimaculatus*, was found by Bates in the southern Cameroon on a hill with a large area of bare rock, though it was entirely surrounded by the forest.

### HUMID MONTANE AREAS

(VI of Faunal Map)

All the mountainous areas of the eastern and southeastern Congo are more closely related, faunally, to eastern than to western Africa. The West African subregion is a lowland area. Its boundary, on Ruwenzori and the neighboring mountains, comes at a level of about 5000 feet. Here the changes in make-up of the forest are matched by changes in the bird fauna, the disappearance of the majority of lowland forest forms, such as one finds in the central Ituri district, and their replacement by mountain forms often related to those one would find on Mt. Cameroon, Mt. Elgon, Mt. Kenia, Kilimanjaro, or in the mountains of Nyasaland. Such a boundary is never so sharp as it has to be traced on a map. Not a few of the lowland forms straggle higher up the slopes than they ought in due respect to our theories, and the lower level of the mountain forms is but slightly more regular. On the eastern slopes they sometimes do not come down so far, because the mountain forests, as a result of the repartition of rains and perhaps also of the activities of the natives, stop at a rather higher level. Then in the grasslands which replace the rain forest of the west, one finds many representatives of the avifauna of the savannas and grassy plateaus of East Africa.

The numerical strength of this mountain fauna in the eastern Congo might easily be overestimated. It has attracted much attention, despite the remoteness of the region, which was visited for the first time after the middle of the last century. Many of the West African lowland birds were well known before Linnæus gave them binomial designations. But the mountain region is healthful and attractive. From the many reports of collections made in this "lake region" of Professor Reichenow, I have carefully tabulated the mountain-dwelling species and their races; that is, the birds recorded from the humid montane areas of our faunal map. These include not only Ruwenzori, the Kivu Volcanoes, and the western Kivu ridge, above the lower edge of the mountain forest, but also all the isolated patches of mountain forest in the whole Kivu area, and those in the mountains west of Lake Albert.

The total number of species recorded from the forested montane area is only one hundred and ninety-seven; and after subtracting those

which are merely stragglers from the surrounding lowlands, we may retain ninety-six species. Only 9.2 per cent, approximately, of the total number of species in our territory is restricted to the wooded mountains above 5000 feet. The number of subspecies to be recognized is still unsettled and need not concern us here. Within this mountain area the arrangement of the floral zones and life zones for animals has already been discussed.

When we compare, for example, the lists of birds which Woosnam gave for the mountain forest and for the bamboo zone, we find that of the twenty-four species listed for the former, twenty are also repeated in that for the bamboo zone. Moreover, the eight additional species mentioned as found in the bamboos are not sufficiently restricted in range to furnish justification for a distinct life zone. *Sitagra aliena* [= *Hyphanturgus alienus*] is by no means restricted to the bamboos, but is common in the mountain forest. The same is true of *Cinnyris regius* and *Zosterops "jacksoni"* [= *scotti*]. *Cossypha* [*Bessonornis*] *archeri* is known to descend to 6000 feet, and *Alseonax murinus pumilus* [= *A. minimus subtilis*] has been reported still lower.

*Chloropeta kenya* [= *similis*] is indeed very characteristic of the bamboo levels, and I have never taken it below 7000 feet. *Gallirex johnstoni* [= *Ruwenzorornis j. johnstoni*] is seldom seen on Ruwenzori below 7500 feet. But two species do not make a life zone.

The birds do not justify more than a single mountain forest or subtropical zone. In the subsequent collections made on Ruwenzori nothing has appeared to invalidate such a view. There is no reason for differentiating the birds of these two floral zones in any other part of the mountainous region, as in the Kivu district. Different mountains lack certain of the forms, or have subspecies distinct from those on Ruwenzori, or even species not found there, so that the total number of species restricted to the mountain-forest zone amounts to about ninety-two.

Many of the names I use in the subjoined list are of course different from those of Ogilvie-Grant. The highland birds represented on the Katanga and Marungu plateaus will be treated elsewhere, because that area is not so humid; and the increased altitude, instead of favoring mountain forest, has caused the development of a steppe vegetation. There are patches of highland forest in the Upper Katanga; but they are very small, and thus far have only been found to harbor a reduced number of mountain-forest birds.

The following list does not include all the birds known to inhabit the mountain forests of the eastern Congo, but only those which are

characteristic of such a habitat. If they descend to the lowlands, then they are found there only in the immediate vicinity of the mountains. A few are represented by other races in the lowlands, and a few are also known from the highlands of the southeastern Congo.

### Birds Typical of the Mountain Forest Zone in the Eastern Congo

<i>Buteo oreophilus</i>	<i>Bradypterus cinnamomeus</i>
<i>Accipiter r. rufiventris</i>	<i>Bradypterus barakæ</i>
<i>Francolinus nobilis</i>	<i>Burnesia bairdii obscura</i>
<i>Streptopelia lugens lugens</i>	<i>Alethe poliophrys</i>
<i>Aplopelia simplex jacksoni</i>	<i>Sheppardia cyornithopsis æquatorialis</i>
<i>Columba a. arquatrix</i>	<i>Bessonornis roberti rufescentior</i>
<i>Cercococcyx m. montanus</i>	<i>Bessonornis caffra iolæma</i>
<i>Ruwenzorornis j. johnstoni</i>	<i>Bessonornis archeri</i>
<i>Ruwenzorornis j. kivuensis</i>	<i>Pogonocichla stellata intensa</i>
<i>Poicephalus robustus suahelicus</i>	<i>Geokichla piaggæ</i>
<i>Melittophagus lafresnayii oreobates</i>	<i>Geokichla gurneyi tanganjicæ</i>
<i>Asio abyssinicus graueri</i>	<i>Turdus olivaceus baraka</i>
<i>Caprimulgus poliocephalus ruwenzorii</i>	<i>Turdus olivaceus bambusicola</i>
<i>Microopus æquatorialis æquatorialis</i>	<i>Chloropeta similis</i>
<i>Heterotrogon vittatus camerunensis</i>	<i>Seicercus lætus</i>
<i>Viridibucco coryphæus jacksoni</i>	<i>Alseonax minimus subtilis</i>
<i>Pogoniulus leucolaima mfumbiri</i>	<i>Alseonax lendu</i>
<i>Pogoniulus bilineatus jacksoni</i>	<i>Dioptornis toruensis</i>
<i>Campethera tæniolæma</i>	<i>Dioptornis semicinctus</i>
<i>Mesopicos griseocephalus ruwenzori</i>	<i>Batis diops</i>
<i>Pseudocalyptomena graueri</i>	<i>Batis molitor puella</i>
<i>Smithornis capensis meinertzhageni</i>	<i>Trochocercus albiventris toroensis</i>
<i>Arizelocichla kikuyuensis</i>	<i>Trochocercus albonotatus</i>
<i>Phyllastrephus cabanisi sucosus</i>	<i>Psaldiprocne holomelaena ruwenzori</i>
<i>Phyllastrephus flavostriatus olivaceogriseus</i>	<i>Dicrurus ludwigii elgonensis</i>
<i>Phyllastrephus flavostriatus graueri</i>	<i>Chlorophoneus nigrifrons conceptus</i>
<i>Coracina graueri</i>	<i>Chlorophoneus rubiginosus rudolfi</i>
<i>Coracina cæsia pura</i>	<i>Chlorophoneus doherityi</i>
<i>Graueria vittata</i>	<i>Malacomotus lagdeni centralis</i>
<i>Lioptilornis rufocinctus</i>	<i>Laniarius holomelas</i>
<i>Pseudoalcippe atriceps</i>	<i>Parus fasciiventer fasciiventer</i>
<i>Illadopsis pyrrhopterus</i>	<i>Parus fasciiventer tanganjicæ</i>
<i>Illadopsis poliothorax</i>	<i>Oriolus percivali</i>
<i>Apalis cinerea cinerea</i>	<i>Cinnamopterus tenuirostris</i>
<i>Apalis porphyrolæma affinis</i>	<i>Onychognathus walleri elgonensis</i>
<i>Apalis ruwenzorii</i>	<i>Pholia sharpii</i>
<i>Apalis pulchra pulchra</i>	<i>Zosterops scotti</i>
<i>Apalis binotata personata</i>	<i>Zosterops virens reichenowi</i>
<i>Sylvietta neumanni</i>	<i>Cyanomitra alinæ alinæ</i>
<i>Sylvietta leucophrys leucophrys</i>	<i>Cyanomitra alinæ tanganjicæ</i>
<i>Sylvietta leucophrys chloronota</i>	<i>Cinnyris venustus igniventris</i>
<i>Cisticola chubbi chubbi</i>	<i>Cinnyris regius</i>

Birds Typical of the Mountain Forest Zone in the Eastern Congo  
(Continued)

<i>Cinnyris rockefelleri</i>	<i>Cryptospiza reichenowii ocularis</i>
<i>Cinnyris reichenowii reichenowii</i>	<i>Cryptospiza jacksoni</i>
<i>Cinnyris chalybeus graueri</i>	<i>Cryptospiza shelleyi</i>
<i>Nectarinia purpureiventris</i>	<i>Coccopygia quartinia kilimensis</i>
<i>Hyphanturgus alienus</i>	<i>Estrilda atricapilla kandti</i>
<i>Hyphanturgus melanogaster stephanophorus</i>	<i>Poliospiza burtoni tanganjicæ</i>
<i>Phormoplectes insignis</i>	<i>Poliospiza striolata graueri</i>
<i>Symplectes bicolor mentalis</i>	<i>Poliospiza striolata ugandæ</i>
<i>Cryptospiza salvadorii ruwenzori</i>	

Not all these birds live in the heavy shade of the forest, but at least they prefer the proximity of woods, though some may be found, as a rule, in patches of scrub or bracken.

There are other species which occupy much the same region on the mountains, but show a preference for more open grassy or marshy situations. They are never found in lowlands except here and there at the bases of mountains.

*Motacilla capensis wellsii*  
*Cisticola timmiens* near *perpulla*  
*Bradypterus alfredi*  
*Bradypterus graueri*  
*Erannornis albicauda*  
*Hirundo rufula emini*  
*Nectarinia kilimensis kilimensis*  
*Nectarinia famosa centralis*  
*Drepanorhynchus reichenowii*  
*Clytospiza cinereovinacea graueri*  
*Serinus flavivertex sassii*  
*Serinus citrinelloides frontalis*

Two other birds, of which mention must be made, are *Polemaëtus bellicosus* and *Corvultur albicollis*. They range high up the mountains, even to the alpine zone, and in the Congo are scarcely found far from the highlands. But both are known to descend at times to 3000 feet.

One might expect that in and about the mountain forests there would be highland races of many of the tropical lowland birds, but these are relatively few. The following forms may be so regarded:

<i>Francolinus squamatus zappeyi</i>	<i>Sheppardia cyornithopsis æquatorialis</i>
<i>Poicephalus robustus suahelicus</i>	<i>Saxicola torquata axillaris</i>
<i>Pogoniulus leucolaima mfumbiri</i>	<i>Batis molitor puella</i>
<i>Smithornis capensis meinertzhageni</i>	<i>Cinnyris venustus igneiventris</i>
<i>Apalis binotata personata</i>	<i>Symplectes bicolor mentalis</i>
<i>Burnesia bairdii obscura</i>	<i>Estrilda atricapilla kandti</i>

A larger number of the birds restricted in the eastern Congo to mountains belong to groups which descend to sea level in South Africa, such as *Nectarinia famosa*, *Pogonocichla stellata*, and *Mesopicos griseocephalus*. In other words, the preference for cool climate may be regarded as a character of long standing, specific more often than racial. Furthermore, the number of lowland birds which range up to relatively cool altitudes in Central Africa, without noticeable change in color or size, is good evidence that such differences in climate are not the direct influence in the production of new races.

In the mountain forest of Ruwenzori collecting birds is more laborious than in the lowlands. Steep slopes, tangled undergrowth, and frequent showers are discouraging, and the birds rather less numerous. It is a surprise, in old clearings at 6900 feet, to see how some birds straggle up from the valley: *Streptopelia semitorquata*, *Centropus monachus*, *Colius striatus*, *Pycnonotus tricolor*, *Ptyonoprogne rufigula*, *Tchagra australis*, and *Othyphantes stuhlmanni*.

In the mountain forest, on the other hand, it seems strange that so few of the lowland forest species are in evidence; no guinea-fowl, no rail, roller, kingfisher, hornbill, or pitta. From 6700 to 8900 feet, *Francolinus nobilis* must be common. One hears it, but never sees it except in traps. *Columba arquatrix* is conspicuous, and sometimes gathers in numbers where a tree is bearing the fruits it loves. The familiar voice of *Turacus s. emini* is heard mostly below 7500 feet, the monkey-like calls of *Ruwenzorornis* generally above that level. But the latter finds no food on the bamboos. The berries it eats most often are those of an *Agauria* tree which grows mainly above 8000 feet. *Asio abyssinicus* occurs on this range, for we found a dried head in a hut, and also one of *Strix woodfordii*, which is certainly commoner. The mountain goatsucker (*Caprimulgus poliocephalus ruwenzorii*) alights in the cultivated fields, and calls especially when the moon shines brilliantly.

In the course of the morning the large swifts of the upper slopes sometimes circle in flocks over the Butahu gorge, where *Hirundo rufula emini*, *Ptyonoprogne*, and *Psalidoprocne* feed still more often.

Woodpeckers are scarce; but one of the bulbuls, *Arizelocichla kikuyuensis*, seems omnipresent in the woods. The voice of *Eurillas latirostris* also shows it to be numerous. Among the babblers the sweet-voiced *Pseudoalcippe atriceps* is the most frequent. I doubt if mixed bird-parties are typical of the mountain forest of Ruwenzori, but they certainly are popular in the mountain forest near Djugu.

Driver ants are found up to the higher levels of the bamboo belt, and attract not only *Alethe poliophrys*, but also *Bessonornis archeri* and

*Pogonocichla stellata*. *Bradypterus cinnamomeus* slips in and out of the lower underbrush, and *Cinnyris regius* feeds in the woods perhaps more than *Cinnyris venustus igneiventris*, which is found of open glades.

Flocks of large starlings (*Cinnamopterus*) feed in the lower mountain forest during the day, but in the late afternoon fly swiftly up the valleys again to the neighborhood of the glaciers. *Hyphanturgus alienus* is a solitary bird of the woods, but *Cryptospiza*, *Coccopygia*, and *Poliospiza striolata* are more apt to be seen in old clearings.

It does not seem strange that the mountain-forest avifaunas of Ruwenzori and the Kivu Volcanoes are so similar, for on a clear day the two ranges are just within the range of vision. Rather have I wondered why certain species that are rare or wanting on Ruwenzori should be more common in the Kivu. It seems partly due to a measure of isolation by the rift valley, partly to differences in vegetation.

There can be no mystery as to why many mountain-forest birds range far higher on the volcanoes, when one has visited the Hagenia woods of Mikeno and Karisimbi. But why are *Streptopelia lugens*, *Poicephalus robustus*, *Campethera tæniolaema*, *Graueria vittata*, *Besonornis caffra*, *Oriolus percivali*, and *Serinus flavivertex* unrepresented on Ruwenzori? I cannot answer my question, nor can I tell why *Pseudocalyptomena*, *Sylvietta neumanni*, *Chlorophoneus nigrifrons*, and *Drepanorhynchus* have thus far been found only on the mountains northwest of Lake Tanganyika, though two of them are represented in East Africa.

#### ALPINE ZONE

Above the bamboo belt on Ruwenzori, the scarcity of birds becomes most marked. The change occurs on the western side at about 9300 feet. With the tree heaths begins a sort of vegetation, still largely arborescent, which despite temperate zone affinities, takes on a most grotesque appearance, the habit of the plants being adapted to the alpine conditions of cold, coupled with alternating humidity and evaporation. These conditions, so disagreeable to the explorers who attempted the ascent of Ruwenzori, must be unfavorable in the extreme to avian life. The heaths themselves furnish no edible fruit, nor do they seem to support many insects. Terrestrial plants are largely crowded out by mosses. Birds therefore find little to eat.

Woosnam listed the birds inhabiting the heath zone separately from those of the senecio-lobelia zone, giving twelve species for the first-named. Of these heath-zone birds none is so restricted in range as to justify the recognition of a corresponding zoölogical life zone, unless it

be the sunbird, *Cinnyris stuhlmanni*, which is found in a narrow belt just above the bamboos. Of the other species, six have already been mentioned as occurring in the zones below; another, a swift (possibly *Micropus æquatorialis*) was not collected, and three (*Corvultur albicollis*, *Cinnamopterus tenuirostris*, and *Buteo oreophilus*<sup>1</sup>) are to be found much lower down in other parts of the mountain region. But one species remains, *Cryptolopha alpina* [= *Seicercus umbrovirens alpinus*], a fly-catcher extending its range upward above the level of the tree heaths.

In dealing with bird distribution, therefore, it will be unnecessary to recognize a tree heath or temperate zone, but more advisable to unite it with the senecio-lobelia zone under the term "alpine." In the upper half of the alpine life zone, where there are no more tree heaths and where the largest plants are giant groundsels and lobelias, the characteristic birds listed by Woosnam number only seven, of which three are known to visit the mountain forest zone. Consequently, the entire list of species restricted, on Ruwenzori, to my alpine life zone (extending from the lower edge of the heath zone to the snow line) will number but four:

*Micropus melba maximus*  
*Seicercus umbrovirens alpinus*  
*Cinnyris stuhlmanni*  
*Nectarinia johnstoni dartmouthi*

Of these the first two might be said to have affinities with the fauna of the temperate zones, since the swift is no more than sub-specifically distinct from the alpine swift of Europe, and the genus *Seicercus* has numerous species ranging from western China, the Himalayas, and the Philippine Islands south to the mountains of Celebes, and to East and South Africa. *Cinnyris stuhlmanni* and *Nectarinia johnstoni* are of course highland forms typical of Africa, the first-named showing affinities with a South African group.

The nature of the alpine bird life in our territory may be illustrated by the known ranges of its characteristic birds. Thus far *Micropus melba maximus* has been found nowhere else than on Ruwenzori, about the cliffs between 10,000 and 15,000 feet. There at least it makes its home and comes to roost. But during the day the swifts fly out over the surrounding country, at least to a distance of sixty to eighty miles, and often feed over the low-lying shores of Lake Edward. Other races of the species nest from northwest Africa and the Alps to the Himalayas, and southward to Madagascar and South Africa.

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<sup>1</sup>This was mistaken by Ogilvie-Grant for the young of *B. auguralis*.

*Seicercus u. alpinus* is still known only from Ruwenzori, but other races of the species are found on high mountains from southwestern Arabia and northern Abyssinia to Kilimanjaro and the Kivu District.

*Cinnyris stuhlmanni*, first described from a specimen which Dr. Stuhlmann must have secured above the Butahu Valley, but of which the label was lost, has been observed only on the Ruwenzori Range. It has sometimes been regarded as a race of *C. afer*, but the relationships of *afer*, *chalybeus* and their allies are difficult to unravel. The whole group is characteristic of southern Africa.

*Nectarinia johnstoni dartmouthi* is the geographical representative of an East African species inhabiting Mt. Kenia, Kilimanjaro, and the Livingstone Mountains. This western race is now known on both sides of Ruwenzori, as well as on the higher Kivu Volcanoes.

On the Kivu Volcanoes the alpine zone is of still smaller area. Besides *Nectarinia johnstoni dartmouthi* it has *Seicercus umbrovirens wilhelmi*, a near ally of the Ruwenzori race, and *Cinnyris graueri*, which is stated to extend downward to an altitude of 7800 feet, so that it includes the upper mountain forest in its range. All three of these birds are now known to occur sparingly on the western Kivu ridge as well. We have *Nectarinia j. dartmouthi* and *Seicercus u. wilhelmi* from the mountains west of the Ruzizi, and *Cinnyris graueri* from west of Lake Edward. Grauer's sunbird may be a race of *C. chalybeus*, and is at least of southern affinity.

The exact level at which the alpine zone begins on Mt. Karisimbi, for example, is hard to say. The hospitable woodland that extends up to nearly 12,000 feet shelters many mountain-forest birds, yet *Nectarinia johnstoni* wanders down to 11,000. There is also an open meadow at 12,000 feet where I have seen *Bradypterus cinnamomeus*, *Bessonornis caffra*, *Saxicola torquata axillaris*, *Riparia paludicola ducis*, and *Serinus flavivertex sassii*.

#### GRASSY PLATEAUS OF THE KIVU REGION

(VII of Faunal Map)

The most typically East African portion of our territory is in the highland region of the Kivu District, with the mandated territory of Ruanda-Urundi. Except for the several areas of mountain forest, all of which are referred to area VI of our faunal map, it is a highland savanna country, or sometimes a grassy steppe, with few trees or bushes.

The savanna bird fauna of the Kivu highlands is a mixture of wide-ranging species which may also live near the border of the western

forests (especially birds of the southern Guinean savanna) with a large proportion of eastern and southeastern species. These latter are part of a fauna which invades Congo territory in the Upper Katanga, Marungu, and about Lake Tanganyika, in short, the part of the colony which we assign zoologically to the East African subregion. It is no surprise, then, to note how many species, rare or unknown elsewhere within our limits, are common to areas VII and VIII. But there is also a similarity between the birds of southwestern Uganda with those of the Kivu; and as already stated, the southern Congo (Guinean) savanna furnishes many species which progress northward around the corner of the Congo forest in this region. The lowland forest fauna reaches the base of the mountains to the west of the Ruzizi River, but scarcely crosses them.

Whether the low country of the Ruzizi Plain and the northern shore of Lake Tanganyika is best included with the highland area may be questioned. It has a richer savanna vegetation, and it may be argued that it is more like the southern Congo savanna. But in spite of a difference of altitude of a couple of thousand feet, many birds are the same, and gallery forests are absent. It has seemed better to include it in the Kivu grasslands. Relatively little collecting has been done along the eastern boundaries of Ruanda and Urundi, so that still more eastern species are to be expected there.

The treelessness of many parts of the Kivu highlands is so pronounced that records of woodpeckers are anything but common, and they include only some five species, all but one of which are of East and South African affinity. The number of species of bulbuls is also a test of the amount of woods in a region. The Anglo-Egyptian Sudan can boast of but five species of bulbuls, and the grasslands of the Kivu are known to possess only three. The total number of distinct species of this family known in the whole Congo is thirty-six, and most of them live in the lowland rain forest, the mountain forests having but six.

Besides Lake Kivu and the northern end of Lake Tanganyika there are a number of smaller lakes in the Kivu area, so that the ducks of eastern and southern Africa are well represented, a point of resemblance to the Upper Katanga district. The Kivu is not arid, growing bounteous forage for the natives' herds, and it is this rather humid condition which discourages many of the pronounced steppe birds from colonizing it.

The Masai ostrich does not reach Urundi, sand-grouse are still unknown there, and but two coursers are thus far reported. Bustards are probably represented by two species, as in the Uelle; the francolins are slightly more in evidence. No species of guinea-fowl is known from the

high grasslands of the Kivu, but there is one in the Ruzizi Valley. The larger vultures have not yet been collected there, although several occur on the shore of Lake Edward. Larks are fewer than one would expect. Among the passerine birds there are many eastern forms characteristic of the grassy highlands, though hardly to be considered as high-mountain forms. These include two or three species of *Nectarinia*, and several Fringillidæ.

#### Characteristic Birds of the Kivu Grassland Area

<i>Podiceps cristatus infuscatus</i>	<i>Bradypterus brachypterus centralis</i>
<i>Nyroca erythrophthalma</i>	<i>Cisticola ayresii entebbe</i>
<i>Anas undulata undulata</i>	<i>Cisticola robusta nuchalis</i>
<i>Nettion punctatum</i>	<i>Cichladusa arquata</i>
<i>Pæcilonitta erythrorhyncha</i>	<i>Saxicola torquata axillaris</i>
<i>Circus ranivorus æquatorialis</i>	<i>Turdus stormsi graueri</i>
<i>Accipiter minullus intermedius</i>	<i>Alseonax infulatus ruandæ</i>
<i>Buteo rufofuscus augur</i>	<i>Chloropeta massaica massaica</i>
<i>Aquila wahlbergi</i>	<i>Erannornis albicauda</i>
<i>Pternistis cranchii harterti</i>	<i>Tchitrea viridis suahelica</i>
<i>Francolinus levaillantii kikuyuensis</i>	<i>Riparia paludicola ducis</i>
<i>Francolinus coqui ruandæ</i>	<i>Hirundo rufula emini</i>
<i>Gallinula chloropus brachyptera</i>	<i>Fiscus excubitorius bohmi</i>
<i>Fulica cristata</i>	<i>Lamprocolius chalybæus massaicus</i>
<i>Balearica regulorum gibbericeps</i>	<i>Lamprotornis purpuropterus purpuropterus</i>
<i>Stephanibyz coronatus</i>	<i>Cinnyris venustus falkensteini</i>
<i>Hemiparra crassirostris hybrida</i>	<i>Nectarinia erythroceria</i>
<i>Hydrocolæus cirrocephalus</i>	<i>Nectarinia kilimensis kilimensis</i>
<i>Columba guinea guinea</i>	<i>Nectarinia famosa centralis</i>
<i>Vinago calva salvadorii</i>	<i>Sitagra dimidiata usumburæ</i>
<i>Gymnoschizorhis personata centralis</i>	<i>Sitagra jacksoni</i>
<i>Merops superciliosus (migrant)</i>	<i>Textor nigriceps graueri</i>
<i>Tyto capensis</i>	<i>Othyphantes stuhlmanni stuhlmanni</i>
<i>Otus senegalensis graueri</i>	<i>Pyromelana orix nigrifrons</i>
<i>Micropus barbatus roehli</i>	<i>Coliuspasser eques</i>
<i>Colius striatus kiwuensis</i>	<i>Lagonosticta senegala ruberrima</i>
<i>Campethera abingoni annectens</i>	<i>Estrilda rhodopyga centralis</i>
<i>Campethera bennettii uniamwesica</i>	<i>Estrilda roseicrissa</i>
<i>Mirafra africana tropicalis</i>	<i>Hypochoera orientalis</i>
<i>Motacilla capensis wellsi</i>	<i>Steganura aucupum obtusa</i>
<i>Turdoides melanops sharpei</i>	<i>Serinus sulphuratus shelleyi</i>
<i>Sylvietta whytii jacksoni</i>	<i>Serinus citrinelloides frontalis</i>

Notwithstanding that the Kivu is for the most part an elevated region, it is hardly possible to regard the fauna, listed above, as a true montane fauna. Most of the species are usually found at intermediate

levels, or elsewhere even close to sea level. Their affinities lie mostly with the savannas of the southern and eastern districts of the continent.

### MARUNGU AND UPPER KATANGA

(VIII of Faunal Map)

Instead of being intermediate in character between the Kivu highlands and the Katanga, Marungu has an avifauna very like that of the Upper Katanga. Below 5500 feet it has a rather well wooded savanna, where most of the birds are the same as those of the southern Katanga. Very few of the mountain birds of the country just north of Lake Nyasa extend into this southeast corner of the Congo, perhaps because it is so nearly devoid of true forest at its upper levels.

Lake Tanganyika forms a rather effective barrier between the birds of its opposite shores, and Marungu has less resemblance to East Africa than might be expected. Rockefeller and Murphy found a few birds in Marungu which are not known yet from the Katanga, among them:

<i>Centropus cupreicaudus</i>	<i>Hirundo atrocærulea</i>
<i>Micropus horus</i>	<i>Amblyospiza albifrons montana</i>
<i>Neolestes torquatus</i>	<i>Coliuspasser macroura intermedia</i>
<i>Parisoma lugens jacksoni</i>	<i>Lagonosticta jamesoni</i>

Of these, only two are of easterly distribution. On the top of the nearly treeless Marungu plateau there are some birds which live in the open, but have a distribution that may be called montane. Such are:

<i>Mirafraga angolensis</i>	<i>Diatropura prognæ ansorgei</i>
<i>Macronyx fulleborni ascensi</i>	<i>Clytospiza cinereovinacea</i>
<i>Nectarinia kilimensis kilimensis</i>	<i>Coccopygia quartinia kilimensis</i>
<i>Nectarinia famosa centralis</i>	<i>Serinus citrinelloides frontalis</i>

There are fortunately a few small patches of trees at high elevation, and these must account for the presence of

<i>Mesopicos griseocephalus ruwenzori</i>	<i>Cisticola chubbi marungensis</i>
<i>Apalis binotata marungensis</i>	<i>Bessonornis caffra iolæma</i>
<i>Apalis pulchra murphyi</i>	<i>Dioptrornis nyikenstis</i>

The birds of the Katanga were first investigated carefully by S. A. Neave,<sup>1</sup> who visited the country in 1907. Faunistically he found the region of the Congo-Zambesi watershed divisible into three parts:

- (1) Low ground in the Zambesi basin, which resembles the lowlands of south-eastern Africa.
- (2) The watershed, with the high ground on both sides of it.
- (3) The low ground in the Congo basin.

<sup>1</sup>1910, Geogr. Journal, London, XXXV, pp. 132-146, map opposite p. 224

The first of these divisions lies beyond our limits. The third is that part of the southern Guinean savanna which reaches the river bottoms of the Lower Katanga. The high ground north of the watershed is included in our area VIII, which has a general similarity throughout as regards its flora and fauna. On this plateau, at the sources or along banks of some of the streams, stand copses of tall trees, much crowded together and with a tangle of creepers around their trunks. In the Congo drainage, especially towards the west, the forest may follow the streams for many miles, assuming the character of galleries. Here, during a part of the year at least, is found the West African starling *Lamprocolius splendidus*. A few species of *Bessonornis* are also present, and various woodland species of bulbuls and flycatchers.

The southern part of the plateau, largely covered with savanna woods, is plentifully supplied with birds. To the north, the high ground continues as huge island plateaus. Their top is covered with wide open plains interrupted by patches of woodland. To the west, especially near the upper Lufupa River, there are numerous undulating areas of moorlike ground, covered only with stunted grasses and other plants.

Neave remarked that the Katanga plateau has close faunistic affinities with the interior of southern Angola, and the highlands near Lake Tanganyika. He called special attention to the way the fauna differed from that of the Loangwa Valley below the Mchinga Escarpment.

L. B. Mouritz visited the Katanga in 1911, and wrote of his impressions<sup>1</sup> of birds seen during a prospecting expedition. J. De Riemaecker has made further collections in the neighborhood of Elisabethville, and Dr. Schouteden<sup>2</sup> has also investigated the birds of the Katanga. Neave's extensive collection from the district was reported upon in the *Ibis*, 1910; and from this and other sources I have culled a list of characteristic birds of the Katanga and Marungu. Some of them extend into adjacent parts of the southern Congo or Guinean Savanna.

*Polemaëtus bellicosus*  
*Cerchneis rupicola*  
*Dissodectes dickinsoni*  
*Numida meleagris marungensis*  
*Francolinus shelleyi whytei*  
*Rallus caerulescens*  
*Bugeranus carunculatus*  
*Podica petersii*

*Streptopelia decipiens ambigua*  
*Vinago calva schalowi*  
*Turacus schalowi marungensis*  
*Poicephalus meyeri neavei*  
*Coracias nœvius mosambicus*  
*Dicrocercus hirundineus hirundineus*  
*Aerops boehmi*  
*Lophoceros p. pallidirostris*

<sup>1</sup>1914, *Ibis*, pp. 26-38.

<sup>2</sup>1930, *Rev. Zool. Bot. Afr.*, XVIII, pp. 277-290.

<i>Bycanistes bucinator</i>	<i>Alseonax adustus subadustus</i>
<i>Glaucidium capense</i>	<i>Myopornis böhmi böhmi</i>
<i>Caprimulgus ferridus</i>	<i>Hyliota australis australis</i>
<i>Neafrapus böhmi</i>	<i>Batis molitor puella</i>
<i>Trachyphonus vaillantii suahelicus</i>	<i>Trochocercus vivax</i>
<i>Stactolæma anchietæ anchietæ</i>	<i>Hirundo dimidiata</i>
<i>Tricholæma diadematum frontatum</i>	<i>Nilaus affinis nigritemporalis</i>
<i>Dendropicos fuscescens centralis</i>	<i>Tchagra souzæ souzæ</i>
<i>Thripas namaquus namaquus</i>	<i>Chlorophoneus nigrifrons manningi</i>
<i>Smithornis capensis albigularis</i>	<i>Laniarius ferrugineus mossambicus</i>
<i>Pinarocorys nigricans</i>	<i>Prionops retzii nigricans</i>
<i>Macronyx fülleborni ascensi</i>	<i>Prionops poliocephalus</i>
<i>Eurillas virens zombensis</i>	<i>Parus afer griseiventris</i>
<i>Phyllastrephus cerviniventris</i>	<i>Salpornis spilonota salvadori</i>
<i>Camaroptera brevicaudata noomei</i>	<i>Lamprocolius acuticaudus</i>
<i>Calamonastes kalangæ</i>	<i>Zosterops virens sarmenticia</i>
<i>Apalis alticola</i>	<i>Zosterops senegalensis anderssoni</i>
<i>Sylvietta ruficapilla chubbi</i>	<i>Chalcomitra amethystina deminuta</i>
<i>Eremomela atricollis</i>	<i>Cinnyris chalybeus ludovicensis</i>
<i>Eremomela griseoflava poliozantha</i>	<i>Plocepasser rufoscapulatus</i>
<i>Bradypterus msiri</i>	<i>Sitagra intermedia cabanisi</i>
<i>Dryodromas pearsoni</i>	<i>Tector nigriceps nigriceps</i>
<i>Cisticola dambo</i>	<i>Notiospiza angolensis</i>
<i>Bessonornis bocagei</i>	<i>Pyromelana afra taha</i>
<i>Myrmecocichla arnotti leucolæma</i>	<i>Diatropura progne ansorgei</i>
<i>Tychædon barbata barbata</i>	<i>Lagonosticta rhodopareia hæmatocephala</i>
<i>Erythropygia leucophrys zambesiana</i>	<i>Lagonosticta nitidula</i>
<i>Saxicola torquata robusta</i>	<i>Estrilda paludicola poliopareia</i>
<i>Monticola angolensis</i>	<i>Poliospiza gularis reichardi</i>
<i>Turdus libonyanus niassæ</i>	<i>Poliospiza melanochroa</i>

In the savanna woods of the Upper Katanga, Neave met with large bird parties which he has described briefly.<sup>1</sup> The species are mixed, all traveling slowly in a definite direction, as they search the trees and bushes for insects.

Flocks are hardly so large or varied as those of the lowland rain forest of the Upper Congo and the Cameroon. Yet they are more mixed than the small association we noted in the northeastern Uelle. It is noteworthy that several of the birds are the geographical representatives of those in the Uelle, belonging as they do to the genera *Salpornis*, *Parus*, *Eremomela*, *Nilaus*, and *Hyliota*. Instincts, in such cases, seem to be as truly genetic or hereditary as the pattern of the plumage or the form of the beak. An actual count of such a party, near Kambove, on March 29, gave the following figures.

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<sup>1</sup>1910, *Ibis*, pp. 79, 80.

<i>Phaeniculus purpureus marwitzi</i> .....	4 or 5
<i>Rhinopomastus cyanomelas schalowi</i> .....	1
<i>Dendropicos fuscescens</i> .....	2
<i>Eremomela</i> and other tree-warblers.....	several
<i>Myrmecocichla arnotti leucolæma</i> .....	4
<i>Batis molitor</i> .....	several
<i>Tchitrea viridis plumbeiceps</i> .....	2
<i>Parus rufiventris rufiventris</i> .....	1
<i>Parus afer griseiventris</i> .....	1
<i>Salpornis spilonota salvadori</i> .....	1
Nectariniidæ.....	several species

Other species frequently observed by Neave in such parties are:

<i>Coracina pectoralis</i>	<i>Dryoscopus cubla hamatus</i>
<i>Hyliota australis</i>	<i>Zosterops senegalensis anderssoni</i>
<i>Erannornis albicauda</i>	<i>Anaplectes melanotis</i>
<i>Nilaus affinis nigritemporalis</i>	

The opinion of Neave as to the advantage of such behavior is of special weight, because he is an expert entomologist. "It has been suggested that they may obtain some protection from hawks under these circumstances. Personally I incline to the view that by traveling through the woodland in such numbers they greatly benefit each other by the disturbance they cause among the insects upon which they prey."

#### CONCLUSIONS

The ecological study of distribution involves so many details that it can best be carried on within restricted areas, where a personal familiarity with conditions is essential. There is no doubt that it will cast light on many questions concerning the dispersal of animal life where impassable physical barriers are not involved. Many of the important phyla of birds have plainly evolved in continuous relation to certain types of environment. Ostriches, vultures, bustards, and larks are certainly adapted to life in grasslands or steppes, so that aridity is one of the conditions of their dispersal. On the other hand trogons and plantain-eaters could not possibly exist without some sort of woods. It cannot be denied that in some groups habits have changed from forest-dwelling to life on open plains. Among the hornbills, *Bucorvus* must have arisen from the normal tree-dwelling stock; and even the woodpeckers have produced a few ground-loving genera. Such adaptations are rare enough to cause surprise.

<sup>1</sup>I have brought the scientific names up to date.

Much can be learned from geology, perhaps, as to how Nature first obtained the materials with which she has worked in each large land area of the globe; but when we come to investigate recent evolution and present distribution within such a territory, ecological study cannot be neglected. After all, field observers have always busied themselves with ecology, whether they called it by its present name, or by none at all.

Just as aquatic birds can occur only regularly where they find suitable streams or bodies of water, so land birds are largely divisible into forest-loving or forest-shunning. This is true among montane birds as among lowland species, and a similar distinction may often be made among aquatic forms. Within such ecological divisions of the avifauna there are further variations, and finally we see that each species has its peculiar requirements and preferences.

These largely determine a bird's range, for birds are free in an unusual degree to choose their own haunts. It is often claimed that environment makes a bird what it is. On the contrary, I would argue, the bird is a product of heredity; and how environment can influence heredity except through selection is very obscure.

A desert bird is subjected to extreme environmental influences not because it cannot escape, but because it prefers those conditions. It succeeds best in a desert. Similarly a mountain forest is attractive to the birds which regularly inhabit it. They choose their own home. Barriers there are to distribution; but often they are barriers like a forest belt or a desert, which repel birds not suited to life in them, and at the same time attract the kinds that are.

The boundaries of our faunal areas are conventional, they attempt to show the main features of distribution, but many species are sure to overstep them. Few sharp lines save coast-lines mark the common boundary of a whole section of a fauna.

## CHAPTER VII.—TYPICAL CASES OF GEOGRAPHIC VARIATION

### GENERAL REMARKS

Geographic variation is intimately related to distribution. Isolation, so potent a factor in abetting variability, is an important aspect of an animal's range. On poorly stocked oceanic islands the introduction of a single strain may apparently give rise in time to a large number of forms, variously adapted, as with the Fringillidæ of the Galapagos and the Drepanididæ of the Hawaiian Islands. These are famous results of isolation.

In a well-established continental fauna, on the other hand, virtually all the ecological "niches" are occupied; and the rôle of isolation is merely to cut apart the widely separated individuals of a species, first into races, later into species. From well-marked species come genera. I am among those who believe that subspecies have been the fore-runners of "good" species; and that the slight characters of valid subspecies, however they may arise, are usually mutational, and not simply brought out by the influences, especially climatic, of the environment. Thus they would not necessarily revert to some earlier condition as soon as subjected to the earlier environment.

The difficulty of distinguishing between well-marked subspecies and barely differentiated species should be enough to prove their essential identity. There are representative species, worthy nevertheless of binomial rank, just as there are representative races; and if we do not attempt to employ the test of intergradation, the treatment of such allied forms by different authors will be very diverse. Biological understanding, at all events, is a higher aim than uniformity of nomenclature.

In the wild state, related forms can seldom be shown to have arisen suddenly through a process of "saltation," or very considerable mutation; yet nothing obliges us to draw a line between the various degrees of variation or mutation. A very trifling alteration of color or form may represent a true genetic mutation. In the case of continental faunas, when we find distinct though closely allied species of a bird genus living in the same region, there are apt to be better grounds for believing that they took their origin in separate areas, and only later came to live together. The origin of several species on a single oceanic island is a special case with which we have not to deal here; it can probably be explained, in part, by the previous lack of competitors in the habitat. On the Galapagos, *Geospiza* seems to have profited, not only by isolation, but also by opportunities for subsequent recolonization of adjacent islands.

For the birds of continental Africa, as we have seen, isolation may mean a barrier to communication like a belt of unfavorable vegetation, or of desert. In other cases we shall find subspecies depending merely upon the distance from one part of the range to another, which suffices for a sorting of the stocks. The causes which determine the extent of birds' ranges must be sought in the nature of the faunal areas and life zones we have proposed, since these areas are based upon the occurrence of species and races. Our purpose is now to examine particular examples of variation in the Congo, in order that they may suggest how the lesser taxonomic groups of birds arise, and why they adhere to their present areas of dispersal.

The Formenkreis theory has stimulated many papers on this subject, and very often it has been shown that forms previously regarded as species were only representative races. The "degradation of species" is highly desirable wherever it can be proved necessary by adequate material, but it should not be carried too far. Complementary ranges may show relationship, but the characters of the representative forms and the results of their hybridization are still more reliable evidence.

Hasty "lumping" under a binomial name, without due consideration of abrupt differences, even if slight, does not mark an advance in knowledge. If we accept the truth of evolution, we admit blood relationship between all birds of a given order, and a very close genetic bond between all the members of the same genus. Common origin is admitted from the start. But it is a handicap to use the same binomial to include groups that have diverged to a point beyond the possibility of intergradation, unless it can be demonstrated that the differences are due to a few very striking mutations.

Such mutations usually behave as "sports" or "color-phases," but they may produce geographic races. They have, no doubt, in the genus *Tchitrea*, in *Ruwenzorornis*, and in *Coliuspasser ardens*. Possibly the shoulder-patches of *Campephaga*, the black throat-area in *Coccopygia*, and red cheek-spot in *Uraginthus* are all governed by a very few genes. But if the bearers of such characters do not interbreed in the wild state, they will have to be crossed experimentally before we can say that the characters are only subspecific. These considerations are ignored when a single specific name is clapped arbitrarily on geographic representatives. Let us study the birds alive as well as dead, let us look for evidence, instead of making premature decisions.

It is often claimed that racial characters merely reflect differences in environment, that they are a direct result of climate, running parallel

with changes in temperature and humidity. Let us then examine a few cases, to see if there is any such uniformity in geographic variation.

#### BIRDS OF LOWLAND FORESTS

That the same genus often has representative species in Upper and Lower Guinea is a fact well known. The two bare-headed forms of *Picathartes*, the two violet plantain-eaters (*Musophaga violacea* and

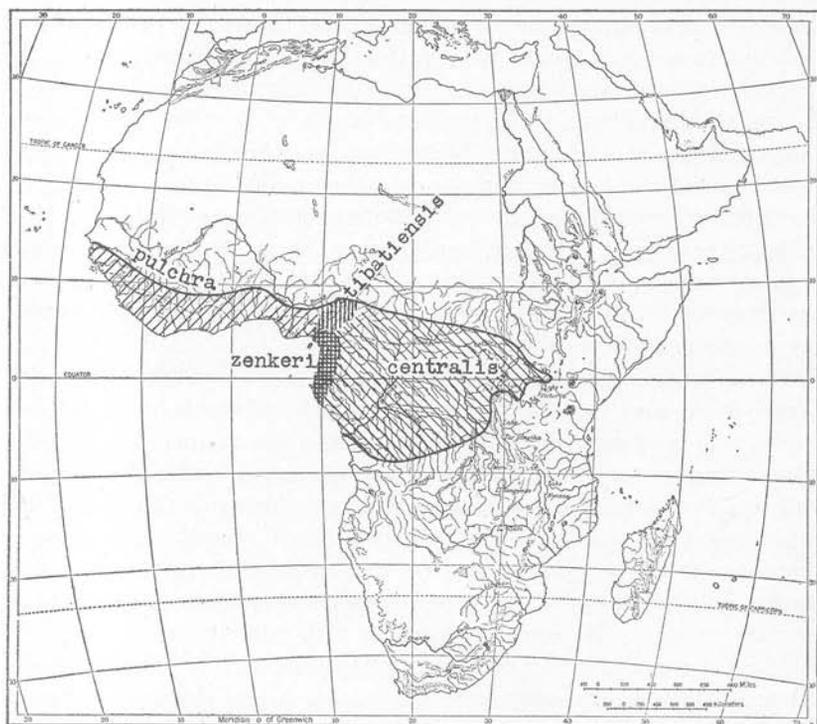


Fig. 128. The races of *Sarothrura pulchra*, a small rail living near streams in the Guinean forests and forest-galleries.

*rossæ*), *Lophoceros semifasciatus* and *fasciatus* among the hornbills, are familiar examples. More rarely the birds show representative genera, like *Agelastes* and *Phasidus* among the guinea-fowls. Some students will seek in this condition evidence of former submersion of the land near the present Niger delta; others will be content to point to the present interruption of the rain forest in Togo and Dahomey, though this is not always the exact dividing line between the forms to-day. Many forest species,

moreover, range across both Upper and Lower Guinea, but have two or more geographic races. The fact that they may have several races in Lower Guinea may mean that complete isolation is not indispensable in the development of subspecies, or that a Pleistocene lake in the central Congo basin acted as a barrier.

*Sarothrura pulchra*, a small rail, has a rather light race in Upper Guinea (*pulchra*), the male with relatively small spots above, and the female with few or no dark bars on the rufous tail. In the coastal region of the Cameroon the coloration is much darker (*zenkeri*). In the part of the Cameroon which drains toward the Congo, the coastal form is replaced by a third race, (*centralis*), which extends all across the forested Congo basin, and even to Uganda and northern Angola. The Congo form resembles that of Upper Guinea, but has usually some dark bars on the tail of the female, and the white spots of the male are larger. North of the forest of the Cameroon dwells a fourth race (*tibatiensis*), not unlike typical *pulchra*, but distinctly larger. Now the Cameroon coast has very heavy rainfall. It might be claimed that this caused increased pigmentation. But in the case of *Sarothrura rufa* the Cameroon race has an unusually light-colored female.

*Corythornis leucogaster*. Named originally from the island of Fernando Po, the "typical" race of this small kingfisher is found to have the bill thicker by about one millimeter than the mainland races. In color, however, the birds of the southern Cameroon and Gaboon agree with the island form, whereas those found from Portuguese Guinea to the Gold Coast have much more light rufous on the forehead and eyebrows. Specimens from the Congo forest (*C. l. leopoldi*) differ in the opposite respect, and have lost the rufous on the forehead and gained a deep blue superciliary band. No correlation is seen with rainfall.

*Podica senegalensis*. The finfeet of Africa have usually been treated as two distinct species, because of the smaller size of the western birds. Females of the East-and-South-African *petersii* are about equal in measurements to males of *senegalensis*, which explains how they have so often been confused. The West African group shows marked variability in color. Adult males from Upper Guinea are white-breasted, streaked, at most, on the belly with dusky. The Senegal form ranges eastward to Mt. Cameroon, but in the remainder of southern Cameroon, Gaboon, and central Congo, there lives a dark form (*camerunensis*), the adult male of which often has the breast and belly entirely blackish. The most surprising fact is that the finfoot of the Ituri is indistinguishable from the Upper Guinea form. There is no approach in size to *petersii*, unless

it be in the Lower Katanga district.<sup>1</sup> Because of their love of forest, there is little probability that the two populations of *P. s. senegalensis* will yet be found to meet along the northern edge of the Cameroon forest. The Cameroon bird is dark, but the race living in East Africa is little paler than that of rainy Liberia.

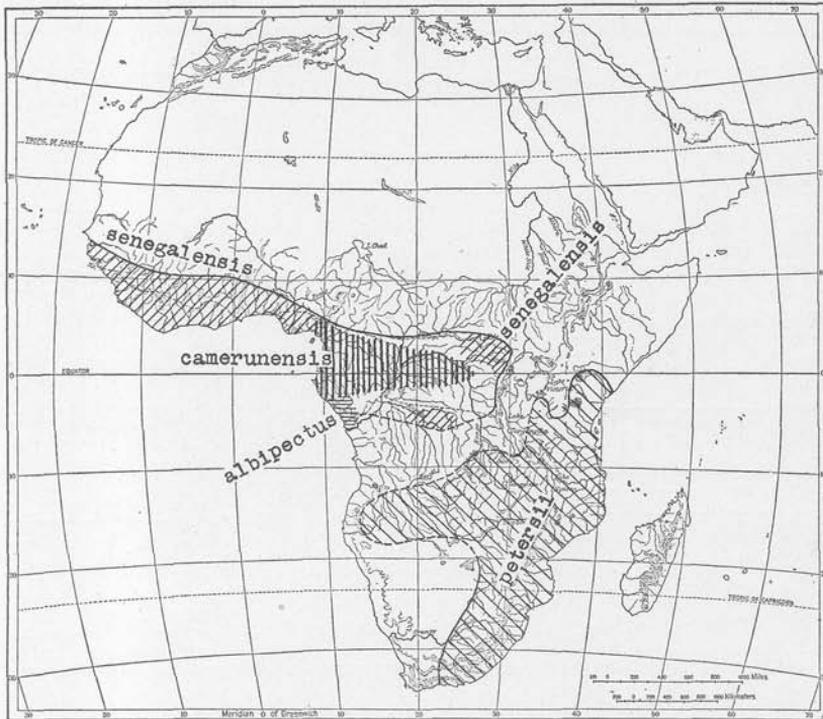


Fig. 129. Distribution of the genus *Podica*, so far as known. The apparent gap in the southern Congo may be due only to insufficient collecting.

*Apaloderma narina*. In other cases the lines of demarcation follow, or parallel, the border of the forest area. First, we may consider the trogons, *Apaloderma narina* and *æquatoriale*, which between them occupy the heavier woodlands of a large part of the Ethiopian Region. Their distribution can be explained only in respect to the equatorial forest. Typical *narina* occurs in scattered forest areas in southern and eastern Africa to Darfur and Abyssinia. It is replaced, however, in the Congo

<sup>1</sup>I am not convinced that birds of the Loango Coast (*albipectus* Stresemann) are really of intermediate size.

rain forest, and in Uganda, by a shorter-tailed subspecies (*brachyurum*). In the same forests of Lower Guinea is found the other species of the genus, *A. æquatoriale*, slightly smaller and easily distinguished by a break in the line of feathers across the naked cheek.

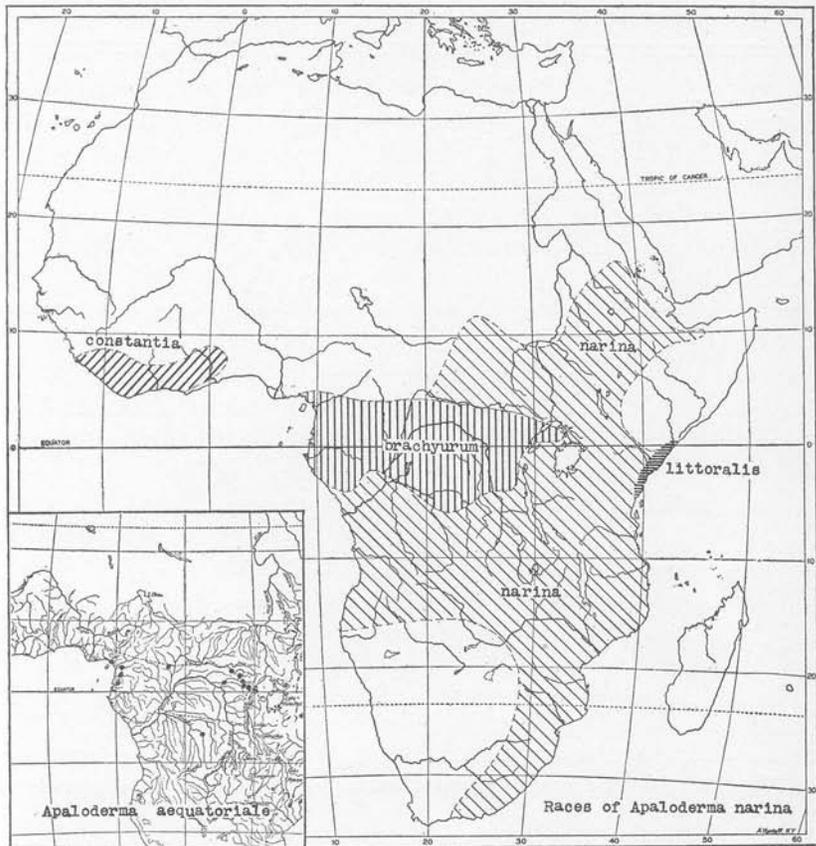


Fig. 130. Ranges of two African trogons: *Apaloderma narina* wide-ranging and divisible in several races, and *Apaloderma æquatoriale* restricted to the Lower Guinea forest.

*Apaloderma æquatoriale* is the commoner species in the southern Cameroon, but is wanting in Upper Guinea. There *Apaloderma narina* is represented by another race, *constantia*. Possibly we may regard *æquatoriale* as a rain-forest form which originated at a time when *narina* was restricted to some other regions. Now both live in Lower Guinea.

If the specific divergence was produced by climatic difference, why does it persist now that they dwell together?

*Guttera edouardi*. That the curly-crested guinea-fowls are not normally inhabitants of the central forest in Lower Guinea has already been pointed out. Extending as the species does, from Upper Guinea to Natal, it might be expected to vary. *G. e. pallasii* of Upper Guinea has a bushy crest and a moderate amount of black feathering on the neck. *G. e. sclateri*, of the northern edge of the Cameroon forest, has the feathers of the front of the crest shortened. Going farther east, we find again in the Uelle, Uganda, and Semliki Valley a bird, *seth-smithi*, with a bushier crest, but vivid blue spots. On the southern border of the Congo forest lives *G. e. schoutedeni*, a form somewhat similar in appearance to *pallasii*, though separated from Upper Guinea by so wide a gap. *G. e. chapini* of Benguela has crest-feathers straight, the anterior ones short.

*Guttera pucherani* of East Africa has been considered specifically distinct, lacking black on its neck. But it is probably only a race of *edouardi*. A little farther south, in Tanganyika Territory, is *G. e. granti* with black on neck, but a red spot on the orbit. *G. e. barbata* lacks red on the orbit. Finally, from Rhodesia southward is found *G. e. edouardi*, with dark orbit, a very curly crest, and gray skin on hind-neck. The races in Lower Guinea are not darker than those of East Africa, and the subspecific characters can have no relation to climate.

The genus *Pirenestes*, among the Estrildinæ, exhibits remarkable variation in size, especially of the beak, correlated with the extent of forest in the several regions it inhabits. On the basis of color and pattern we may distinguish three species: *P. sanguineus*, Senegal to Liberia; *P. ostrinus*, Gold Coast to Uganda and northern Angola; and *P. minor*, Tanganyika Territory to Mozambique. Among the nine recognizable races of these three species, we find birds of approximately three sizes, in so far as the bill is concerned. Of *sanguineus* large and small birds are known. *P. ostrinus* appears in all three sizes. *P. minor* has only a small and a medium-sized representative.

Taking the distribution of *ostrinus* in Lower Guinea, we find that the smallest birds are collected in the clearings of the rain forest, the medium-sized ones usually along the border of continuous forest, and the largest birds almost always in the swamps of the Guinean savannas. Exceptions to this rule are few, and are to be explained in part by recent clearing of the forest. In the case of *sanguineus* the large form comes from the country near the Gambia River, the small one from Sierra Leone and

Liberia. Here again the rule of distribution according to forest or savanna proves valid.

The few localities in eastern Africa whence comes the small form of *P. minor* are all places of unusually heavy rainfall, and are known to be

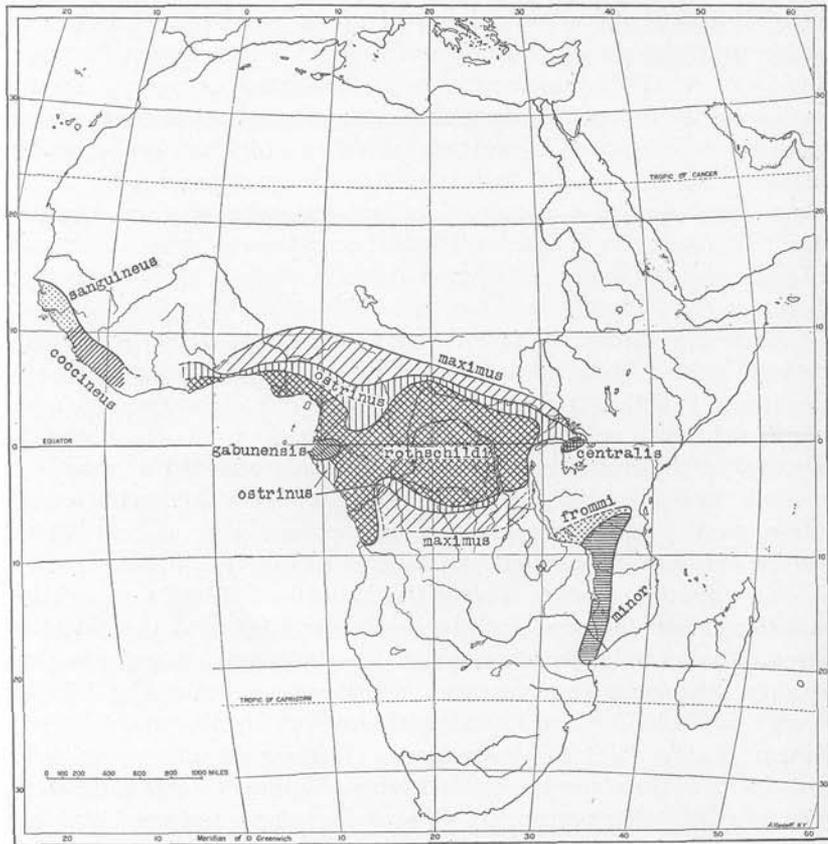


Fig. 131. Distribution of races in the genus *Pirenestes*. Compare with maps of rainfall (Fig. 9) and of vegetation (Fig. 20).

forested, whereas the larger form (*frommi*) has been obtained at two points, one of which is relatively dry.

Illuminated by a comparison of the birds' ranges with a map of annual rainfall, the remarkable distribution of *Pirenestes* shows a correlation with rains, and vegetation, of the occurrence of large- and small-billed birds. An explanation might be sought in the adaptation of the

large-beaked forms to eating extremely hard-shelled seeds of certain sedges (*Scleria*). These sedges are rare within the heavy forest of the Congo, where we know that the small-billed race of *ostrinus* feeds largely on other softer seeds.

The case of *Pirenestes* is paralleled in a way by that of *Halcyon senegalensis*, where color and not size is concerned. In the clearings of heavy rain forests in both Upper and Lower Guinea, eastward to the Upper Congo, this kingfisher is represented by the form *fuscopilea*, with dusky gray crown. Along the northern border of the forest especially, from Senegambia to the Upper Uelle, and also in eastern and southern Congo, the subspecies *senegalensis*, with pale grayish crown, is resident. Then in savanna regions far to the east and south of the Congo forest, lives *cyanoleuca*, with colors still brighter, the crown washed with blue, and a black streak behind the eye.

*Vinago calva*, a wide-ranging fruit pigeon, offers a slightly different case. Two dark green races, with large swollen cere, living in the rain forests of Upper and Lower Guinea, respectively, make this appear a western forest bird. But the species also extends out into the savanna regions, and is represented there by additional races, with brighter yellowish and gray tints. Such are *V. c. nudirostris* of Senegambia, *V. c. salvadorii* of east central Africa, and others to the east and southeast. In the Katanga the tail changes from gray to greenish, and the species extends to Damaraland and Portuguese East Africa.

Some species are more narrowly restricted to the forest edge, but vary slightly from one part to another of their bandlike range. *Phaeniculus bollei* thus extends from Upper Guinea along the northern rim of the Congo forest to the eastern Ituri. On the eastern edge of the Congo forest it extends southward to the mountains near Baraka; and it also occurs in forests on Mt. Elgon, the Mau Escarpment, and Mt. Kenia. In the Congo the narrowness of its distribution is extraordinary. Going north from the Ituri, we first met it near Bafwabaka, on the north side of the Nepoko River. One or two more days' march northward, from this point, will carry one beyond its range.

From the western to the eastern portions of the range there is a slight geographic change. The Upper Guinea bird has a browner head; and eastward of the Ubangi, the white-headed race is known as *Phaeniculus b. jacksoni*. There would seem to be every opportunity for racial segregation in the mountains of East Africa, where the species ascends to 8000 feet. But if there are minor differences among the East African representatives, they have not received taxonomic recognition.

*Caprimulgus nigriscapularis* has a very similar range, just outside the forests, and shows no subspecific characters. Yet *Colius striatus*, in somewhat the same area, is represented by three different races.

#### BIRDS OF LOWLAND SAVANNAS

In the short comparison already made of the birds of savannas north and south of the forest, a certain number of forms were mentioned as extending completely around the Congo forest, so as to occur in both Guinean savannas, without exhibiting racial changes. In many other cases the forms are either subspecifically different, or distinct representative species, a natural result of isolation by the equatorial forest belt. If we carry our comparisons beyond the Congo limits, over the whole ranges of the species, we shall find evidence of geographic variation suggesting the possible origin of many forms. Yet climatic conditions in savannas north and south of the equator being so similar, they cannot account for the divergence that is commonly seen.

Taking, for example, the horned guinea-fowls, we find them inhabiting all the savanna regions of Africa, but shunning alike barren deserts and dense rain forest. It used to be believed that there were at least four well-marked species of the genus *Numida*. First, the bird from northwest Africa (*galeata*), now widely domesticated, with lilac or brownish chest; second, that of northeast Africa (*meleagris*) with a tuft of horny bristles over the nose; third, that of southeastern Africa (*mitrata*), with neither lilac chest nor nasal bristles; and fourth, that of Southwest Africa (*papillosa*). Other distinguishing marks are found in the spotting of the plumage, feathering of the neck, coloration of wattles, and size and shape of the horn on the crown.

As the exploration of Africa proceeded, many new forms were discovered and described as races in the groups outlined above. But now that we have the birds of Central Africa in our collections, we see how the characters tend to intergrade, especially in East Africa, near the Ubangi River, and in the Kasai. It is safe to say that all the horned guinea-fowl are scarcely more than geographic races of a single species. Perhaps *Numida sabyi*, living in Morocco, is really the best-marked form, because it is isolated by a broad belt of desert.

*Numida strasseni*, on the Ubangi, bridges the gap between *N. galeata* of northwest and *N. meleagris* of northeast Africa. *N. intermedia* of southwest Uganda is like a blending of *meleagris* with *mitrata* of southeast Africa. A third intermediate form occupies the Kasai.

The equatorial forest has been the barrier about which the horned guinea-fowl evolved into many forms. Yet one of them has succeeded

in crossing this forest, probably in relatively recent times, in the Cameroon-Gaboon region. *N. meleagris marchei* of the Gaboon and the Lower Congo is still but poorly differentiated from *galeata*. One result of life near the forest seems to be reduction of the size of the horn in the

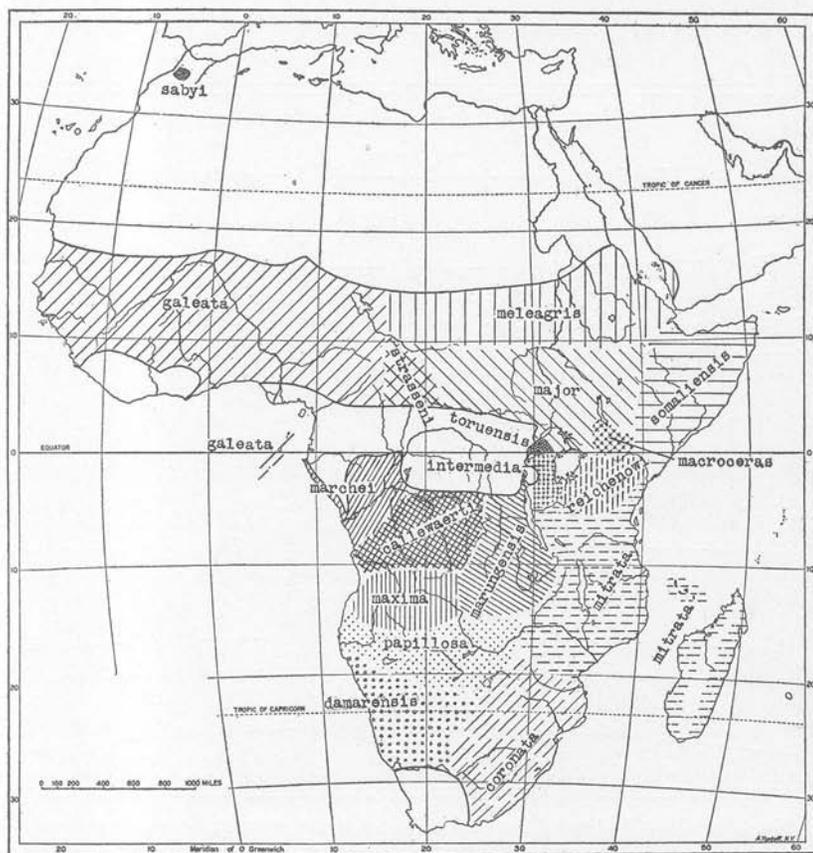


Fig. 132. Approximate ranges of the various races of *Numida*. *N. meleagris galeata* occurs also on the Cape Verde Islands, and has been introduced in the West Indies. *N. meleagris mitrata* is found on Rodriguez.

genus *Numida*. The races living nearest the Congo-Cameroon forest have low, inconspicuous horns; whereas *reichenowi*, in an arid region of the same latitude in East Africa, attains the maximum development of this feature. The character that seems most related to climate is the least important in their classification.

The lapwing, *Afribyx senegallus*, has a southern representative, like the typical race in almost everything save its dusky flanks, for which it has received the name *lateralis*. Among the doves, *Streptopelia vinacea* finds its southern counterpart in *Streptopelia capicola*, with a distinction in tail-pattern. Diurnal birds of prey are often distributed in like manner, *Melierax* having *M. metabates metabates* north of the forest, *M. metabates*



Fig. 133. Distribution of the African races of the creeper, *Salpornis spilonota*.

*mechowi* south of it; *Astur*, with *A. badius sphenurus* and *A. badius polyzonoides* in corresponding regions.

A kingfisher, *Halcyon leucocephala leucocephala*, living north of the forest, has deeper chestnut abdomen and wings of a greener tone than *H. l. pallidiventris* of southern Africa; but the gap is perhaps bridged by one or two other races inhabiting East Africa. The rosy bee-eater of the Sudan (*Merops nubicus*) is replaced in southern Africa by *Merops nubicoides*, differing by its pink throat. I prefer to call these bee-eaters

distinct species, although clearly geographic representatives. *Bucorvus*, the ground hornbill, has one species north of the forest, another south and east of it, with constant differences in the beak and in the colors of the bare face. These characters, whether we call them racial or specific, are not of a kind that can be attributed to climatic influence.

In the Congo, *Caprimulgus fossii* largely replaces *Scotornis climacurus* to the south and east of the forest; and *Cosmetornis vexillarius*, though it migrates across to the northern savanna, is certainly the southern representative of *Macrodipteryx longipennis*.

The creepers of Africa are considered as subspecies of *Salpornis spilonota*, occurring also in India. The African birds themselves vary in different regions to a marked degree. The plumage is generally brownish, spotted with white and buff, and mottled with dusky, so as to resemble the bark on which the birds seek their food. The general tone is altered by the relative proportions of the light and dark markings, *S. s. rovomæ* of southern East Africa standing at the lightest end of the series, and *S. s. riggenbachi* of northern Cameroon at the darkest. *S. s. salvadori* of Angola is slightly darker than *rovomæ*, and *emini* of the northern Uelle and Upper White Nile begins to approach *riggenbachi*. *S. s. maclaudi*, of Upper Guinea, is perhaps a little lighter again than *riggenbachi*; and *S. s. erlangeri* of southern Abyssinia has a short bill and a strong rufous wash on the body plumage.

A certain connection might be suspected between intensity of coloration and the rainfall of the region, in the case of the lightest and darkest forms; but it will be noted that the species is everywhere wanting in rainy forests. It is comparatively local, and requires savannas with many small trees.

The case of the paradise whydahs is a splendid illustration of isolation through the agency of the equatorial forest. *Steganura* may be split into two distinct groups, whether one calls them species or not: *aucupum*, with long, band-shaped tail-feathers, and *paradisæa*, with tapering feathers. In a few districts males of both groups have been found, but *paradisæa* is restricted to eastern and southern Africa, while the *aucupum* group, though reaching not quite so far south, does extend westward along the northern border of the rain forest to the Senegal. It alone occurs west of the White Nile. The *paradisæa* group is not divisible into subspecies; but the *aucupum* group, extending as it does around the equatorial forest, has been more influenced by this sort of isolation, and may be considered as made up of six races, differing not only in the average length and width of the long rectrices but to some extent in the color of chest and nape.

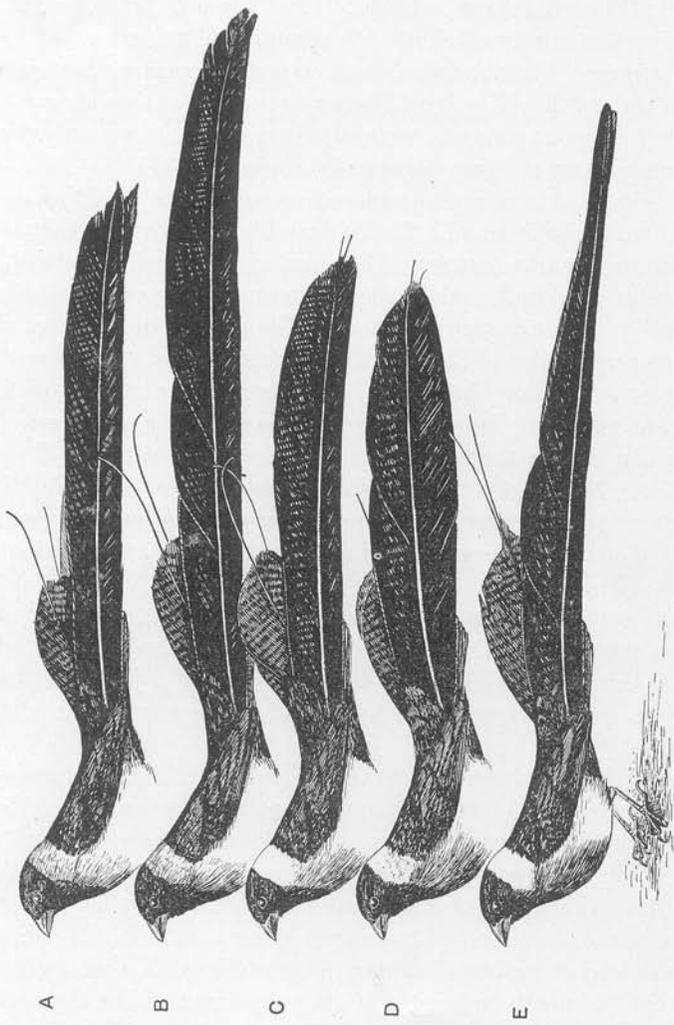


Fig. 134. Some races of *Steganura*, one-third natural size. A, *S. a. aucupum*; B, *S. a. interjecta*; C, *S. a. orientalis*; D, *S. a. obtusa*; E, *S. a. paradisea*.

The hypothesis I have offered is based upon the varying extent of the equatorial forest, which once extended farther over East Africa, cutting the ancestral *Steganura* into two distinct populations. Later, with increasing aridity, grasslands were opened east of the forest. The southern *paradisæa* spread north to Abyssinia, and the *aucupum* group

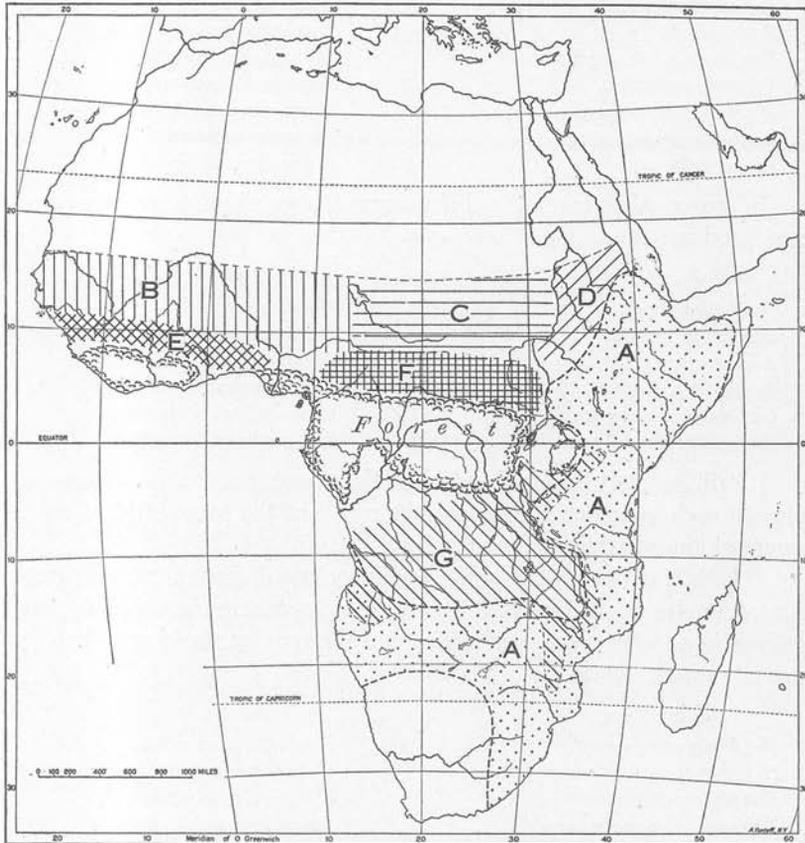


Fig. 135. Distribution of the members of the genus *Steganura*: A, *S. paradisæa*; B, *S. a. aucupum*; C, *S. a. kadugliensis*; D, *S. a. orientalis*; E, *S. a. togoensis*; F, *S. a. interjecta*; G, *S. a. obtusa*.

went south to Gazaland and Angola. The imperfect isolation of more recent times has sufficed for the further subspecific differentiation of the *aucupum* group.

The comparison could be continued through the Passeres, but perhaps it will suffice to give a short list of good examples, species which

are represented in the Congo by distinct races north and south of the forest:

<i>Mirafra fischeri</i>	<i>Parus niger</i>
<i>Cisticola erythropus</i>	<i>Salpornis spilonota</i>
<i>Cisticola lateralis</i>	<i>Oriolus auratus</i>
<i>Cisticola natalensis</i>	<i>Cinnyricinclus leucogaster</i>
<i>Hyliota flavigaster</i>	<i>Anthreptes longuemareii</i>
<i>Batis minor</i>	<i>Lagonosticta rhodopareia</i>
<i>Bessonornis niveicapilla</i>	<i>Sporæginthus subflavus</i>
<i>Tchagra senegala</i>	<i>Steganura aucupum</i>
<i>Malaconotus poliocephalus</i>	<i>Serinus mozambicus</i>
<i>Laniarius ferrugineus</i>	<i>Emberiza cabanisi</i>
<i>Fiscus collaris</i>	<i>Fringillaria tahapisi</i>

In many other cases the differences though slight have often been considered specific:

NORTH		SOUTH
<i>Turdoides plebejus</i>	and	<i>Turdoides jardinii</i>
<i>Bradornis pallidus</i>	"	<i>Bradornis murinus</i>
<i>Nilaus afer</i>	"	<i>Nilaus affinis</i>
<i>Prionops plumatus</i>	"	<i>Prionops poliocephalus</i>
<i>Chalcomitra senegalensis</i>	"	<i>Chalcomitra gutturalis</i>
<i>Uræginthus bengalus</i>	"	<i>Uræginthus angolensis</i>

It will scarcely be doubted that the more noticeable differences between such incipient species are the result of the same kind of evolutionary changes, carried a step farther.

A little farther in the same evolutionary direction we encounter pairs of species distinct enough to be granted separate binomials by most systematists. They are still mainly separated by the forest belt, at least in western Africa.

NORTH	SOUTH
<i>Hoplopterus spinosus</i>	<i>Hoplopterus armatus</i>
<i>Edicnemus senegalensis</i>	<i>Edicnemus vermiculatus</i>
<i>Streptopelia vinacea</i>	<i>Streptopelia capicola</i>
<i>Proturacus bannermani</i>	<i>Turacus erythrolophus</i>
<i>Coracias abyssinicus</i>	<i>Coracias caudatus</i>
<i>Upupa epops</i>	<i>Upupa africana</i>
<i>Caprimulgus nigriscapularis</i>	<i>Caprimulgus fervidus</i>
<i>Urocolius macrourus</i>	<i>Urocolius indicus</i>
<i>Pinarocorys erythropygia</i>	<i>Pinarocorys nigricans</i>
<i>Sylvietta brachyura</i>	<i>Sylvietta rufescens</i>
<i>Melænormis edolioides</i>	<i>Melænormis pammelaina</i>
<i>Hirundo lucidus</i>	<i>Hirundo angolensis</i>
<i>Lamprocolius chloropterus</i>	<i>Lamprocolius acuticaudus</i>
<i>Pyromelana franciscana</i>	<i>Pyromelana orix</i>
<i>Lagonosticta rufopicta</i>	<i>Lagonosticta nitidula</i>

Here and there these more distinct species show signs of finding their way across the barrier. Presumably they no longer hybridize if they happen to meet. As they extend their ranges farther the relation between their origin and the forest belt will be obscured. But it is none the less true.

#### BIRDS OF HIGHLAND SAVANNAS

The species found in the grasslands and savanna woods of the Kivu and Katanga plateaus are of more general distribution than the mountain-forest birds. Where divisible into subspecies, they still show wide ranges, presumably because the type of country they inhabit is extensive, offering fewer gaps or barriers. Examination of the ranges of a few Kivu birds will show that some have their nearest allies in eastern and southern Africa, some appear to have been derived from the southern Guinean savanna, and others extend to the highlands of southern Angola. There are a small number ranging from the highlands of northeast Africa to the eastern edge of the Congo; and finally, others which are characteristic of the semi-arid Sudan, extending westward also to the Gambia or Senegal. As might well be expected, the fauna of the grassy plateaus has very little in common with the forests of the Congo basin, which approach them so closely on the west.

Typical of the South African savanna birds extending to the southeastern Congo is the hawk, *Accipiter minullus*. Occupying all the southern portion of the continent, with the exception of the deserts, it is represented by a lighter gray subspecies, *tropicalis*, near the coast of East Africa. As in so many cases, the eastern highlands form a bridge leading to northeast Africa, and a third subspecies, *intermedius*, is known from Lake Tanganyika to Abyssinia.

As an example of the species extending from the lowland savannas of the west, south of the forest, we may take *Pternistis cranchii*, a bare-throated francolin. *P. c. cranchii* extends from the Lower Congo eastward almost to Lake Tanganyika, and a very similar form with chest a little more streaked (*nyanzæ*) replaces it from the Kivu district to the shores of Lake Victoria. In the Ruzizi Valley there is a special race (*harterti*) with deeper and more contrasting colors beneath. *P. c. itigi* of Tanganyika Territory is very boldly streaked below; it is connected with the western races by *P. i. böhmi* and *intercedens*.<sup>1</sup>

The extension of *Erannornis albicauda*, a small blue flycatcher, from the highlands of Angola, Katanga, and Nyasaland northward through the

<sup>1</sup>W. W. Bowen (1930, Proc. Acad. Nat. Sci. Philadelphia, LXXXII, pp. 149-164) would include all these races in the species *P. afer*, extending south to the Cape Province. I concur, in the main, with his opinion.

Kivu district nearly to Ruwenzori, is easily explained on the basis of topography and vegetation. This species is allied to *E. longicauda*, a lowland bird living mainly north of the forest belt. *E. albicauda* may thus be said to have its closest relative in the lower regions of western and central Africa, with ranges almost complementary. *Erannornis longicauda* is by no means a true forest bird; in the Ituri we found it only

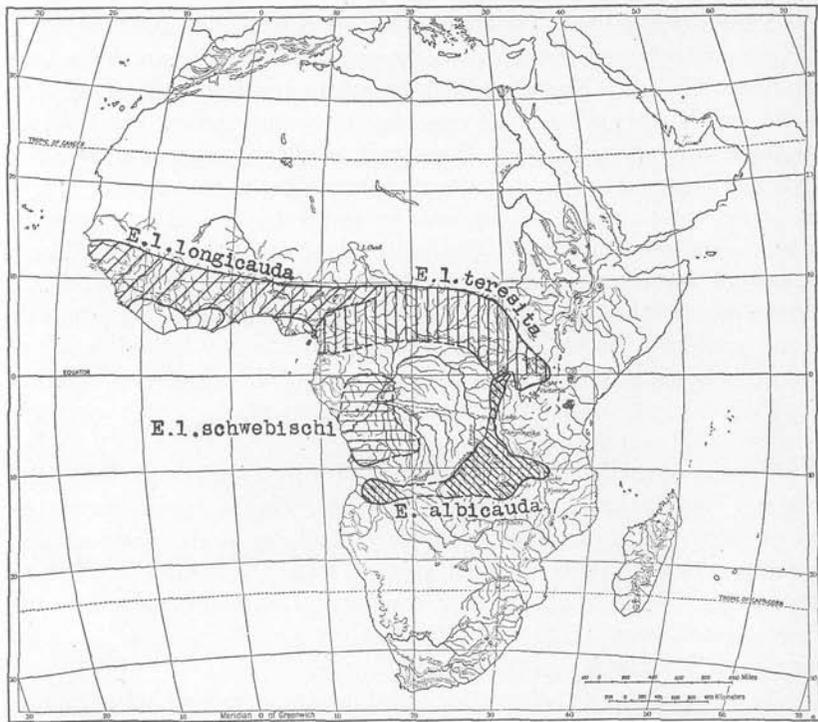


Fig. 136. Distribution of the genus *Erannornis*. *E. albicauda* is restricted to highlands above 4000 feet. *E. longicauda* inhabits lowland savannas and clearings and sometimes ascends mountain slopes to 6000 feet.

in the largest clearings. The length of its range in the north—from eastern Uganda to the Gambia—has allowed other slight distinctions of color to arise between the Upper Guinea form and that of the southern Sudan.

In the case of the Guinea dove (*Columba guinea*) the form inhabiting the Kivu region is identical with that of Abyssinia and the whole Sudan westward to Senegal, though a larger, local form, *dilloni*, is known from

Eritrea, and the specimens from Uhehe in East Africa are said to differ somewhat in color. They do not bridge the gap, however, that separates *C. phaeonotus* of South Africa, the southern representative of the group. These doves seem to require conditions of relative aridity. It is certainly

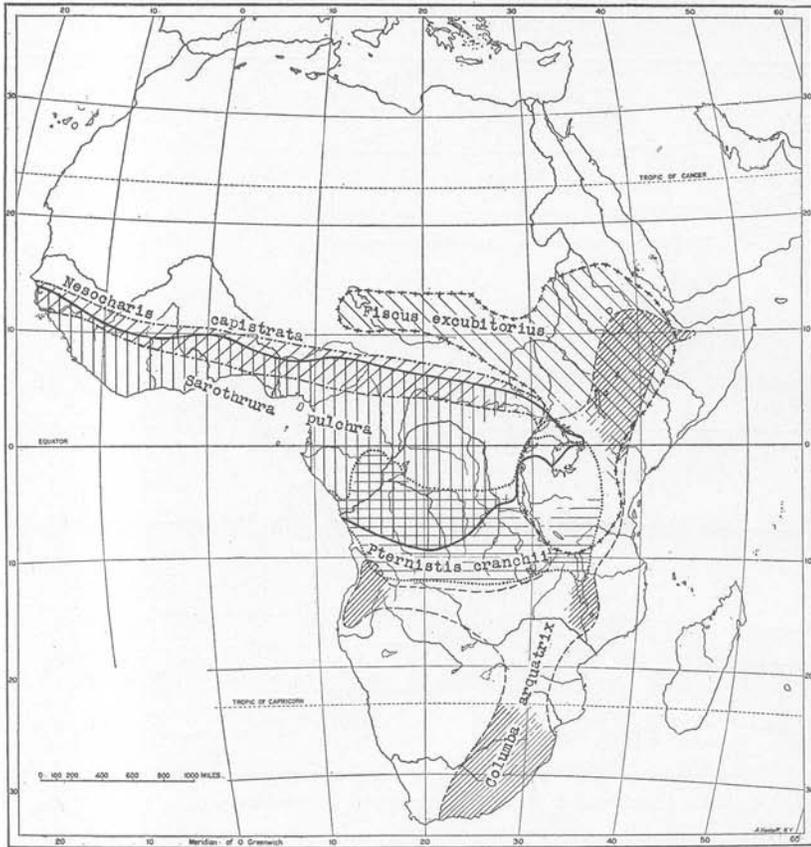


Fig. 137. Approximate limits of distribution of five species of birds which occur in the "Lake Region" of Africa. The ranges are shaded only in part, but their outlines may be followed into the eastern region of the Congo. The sharpest line of demarcation is just west of Lake Kivu and the Ruzizi River.

this aspect of the country, and not its altitude, which is responsible for the outline of the range in the case of *C. guinea*.

A more restricted distribution, showing relationship with northeast Africa, is to be seen in the case of the long-tailed shrike, *Fiscus excubi-*

*torius*. The typical, or first-named race, inhabits the Upper Nile Valley, and is said by van Someren to be migratory, so that it reaches Lake Naivasha in Kenya Colony. *F. e. intercedens*, larger and deeper gray, extends from Southern Abyssinia to the vicinity of Mt. Elgon. *F. e. böhmi*, in the Kivu region and Tanganyika Territory, is again a larger, darker form.



Fig. 138. Distribution of the three races of *Diatropura progne*, the great-tailed whydah.

The variety of the avifauna in the "lake region," as illustrated in Reichenow's report of 1911, might be explained by superimposing the outlines of ranges for five species upon a single map, as in Fig. 137, to show how many different faunas send representatives to the Kivu region. They overlap according to local conditions of altitude and vegetation. At any one locality, I believe, there are hardly as many species as in a place in the western lowland forest or savanna. Yet by extending the limits, as Professor Reichenow did, so as to include parts of two subregions, or at

least five different faunal areas, it is easy to increase the number of species to an amazing extent. Situated at the eastern end of the equatorial forest, the most important faunal barrier in Africa, and offering a plateau attractive to grass-dwelling birds from both north and south, the lake region is invaded accordingly by birds from very diverse parts of the continent. In it, too, are the forested mountains.

If the Kivu country has some affinities with the highland of southern Angola, the Upper Katanga and Marungu have many more; and they likewise share a number of species with Nyasaland. The hornbill, *Lophoceros pallidirostris*, ranges from Angola east to the Katanga and Northern Rhodesia, and into Tanganyika Territory. The western race (*pallidirostris*) reaches the southern end of Lake Tanganyika, but is replaced from northern Nyasaland and the Rovuma River to the mainland near Zanzibar by a slightly smaller race (*neumanni*) with reddish-tipped beak.

*Diatropura progne*, greatest of the whydahs, occurs in South Africa from eastern Cape Province to the high-veld of the Transvaal. This southern race (*progne*) has both wings and tail of moderate length. In the form occurring on the highland of Benguella and in Marungu (*ansorgei*) the wings are much longer. A third race (*delamerei*) isolated in elevated parts of Kenya Colony, has far longer tail-feathers, but the wing about the same as in South Africa.

#### MOUNTAIN-FOREST BIRDS

There is no avian family restricted to the African mountains, all their birds were derived from lowland stock or are nearly related to it. Yet the highlands we are dealing with, save for the Kivu Volcanoes, have existed from remote antiquity; and the volcanoes have merely borrowed their bird fauna from neighboring ranges. Among the mountain species the proportion of Passeres, eighty-three per cent of the total, is very high. In the lowlands it would amount to about fifty-five per cent.

The altitudinal range of a bird is sometimes surprising. *Corvultur albicollis* is to be seen on Ruwenzori at 15,000 feet, and on the shore of Lake Edward at 3000. The type of *Sarothrura loringi*, which I find indistinguishable from *S. elegans reichenovi* of the lowland, was caught at 9000 feet on Mt. Kenia. Such cases are rather exceptional. Far more often the birds characterizing the humid montane and alpine zones are specifically distinct from their nearest allies in the adjacent lowlands, and more apt to have closer relatives in distant highlands at a similar level.

The mountain fauna, I am convinced, became established long ago as distinct from that of the lowlands. An altitudinal line of separation, similar to that of to-day, has been a permanent feature of zoögeography. Above it and below it, evolution has tended to pursue independent ways. Interchange was more likely to take place between the upper levels of

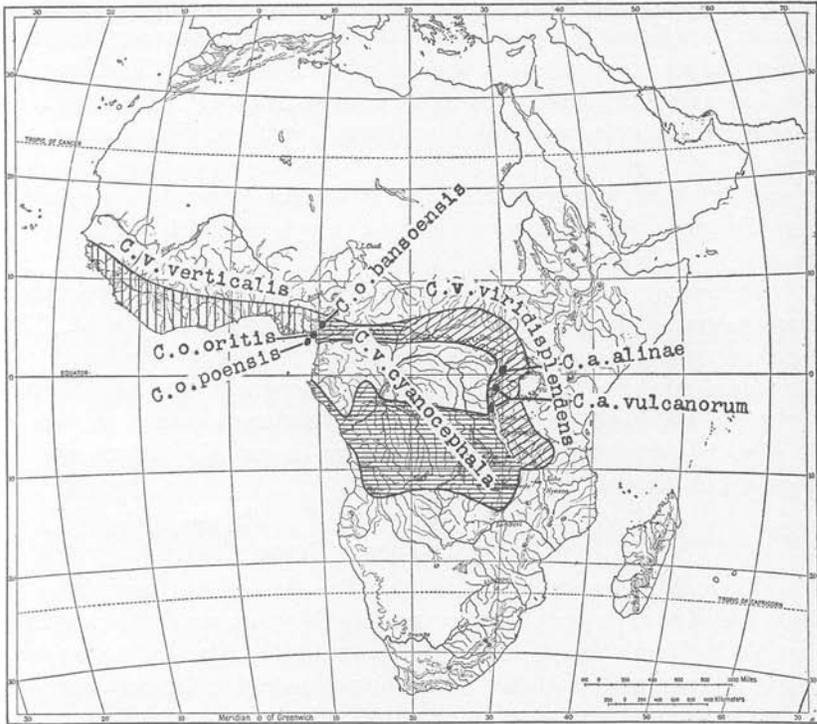


Fig. 139. Closely related sunbirds of the genus *Cyanomitra*: *C. verticalis* with three races in the tropical lowlands; *C. oritidis* on the mountains of the Cameroon region; and *C. alinae* on those of the eastern Congo.

separate mountain chains than between upper and lower levels of the same district.

I find but few cases where a present lowland forest bird has given rise to a nearly related highland race. Among them may be cited *Lamprolaima olivacea akeleyorum* (of Mt. Kenia), *Sheppardia cyornithopsis æquatorialis*, *Apalis binotata personata*, *Burnesia bairdii obscura*, *Symplectes bicolor mentalis*, and *Estrilda atricapilla kandti*.

Sometimes origin from a lowland form seems likely, but the difference is now more than racial. *Cyanomitra alinx* is evidently related to *C. verticalis*, but comparison of females will show them to be quite distinct. *Illadopsis pyrrhopterus* resembles *I. rufipennis*, *Apalis cinerea* is allied to *A. rufogularis*, *Oriolus percivali* to *O. nigripennis*, and *Phormoplectes insignis* to *P. preussi*.



Fig. 140. Distribution of the three species of weaver-birds belonging to the genus *Phormoplectes*. *P. preussi* is a lowland bird, known thus far only from the areas shaded. The small areas occupied by *P. insignis* in the highlands are shown in black. *P. dorsomaculatus* has been obtained only in the two districts marked by asterisks.

Contrast these cases, on the other hand, with the larger number where the mountain forms are better-marked species, or even genera distinct from anything in the lowlands. Where they extend their range in other parts of the continent, or where their nearest allies are found, is next to be considered. A certain small proportion may be admitted to

have north temperate affinities. Such are *Buteo oreophilus*, *Asio abyssinicus graueri*, *Micropus melba maximus*, and *Hirundo rufula emini*, with allies in Eurasia and the Abyssinian mountains.

The species in the next list may be taken to represent a South African element of the fauna, climbing higher as it approaches the equator, and



Fig. 141. *Ruwenzorornis johnstoni*, a mountain turaco with two races in the eastern Congo, is most nearly related to *Gallirex porphyreolophus* of the lowlands of eastern and southeastern Africa.

often differing locally, as a result of isolation in the mountains. A few of them may originally have come from the north.

*Accipiter r. rufiventris*  
*Columba a. arquatrix*  
*Mesopicos griseocephalus ruwenzori*  
*Smithornis capensis meinertzhageni*  
*Coracina caesia pura*  
*Lioptilornis rufocinctus*  
*Pogonochila stellata intensa*  
*Bessonornis caffra iolama*

*Turdus olivaceus baraka*  
*Batis molitor puella*  
*Dicrurus ludwigii elgonensis*  
*Chlorophoneus rubiginosus rudolfti*  
*Corvultur albicollis*  
*Cinnyris graueri*  
*Cinnyris stuhlmanni*  
*Nectarinia famosa centralis*

They form but a part of the montane fauna, so that the majority of its characteristic species are confined to the equatorial region of Africa, where they must long have inhabited the higher mountains. This is indicated by the enormous stretches of lowland which often interrupt the distribution of a single species. Most surprising of all are the cases where a species dwelling on the Cameroon highlands or Fernando Po reappears



Fig. 142. The range of *Nectarinia famosa*, a sunbird of highland savannas in eastern tropical Africa, but reaching sea level in the Cape Province.

in the mountains of the eastern Congo, skipping the whole of the Cameroon-Congo lowlands. To-day we know the fauna of the Congo well enough to be positive that such birds really are lacking in the intervening territory. Chance dispersal by their own wanderings is not sufficient to explain the distribution of such birds. It is necessary to assume an old connection (stepping-stones at least) between these mountains, lost partly by erosion of the Congo-Nile watershed, but principally through changes in climate, affecting the flora as well. Just how the

mountain birds of tropical Africa are distributed, and how they vary, can best be explained with the aid of a few maps and descriptions.

*Aplopelia*.—The lemon dove of the wooded parts of South Africa, as it extends northward on the east side of the continent, becomes restricted to the mountains, occurring in the wooded, lower montane region. A closely allied race, *A. larvata bronzina*, inhabits the highlands of

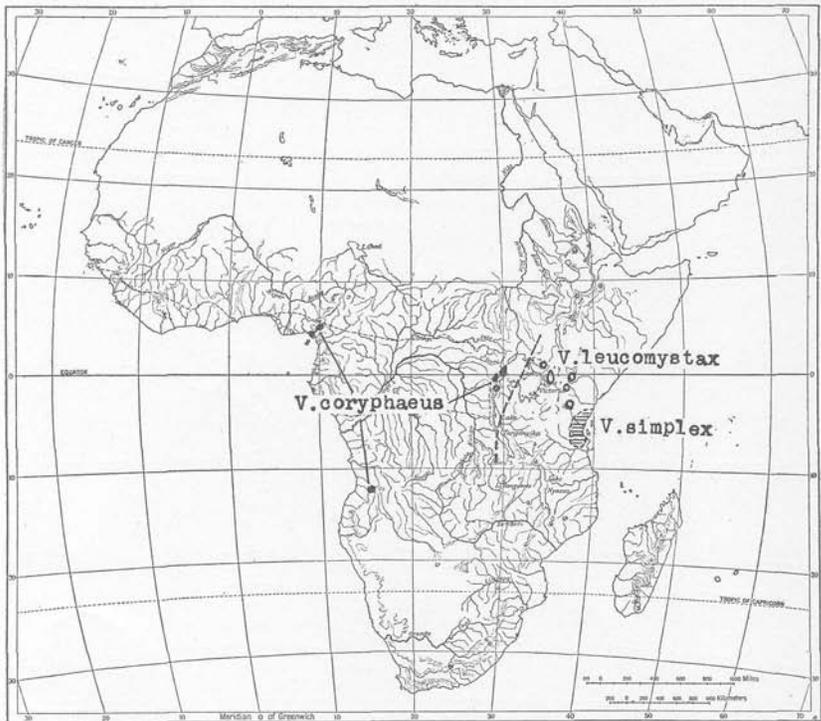


Fig. 143. Small barbets of the genus *Viridibucco*. Two of them are restricted to wooded highlands, and the isolated groups of *V. coryphaeus* are racially distinct.

Abyssinia. All the remaining forms in the genus may be referred to a single species, *A. simplex*,<sup>1</sup> for the cock birds are very uniform in color, the females exhibiting greater differences. With the exception of Liberia and a part of the Cameroon forest, their ranges are either on mountains or on islands in the Gulf of Guinea, where a subspecies has been named for each of the principal islands. The wide gap in the range

<sup>1</sup>With the possible exception of *A. forbesi*, the habitat of which remains a mystery.

of the species between the River Ja and the highland of the eastern Ituri is not due to a lack of exploration. Collecting in the forested Ituri proves that no member of the genus is found there. A change of climate in tropical Africa, which restricted the cool, damp mountain forests, is undoubtedly the simplest explanation. The islands it inhabits form a volcanic chain related to Mt. Cameroon.

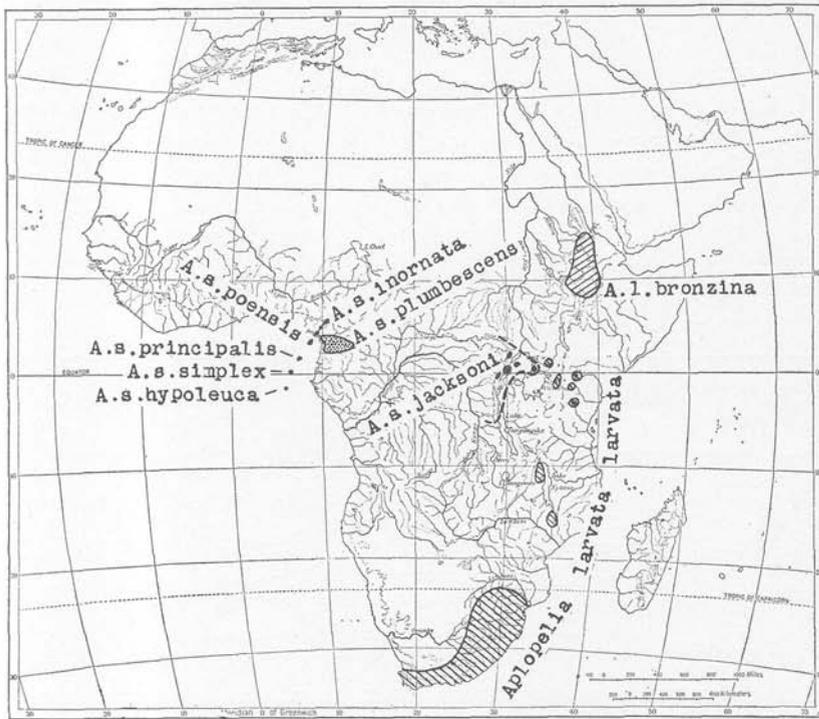


Fig. 144. Ground-doves of the genus *Aplopelia* are mainly restricted to highlands, except in South Africa and some parts of forested western Africa. A single specimen was recently obtained in Liberia by G. M. Allen.

*Heterotrogon vittatus*.—Not very distinct from the wide-ranging genus *Apaloderma*, the bar-tailed trogon is distinctively a mountain-forest bird. How it found its way between Mt. Cameroon and the Ruwenzori region has been suggested, but Bates' collecting in the southern Cameroon and mine in the Ituri prove that it does not now range through the intervening lowland forests. Long separation has now resulted in a slight differentiation. The specimens from Mt. Cameroon and Fernando Po

have shorter wings than East African examples, while those from the eastern Congo, though intermediate, are closer to the Cameroon form.

The white-starred robin of South Africa (*Pogonocichla stellata*) ranges northward into eastern Africa, but is found there only on mountains, in the forest zone. The subspecific characters are slight—color of



Fig. 145. Present distribution of *Heterotrogon vittatus*. Broken lines indicate supposed routes of communication in the past. Two other races have been named, but their validity has been questioned.

wing-coverts and tail-pattern—except in the case of *elgonensis*, which has the tail entirely black.

The range of *Bessonornis roberti* is more remarkable. First found by Alexander at Bakaki, on Fernando Po, 4000 feet above the sea, it was re-discovered by R. Grauer, in the mountain forest west of Lake Edward, but is not known to occur anywhere else in the Congo. The eastern form differs in having less white on the middle of the underparts.

The fringilline genus *Linurgus*, represented by four members, scarcely more than races, on the mountains of Fernando Po, Cameroon, Elgon, Kenia, Kilimanjaro, Uluguru, and Rungwe, is not known from the Congo, except perhaps by a single immature specimen without locality, obtained by Pilette. If it occurs in the eastern Congo it must be exceedingly rare.



Fig. 146. Distribution of the races of *Pogonocichla stellata*.

#### ALPINE BIRDS

Of the four species which have been cited as characteristic of the alpine zone of the eastern Congo, *Micropus melba* has the widest range. This swift breeds in the mountains of southern Europe, northwest Africa, Asia, east to Turkestan and India, Ceylon, in the mountains of eastern and southern Africa, and in Madagascar. *M. m. maximus* is the largest and perhaps the darkest of the six races. *M. m. africanus* is somewhat smaller but nearly as dark.

It should not be assumed that such a species has invaded Africa from the Alps. On the contrary, during the Pleistocene it must have lived farther south, and its range at that time may have been mainly in Africa and India. Statements of range, as in the present chapter, are not to be construed as meaning that the species has actually extended its dispersal in a given direction.



Fig. 147. Ranges of races of the alpine swift, *Micropus melba*, south of the Sahara.

*Nectarinia johnstoni dartmouthi* is a large green-and-blue sunbird, with red pectoral tufts. It has near relatives on all the highest mountains of East Africa, differing but slightly in the relative amounts of green and blue in the plumage of the males, and in the length and curvature of bill. The typical race inhabits the heights of Kilimanjaro, *N. j. idius* those of Mt. Kenia, and *N. j. salvadorii* the Livingstone Mountains, near the northern end of Lake Nyasa.

The long-tailed sunbirds of the genus *Nectarinia* are characteristic of the East and South African subregion, where nine of the ten species have their home. *N. pulchella* extends westward, north of the forest, as far as Senegal; but within the forest area there is only one species, *Nectarinia congensis*, which strangely enough is of pronounced riverain habits. It may well be asked whether the genus *Nectarinia* is not a



Fig. 148. Two species of *Nectarinia* restricted to the higher mountains. Both occur on Mt. Kenia and Kilimanjaro, *tacazze* living at a lower level than *johnstoni*; but *tacazze* does not extend to the eastern Congo.

heterogeneous group, merely uniting long-tailed examples of several types of sunbirds. The smaller lowland species are mainly red-breasted, like many species of *Cinnyris*.

The other sunbird restricted to the higher slopes of Ruwenzori, *Cinnyris stuhlmanni*, has often been made a race of *C. afer*. It certainly is not an immediate ally of *C. reichenowi* of the lower levels on Ruwenzori and neighboring mountains, and must be related to the southern group

containing *afer*, *chalybea*, *subalaris*, and *ludovicensis*. Until we settle the relationships of the latter forms, it seems nearly hopeless to assign *stuhlmanni* to its proper position.

*Cinneryis graueri*, of the Kivu Volcanoes and adjacent ridges, has a much shorter bill than *stuhlmanni*, but may belong to the same species.



Fig. 149. Distribution of five species of *Seicercus* in Africa. With the exception of *S. budongoensis*, all are mountain birds, *S. umbrovirens* ranging higher than any of the others.

It ranges northward to the mountains west of Lake Edward. How can such a difference be ascribed to climatic influences, rather than to simple hereditary variation, abetted by isolation?

*Seicercus umbrovirens* has about eight races, living only on high mountains, from Eritrea and Yemen to Kilimanjaro, Ruwenzori (*alpinus*)

and the Kivu Volcanoes (*wilhelmi*). *S. u. mackenzianus* of Kenya Colony is washed above and on flanks with rufous brown, *alpina* is less ruddy, and *wilhelmi* still more grayish.

Another species, *S. lætus*, of more greenish color, lives in the lower mountain forests of the eastern Congo; and *S. budongoensis* in forests of Uganda and the eastern Ituri, at about 4000 feet. *S. herberti* occupies the mountains of Fernando Po and Cameroon, while *S. ruficapilla* has three races, in South Africa, the mountains north of Lake Nyasa, and those of Usambara. *S. lauræ*, allied to *ruficapilla* and *lætus*, has recently been discovered in the Benguellan highlands by Rudyerd Boulton.

Just as we delimit faunal areas in the lowlands, it will become useful to group the various ranges of mountains so as to express their faunal relationships. Those of the Cameroon region will stand well apart. Northern Nyasaland shares many montane species with Uluguru and Usambara, but few with the southeastern Congo. Marungu and the Katanga plateaus go plainly with Benguella. The Ruwenzori Range, Kivu Volcanoes, and adjacent ridges form a group by themselves, despite some affinity with the Cameroon region and some with Elgon and Kenia. The Kenia region, again, is a little more like the Abyssinian mountains, but not wholly. *Nectarinia tacazze* and *Pinarochroa sordida* extend from Abyssinia to Kilimanjaro, but do not reach Ruwenzori. Some other Abyssinian species have more restricted ranges.

#### CONCLUSIONS

The external factor which most influences geographic variation is isolation. Humidity, temperature (in relation to altitude), food-supply, and competition with other species—including predatory enemies—are all believed to affect the result, but in selective fashion. Such factors of environment are interrelated to a surprising degree. In Africa, more often than not, isolation results from the effect of humidity (or its lack) and of temperature upon the general type of vegetation. And upon the plants, finally, the food-supply depends. Altitude is important if it causes a marked change of temperature. But its effect is enhanced by dissimilarities in vegetation. We find birds of the equatorial forest ranging from sea level to 5000 feet, with no differences; but a little higher almost the whole bird population may be replaced, especially if there be forest. The distinctness of mountain species and races show how little the lowland birds can enter the higher forest.

Study of the ranges of related subspecies and species impresses me with the evident fact that species commonly arise from geographic races,

usually by slight hereditary variations at first, a procedure favored above all by isolation. It seems as though segregation alone suffices to bring forth differences in birds, when their respective habitats hardly differ as to climate or vegetation. We may, however, assume that slight differences exist between any two environments; and we may also be sure that peculiarities of environment often affect the birds, if only through their health and physiological processes. Otherwise, we could hardly explain the omnipresence of adaptation, and the close connection, between season—for example—and the birds' fecundity, song, and molt. Yet many details by which races or species differ seem too inconsequential to be ascribed to selection.

The way in which isolation seems of itself to favor the origin of new forms is doubtless to be explained through genetic peculiarities of the bird stocks concerned. By means of barriers more or less effective, Nature—if I dare use an old-fashioned figure of speech—is confining her live-stock in the various faunal areas, much as the geneticist isolates strains of *Drosophila* in bottles. The faunal zoölogist now looks into the various areas of his country and compares the results. The modifying influences are not always understood; and above all, we can scarcely guess just what went into the experiment at its start. But we have the advantage of observing a large and varied lot of results, and measuring their mass effect.

Simple Mendelian ratios are the rarest of Nature's wild exhibits. Distinct crosses like those made by the breeder are the exception among free-ranging animals, for they have antipathies that may exclude the mating of species even so closely allied as to puzzle the taxonomer. In most cases hybrids between species will prove sterile; and in certain well-known cases where birds hybridize incessantly along overlapping borders of ranges,<sup>1</sup> the mixed offspring seem unable to produce a new taxonomic group.

The slight differences that characterize many recognizable subspecies are doubtless grounded in the germ-plasm, where they may have been produced by mutations of small degree. Numbers of slight Mendelian characters will simulate blended inheritance. Environment selects, rather than directs the variations. Deserts are characterized by numbers of vertebrate animals, including birds, of pale brown hues. But a forest environment does not make for corresponding uniformity of coloration, even among the terrestrial creatures. In Africa depth of color does not always vary in direct relation with increasing rainfall.

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<sup>1</sup>For example, some American flickers, tufted titmice, and warblers of the genus *Vermivora*.

General increase in pigment is subspecific; it has no great importance in the origin of species, nor does it have a cumulative effect, or all the forest birds would be sooty. In some cases it may be that a generous production of feather-pigment is a by-product of some heritable physiological condition that is advantageous for life in the humid tropics. The thyroid gland is known to influence coloration in a similar way.

The characters most often cited as being influenced directly by climate, in addition to pigmentation, are general body size, and relative proportions of extremities.<sup>1</sup> Tables may then be given to show the high degree of correlation between climatic factors and the characters in question. The cases are generally chosen from groups of birds which seem likely to furnish the desired evidence. But even if all this be true, I find that the characters for which climatic influences are claimed are not those which best distinguish species and genera. Will anyone assert that climate has caused the median pair of rectrices to lengthen in a few genera of sunbirds: *Nectarinia*, *Hedydipna*, and *Drepanorhynchus*? Or that it produced the differences between the remiges of *Cosmetornis* and *Macrodipteryx*, the notching of the primaries in certain doves and starlings, or the swollen maxilla of *Musophaga*—not to mention the casque in hornbills?

Finally, it seems to me, if evolution were motivated wholly by environmental influences, it would lack that very centrifugal force which is so evident. Evolutionary progress would lack a stimulus. A forest environment, instead of permitting vivid and varied colors of plumage, would tend to impose a sombre uniformity upon its subjects. There might, to be sure, still remain a possibility of structural adaptation for gaining a living, but the "urge" that makes for adaptation is inherent in the animal. It takes advantage of what heredity provides, and if this suffices, it succeeds. Climatic factors may possibly alter the rate of genetic variability, but there is no reason to suppose that the direction of mutations is determined thereby. Mutation is an observed fact, the gradual fixation in the germ-plasm of environmental tendencies is not.

As to the exact mode of selection, I have no very new suggestions. Rigorous weeding out of less competent individuals is no more evident than in our colder northern climates. Bates once collected in the Cameroon forest a small hawk which had continued to maintain itself comfortably long after the sight of one eye had been destroyed by a native's arrow, notwithstanding a piece of the shaft which still remained

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<sup>1</sup>See especially B. Rensch, 1929, 'Das Prinzip Geographischer Rassenkreise und das Problem der Artbildung'; E. Banks, 1925, Proc. Zool. Soc. London, pp. 311-322; and G. L. Bates, 1931, Ibis, pp. 255-300.

in the wound. I took a swallow (*Hirundo nigrita*) with one leg destroyed by a driver ant's bite, but it was mated and in good health. These are of course exceptional cases.

The majority of tropical birds suffer no abnormal death rate. On the contrary, the number of eggs laid is usually smaller than in related groups of the temperate zones. The sociability and coöperation of birds with similar feeding habits are evinced by mixed bird-parties in the wooded regions. And yet, thus far, no other theory has half the logical force of natural selection.

That there is destruction by predatory mammals, birds, and reptiles, not to mention parasites and other influences, cannot be denied. For mutations to result in evolutionary change it is essential that a large number of individuals be eliminated, above all to make room. The faculties favoring survival may seem very different from variations in color, size, and structure, yet genetically they may be intimately connected.<sup>1</sup> The selective agencies in a given environment would naturally produce some parallel results in the various species of birds subjected to it, so that there is no need to explain such cases as direct modifications by climate.

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<sup>1</sup>For the geneticists' point of view see H. J. Muller, 1929, 'The Method of Evolution,' *Scientific Monthly*, XXIX, pp. 481-505; and T. H. Morgan, 1932, 'The Scientific Basis of Evolution,' especially Chapters V and IX.

## CHAPTER VIII.—BREEDING SEASONS OF BIRDS IN THE CONGO

### GENERAL REMARKS

The great majority of birds in temperate climates nest during the warmer part of the year, in the spring and summer. Temperature is not the only determining influence, for nesting is often completely ended before the hottest period arrives, and certain species like the American horned owl and Canada jay may begin while winter still reigns. Climate acts through food-supply in determining the period of reproduction; so that where foods of some kinds are available throughout the year, considerable individuality in nesting dates may be expected, in accordance with the bird's food habits.

Wide irregularity, consequently, would be expected in the equatorial regions; and yet even there it has often been assumed that as the season of rains corresponds to summer, this would be the principal season in which the birds would nest.<sup>1</sup> To a certain extent this is true. But it is mainly the case with the small insectivorous birds, and depends upon the abundance of insect life at the time, as well as the better shelter then provided for their nests by the vegetation. It is only clearly marked in a region with well-defined seasons; but it may be demonstrated upon the equator, in a district of mixed savanna and forest, with two rainy seasons annually, as Belcher<sup>2</sup> has shown for the region around Entebbe in Uganda. With a list of 126 species of breeding birds, he tabulated the number of nests found according to months over a period of more than three years. Out of a total of 716 nests, 192 were taken in April, which was thus accepted as the high point of the breeding season, as it is of the annual rainfall. A lesser rainy season reaches its height in November, when a slight increase in the number of nests was again noticeable, but it amounted to only 42 nests in all for that month. The two minima, 21 and 20 nests, are for the months of January and August, which are usually the driest months at Entebbe. So nests are to be found in every month of the year, a fact which need not surprise us, because this is anything but an arid region, and it lies directly on the equator.

As a generalization this is instructive, but it does not exhaust the possibilities of the subject. The families Hirundinidæ, Muscipidæ, Laniidæ, Ploceidæ, Nectariniidæ, and Sylviidæ are fairly well represented in Belcher's table, and they show more or less preference for the month of April, or at least for that general period of the year. Yet among the Columbidae no nest was found in April, as opposed to three in January

<sup>1</sup>See Reichenow, 1900, 'Vögel Afrikas,' I, p. xc.

<sup>2</sup>1919, Journ. E. Afr. and Uganda Nat. Hist. Soc., No. 15, pp. 473-478.

and four in August—the dry months. Of the six nests of Phasianidæ listed, not one was found in April. The single owl's nest (of *Bubo cinerascens*) was discovered in December; and of four nests of diurnal raptores, none chanced to fall in the month of April. Among the Alcedinidæ, only *Ceryle rudis* was found to nest in April. We might already conclude then, that different families of birds prefer different seasons; and as I shall show, tastes may differ even within families.

In a district not quite so close to the equator these questions are more easily studied, because there is only a single really dry season. First, however, let us consider another investigation carried on by Mr. G. L. Bates in the southern Cameroon, at only three degrees from the equator, where the country is forested, and the dry seasons are of slight importance, though there are two within the year.

#### BIRDS IN THE LOWLAND FOREST

Bates' conclusions will be found in the Ibis, 1908, pp. 558-570. He soon felt that he would have to give up hope of establishing definite breeding seasons for the birds in general. Still he continued in the hope of finding some groups or species that formed exceptions to the general irregularity, by showing a preference for one season over another. Breeding specimens of the fruit-pigeon, *Vinago calva*, were found at all seasons, as also with *Francolinus lathamii*, *Chrysococcyx caprius*, *Gymnobucco* and *Heliobucco*, many Muscicapidæ, *Textor cucullatus*, *Hyphanturgus nigricollis*, *Malimbus*, *Bleda syndactyla*, *Bleda eximia notata*, *Andropadus*, *Pycnonotus barbatus gabonensis*, *Cisticola erythropus*, *Camaroptera brevicaudata*, *Burnesia*, *Hylia prasina*, *Sheppardia cyornithopsis*, and three species of *Illadopsis*. There are no more constant breeders, said Bates, than the paradise flycatchers. He had no record of an adult *Tchitreia viridis* with the sexual organs small. *Textor cucullatus* likewise retains its breeding plumage throughout the year, and when once adult always has the breeding organs large.<sup>1</sup>

As to birds showing some slight seasonal preference, Bates tells us:

Certain species—as the Woodpeckers, Barbets, and Starlings—seem to be hindered in breeding by the rains, or for some reason, at least, to prefer the dry season. They seem to be mainly birds which breed in holes in trees.

Other species—as the Colies and the Thrushes and their allies—seem to prefer the rainy season.

But certain Weavers, mainly those of the Spermestine group [meaning *Pyromelana hordacea*, *Vidua macroura*, *Amblyospiza*, *Spermospiza*, *Pirenestes*, *Spermestes*, and *Estrilda*] have a definite half of the year in which all their breeding is done. Herein they are exceptional among all the birds of the country.

<sup>1</sup>In the grasslands of the north—Lake Chad, the Upper Uelle, and Abyssinia—males of this species have a dull dry-season plumage, but in the forest they do not.

In connection with the more or less continuous breeding of many Cameroon birds, Bates noted that they seldom laid more than two or three eggs at a time. In the Upper Congo I found that *Vinago calva* lays but a single egg. We, too, have records of nests of this fruit-pigeon in the forest region for July, September, and December, besides young birds in August; and dissections of seventeen adult birds, including some taken in January, invariably disclosed enlargement of the gonads.

Bates' careful and extended observations on the breeding of the forest birds in the Cameroon are all confirmed for those of the Congo forest. We collected a number of nests, eggs, and young birds; but of wider significance are the notes kept for nearly every adult bird on the development of the sexual organs. I regret that the convoluted condition of the vasa deferentia which marks the peak of reproductive activity in the male<sup>1</sup> was not recorded, but the size of the testes is a fair indication of the season for breeding. The condition of the ovary is even better. The data will be given in more detail in the systematic section of this report, but they may be summarized here.

There is no period of the year, in the Ituri forest, which stands out as a special breeding season. By taking twenty-two of the more important families, and tabulating the months in which we had evidence of breeding for the various species best represented in our collection, it was possible to draw annual charts for the number of species found ready for reproduction in each month, in the forest and in the savanna to the north.<sup>2</sup> For the Passeres I took four common families, and found that the maximum number of species breeding was recorded in the Ituri forest during July, though the number was also high in April, August, and September. The minimum number prevailed in November, December, and January.

For fourteen families of non-Passeres, the maximum in the forest was in September, but December and January were not so low as several of the other months. If the two curves are combined, the maximum comes in September, but it is to be noted that the data are far less complete for the Passeres. Little more would be learned from such calculations, and the tables for species of individual families are more instructive. In the forest certain species may be found breeding at any season, others have definite preferences.

In the case of certain birds breeding along rivers, such as *Galachrysis nuchalis*, it is the time of low water that is chosen, and this usually

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<sup>1</sup>See Bates, 1927, *Ibis*, pp. 6, 7.

<sup>2</sup>These diagrams differ from Belcher's table in that they represent the number of species found breeding in each month, not the total number of nests found. Because of the ease of finding nests of common passerine birds, these are apt to receive undue importance.

coincides with the principal dry season, notwithstanding that the birds are insectivorous. Other birds of the river banks may choose the period of high water, like *Hyphanturgus aurantius*, a weaver building on boughs out over the stream, especially on islands and in rapids.

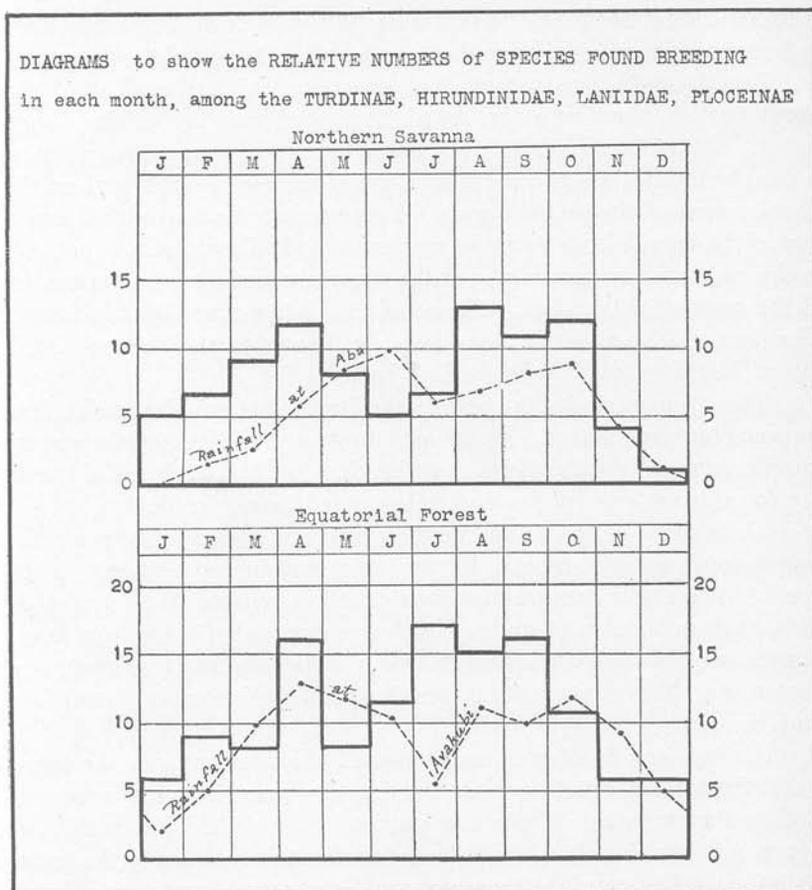
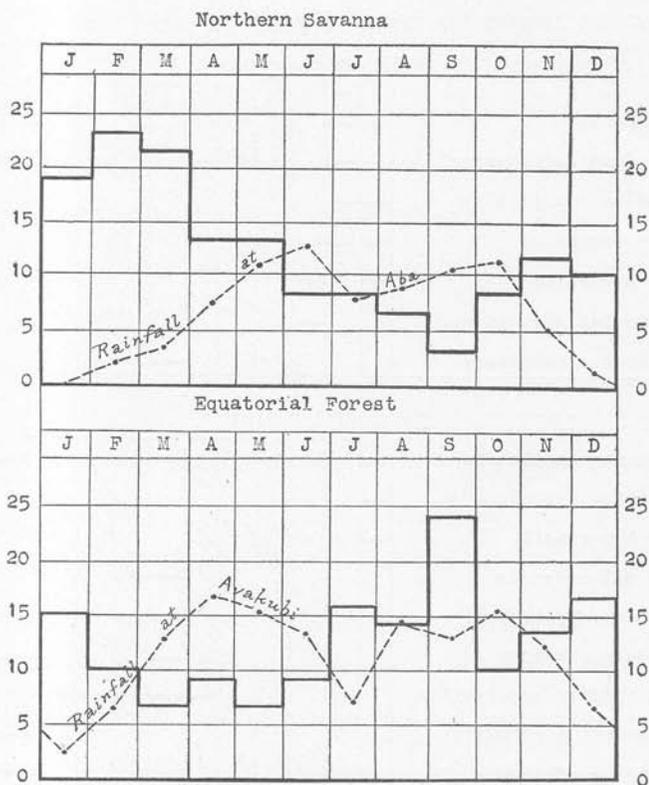


Fig. 150. Diagrams to illustrate the tendency among passerine birds to nest more commonly during the rains.

*Podica senegalensis*, an aquatic bird typical of the forest region, appears to nest in the Ituri only during the season of rains and of high water. A female carrying a fully formed egg in the oviduct was secured on May 22, another with ovary large in July, and young birds in

DIAGRAMS to show the RELATIVE NUMBERS of SPECIES FOUND BREEDING in each month, among eighteen families of non-passerine birds.



The families represented:

- |             |              |               |
|-------------|--------------|---------------|
| Aquillidae  | Glareolidae  | Meropidae     |
| Numididae   | Burhinidae   | Bucerotidae   |
| Phasianidae | Columbidae   | Tytonidae     |
| Turnicidae  | Cuculidae    | Bubonidae     |
| Rallidae    | Musophagidae | Caprimulgidae |
| Otididae    | Alcedinidae  | Picidae       |

Fig. 151. Among non-passerine birds, those of the Uelle savanna are more apt to breed during the dry months, while those of the Ituri forest show no great preference, unless it be for the rainy month of September.

September and December. The nest is probably built on stumps or large boughs above the water.

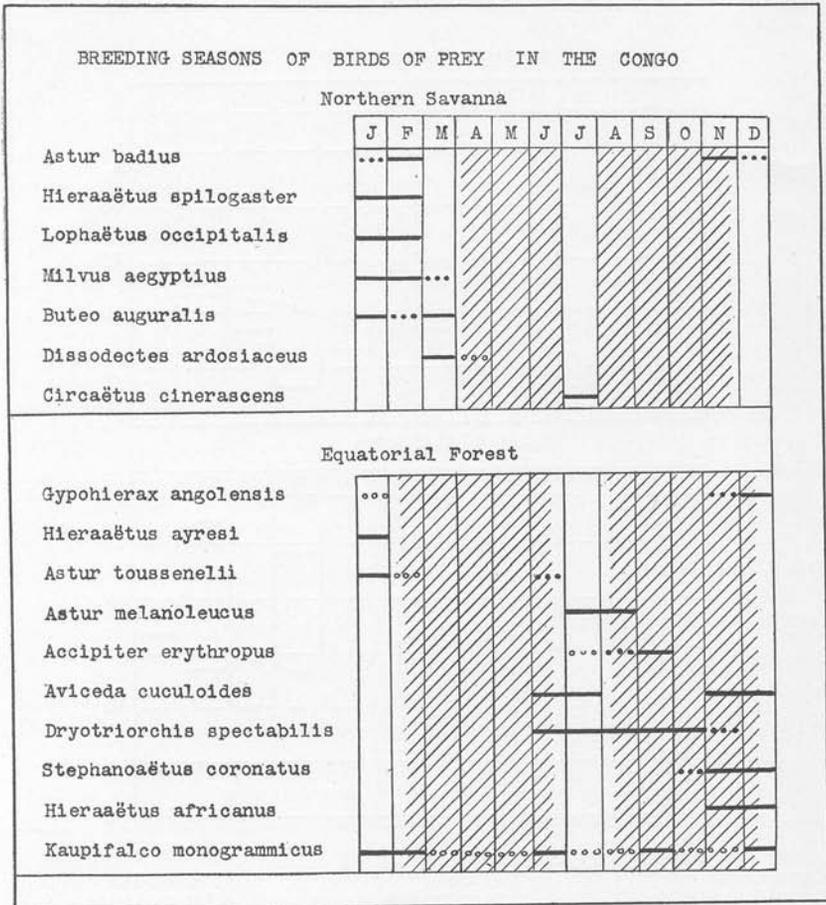


Fig. 152. A solid black line indicates that nests were found or breeding specimens collected in the month indicated. Black dots indicate the probability of breeding, small circles only a possibility. Shading shows rainy periods of the year.

*Hirundo nigrita* is a dark blue swallow which frequents only the rivers of the forest region. Its breeding season is apparently prolonged over the whole year, for I have found nests both in January and August on old trees projecting above the water, or on beams beneath bridges, but always where isolated by the water, whether high or low.

One noteworthy forest species not mentioned by Bates is the crowned eagle (*Stephanoaëtus coronatus*). The young of such a large eagle plainly require many months for their rearing; and there seems to be a definite season for nesting. About Niapu, near the northern edge of the Congo forest, the eggs are laid about early October (latter part of the rainy season). Young birds were taken by Lang in November and December; and at Avakubi, where the breeding season seems to be the same, I found a fully fledged eaglet still perching near the nest in early March. Abandoned nests seen in late March and in July tend to confirm the foregoing conclusion. What advantage there may be in this time of year I can only surmise. The young are in the nest during the driest part of the year, a fact that may have a marked influence on their health. I hardly think that the parents are any more successful in their hunting at this time.

Bates' remarks concerning *Tchitrea viridis* would apply even better to a species dwelling in the true forest, away from clearings, such as *Tchitrea rufocinerea batesi*. Without examining a great number, I noted specimens with enlarged sexual organs in January, March, May, September, and December. Only a single male, taken in June, had testes little developed; and it is not without a suspicion of immaturity in its plumage.

On the other hand, I cannot say I have invariably found the adult male of *T. viridis* in breeding condition. Even in the forest region, such non-breeding birds may be encountered. One male, fully adult, with white back and long tail-feathers, taken at Stanleyville in December, had evidently finished nesting, and its plumage was very decidedly worn.

Of about twenty-six males with lengthened rectrices, however, taken in the forested region from Avakubi to Medje, only two exhibited reduction in size of the testes, while thirteen were described as having them greatly developed. The remainder were all in what one would ordinarily consider the breeding state. Male birds with gonads enlarged were taken therefore in the months of January, February, March, July, August, October, November, and December. To fill in an apparent gap in this record, I may add that I found a nest of the species on May 18; so the perpetual breeding of the species, in the forest area, may be accepted as a fact.

Since this paradise flycatcher is a bird of clearings and second growth, it is not surprising that it should also have a wide range in the African savannas. Let us examine my record then for the country north of the forest, in the Upper Uelle district. Of twelve undoubtedly adult

males, with long tails, taken in the region of Dungu and Faradje, only two were noted as with "testes enlarged." They were taken in January and June, the June specimen having a nest. Seven were in an intermediate condition, scarcely likely to have been breeding; while in the three remaining these organs were quite small. The non-breeding adults were taken in September, December, and January. It is to be concluded, therefore, that whereas *Tchitrea viridis* in the region about Faradje breeds mainly in the middle of the rainy season (I have found the nest in June), the same species in the Ituri forest breeds throughout the

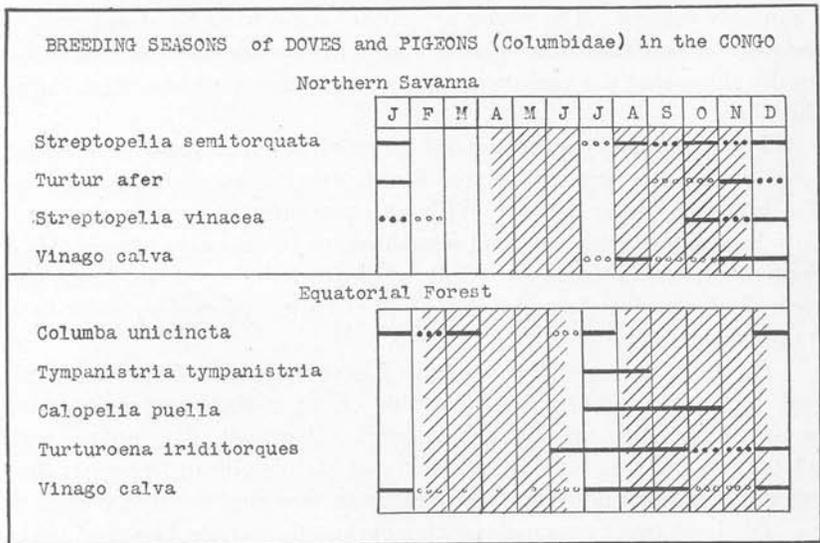


Fig. 153. Most of the doves show an aversion to nesting in the first half of the rains, but *Columba unicincta* and *Vinago calva* in the forest may be exceptions.

year; and that individual males in the forest are much more likely to remain in breeding condition for long periods of time. Thus does the climate regulate their physiology.

A relation between the gonads, acting as ductless glands, and the plumage of certain birds has been demonstrated. It might be suspected that the conditions here noted have something to do with the irregular and puzzling subspecific characters in *Tchitrea viridis*, exhibited by many of the adult males. In the region of Faradje, males with pure white backs and the tails largely of the same color are common, although they may be migrants from the north. About Avakubi in the forest such a plumage is

unknown; the vast majority have the back rufous, and only the two long rectrices white. Occasional birds are darker, sometimes having long black tail-feathers, and more rarely even the back becomes black. These plumages are never seasonal, but they may perhaps be influenced by the gonads. In the savannas of the Kasai and Manyema districts white-backed males are common, but differ slightly from those of the Sudan. The non-breeding male from Stanleyville was of this type.

The strongest argument against such an explanation is that the representatives of the species in southern Africa, though they too must breed during a short period, have no white in the plumage.

#### BIRDS IN THE NORTHERN SAVANNAS

As one approaches the northern or the southern border of the forest, one finds in the clearings certain birds, like *Vidua* and *Pyromelana*, more characteristic of the grasslands; and their plumage-changes and breeding seasons correspond with those of the same species in the neighboring savannas. The change in vegetation from forest to savanna is due to the prolongation of the dry season, and it is during this period that conditions are so unfavorable in the savannas for the nesting of many small passerine birds. For them the ideal time is during the growth of the vegetation, under the beneficent influence of the rains, or at the time when the grass has reached its greatest height, and will best conceal their nests, hidden in it. This is the case for many of the bishop-birds and whydahs. When the rains begin in the Uelle district, toward the month of April, these birds are all in their dull dry-season plumage. Few of them begin to molt at once, this being the case only with *Pyromelana xanthomelæna crassirostris*. Towards June the pin-tailed whydah, *Vidua macroura*, begins to assume its black-and-white plumage, and by early July *Pyromelana hordacea* and *Coliuspasser ardens concolor* are changing. At this time there comes a short respite from the rains, the little dry season, but it is practically without effect upon the developing vegetation or the molting Ploceidæ. For actual nesting, however, they await a taller growth of grass. The young of *Vidua* (which is parasitic on other members of its subfamily, notably waxbills) first make their appearance in September; and the bishop-birds and whydahs generally do not nest until October. Their breeding period is short. I do not think they suffer from the burning of the grass, which does not begin in this region till December. By that time they have reared their young, and are already molting back into brown dress.

In the Uelle, some of the more typical weavers, such as *Textor cucullatus femininus* and *Sitagra tænioptera*, build along the banks of

rivers on trees, papyrus, or reeds at the same period of the year, or perhaps a little earlier. Both species here have a dull eclipse plumage like that of the female. These are two good examples of birds breeding only in the rains, and yet it is perhaps only partly a question of abundance of

## BREEDING SEASONS OF SOME AFRICAN BEE-EATERS

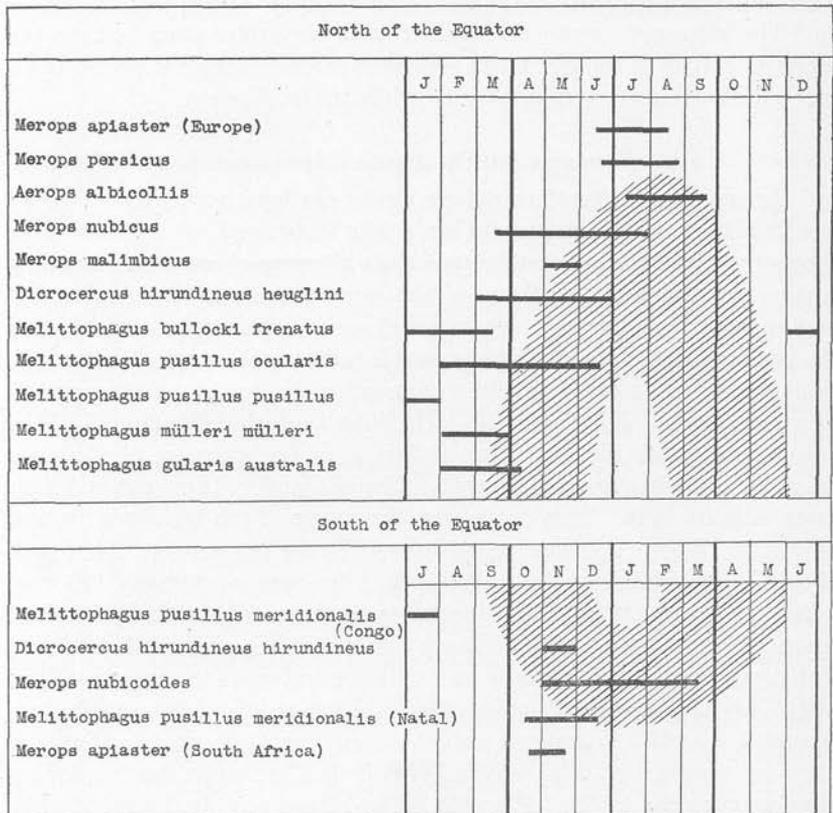


Fig. 154. Bee-eaters in tropical Africa nest largely during the dry season and the early rains. Here the breeding seasons are added of some species which occur only as migrants in the Congo. The southern year is shown as beginning with July.

food, and partly of protection by the high level of the streams. On the Ituri River, though it is in the dense forest belt, we found that *Hyphanturgus aurantius* hung its nests on bushes and trees over the stream while it was in flood, from May to September. Nevertheless, on the Kibali

River in the savannas, I have seen the same species beginning to nest as early as March, while the water was still at nearly its lowest level.

The larger aquatic birds, for the most part, do not nest in the densely forested area, though they may pass a portion of the year along its broader streams. In the savannas north of the forest more of them nest in the dry season than in the wet. The reason is partly to be seen in the fact that when the rivers are low, fishing in the shallow water is more successful; and for shore birds considerable banks of sand or mud are

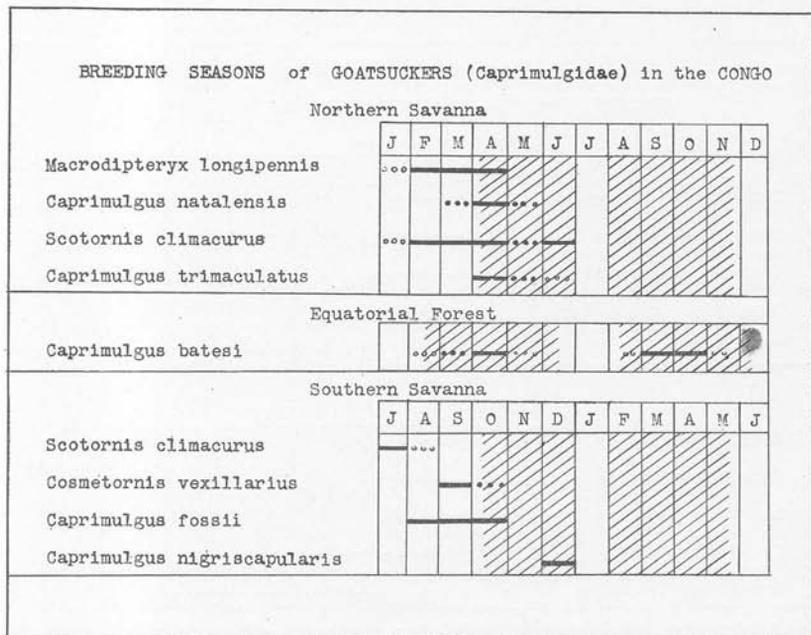


Fig. 155. Most goatsuckers show a preference for the end of the drought and beginning of the rains, but *Caprimulgus batesi* of the forest is an exception.

exposed, which increase their hunting-grounds many fold. There can be no doubt that the birds become thoroughly adapted to such changing conditions through the year, and have regulated not only their reproductive activities but even their migrations accordingly.

In the Uelle district the marabou stork nests in the dry season, as do the wool-necked stork, the Senegal thick-knee, the small gray pratincole (*Galachrysis nuchalis*), and the fishing eagle (*Halizæetus vocifer*). Certain birds nesting in burrows along river banks, like *Melittophagus bullocki*

*frenatus* and *Halcyon l. leucocephala*, also choose this time of year. *Afrityx senegallus senegallus*, a wattled lapwing, is more a bird of dry open spots than of watercourses, but it too nests regularly during the drought.

*Neotis cafra denhami*, a large bustard arriving in the Uelle every year from the north, just at the end of the rains, quickly lays its eggs and spends most of the dry period in rearing its young. Then as the grass recommences its growth, this bird vanishes. Among the common turtle doves there is one (*Streptopelia vinacea*) which arrives from the north

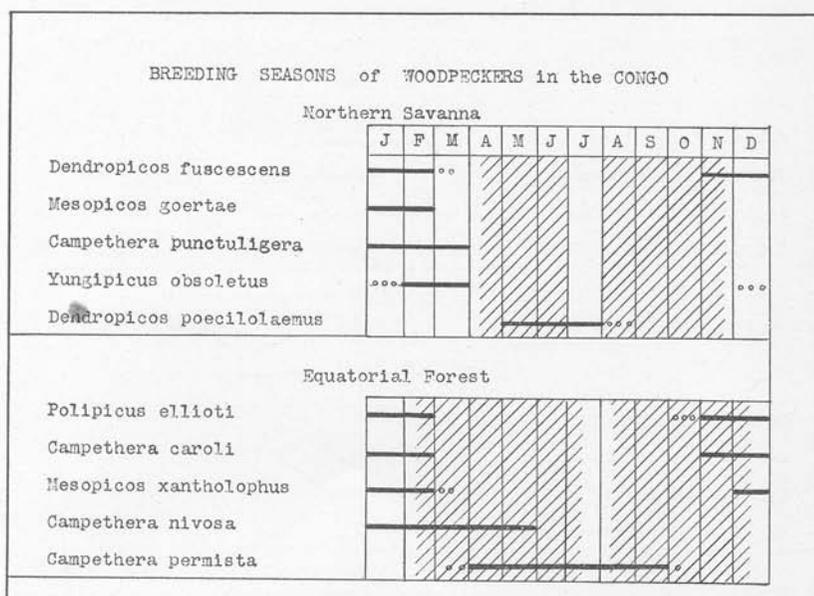


Fig. 156. Many woodpeckers show a preference for the drier periods.

toward the close of the rainy season, and begins to nest at once; while *Stigmatopelia senegalensis*, a resident, seems to nest from July to October, during the rains. Two common gallinaceous birds, *Numida meleagris major* and *Francolinus icterorhynchus dybowskii*, might be said to lay during the rains, but so late that most of the growth of their young takes place during the dry weather.

Many birds of prey regularly choose the dry season for nesting. In the case of the vultures, it is clear that they can find food far more easily when the ground is not concealed by tall grass. It is at this period too

that the natives do most of their hunting; but I cannot say to what extent the nesting of the birds depends on human activities, or even upon the burning of the grass. Other members of the same order which hunt for themselves share the habit. This may perhaps be compared to the very early nesting of most birds of prey in northern countries. Certain

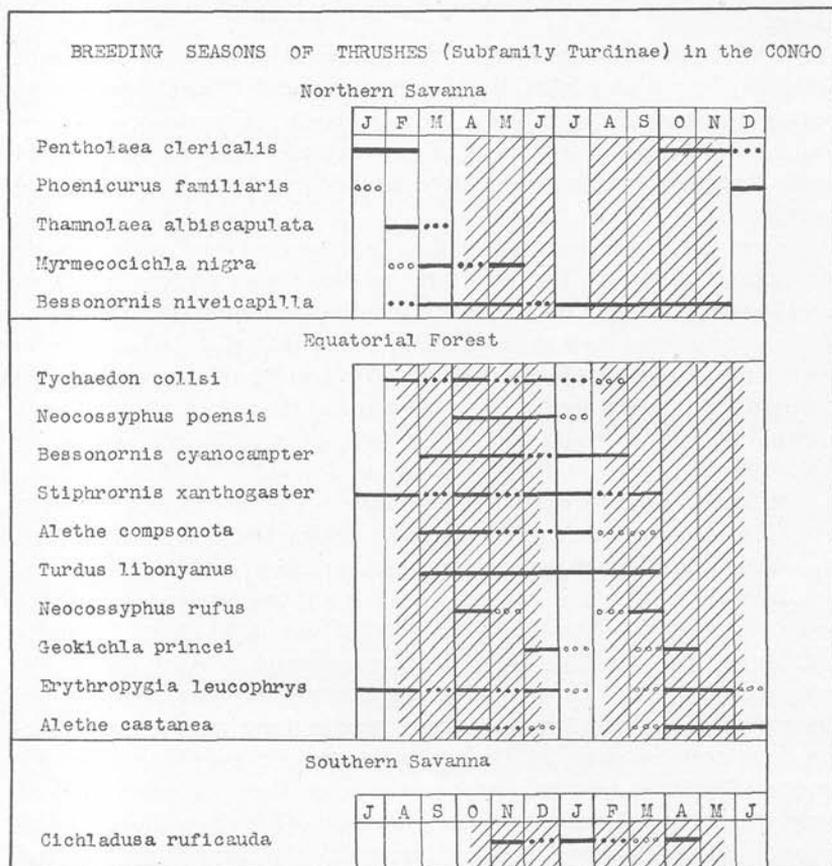


Fig. 157. Many thrushes seem to have protracted breeding seasons, and some species may perhaps nest in every month of the year.

it is that we found the following species nesting in the dry season: *Astur badius sphenurus*, *Milvus ægyptius-parasitus*, *Buteo auguralis*, *Circaëtus cinereus*, and *Hieraaëtus spilogaster*. Many more raptors, I must add, are present at that season as migrants from the north, either from Eurasia or from the Sudan, which show no sign of reproductive activity.

The nocturnal birds of prey also exhibit a certain liking for the dry season in this respect. Each year we found *Bubo cinerascens* laying in January; nests of *Otus leucotis leucotis* were shown us in December and January; and by the beginning of the rainy season the barn owl, *Tyto alba affinis*, had full-grown young. *Bubo lacteus* appears to lay just at the end of the rains, so that its young likewise are reared during the dry season.

Two of the nightjars lay their eggs during the dry weather, namely, *Scotornis climacurus sclateri*, which is resident, and *Macrodipteryx longipennis*, which leaves again when the rains begin. *Caprimulgus natalensis*, on the other hand, is more of a rainy season breeder, for we found its newly fledged young in April, May, and September, all rather rainy months.

Even the Passeres are not without species that nest in the months here almost rainless. The little sunbird *Hedydipna platura*, which we used to see in the Uelle only for a few months, beginning with December, was found to build its nest in February<sup>1</sup>; and that of *Anthreptes longuemarei* I also discovered in the same month, though other members of the family did not begin nesting for a few months thereafter. Even a little brown bunting, *Fringillaria tahapisi goslingi*, was found nesting on rocky hills in December, the first month of drought.

It hardly seems necessary here to discuss the breeding of the many small insectivorous birds which nest only during the rains, though there may be some difference in the exact months chosen.

By now it should be evident that for a given family the breeding season by no means always falls in a definite part of the year. There is a notable exception to the rule that the weavers prefer some part of the rainy season. About Faradje, long after *Textor cucullatus femininus* and *Sitagra tænioptera* have quit their breeding quarters, leaving hundreds of sun-dried nests hanging by the riverside, one occasionally comes upon groups of yellow-and-black weavers hanging their nurseries on long boughs hanging out over the water, now at its ebb, or on thorn trees in swamps. Though woven of grass into much the same shape, the materials are partially different, for the lining is mainly of the downy flower-heads of the grass *Imperata cylindrica*. The nest would be much more pervious to rain—if rain were to fall. This bird is *Sitagra atrogularis*, one of the very few weavers to nest at such a time of year. But its nesting is not always carried on in the neighborhood of water. Still

<sup>1</sup>Males of this sunbird lose their metallic plumage in May and June, and renew it in November, according to Bates, 1927, *Ibis*, p. 53.

more often small colonies are found weaving their nests on the boughs of a tree that contains the nest of some raptorial bird, a buzzard, a vulture, or sometimes a marabou stork, the latter being more a carrion-feeder than it is a water bird. These large birds do not molest the weavers. Instead, their proximity offers protection to their small neighbors; and the fact that the raptorial species like to nest during the drought may have

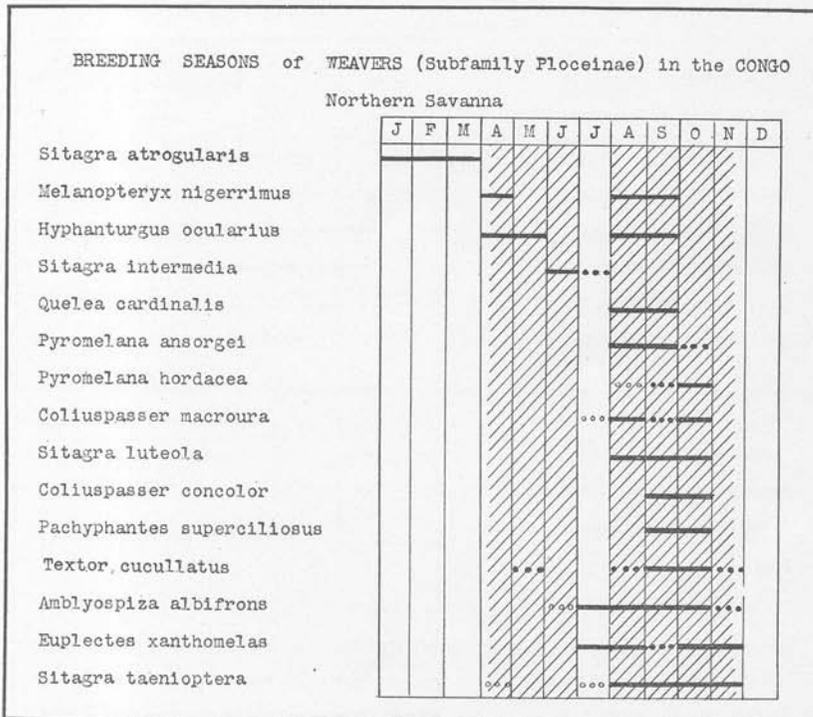


Fig. 158. With one exception, the weavers of the Uelle savanna show a decided preference for the rainy portion of the year.

something to do with the preference of this species of weaver. In the forest region we found other weavers displaying the same sociable habit. *Malimbus erythrogaster* sometimes builds in numbers near an aerie of *Stephanoaëtus coronatus*, and I have seen a colony of *Textor cucullatus* about a nest of *Gypohierax*.

In summarizing the records of breeding birds for the savanna of the Upper Uelle, I found that among the non-Passerés the greatest number of

species showed sexual activity in February and March, the smallest number in September. Among four large groups of Passeres conditions were nearly the opposite, with maxima in April and August, October still high, and the minimum in December. (See Figs. 150, 151.)

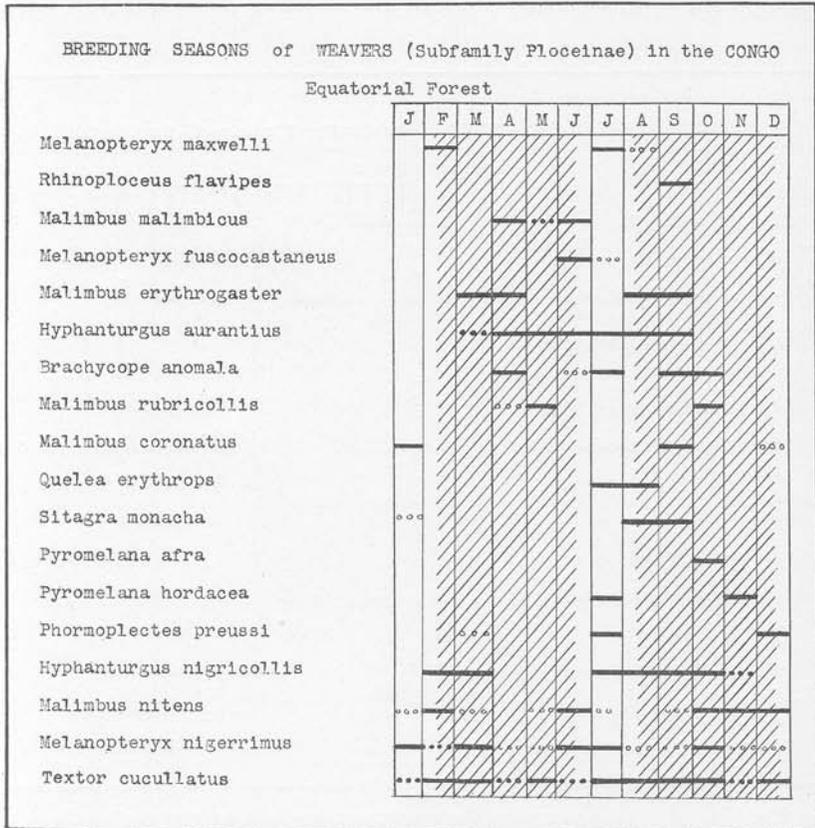


Fig. 159. The weavers of the Congo forest have less definite breeding seasons than those of the savannas. Some species seem to nest throughout the year. Further study in this region may still show longer reproductive periods for many of them.

In a general way we are forced to conclude that in these equatorial regions, where there is food available throughout the year, even in the grasslands that have but one pronounced dry season, each species of bird has adapted itself to conditions so as to nest at its optimum period. This is not determined by temperature, nor even directly by humidity,

but rather by the available nesting sites, the protection or concealment of the nest, the health of the nestlings, and the readiness with which food may be procured for the young. Beyond the forest limit very few species, however, will be found reproducing throughout the year, as so many do in the forest belt. The minimal variation in day-length so close to the equator surely does not govern the breeding cycle.

A little farther north in the Sudan, conditions are somewhat exaggerated with respect to drought; and judging from the migratory birds which nest there in the rains, I should expect fewer birds to lay during the dry season.<sup>1</sup> In the northern Congo, as I have shown, two species of storks nest during the dry part of the year. But in the Sudan *Sphenorhynchus abdimii* does so during the wet season. A number of birds of prey, including *Butastur rufipennis* and *Melierax metabates*, also nest there during the rains.

#### BIRDS IN THE EASTERN SAVANNAS

In the savannas bordering the eastern Congo, conditions ought not differ from those in Uganda, as described by Belcher. The seasons are not so clear-cut as in the Uelle or Kasai, and consequently the behavior of birds might be a little less regular. We spent only a year between Lake Albert and the north end of Tanganyika, so our observations in any one district did not cover more than a few months.

On the west side of Lake Albert conditions in August and September were like those in the same months in the Uelle, very many Passeres breeding, bishop-birds and whydahs in full dress. Yet *Numida meleagris major* still had coveys of half-grown young, *Francolinus icterorhynchus* was breeding, and so were *Turnix s. lepurana* and *T. nana*. I was rather surprised to find a nest of *Halizætus vocifer* with a young bird, nearly fledged.

We saw the grasslands north of Lake Edward in October, November, January, and February. October was very wet, January and February very dry. *Coliuspasser ardens* and *Urobrachya axillaris* were still breeding in October, as were *Amblyospiza capitalba*, *Sitagra dimidiata*, *Textor cucullatus*, and *Estrilda astrild*. In November *Chalcomitra senegalensis* and *Cinnyris cupreus* were still breeding. Soon thereafter *Coliuspasser* and *Urobrachya* went into brown dress.

January and February (dry season) are the breeding time for *Caprimulgus nigriscapularis* in the Semliki Valley. *Vidua macroura* had males with long tails growing in during January, north of Lake Edward, and

<sup>1</sup>Lynes, (1925, *Ibis*, p. 784) found that in Darfur only fifteen per cent of the birds nest during the winter, and fifty-five per cent in summer, or rainy season.

there seemed to be other irregularities among the whydahs. Occasionally males of *Coliuspasser eques* and *Urobrachys axillaris* in breeding plumage would be seen in January at the south end of Ruwenzori, and brown males of *Coliuspasser ardens* often had lengthened rectrices, as they do in Uganda but not in the Uelle. *Pyromelana xanthomelæna* frequently retained its black-and-yellow dress at this season. Right on the equator we found, therefore, a mixed condition of plumages among the whydahs and their allies.

*Streptopelia decipiens* was breeding there in January, as were *Campethera nubica*, *Anthus rufulus*, and *Anthus leucophrys*. Perhaps they nest in both of the dry seasons of the vicinity of Lake Edward.

*Caprimulgus natalensis* nested near Beni in February, and in the Rutshuru Plain in May. On the south of Lake Edward the nesting seasons for whydahs differ markedly from those in the Uelle. *Coliuspasser ardens*, *C. eques*, *Urobrachya axillaris*, *Pyromelana orix nigri-frons*, *Sitagra dimidiata*, and *Sitagra intermedia* are seen in full dress in March and May. Conditions are now becoming more southerly; but not having been there in the dry period of July, I cannot say how much irregularity there is.

About Lake Kivu and in the Ruzizi Valley the birds follow the southern seasons. No whydahs or bishop-birds are seen in breeding dress during July—just the opposite of the Uelle District. No doubt, of course, there are some other small birds nesting during the drought, and *Bubulcus ibis* and *Phalacrocorax africanus* are in nuptial plumage on Lake Kivu in July. *Pternistis c. harterti* in the Ruzizi Valley has coveys of young at this time, *Afribyx s. lateralis* and *Caprimulgus fossii* are laying. So just as in the other savannas, there is great variation in the time for nesting among different species.

#### BIRDS IN THE SOUTHERN SAVANNAS

In the southern Guinean savanna, so far as our information goes, conditions are the same as in the Uelle, allowing for the reversal of seasons. This is supported by my own observations in the Lower Congo in June and July and again in December, January, and April. At Kwamouth, about December 20, the condition of the savanna vegetation, the songs of birds like *Melocichla mentalis*, *Cisticola lateralis*, and *Myrmecocichla nigra*, and the changing plumage of some of the Ploceidæ reminded me most forcibly of the Upper Uelle in May. In early July at Stanley Pool, *Coliuspasser macroura* had just gone out of nuptial dress, and the general behavior of the birds was what one would observe in the

Uelle in December. In the Lower Congo the nests of *Textor collaris* hung deserted at the end of June, but in January and April the colonies were full of activity.

The nesting of water birds on the Kasai and other rivers of the southern savanna invites study. The level of the streams will probably be found to play a very important part. On the sand-bars exposed in Stanley Pool in July one sees many birds that are missing in a period of high water like that of December. On the lower Congo, Lang found *Rynchops flavirostris* and *Galachrysis cinerea* nesting on sand-bars in June, after the swollen waters of the stream, which attain their maximum towards April, had subsided.

During a trip up the Lualaba in the dry season (August), from Kabalo to Bukama, I was struck again by the similarity to the Uelle in January. All the whydahs and bishop-birds were in eclipse, and the majority of small birds were not breeding. But *Caprimulgus fossii* was ready to nest, and specimens of *Saxicola torquata* and *Hirundo abyssinica* were found sexually active.

Wherever distinct plumages or nestling birds give clues to the breeding season, Father Callewaert's collections from Luluabourg bear out the conclusions already stated.

#### BIRDS IN HIGHLANDS OF THE SOUTHEAST

There is little doubt that in Marungu and the Upper Katanga the effect of season on birds' breeding is even more pronounced than in the southern Guinean savanna. I have visited the Katanga only in August, when no whydahs in full plumage are to be seen. The majority of small Passeres seemed not to be nesting, yet specimens with large gonads were taken of *Myrmecocichla arnotti*, *Hirundo abyssinica*, *Lamprocolius acuticaudus*, and *Poliospiza melanothroa*. Many of the larger birds, too, are undoubtedly breeding at this time.

In Marungu, between February and May, Rockefeller and Murphy collected specimens of over fifty species with gonads enlarged, and bishop-birds, three species of *Coliuspasser*, *Diatropura progne*, *Vidua*, *Steganura*, and *Hypochera* in breeding dress. The young of *Cosmetornis* were all well grown, but other breeding birds included *Anas undulata*, *Streptopelia capicola*, *Turacus schalowi*, *Chrysococcyx caprius* and *klaasi*, several swallows, grass-warblers, sunbirds, *Poliospiza gularis*, *Fringillaria tahapisi*, *Plocepasser rufoscapulatus*, and several weaver-finches. So the birds that choose the rainy period are many.

## BIRDS ON FORESTED MOUNTAINS

Before visiting Ruwenzori, I had an impression that the short dry periods there might be especially favored as breeding seasons. It may have come from Woosnam's notes. But I soon found that conditions were essentially similar to those in the lowland forest on the equator.

At any given date birds are collected in every stage: young, non-breeding, or with gonads enlarged. From what we saw on Ruwenzori in late July and from November 11 to January 8, I conclude that among the small Passeres many species must nest throughout the year, without reference to dry periods. Adults in sexual activity are taken at the same dates as fully fledged young. Among such birds are *Cinnyris regius*, *Cinnyris v. igniventris*, *Pogonocichla s. intensa*, *Poliospiza s. graueri*, and *Hyphanturgus alienus*.

Some adults of *Nectarinia j. dartmouthi* were in breeding condition in the rains of November and in the dry period of January, while young birds appeared also to have been hatched toward September or October. Among other species breeding during the rains of November may be mentioned: *Eurillas l. eugenia*, *Arizelocichla kikuyuensis*, *Phyllastrephus c. sucosus*, *Pseudoalcippe atriceps*, *Bradypterus cinnamomeus*, *Apalis porphyrolæma*, *Seicercus lætus*, *Serinus c. frontalis*. Some of these, we know, continued to breed in the dry period that began in December.

Other species seemed to be entering their period of reproduction during the second half of November: *Caprimulgus p. ruwenzorii*, *Seicercus u. alpinus*, *Trochocercus albonotatus*, and *Parus fasciiventer*. Only in December did the following begin to show evidence of breeding: *Buteo oreophilus*, *Francolinus nobilis*, *Aplopelia s. jacksoni*, *Psalidoprocne holomelæna*, *Zosterops scotti*, and *Cinnamopterus tenuirostris*. *Micropus æquatorialis* was not ready to breed until February.

I need not discuss the breeding seasons on the Kivu Volcanoes and other mountains further than to state that similar conditions prevail, although the dates for breeding are probably different in many cases from those on Ruwenzori.

## SUMMARY

In no part of the Congo is there any approach to a universal breeding season, or even a time of year when the great majority of birds are nesting. The region of least seasonal change in this respect is unquestionably the equatorial belt of heavy forest, though conditions may be equally stable in the mountain forests.

Within the lowland forest area certain species appear to breed through the whole year, at least some individuals are nesting in every month. There are even a few species, the males of which seem to have gonads continuously enlarged. Other species may have definite seasons for nesting,<sup>1</sup> despite the little seasonal variation in weather.

In the savanna districts north and south of the forest, each species of bird has a definite season of reproduction, adapted to its special needs. Some prefer dry weather, others the rains; but each has usually one period of the year for breeding. Near the equator on the eastern side of the Congo forest, two dry seasons are more noticeable, and more irregularity in breeding is expected. This is suggested by the molts of some Ploceidæ, especially in the vicinity of Lake Edward.

In North America experiments by Rowan<sup>2</sup> and by Bissonnette<sup>3</sup> seem to prove that lengthening daylight stimulates the gonads of birds and thus determines the breeding season. In equatorial Africa, where there is little or no seasonal change in length of day, this factor cannot conceivably regulate the breeding of sedentary birds.

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<sup>1</sup>Avakubi being in the northern half of the forest belt, the diagrams I have given for breeding in that vicinity may not apply exactly to the forest south of the equator, where one would expect a slight approach to southern seasons.

<sup>2</sup>1928, *Nature*, London, CXXII, pp. 11, 12; 1929, *Proc. Boston Soc. Nat. Hist.*, XXXIX, pp. 151-208.

<sup>3</sup>1931, *Journal of Experimental Zoology*, Philadelphia, LVIII, pp. 281-319; 1931, *Physiological Zoology*, Chicago, IV, pp. 542-574.

## CHAPTER IX.—BIRD MIGRATION IN THE CONGO

### INTRODUCTORY REMARKS

There are regions in Africa where the bird population, like the weather, shows very little seasonal change. Month after month one hears the same bird songs, and the same species of weaver-bird may be watched breeding throughout the year. Yet there—for I speak of the heavy belt of rain forest—a few Ethiopian species appear with seasonal exactitude, like the cattle heron and pennant-winged nightjar, along the rivers or in the gaps hewn by man in the covering of gigantic vegetation. Even more of the migrants from Europe and Asia make regular appearances in the clearings of the forest.

Within only 200 or 300 miles of the equator, moreover, there are open regions where the drying up of the vegetation and its extensive burning by the natives are accompanied not only by the arrival (in the north especially) of a greater number of Palæartic migrants but also by the invasion of a fair proportion of strictly Ethiopian birds. The latter come to spend perhaps a third of the year, some nesting during their visit, while others are just as plainly in the non-breeding period of their annual cycle. There is no chance in this phenomenon, it is as regularly established as the seasons. The importance of migration among the birds of equatorial Africa has not yet been generally appreciated.<sup>1</sup> In the savannas of the Uelle district the migratory Ethiopian species amount to nearly ten per cent of the total number of species living there, which I estimate at some 450. If to this we add the Palæartic migrants, the percentage is more than doubled.

A further evidence of migration may be seen on the larger rivers. Comparison of the water birds to be seen along the upper Congo in July and in December again suggests the existence of seasonal movements right on the equator. In December the crocodiles and hippopotami may be merely hidden in the turbid stream which is now unbroken by a single sand-bar, but certain of the water birds one saw at low-water in July have deserted this part of the river. With the rise of the stream its waters encroach so upon the forested banks that little or no margin is left where the aquatic birds may seek their sustenance. Few of the typical river birds are inclined to venture into the shady forest fastness, where a different set of aquatic species, including *Podica* and *Tigrionis*, hold dominion. Not many hundred miles away there are other rivers, now at a low level, and it is to these that they find their way.

On the central African lakes, in so far as can be gathered from published reports, the water birds are more sedentary than on the rivers

<sup>1</sup>See, for example, A. L. Thomson, 1926, 'Problems of Bird Migration,' where there are brief remarks on pp. 33, 270.

of the Congo and Nile systems. This is the result no doubt of the slighter seasonal variation in level, on Lakes Kivu and Edward especially. Even Lake Tanganyika is not known to change appreciably during the year. Lake Albert, on the other hand, because of its connection with the White and Victoria Niles, does show a marked rise and fall, which affects the population of water birds. Mr. F. François, who was stationed on Lake Albert for the Belgian sanitary service, told me that egrets and other aquatic species, though numerous when the waters had receded, became scarce when the level of the lake rose again.

Nearly eighty years ago Dr. Richard Spruce<sup>1</sup> observed a migration of the American wood ibis between the Amazon and the Orinoco, so timed that the birds were always frequenting rivers at low water. Flocks of ducks sometimes accompanied the wood ibises, and it was thought possible that some smaller aquatic species migrated in a similar fashion. Conditions in Africa have thus their parallel across the Atlantic.

Herbert Lang and I have called attention to the migrations, possibly erratic, of the African fruit bat, *Eidolon helvum*; and I have already treated the general question of bird migration in Africa in the American Museum Journal, XVI, 1916, pp. 540-545. Though I must repeat my earlier statements, they will now be considerably amplified.

In my previous article, I failed to pay tribute to the pioneer in this question for equatorial Africa. It was Emin Pasha, in almost the same regions where I studied the migration of many strictly Ethiopian birds, who first called attention to the widespread seasonal movements of birds in the Equatorial Province of the Egyptian Sudan. In 1916 I was not familiar with his account, which will be found in 'Emin Pasha in Central Africa,' edited by Schweinfurth, Ratzel, Felkin, and Hartlaub, English translation, 1888, p. 392.<sup>2</sup>

Emin attributed the necessity for migration to the lack of fruits and insects during the drought and the territorial requirements of each pair of breeding birds. He called special attention to the movements of *Poliornis* [= *Butastur rufipennis*], *Eurystomus*, *Merops*, *Hyphantornis*, *Euplectes*, *Chrysococcyx*, *Oxylophus* [= *Clamator*], and many waders. *Coturnix delegorguei*, he found, lived through the whole year between Lakes Albert and Victoria, and nested there. Yet it migrated in flocks to the north and south, and was present at 14° in Kordofan in September.

He spoke of the movements of African birds at "local wanderings," and rightly pointed out that the African migrants are inhabitants of

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<sup>1</sup>1908, 'Notes of a Botanist on the Amazon and Andes,' II, p. 376. An extract was republished in 1910, *Ibis*, pp. 212-214.

<sup>2</sup>Thirty-five years earlier, R. Vierthaler, 1853, *Naumannia*, III, pp. 18-22, had called attention to several African migrants near Khartoum.

savanna or steppe, usually not of real forest. This last statement is important. The great forest was found only on the southwestern border of Emin's Equatorial Province, but he was quite correct in stating that the true forest birds are non-migratory. It is only pronounced seasonal change in weather that causes the birds of the tropical zone to migrate, and such changes are mainly confined to the steppes and savannas of Africa. As I have shown in previous articles on this subject,<sup>1</sup> some of the savanna birds, on their migrations, do nevertheless invade the vast belt of equatorial forest. Despite Emin's unfavorable comparison with the Eurasian migrants, a few of the African migrants are true birds of passage.

Except in South Africa, the African migrants have seldom received the consideration they merit. In the published notes by the Verreaux brothers, migratory habits are often briefly mentioned, even more often, I believe, than they exist. Heuglin, Rüppell, and other authors have told of the northward movements of many birds into the Sudan, in the season of rains, and of water birds coming down the Nile with the flooding of that mighty stream. Nearer the equator, it is the period of low water that is most favorable to water birds; yet in both cases the attraction to the birds must be the same, namely, large areas of shallow water and open shore lines, where food can best be sought.

In the Fernand Vaz district of the Gaboon coast, Du Chaillu,<sup>2</sup> for instance, noted that marabou storks, pelicans, sacred ibis, ducks, gulls, flamingos, and the red-breasted bee-eater (*Merops malimbicus*) appeared there in the dry season (late July and early August) though not to be seen during the rains.

Farther south on the west coast the arid condition of the land again emphasizes the need of migration, and many remarks on this subject will be found in Andersson's 'Birds of Damaraland.' It is only in South Africa, where one may speak again of winter and summer, that conditions really begin to parallel those of Europe or other northern continents.

In 1905, at the Johannesburg meeting of the British Association, Mr. W. L. Sclater<sup>3</sup> spoke on this subject. According to his calculation, of the 814 species of birds known to occur in South Africa, 731 are resident, 76 are northern migrants (from Europe and Asia), 21 may be counted as African migrants, 50 as partial migrants or wanderers, and 36 as island breeders (sea birds returning regularly to nest on certain islands off the coast). Even here the proportion of migratory species is

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<sup>1</sup>See also 1916, Bull. Amer. Mus. Nat. Hist., XXXV, p. 73.

<sup>2</sup>1890, 'Adventures in the Great Forest of Equatorial Africa and the Country of the Dwarfs,' pp. 183-185.

<sup>3</sup>1906, Journ. S. Afr. Orn. Union, II, pp. 14-24.

relatively small, particularly after deduction of the Eurasian visitors. Of the latter, but few are suspected of breeding in South Africa, though the bee-eater (*Merops apiaster*) has been known to do so, and probably *Clamator glandarius*, *Ciconia nigra*, and *Crex crex* will also be found breeding. Of the African migrants that visit South Africa in the southern summer, seven species of cuckoos were known to breed, also the swallow, *Hirundo cucullata*.

Of the species visiting South Africa, some are found in equatorial Africa throughout the year, so that we have to do only with an extension of their range. Others, like *Sphenorhynchus abdimii*, perform extended migratory journeys, as I have shown. The South African aspect of the question cannot be overlooked, because the Eurasian species often pass through our territory on the way south, and on their return; further, some of the African migrants to the Cape region must have their winter quarters within our limits.

A brief statement of conditions in South Africa may be taken from Stevenson-Hamilton, 'Animal Life in Africa,' Part 3, 1917, pp. 2, 3. White storks begin to arrive about the middle of October, and depart from February onwards till April. European rollers arrive in October, and leave in March. Bee-eaters (*Merops apiaster*) are resident from October till the beginning of May. European swallows begin to arrive about the end of September, and the last of them leave about the first week in May. These four species traverse the Congo, both coming and going. Of African migrants, the swallow *Hirundo cucullata* remains from September till April in South Africa. Its northward migration cannot take it very far, for it is hardly known beyond Mossamedes and the Zambesi River. The only record from Congo territory is by Mouritz<sup>1</sup> in the Upper Katanga, and that was in December, at the same season when they are said to be nesting in South Africa. The carmine-throated bee-eater (*Merops nubicoides*) spends the period from September to the end of March in South Africa, and there is, in fact, a general arrival of all visitors about the beginning of October, and an exodus at the commencement of the following April. *Merops nubicoides* has been found breeding in November even as far north as the Zambesi. A migratory movement is nevertheless noticeable at the northern edge of its range, for the northernmost records, in the Kwango region, and at the northern end of Lake Tanganyika, are in the months from May to July, inclusive. In the Sudan, it is worthy of remark, this bird's close ally, *Merops nubicus*, makes a corresponding shift of range according to season, not a few going south to the coast of Tanganyika Territory.

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<sup>1</sup>1914, *Ibis*, pp. 30, 37.

It should now be clear that the moist Congo basin lies between two wide drier areas of Africa in which the birds have good reason for migration. These migrants enter the Congo by the northern and the southern borders. A few hail from Madagascar. Add to these the species of Europe and Asia seeking a refuge from the northern winter, and a certain number of native water birds varying locally in abundance according to the level of the great streams. Then one will have a rough idea of what a complex problem the migratory birds offer in many parts of the Congo territory.

#### MIGRATIONAL OBSERVATIONS IN THE NORTHEASTERN CONGO

Aside from Palæartic visitors, among which I early encountered *Actitis hypoleucos* on my way up the Congo River in late July, the migrants first to attract my attention were those in the savannas of the Uelle district. From November, 1910, to July, 1913, we were able to keep track of their appearances and disappearances, with the result that before leaving Africa I had drawn up a list of migratory birds, classified according to season (the northern wet and dry seasons). In reproducing this here, I have only changed the scientific names to correct and to bring them up to date.

#### MIGRATION OF BIRDS IN THE UPPER UELLE AND ITURI DISTRICTS

##### I.—Species passing through the Uelle and Ituri on migration.

EURASIAN	<i>Micropus apus</i>
<i>Ciconia ciconia</i>	<i>Caprimulgus europæus</i>
<i>Pernis apivorus</i>	<i>Motacilla cinerea</i>
<i>Pandion haliaetus</i>	<i>Muscicapa striata</i>
<i>Erythropus vespertinus</i>	<i>Ficedula albicollis</i>
<i>Erolia testacea</i>	<i>Delichon urbica</i>
<i>Pisobia minuta</i>	<i>Lanius minor</i>
<i>Philomachus pugnax</i>	<i>Enneoctonus collaris</i>
<i>Capella gallinago</i>	
<i>Capella media</i>	AFRICAN
<i>Glareola nordmanni</i>	<i>Bubulcus ibis</i>
<i>Chlidonias leucoptera</i>	<i>Anastomus lamelligerus</i>
<i>Coracias garrulus</i>	<i>Sphenorhynchus abdimii</i>
<i>Merops apiaster</i>	<i>Anomalophrys superciliosus</i> (Ituri)
<i>Merops persicus</i>	<i>Cosmetornis vexillarius</i>

II.—Species coming to spend dry season in the Uelle (December-March, roughly). \*Species seen in Ituri forest as well.

## EURASIAN

(none breeding)

- \**Querquedula querquedula*
- \**Buteo buteo vulpinus*
- Aquila nipalensis*
- Circus aeruginosus*
- Circus macrourus*
- Circus pygargus*
- \**Cerchneis tinnunculus tinnunculus*
- \**Cerchneis naumanni*
- Falco subbuteo*
- Coturnix coturnix coturnix*
- Crex crex*
- \**Charadrius hiaticula*
- Charadrius dubius*
- \**Charadrius asiaticus*
- \**Tringa ochropus*
- \**Rhyacophilus glareola*
- \**Actitis hypoleucos* (arrives in July!)
- \**Cuculus canorus*
- Micropus melba melba*
- \**Anthus trivialis*
- \**Motacilla alba alba*
- \**Budytes flavus*
- Budytes feldegg*
- Sylvia borin*
- \**Phylloscopus trochilus*
- \**Phylloscopus sibilatrix*
- Hippolais pallida*
- \**Acrocephalus schænobænus*
- \**Acrocephalus scirpaceus*
- \**Acrocephalus arundinaceus*
- Phænicurus phænicurus*
- \**Saxicola rubetra*
- Œnanthe œnanthe*
- Luscinia megarhyncha*
- Monticola saxatilis*
- \**Riparia riparia*
- \**Hirundo rustica*
- Enneactonotus cristatus isabellinus*
- Enneactonotus senator niloticus*

## AFRICAN

(breeding during their stay)

- Leptoptilos crumeniferus*
- Dissoura episcopus microscelis*
- Milvus ægyptius parasitus*
- Buteo auguralis*
- Neotis cafra denhami*
- Afribyx senegallus senegallus*
- Œdicnemus senegalensis*
- Streptopelia vinacea*
- Halcyon leucocephala leucocephala*
- Lophoceros nasutus nasutus*
- Upupa epops somalensis*
- Macrodipteryx longipennis*
- Hedydipna platura*
- Cinnyris osea decorsei*
- Sitagra atrogularis*
- Fringillaria tahapisi goslingi*

## AFRICAN

(not known to breed in Uelle)

- \**Ardeola ralloides*
- \**Phalacrocorax africanus*
- \**Anhinga rufa*
- \**Ardea melanocephala*
- \**Sarkidiornis melanotos*
- Meliëraz metabates metabates*
- Butastur rufipennis*
- Aquila rapax raptor*
- Cerchneis alopex*
- Falco biarmicus abyssinicus*
- Coturnix delegorguei*
- Cuculus gularis*
- Coracias abyssinicus*
- Merops nubicus*
- \**Aerops albicollis*
- Caprimulgus inornatus*

## III.—Species coming to spend part of rainy season in the Uelle.

EURASIAN	AFRICAN
<i>Micropus apus</i> (arrives in Uelle in August, but continues southward)	<i>Eurystomus afer</i> (migratory only in N. E. Uelle)
	<i>Cosmetornis vexillarius</i>
MADAGASCAN	<i>Tchitrea viridis plumbeiceps</i>
<i>Eurystomus glaucurus</i>	<i>Pseudhirundo griseopyga</i> (arrives in March)

## IV.—Species arriving in Uelle savannas late in the rains, remaining until January only.

AFRICAN
<i>Pytilia phænicoptera emini</i> (Uelle, Oct. to Jan., breeds)
<i>Hypochera camerunensis</i> (Uelle, Aug. to Jan., breeds)
<i>Steganura aucupum interjecta</i> (Uelle, Nov. to Dec., not known to breed)

## V.—Species of Irregular Occurrence in Ituri or Uelle, probably migratory.

UELLE	ITURI
<i>Pyrhrherodia purpurea</i>	<i>Egretta garzetta</i>
<i>Ibis ibis</i>	<i>Mesophoyx intermedius</i>
<i>Ephippiorhynchus senegalensis</i>	<i>Casmerodius albus</i>
<i>Threskiornis æthiopicus</i>	<i>Pyrhrherodia purpurea</i>
<i>Alopochen ægyptiacus</i>	<i>Threskiornis æthiopicus</i>
<i>Hoplopterus spinosus</i>	<i>Dendrocygna viduata</i>
<i>Himantopus himantopus</i>	<i>Hæmatopus ostralegus</i> (accidental)
<i>Pluvianus ægyptius</i>	<i>Halcyon leucocephala pallidiventris</i>
<i>Creatophora carunculata</i>	<i>Lamprocolius splendidus</i> (migratory locally)

The foregoing list of migrants was made in a region immediately adjoining, almost overlapping, that in which Emin worked in the Equatorial Province, some thirty years before me. It shows that there, in a region scarcely reaching more than four degrees north of the equator, we have about forty Ethiopian species plainly migratory in habit, with another sixteen less certainly so. This compares well with the number Sclater recorded in South Africa.

Our list did not, of course, indicate from what distance the African migrants come. This could be determined only after my return, by looking up the known ranges of the species, and the dates of capture in other districts, so far as these could be culled from the literature. Since many of the species are only known from the northern half of the continent, or the Sudan and adjoining regions, it is clear that many of the migrations may not involve a journey of more than a few hundred miles.

This is a very short distance as compared with the extent of the ranges of some of the species, reaching often across almost the whole Sudan. Yet while the movements may be called local, they are of surprising regularity, comparable in this respect with those of the Eurasian migrants.

The finest confirmation of my migrational observations came through the work of Admiral H. Lynes<sup>1</sup> in Darfur. No better country could have been chosen with which to compare conditions in the Upper Uelle district, for it is near the northern end of the region over which many of our African migrants travel so regularly. Our observations in the Uelle from 1910 to 1913 furnish answers to most of the questions so aptly stated by Admiral Lynes.

Some of the migratory species are wide-ranging, distributed over great areas of the grass-country, both north and south of the equator; and it is in such cases that the longest migrations are to be looked for. Sometimes one is disappointed—the case of the common kite (*Milvus ægyptius parasitus*) did not give the clean-cut results I had hoped for. In the majority of cases the migratory movement consists in approaching the edge of the equatorial forest during the time of drought, sometimes to nest there, sometimes to pass the non-breeding period of the year. In a certain number of other cases the African migrants have nevertheless discovered the route from one hemisphere to the other, crossing the forest belt in the Congo basin, which ordinarily is an impassable barrier to savanna birds. The best examples are *Sphenorhynchus abdimii* and *Aerops albicollis*, species which nest north of the equator, and *Anastomus lamelligerus* and *Cosmetornis vexillarius*, among those whose young are hatched only to the south. The cattle heron (*Bubulcus*) is migratory, but nests in eastern equatorial Africa as well. The less pronounced seasonal changes so close to the equator may not make it imperative for them to migrate from that part of the continent.

At the bases of mountain ranges in the north temperate zone a seasonal movement of birds is sometimes noted, which is called altitudinal migration. Some of the montane birds descend for the winter into the warmer lowlands. In equatorial Africa such migrations are virtually unknown. In the Rutshuru Valley at 3700 feet, toward the end of March, I have seen flocks of *Columba arquatrix*, a pigeon that usually remains above 5000 feet. Dr. Schouteden has reported that during his visit to the Kivu Volcanoes he found *Ruwenzorornis j. kivuensis* in numbers in the lower mountain forest near Lulenga, and a few even as low as 6000 feet. At other seasons it does not seem to come below 7500 feet, so possibly there was some special fruit to attract it.

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<sup>1</sup>See especially Lynes, 1925, *Ibis*, pp. 775-783; but also his other notes in *Ibis*, 1924-1926.

## NOTES ON ETHIOPIAN MIGRANTS

To take a broader view of the African migrants and their movements in the Congo, we shall classify them first according to the hemispheres in which they breed, northern or southern, or both. The next point of distinction is whether or not their journeys carry them across the equatorial forest. A few examples of each class will be offered here, more particulars being added in the systematic section.

## 1.—NESTING BOTH NORTH AND SOUTH OF THE CONGO FOREST, BUT NOT CROSSING IT

<i>Leptoptilos crumeniferus</i>	<i>Coturnix delegorguei delegorguei</i>
<i>Dissoura episcopus microscelis</i>	<i>Cuculus gularis</i>
<i>Buteo auguralis</i>	<i>Eurystomus afer</i> (distinct races)
<i>Lophoceros nasutus</i> (distinct races)	<i>Merops malimbicus</i>
<i>Ardea melanocephala</i>	<i>Steganura aucupum</i> (distinct races)
<i>Aquila rapax</i> (distinct races)	<i>Pseudhirundo griseopyga</i>
<i>Falco biarmicus</i> (distinct races)	

## Examples

*Leptoptilos crumeniferus*.—The marabou stork is so much a bird of savanna country that the only place in the Congo forest where it is found seems to be near Nouvelle Anvers, on a very broad part of the Congo River. In the Uelle this species is distinctly migratory, appearing each year about December, at the end of the rains. Its nesting begins in January, and young may still be seen in April; but soon thereafter the birds all disappear again. In Haussa Land, Hartert found conditions similar, while Heuglin's remarks show how the marabous move northward in the Sudan during the early rains, to the plains between the Atbara and southern Nubia. Marabous are found in Kenya Colony in August, so they do not quit this drier region as they do the northeastern Congo. South of the Congo forest a similar migration may be expected, but has not yet been definitely established. The species is rare in South Africa, and not known to nest there. It does breed, however, in Nyasaland, and near the southeastern border of the Congo, where Neave reported a young bird that had been taken from the nest by natives. It also nests near Kilimanjaro in East Africa.

*Ardea melanocephala*.—This heron occurs in the forest area only sparingly, and at no fixed season. It certainly does not breed there, nor does it even in the Uelle savannas, where it is a regular visitor during the dry season, from early November till the end of April. In the Sudan it extends its range northward during the rainy season, when it nests in

Kordofan and neighboring areas. North of the forest there is, thus, a regular migration, but in East Africa this seems less true, and the species nests there, as it also does in Uganda and on Lake Tanganyika. It has been said to breed as far south as the Berg River in South Africa.

*Coturnix d. delegorguei*.—Observed in the Uelle only during the latter part of the dry season. A little later, according to Heuglin, they

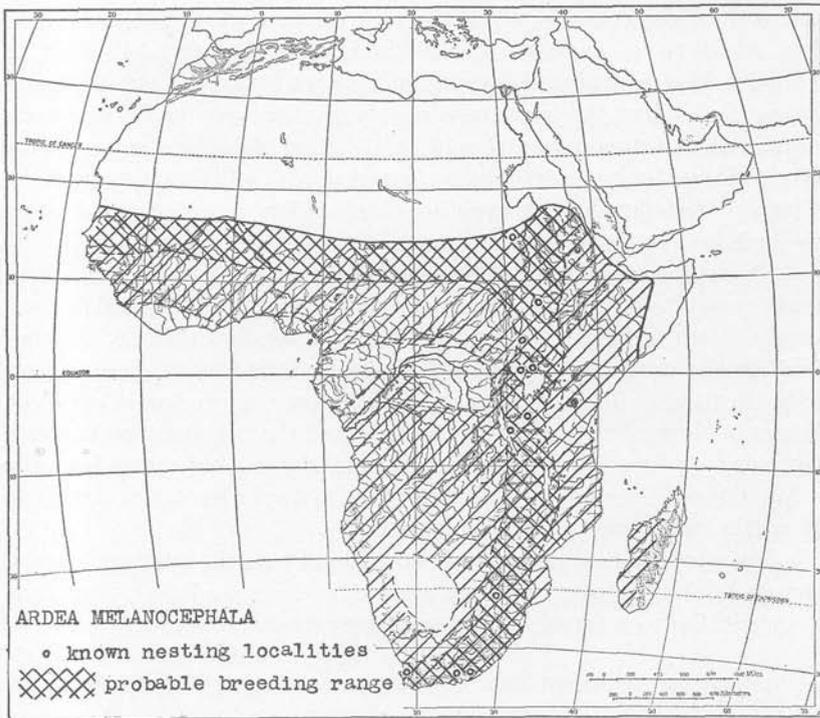


Fig. 160. Distribution of the black-headed heron, which breeds from the equator northward from May to July, and in southern Africa from September to December. Non-breeding birds wander widely, even into the borders of the Lower Guinea forest.

seem to appear in northeast Africa, and breed toward August or September. There does seem to be a true migration, as has been also stated for South Africa, where their movements coincide with the rains. In East Africa the species is said to be resident and to breed, so that the migratory journeys of the northern and southern birds are quite independent, more so than Emin's account would indicate.

*Merops malimbicus*.—This crimson-breasted bee-eater I have seen along the Upper Congo, near Lukolela and in the Bangala country, from July to early April, at least. It probably nests toward March. I could not see any evidence of migration. In the Fernand Vaz region of the Gaboon, Mr. Aschemeier tells me, it is present during only a part of the year, three months at most. He collected specimens from September 15 to November 17. It will be recalled that Du Chaillu also said this species visited the Gaboon coast only at the time of low water, this I am told is from mid-July to October. Near Landana, according to L. Petit, it arrived in May, and nested later in the banks at Malimbe; but it was not present throughout the year, and certainly wanting towards February and March. This latter period should be the time of highest water in the rivers. Since the species ranges northwest to the Gold Coast, it would be of interest to follow up this question of migration, to determine whither the birds betake themselves.

*Steganura a. interjecta*.—The broad-tailed paradise whydahs occur from Senegal to Eritrea and south through East Africa to Gazaland and Angola. In the Belgian Congo we find a long-tailed race (*S. a. interjecta*) on the northern border, and a broader-tailed form (*S. a. obtusa*) in the southeast. The northern race is migratory, appearing in the Uelle district in November, and leaving again about the beginning of January. It gives no evidence of breeding at this time, and can only come from the Sudan, but not from any great distance, since its place is taken farther to the northeast by another distinct race.

The southern race (*obtusa*) has been found near the northern edge of its range, in the Manyema, Kasai, and on the Kwango River, from June to August, but to what extent it is migratory we do not know.

## 2.—NESTING BOTH NORTH AND SOUTH, BUT SOME INDIVIDUALS CROSSING THE CONGO FOREST

*Bubulcus ibis*

*Ardeola ralloides*

*Milvus ægyptius parasitus*.

### Examples

*Bubulcus ibis*.—I have never seen the cattle heron breeding in the Congo, but noted birds in nuptial dress on Lake Kivu in July. In the forest belt it appears annually in November and December, and again in April or early May. These are northern-breeding birds, as shown by the appearance of the nuptial plumes only in April. In the Cameroon, Bates has made similar observations. Just to the south of the forest, on

the Lualaba, Bequaert has noted them in December and January, apparently "wintering." North of the forest in the Uelle the birds are still transient, and the breeding grounds of these individuals are doubtless in the Sudan, where, according to Heuglin, they breed between  $14^{\circ}$  and  $18^{\circ}$  N. lat. Others are believed to nest in northern Haussa Land and on the Upper Niger. East African birds do not follow this itinerary, but

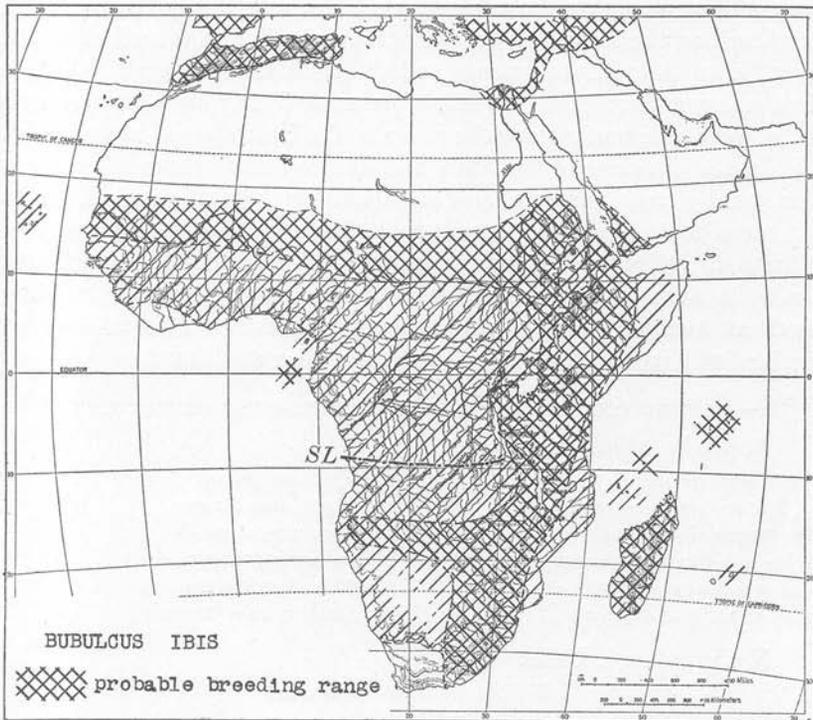


Fig. 161. Distribution of the cattle heron in Africa. Many migrants from the north cross the Lower Guinea forest and seem to reach the line SL.

seem to nest on the equator. The Egyptian cattle herons, too, are said to be resident.

In South Africa the cattle heron is rather common, and it has been found breeding in Natal and on the Vaal River in October and November. South African birds are probably migratory, and some may come north to the southern edge of the Congo forest, although there are few published records of occurrence in the Upper Katanga. It is not difficult to

imagine that in the course of time these distinct communities may become separate geographic races.

*Milvus ægyptius parasitus*.—In the savannas which border on the Congo forest, both north and south, it is a rule that the yellow-billed kites are abundant in the dry season, but disappear early in the rains. Yet the majority cannot simply migrate from one side of the equatorial forest to the other, for in southern Africa, as well as in the Sudan, there are numbers present in the rainy season. It is more likely that both the northern and the southern birds withdraw from the neighborhood of the forest when the rains commence and the grass starts to grow. At this time many of them have just finished rearing their young, for nests are to be found commonly along the rivers of the Uelle system in February.

In the clearings of the Ituri and Congo forests these kites occur occasionally, usually singly, and at almost any time of year. They do not breed there. At times considerable flocks are seen flying over in a definite direction, and there may be a migration across the Ituri forest. Twice, in August, I watched flocks of from thirty to seventy traveling south at Avakubi; and on the slopes of Ruwenzori I have observed similar but larger flocks in late July, journeying southward.

### 3.—NESTING ONLY IN THE NORTH, NOT CROSSING CONGO FOREST

#### Forms breeding in the Uelle:

<i>Neotis cafra denhami</i>	<i>Hedydipna platura</i>
<i>Afribyx senegallus senegallus</i>	<i>Cinnyris osea decorsei</i>
<i>Streptopelia vinacea barbaru</i>	<i>Sitagra atrogularis</i>
<i>Halcyon leucocephala leucocephala</i>	<i>Fringillaria tahapisi goslingi</i>
<i>Upupa epops somalensis</i>	<i>Pytilia phænicoptera emini</i>
<i>Macrodipteryx longipennis</i>	<i>Hypochera camerunensis</i>

#### Not breeding in Uelle:

*Meliærax metabates metabates*  
*Butastur rufipennis*  
*Coracias abyssinicus*  
*Merops nubicus*  
*Caprimulgus inornatus*

#### Examples

*Neotis cafra denhami*.—This is the large bustard which occupies the savannas of the Uelle district during the dry season, arriving in late November from the north, since we are here on the southern border of its known range. It does not come here to "winter," however, for eggs are laid in January; and until April the birds are occupied with the rearing of their young. By the end of May all have quit the district.

For another race of this species, *N. c. jacksoni*, there are a few records along the borders of the Kivu region; but in the southern Congo it appears to be rare, and there is no indication of any migration.

*Streptopelia vinacea barbaru*.—Although abundant in the Uelle district during the dry season, this dove deserts the region by the latter part of April, and is seen again only in August or September. It arrives therefore at the time of heaviest rains, to announce, as it were, the coming

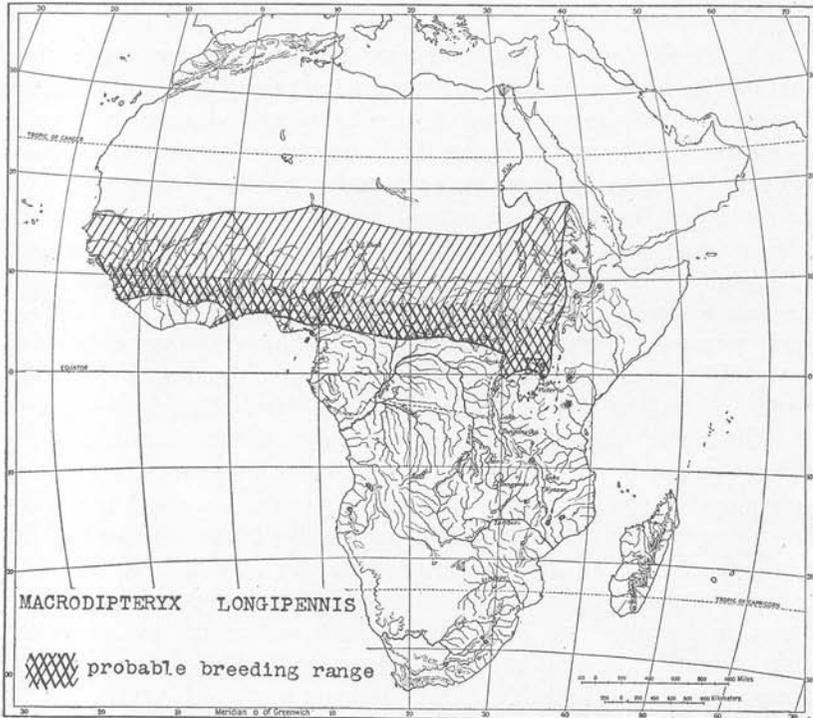


Fig. 162. Range of the standard-wing nightjar. It is known to breed only in the southern part of this area, from February to April, the latter half of the dry season.

of the drought. Nesting, too, is begun in October, which is still a very wet month. The species being characteristic of the Sudan, these migrants can come only from the north.

*Macrodipteryx longipennis*.—This striking goatsucker of the Sudan comes southward into the Uelle every year at the beginning of December. During that month the males are found to be growing their lengthened, racquet-tipped primaries. In February and March they are rearing

their young, and in early April they all take leave together. At this time a northward movement is also noticeable in the Bahr-el-Ghazal Province, for Butler<sup>1</sup> noted that they did not put in appearance near Chak Chak and Meshra-el-Rek (8°–9° N. lat.) until March 5, after which date they became common. It is only the forest which prevents the further southward movement of these birds. In Uganda the southernmost records are from Toro, within less than one degree of the equator, and the birds were taken there only on January 26 and March 10, dates that fall within the usual southern sojourn.

*Hedydipna platura*.—Being likewise a Sudanese species, this sunbird must hail from the north when it arrives in the Uelle district in December. It spends but three and one-half months, though during this time it rears a brood of young. During the latter part of its stay, the bushes and trees of the savanna are putting forth a wealth of blossoms, yet it cannot be said that this is the cause of migration. I believe this sunbird to be less dependent upon flowers than many of the longer-billed members of its family.

*Cinnyris osea decorsei*.—This race of the Palestine sunbird differs so much from the Asiatic form that it cannot be simply a winter migrant to central Africa, as one might at first suppose. It comes to the Uelle district around the 10th of October. I had no doubt that it nested here, for while it showed no indication of breeding in October, adult males in January and February had large testes. Soon afterward the birds all disappeared, after the commencement of rains none was to be seen. The form was known only from French Equatorial Africa, the Bahr-el-Ghazal, and Lado district, so the presumption was that we had to do with a Sudanese migrant. Now Admiral Lynes has found it appearing on Jebel Marra, in Darfur, from November to January, nesting in December. These cannot be the same individuals that visit the Uelle, so the question becomes more complicated. Do they summer north of Darfur?

*Hypochera camerunensis*.—Every year these little black weaver-finches arrive in the Upper Uelle district about the first week in September. They are in flocks, but the black males have enlarged gonads; and the fully fledged young will be found in December. During their stay they continue in flocks, but the species must be parasitic like *Vidua* and *Steganura*, and so may nevertheless breed at this time. Their departure takes place in early January; but where they spend the remainder of the year is in doubt, for in the Bahr-el-Ghazal this species is still unknown, and birds most nearly resembling those of the Uelle come from

<sup>1</sup>1908, *Ibis*, p. 240.

the savannas south of the Congo forest. Lack of any records in the clearings of the forest prevents a possibility that they migrate over the forest.

*Meliërax metabates metabates*.—During two years we noted the arrival of this Sudanese hawk at Faradje, in the northeastern Uelle, in late November and early December, and its disappearance in the latter part of April. Brown immature birds are even more numerous than the blue-gray adults, and the latter were never heard to utter the musical piping note which Heuglin described from the Sudan. It is clear that they do not breed in this southern part of their range; whereas *Buteo auguralis*, which comes south at much the same period, does rear its young in the Congo territory. Some difference in feeding habits may be at the bottom of the matter, yet we did not note any important distinction in this regard. Both species ate small mammals, birds, reptiles, and insects, though the proportion of lizards to the rest of the food is higher in *Meliërax*. Neither does *Butastur rufipennis* have young during its southern sojourn, but here we have to do with a species that is almost entirely insectivorous.

*Butastur rufipennis*.—The migratory habit was already noticed by Emin, but he considered the bird's real home as the country near Latuka, east of the Bahr-el-Jebel. This is more probably its "winter" range, for, so far as is known, the nesting of the species occurs farther north, in the neighborhood of Khartoum on the White Nile, and even as far west as Kati (12° 50' N. lat., 8° 10' W. long.) in the French Sudan. A. L. Butler has described the disappearance of the species from the White Nile in October or early November, and it is in this latter month that it makes its appearance at Faradje. From early December to the end of March it is one of the abundant raptorial birds of the Uelle, but it never nests there. In eastern Africa, the species is now known to wander as far south as Morogoro in Tanganyika Territory.

*Merops nubicus*.—The rosy bee-eater of the Upper Nile appears regularly in the Uelle late in the rainy season. Our earliest record was September 9. It becomes fairly numerous in the dry season, when its hunting is aided by the grass fires, and in February the gonads begin to enlarge, showing the reproductive season to be near. On one occasion, in the latter part of February, I saw over thirty which had been captured by natives, and I supposed they must have been nesting. I am now inclined to doubt this, for shortly after this date the species always disappeared, we took no very young birds, and the species is recorded by Heuglin as nesting in the Sudan from March to August. The records in

Slater and Praed's 'List of the Birds of the Anglo-Egyptian Sudan,' Ibis, 1918-1920, also show that the species is present in Sennar and Kassala in May and June. See Fig. 167.

*Caprimulgus inornatus*.—Its "summer" range extends from southwestern Arabia and Eritrea westward across the Sudan to Asben. In the

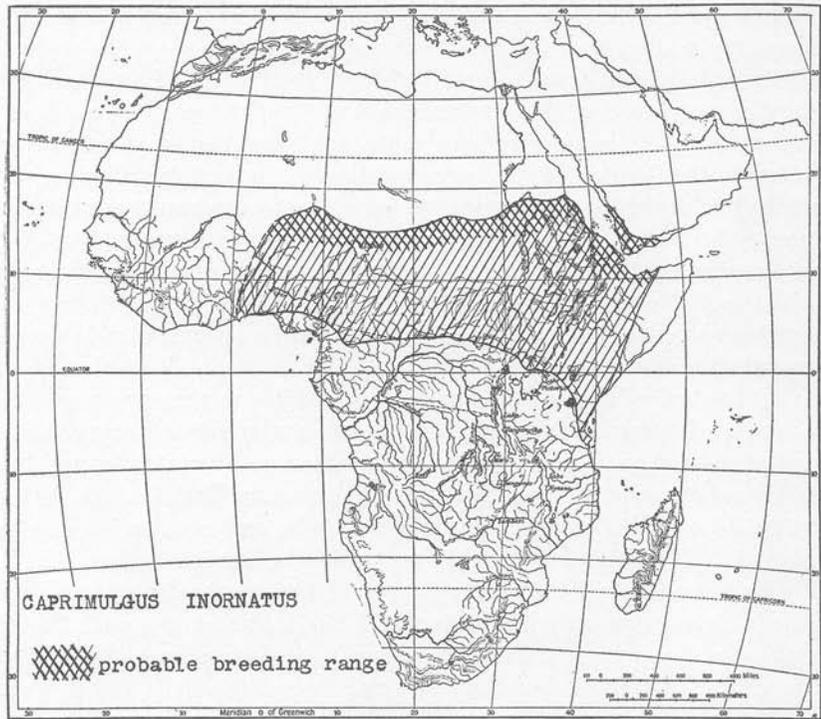


Fig. 163. Range of the plain nightjar. Migrating southward at the same season as the standard-wing, it has already finished nesting in the northern part of its range during the rainy season.

Cameroon and Uelle it occurs only from November to April, and does not breed. This southern movement extends to Kenya Colony and Usaramo in Tanganyika Territory, but does not cross the Congo Forest.

4.—NESTING ONLY IN THE NORTH, BUT MANY INDIVIDUALS CROSSING  
EQUATOR

*Sphenorhynchus abdîmii*

*Aerops albicollis*

## Examples

*Sphenorhynchus abdimii*.—Though listed by Sclater as a migrant in South Africa, this stork does not nest there, nor indeed anywhere save in the Sudan, west to northern Nigeria, and even to Kong, north of the Ivory Coast. The greater part of the African continent south of the desert is visited during this bird's extensive migrations, and we have

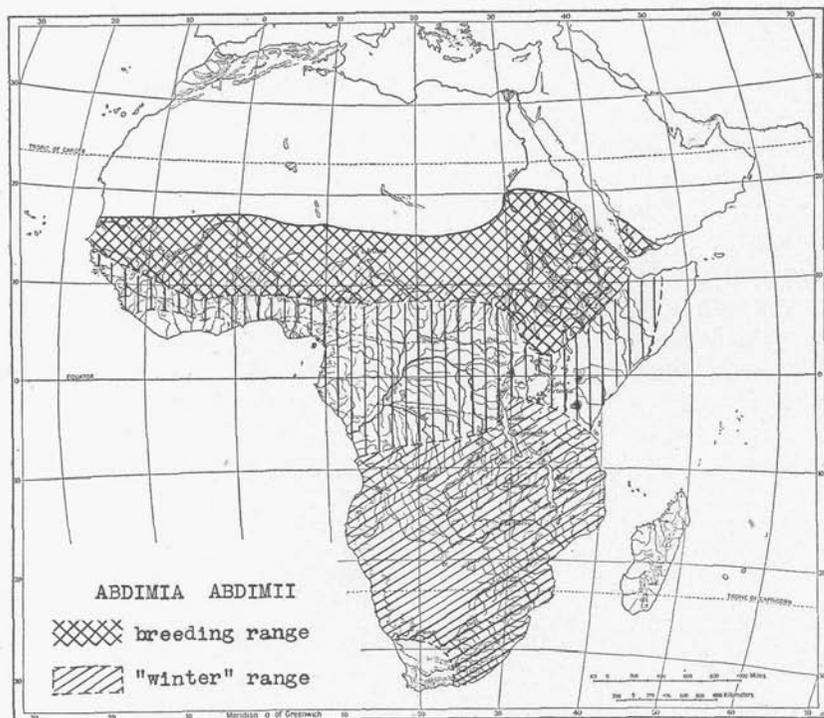


Fig. 164. Distribution of Abdim's stork, showing the large area in equatorial Africa where it is merely a bird of passage.

found that these are extremely regular. In the Upper Congo these little black storks are seen at two seasons: in March and April, then again in October and November. The breeding season in the north is shown by actual observations of nests to last from May to September, and the condition of birds taken in the Congo agrees with these facts. While, for the most part, a savanna bird, Abdim's stork migrates over the forest as well, for we saw it in clearings of the Ituri forest and at Lukolela. By

thus deserting the Sudan at the time of drought, and extending its travels so far south, it finds itself in countries of moderate rainfall throughout the year. In tastes this stork is far more insectivorous than piscivorous.

*Aerops albicollis*.—The fact that eastern and western forms of this bee-eater may be separable on the length of wing has no importance with regard to its migration. Both races come south after nesting in the Sudan, arriving in the northern Congo in late October, when so many Palæartic birds likewise appear, that at first I took this species for one of them. It is, however, a truly Ethiopian species, whose breeding range, occupied from July to September (the rainy season there) extends from southern Arabia and Abyssinia westward with certainty to Asben, and doubtless to Senegal. After rearing its young it starts southward, and instead of halting when it encounters the equatorial forest, it moves onward, occupying the clearings of the forest from November to April, while many individuals even reach the savannas to the southward, and may go ten degrees beyond the equator. Thus to the south of the forest they profit by the rains then in progress, which are favorable to insect life; and in the clearings of the forest, of course, the weather is never too dry. Here again the adaptation to climatic conditions is clear.

5.—NESTING IN THE SOUTH, BUT MANY INDIVIDUALS CROSSING EQUATOR

*Morus capensis*  
*Anastomus l. lamelligerus*  
*Caprimulgus r. rufigena*  
*Cosmetornis vezillarius*  
*Tchitrea viridis plumbeiceps*  
*Hirundo atrocærulea*

Examples

*Morus capensis*.—Of the "island breeders" of South Africa, this is perhaps the only one that regularly migrates northward beyond the mouth of the Congo. I have seen a specimen taken at Bibundi, west of Mt. Cameroon, in latitude 4° 20' N., and seven more collected at Batanga on the Cameroon coast. The Cape gannet nests on the islands off the coast of Great Namaqualand, and on Bird Island in Algoa Bay, beginning toward the first of September. Not only the immature birds, but many adults as well, migrate northward after the breeding season along both coasts, and on the west they are found near Banana and Landana from May to November, inclusive. I have watched large flocks of them off the Gaboon coast in June, while Lang in September secured adult specimens inside the point at Banana. They seem never to ascend the river farther.

Further study at the Congo mouth may show that other water birds of the southwest coast, such as cormorants and terns, are migratory; but few of them range beyond the equator.

*Anastomus lamelligerus lamelligerus*.—The open-bill stork, despite its reputation as one of the most characteristic of aquatic birds in Africa, was found by us in the Ituri and Uelle districts only sparingly from October to January. It seemed to be merely a bird of passage, and after careful searching through the ornithological literature, I find no record of its nesting anywhere save in the southern half of Africa. Though often encountered in numbers on the Upper Nile it would seem to reach there only as a migrant.

In the upper Zambesi Valley Livingstone related how at Chitlane's, in the Barotse country, 175 young birds of this species were gathered by natives, at the end of July. Again in August, 1859, in the Shire River marshes, the same explorer told of vast flocks of *Anastomus*, which nested in colonies there. It is also abundant on the Lualaba River in August. In these latitudes some of the birds are present throughout the year; but it is certain that many of them travel northward, even to the northern Sudan, where Heuglin was unable to secure any evidence of their breeding. The Sudan records with dates which I have found extend from December to May, inclusive, and Hartert has reported the species from the Benue River in June. This is in agreement with the data as to the breeding season in southern Africa. At this same non-breeding time of year a few individuals even wander southward, for they have been taken then in Natal and the Transvaal.

It is to be noted that this migration may be timed in accordance with the drying up of the rivers, a feature of the utmost importance to a stork that feeds almost exclusively on aquatic mollusks. It would nest in the south during the dry season, and arrive in the Sudan at the beginning of the corresponding period.

*Caprimulgus r. rufigena*.—This goatsucker inhabits southern Africa, north to the Katanga and Angola, and has been taken by Bates at Bitye, southern Cameroon, in May, as well as near Yola, eastern Nigeria, in July, and by Lynes in Darfur in June and July. Lynes' three specimens were molting. A male in the Congo Museum was taken near Bolobo on the Congo River.

*Cosmetornis vexillarius*.—That the rainy portion of the year is the more favorable season for most insectivorous birds I have already shown. But among the insects most popular with birds, and with birds of the most diverse families, we must count the termites. It is the winged

sexual brood that are not only the most palatable, but likewise the most easily hunted, as they start with fluttering flight on their perilous marital voyages. These flights are most abundant during the early part of the rains, and take place for the most part in cloudy weather or at nightfall. So it is not unnatural that one bird of crepuscular habits and insectivor-

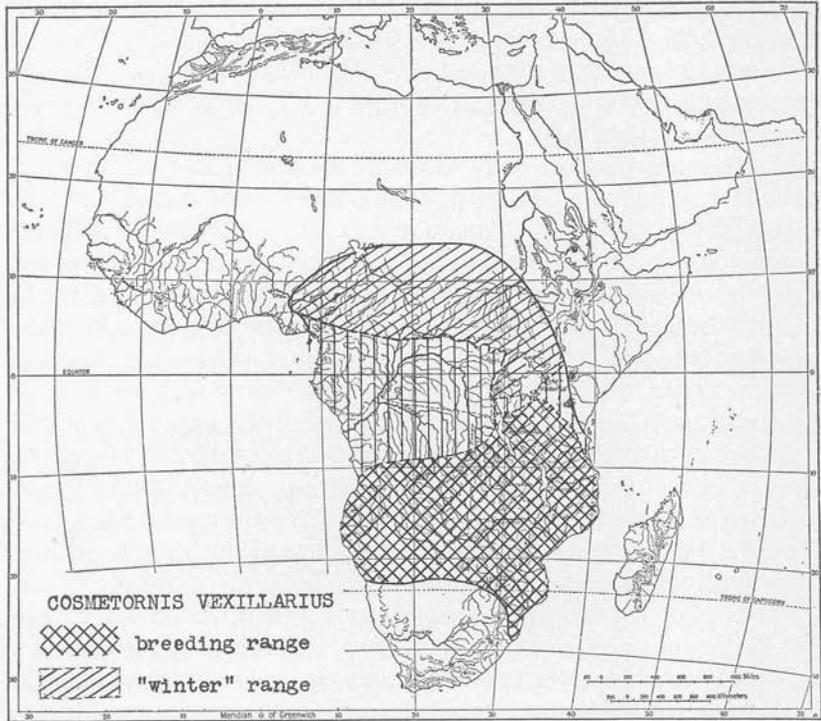


Fig. 165. Seasonal distribution of the pennant-winged nightjar. In the area marked with vertical lines it is only a transient.

ous diet should have arranged its migrations in accordance with the seasonal abundance of winged termites.

Such is the case with the pennant-winged nightjar, which breeds from September to November in the southern savannas, from Lake Tanganyika to Mashonaland, perhaps also from Angola to Damaraland and the Transvaal. This is of course the early part of the rainy season. Having reared their young, many, or perhaps most of the birds start north to catch the early rains in the northern savanna. Across a large

part of their highway stretches the great forest, where dwell but very few Caprimulgidæ. Traveling by dusk, however, they make their way even across this inhospitable territory, tarrying by day in such clearings as they find, often nothing more than a swamp where elephants and buffaloes, coming to wallow, have thinned out the vegetation. The equatorial part of the Congo is crossed on the northward journey in February and March, and in the latter month the species makes its

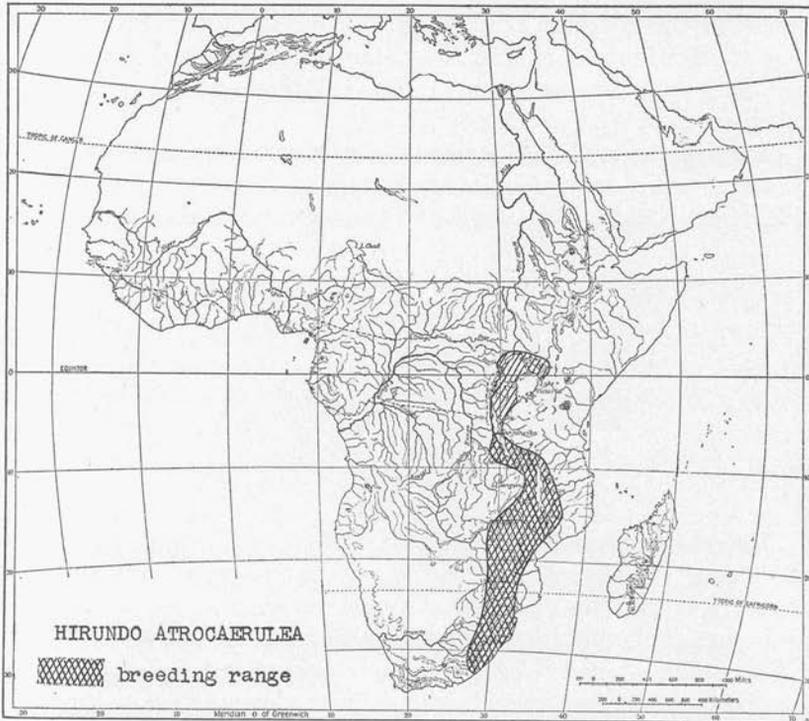


Fig. 166. Distribution of the blue swallow, which migrates north in the off-season to the eastern Ituri district and Uganda.

appearance in the savannas of the Uelle and the adjacent parts of the Anglo-Egyptian Sudan. The northern limits of this movement are approximately the Benue River and Darfur. Here the birds arrive in worn plumage, the ornamental plumes of the males often broken off short. These they soon begin to molt, and during this time a bountiful diet of winged termites causes them to fatten gluttonously. The little dry season of July comes and goes. The long wing-feathers have again

reached their full length, when suddenly the birds diminish in numbers so that by early September practically all have left. The southward migration really begins in July, as may be seen in the forested Ituri, when the first travelers reappear. Often they pass over in pairs, doubtless already mated, flying of course at dusk. They lose little time in regaining their southern breeding grounds, where they arrive likewise as the season opens for their favorite insect prey.

*Tchitrea viridis plumbeiceps*.—There has been some doubt as to the position of this southern race, because of records within the breeding range of other forms of *viridis*. These seem to be non-breeding individuals which wander northward as far as Mombasa, the Uelle, and Cameroon, from April to October.

*Hirundo atrocærulea*.—Numerous from July to September in Uganda and the savannas west of Lake Albert, this swallow breeds in southern Africa, from Natal to Nyasaland, and probably also in Marungu.

#### 6.—NESTING IN THE SOUTH, SELDOM CROSSING EQUATOR

*Chlidonias leucopareia sclateri*  
*Halcyon leucocephala pallidiventris*  
*Merops nubicoides*  
*Hirundo cucullata* (?)  
*Fringillaria tahapisi tahapisi*  
*Fringillaria impetuani*

#### Examples

*Halcyon leucocephala pallidiventris*.—This southern race is so strikingly different from typical *leucocephala* of the Sudan and Uelle that one is tempted to treat them as distinct though representative species. The gap is partially bridged, however, by other races in East Africa. *H. l. pallidiventris* was listed by Sclater as migratory in South Africa, occurring there between October and March. I find no mention of its breeding there, and I believe it to nest at the northern edge of its range, just as *leucocephala* chooses the region nearest the forest for its nesting. *H. l. pallidiventris* has, at any rate, been taken near the base of Ruwenzori in May, July, and August. Near the northern end of Lake Tanganyika and in the Kasai district it has been collected from May to September. These it will be seen are just the months when it is absent from South Africa. There is one further peculiarity about this migration. A few examples have been taken along the northern edge of the Congo forest, in July and August, where their occurrence is at most only erratic, if not accidental.

*Merops nubicoides*.—While only listed by Sclater among his "partial migrants," it seems that this is a regular migrant. In South Africa it arrives in October or November, breeding there, and leaving again in March. Its breeding range extends northward to the Zambesi, or even to the Loangwa River; but from April to July it has been found at the northern end of Lake Tanganyika and in the Manyema, where I do not

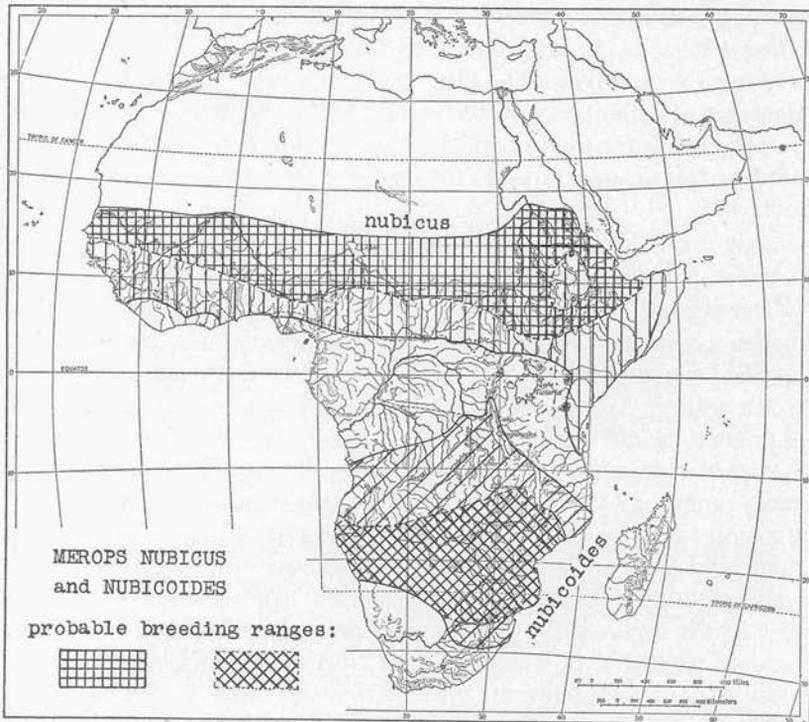


Fig. 167. Seasonal distribution of the carmine bee-eaters, both somewhat migratory, and nesting at opposite periods of the year.

know of its breeding. In July, also, Mechow took this bee-eater on the Kwango River, which borders a part of the Congo on the southeast.

*Fringillaria t. tahapisi*.—From the savannas of the Gaboon and Lower Congo this little brown bunting ranges south to the eastern part of Cape Colony, and in East Africa it occurs far north of the equator. Though not stated to be migratory in the south, and known to have bred in Upper Natal in November, it does seem to be of only seasonal occur-

rence in the Lower Congo. We saw none whatever in June, 1909, whereas in December, 1914 it was a common bird in the streets of Matadi. This is borne out by a number of published dates of occurrence along the northern edge of the bird's range. On the lower Congo River specimens have been collected from November 5 to April. Those taken by us in late November were non-breeding, but they may nest there later.

In East Africa and along the eastern Congo border it appears to be sedentary. Neave has recorded specimens taken in the Katanga and northeast Rhodesia in May, July, and September.

*Fringillaria impetuani*.—Five specimens were taken by Father Callewaert at Luluabourg in the second half of September. These are the only records for the Congo, the range of the species in South Africa extending from Damaraland to the Orange Free State and western Cape Province.

#### African Migrants in the Southern Congo

Our present inadequate knowledge of bird migration in the southern Guinean savanna of the Congo and northern Angola does not permit of a detailed comparison between conditions in the north and south of the Belgian colony. It is possible that fewer species on our southern border will prove to be distinctly migratory. In any case it must be noted that the transition from humid forest to arid conditions of steppe and desert is more rapid in the northern half of the continent than in the southern, if we except the dry coastal strip of Angola. Such changes as are found within ten degrees of the equator in the Sudan would scarcely be equalled in going eighteen degrees south into Rhodesia. The isolation of the Cape region by the arid country of Namaqualand and the Kalahari is slight as compared with that of Mediterranean North Africa. Through south-eastern Africa the way is quite open, without any desert whatever.

The more uniform climate of southern Africa therefore tends toward a wider and more unified distribution of the Ethiopian fauna in the south. The savanna region is much wider, and the greater extension of the gallery forests and other outliers of the equatorial forest in the southern part of the Congo basin may discourage invasion by the steppe fauna during the dry season. Still, the status of many of the South African migrants listed by Selater, at the northern edge of their ranges, is a promising field for study.

## 7.—PARTIAL MIGRANTS, WITH ITINERARIES STILL IN DOUBT

<i>Phalacrocorax africanus</i>	<i>Sarkidiornis melanotos</i>
<i>Anhinga rufa rufa</i>	<i>Dendrocygna viduata</i>
<i>Threskiornis æthiopicus</i>	<i>Anomalophrys superciliosus</i>
<i>Casmerodius albus</i>	<i>Pluvianus ægyptius</i>
<i>Egretta garzetta</i>	<i>Rynchops flavirostris</i>
<i>Mesophoyx intermedius</i>	<i>Pseudochelidon eurystomina</i>
	<i>Lamprocolius splendidus</i>

## Examples

*Phalacrocorax africanus*.—In the northeastern Congo there is no record or even indication of the breeding of this pygmy cormorant. I never saw a specimen there in full breeding dress, though the birds are present during a considerable part of the year. In the Uelle basin they are wholly absent during the full flood of the rivers, or from June until the middle of December. On the Ituri River, which is farther south, they do not quite disappear at this time, a few being seen in August, September, and October. On the Congo River, too, at one degree north of the equator, I have seen them in July.

The migration of this cormorant would thus seem to depend on the level of the rivers; and so in December, at the time of flood, I have traveled from Stanleyville to Kinshasa, some nine hundred miles, without seeing a single example. South of the equator they are likewise migratory, at least in the region of Landana, where Petit found them to be present each year from April to August, inclusive, here again spending the drier season. On the Lualaba River their seasonal regularity is less marked.

Nesting takes place at widely scattered localities in eastern and southern Africa, from Lake Victoria to the Berg River, from May to September. While the species is known to occur as far north as Fayoum Lake in Egypt, there are no breeding records as yet from north of Uganda. It is possible that all the birds of the north are simply an annual overflow from the southern half of the continent.

*Anhinga rufa*.—The African darter is known to breed in the northern as well as the southern part of its wide range, and even at places near the edge of the equatorial forest: Lake Victoria, the Lualaba River, and the Fernand Vaz district of the Gaboon. In the two latter districts, at least, the nesting takes place at low water. Within the forest area of the Congo basin the birds are wanderers, occurring along all the important rivers, yet varying in abundance with the amount of water. At low water in July we found them abundant on the upper Congo, where in December,

on account of the flooded stream, I could find not a single bird from Stanleyville to Coquilhatville.

In the Uelle district, just north of the forest, we found no evidence of these birds nesting. Early July was the latest date at which I observed them there. Then they would vanish for about five months, while the rivers were in flood. They may withdraw into the Sudan, where the breeding season was stated by Heuglin to be in August and September.

*Threskiornis æthiopicus*.—Though found over so large a part of the Ethiopian Region, the sacred ibis is extremely rare in the western forest region close to the equator. I know of only one occurrence in the Ituri, at Avakubi on December 28. On the Uelle River it is almost as uncommon; we saw but one, on the Dungu River at Faradje, March 28. Both of these records are at the time of low water; I doubt whether the bird could secure its food here at any other time. Near Stanley Pool the sacred ibis is commoner, I have seen it in July; and near Lakes Tanganyika, Kivu, and Edward it would seem to be resident at all seasons.

In connection with occurrences in the Uelle and Ituri, we may add that Heuglin found the species migratory in the Sudan, going northward to nest during the rainy season (in June) and returning toward the south again from December to February. Migratory movements have also been observed by Lönnberg in East Africa, and in South Africa, where early in the spring it is said to resort to the coast islands to breed.

*Sarkidiornis melanotos*.—The comb-duck is distinctly migratory in the Ituri and Uelle districts, where we saw it only from November to February, during the period of less rain and low river levels. Only about one bird in eight was an adult male, and dissections indicated that they were not ready to breed. As a rule the stomachs contained nothing but sand; the only remains of food were a few insect larvæ and small fleshy plants of the family Podostemonaceæ, which we watched them pulling from the surface of rocks in rapids. These rocks were covered by water save at the season when the comb-ducks visit the region.

The comb-duck is known to breed south of the equator. It was in February, however, that Andersson found it laying, in Ovampoland, just the season when we saw it in the Uelle. The fact that specimens have been taken in the Sudan from May to November, and at Loko, Nigeria, in July, seems to indicate that the species also nests in the north, though I know of no record of its eggs having been found there.

*Dendrocygna viduata*.—Antinori has described the nesting of this tree-duck in the Sudan, while eggs or young are also known from Liberia

and the Gold Coast. The breeding season falls in August or September in West Africa and in Darfur. Dates of occurrence indicate that it is resident also in southern Africa throughout the year, as it is in the north. In the south, nesting occurs from November to June. In the forested region of the Congo, it is decidedly uncommon, though small flocks sometimes occur, as at Avakubi in the latter half of December, 1913. I have also seen a small party near Irebu on the Congo in March. These I take to be wanderers from the more open countries. Along the eastern border of the Congo, near the Kivu District, specimens have been taken in April, May, and June.

*Anomalophrys superciliosus*.—In 1909 and 1913, this lapwing appeared at Avakubi, on the Ituri River, in some numbers toward the end of November. Its stay was brief, and I feel sure that the species has a definite migration. Supposedly it breeds in Kavirondo in August, and its range extends from Lake Tanganyika to Togo.

*Rynchops flavirostris*.—Skimmers always seemed absent from any river in flood. We saw them in February and March, as well as in June and July on the lower and middle Congo, and in August on the Lualaba. At the south end of Lake Edward I failed to find any in early May, when the sand-bars at the mouth of the Rutshuru were under water, but in April, Gyldenstolpe noted them as abundant. The species nests both north and south of the equator, as well as on the middle Congo.

*Pseudochelidon eurystomina*.—Nests in populous colonies in the sand-bars of the Congo River between Lukolela and Coquilhatville at low water in February and March, but is believed to desert the region between June and December. The African wood-swallow is apparently migratory, though where it spends the off-season is still a mystery.

*Lamprocolius s. splendidus*.—The large glossy starling of the Congo forests is a conspicuous, noisy bird, whose presence is surely never to be overlooked. Its range is continued far out into the gallery forests, on the north to the Sudan border, and in this region of mixed vegetation it was present through the whole year. At Avakubi, in the middle of the Ituri forest, there is a period of four and a half months when it is absent, from early October to the end of February. This I observed in two different seasons. Going northward toward the edge of the forest at the end of December, we first found the species again near the Nepoko River. At Bafwabaka it is evidently a permanent resident. This bird is a strange exception to the rule that birds typical of the forest are not migratory. To be sure, it is found more in second growth or tall trees left standing in clearings than it is in virgin forest.

At Bumba on the Upper Congo, July 29, I once saw an immense flock of these same starlings come flying eastward from across the river, but as they often gather in flocks to roost, this is no proof of migration.

In Neave's account of the Katanga fauna,<sup>1</sup> however, there is a note of interest with regard to this species. On the plateau of the Upper Katanga there are patches of heavy forest, known locally as "msitu," situated commonly on the source or the banks of a stream. These are visited annually by *Lamprocolius splendidus*, from September to November, or possibly longer. It apparently does so to breed, as he found young birds which could just fly, in the first week of November. They also seem to select the time when fruit is ripe for their visits.

There is no possibility of a migration to the Ituri, for the Katanga birds belong to a southern race, *bailundensis*. Moreover, the typical race is known to breed on the eastern edge of the Ituri forest toward September.

#### MIGRANTS FROM MADAGASCAR

*Ardeola idæ*

*Cuculus poliocephalus rochii*

*Eurystomus glaucurus*

*Merops superciliosus*

None of these birds is known to breed on the African continent, yet they all occur with some regularity in its eastern half.

*Ardeola idæ* is not a race of *ralloides*, for both species occur in Madagascar. *A. idæ* has been taken a number of times in East Africa between June and October, and once at Moba on the southwest shore of Lake Tanganyika, May 22. It seems not to occur here in its white breeding plumage.

*Cuculus p. rochii*.—Breeds only in Madagascar, but has occurred between June and September in southeast Africa, on Lake Tanganyika, and even in the Ituri forest. Some specimens are adult, others young.

*Eurystomus glaucurus*.—Allied to *E. afer*, but distinctly larger, and does not nest in Africa. It occurs there, however, with fair regularity, and reaches the Kasai and Uelle districts between June and November.

*Merops superciliosus*.—Of very regular occurrence in eastern Africa, although it nests there only on Pemba Island, in August and September. The main body of migrants must come from Madagascar. Arriving in mid-May, it ranges north to Eritrea, Lake Victoria, and Lake Albert, and replaces *Merops p. persicus*, which has just left for the north. After it leaves again in September, its place is soon taken by *persicus*.

<sup>1</sup>1910, Geographical Journal, XXXV, p. 139.

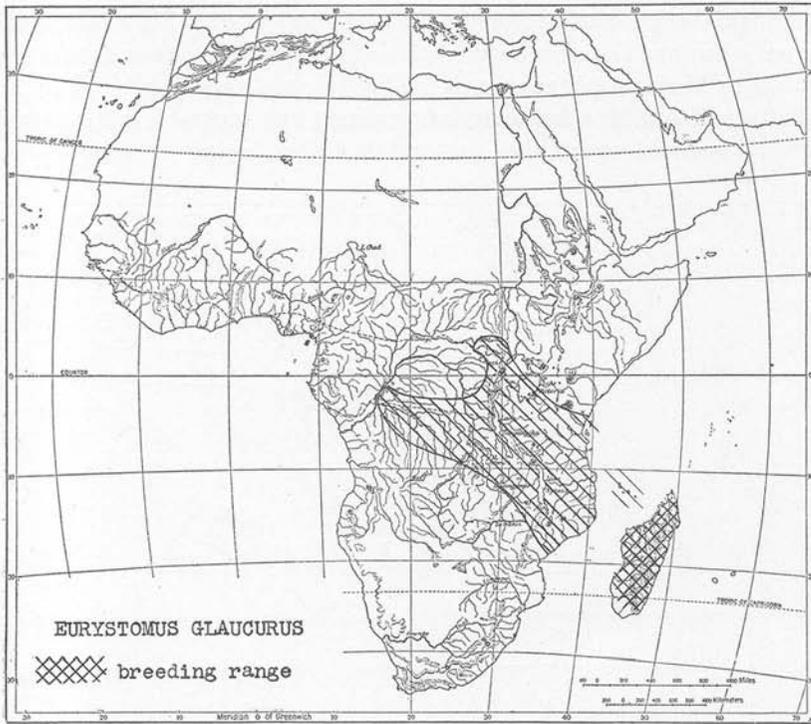


Fig. 168. The broad-billed roller of Madagascar migrates regularly to the African continent.

#### PALÆARCTIC MIGRANTS TO AFRICA

This group of birds has received far more attention than the African migrants, partly because their journeys are often longer, and partly because they are species better known to European ornithologists or residents in Africa. In a number of cases birds bearing rings placed on their legs on the breeding grounds in Europe have been recovered in South Africa and even along the western coast. Still more important contributions are to be expected in the future from this method, which in the case of the purely African migrants can scarcely be used as yet.

Scores of European white storks have thus been traced to South Africa, and F. von Lucanus<sup>1</sup> has attempted to plot the routes by which they travel. He thinks these are mainly two: (1) a southeast path,

<sup>1</sup>1919, Journ. f. Orn., pp. 22-31.

through the Balkans and Asia Minor, to Egypt, the Nile Valley, the great lakes, and thus southward; (2) a southwest path, across France and Spain to Morocco, thence across the Sahara, profiting by the mountains that would furnish a few watercourses and other favorable resting spots until they could reach Lake Chad and the Congo basin.

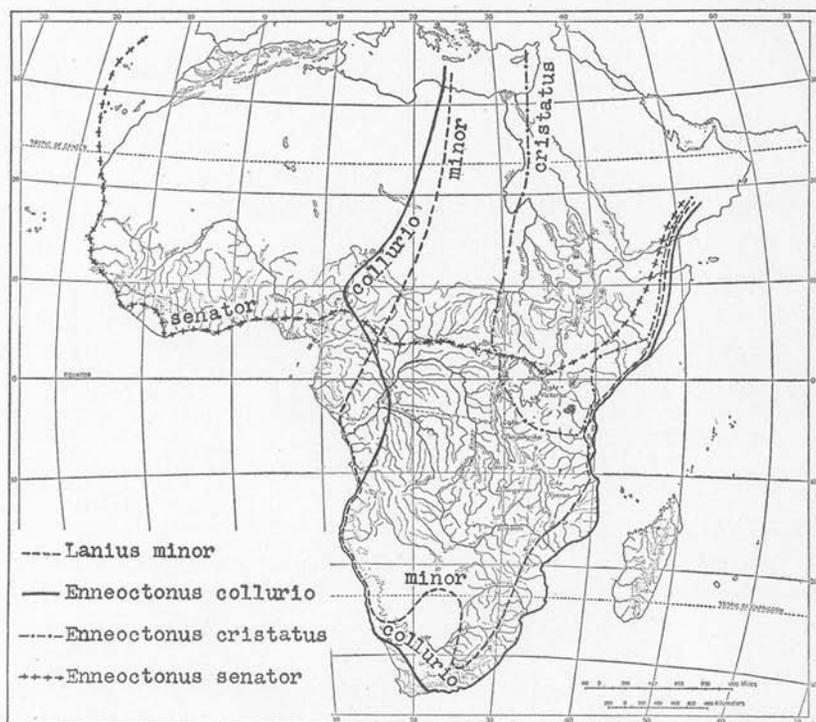


Fig. 169. The migrations of four Palearctic shrikes into Africa. *Enneoctonus senator*, represented by three races, stops at the northern edge of the forest. *E. cristatus*, represented mainly by the subspecies *isabellinus*, reaches Tanganyika Territory. *E. collurio* and *Lanius minor* continue on to South Africa.

These routes agree in the main with the conclusions of Boubier<sup>1</sup> who finds that migrants from Eurasia leave by five great fan-shaped highways, two of which lead to the African continent. These are the European-Senegambian, along the western coasts of Europe and Africa, and the Caucaso-Zambesian, by which birds from southeastern Europe and western Asia pass through Egypt and down the eastern half of Africa.

<sup>1</sup>1919, Bull. Soc. Zool. Genève, II, pp. 216-228, map.

The Nile Valley may be an important road for the many Palæartic migrants to central and southern Africa. But when they have reached the northern limits of the Congo basin, most of the species are not following any narrow lines of travel, and are seen to be scattered broadcast over the country. Any detours they may have had to make on the way do not seem to delay them very much. Lynes<sup>1</sup> reports that the white stork migrates through Darfur, and it seems that many other birds as well must cross the Sahara on migration. Even in Egypt, R. E. Moreau<sup>2</sup> finds that birds migrate on a broader front than is often supposed.

The Cameroon-Congo forest plays an important rôle in determining the winter ranges of certain of the Palæartic migrants, much as it does with the ranges of endemic species. It is to some a barrier preventing further progress south of the equator, to others it is an obstacle that diverts the main lines of travel to East Africa, and yet to some species of strong flight it is only a hurdle, easily crossed. On the whole, one may say that species which do not reach South Africa go farther south in East than in West Africa. The number of those which do cross the Zambesi River limit is remarkably large as compared with those known from the Congo. The latter, I find, amount to eighty-six species, whereas Sclater listed seventy-six from South Africa. Perhaps twenty-four species may yet be added to the Congo list, among them a number of water birds which migrate down the west coast, thus passing the mouth of the Congo, but not yet reported from Belgian territory. According to Grote<sup>3</sup> two hundred species of Palæartic birds reach tropical Africa in winter, but many of these are restricted to the northern and northeastern parts of the continent.

The more temperate climate of South Africa is appreciated by many Palæartic birds, which thus speed as rapidly as possible over the equatorial belt. The European roller is a bird that crosses the Upper Congo on its way, and yet is only occasionally observed there. *Lanius minor* and *Enneoctonus collurio* are seen for but a very brief period during their migrations, though they make their way even across the Ituri forest.

It is doubtless for other reasons that many species stop short in the Sudan. A number do reach the savannas just north of the Congo forests, but a dislike for heavily wooded country limits their wandering, just as it does with many of the Sudanese migrants. Such species among Palæartic visitors are:

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<sup>1</sup>1925, *Ibis*, pp. 549, 777, 778.

<sup>2</sup>1927, *Ibis*, pp. 443-468; 1928, *Ibis*, pp. 453-475.

<sup>3</sup>1930, *Mitteil. Zool. Mus. Berlin*, XVI, pp. 1-116; 1931, *idem*, XVII, pp. 406-414.

*Micropus melba melba*  
*Iynx torquilla torquilla*  
*Hippolais pallida elæica*  
*Phænicurus phænicurus phænicurus*  
*Ænanthe ænanthe ænanthe*  
*Luscinia megarhyncha megarhyncha*  
*Monticola saxatilis*  
*Enneactonus cristatus isabellinus*  
*Enneactonus senator niloticus*

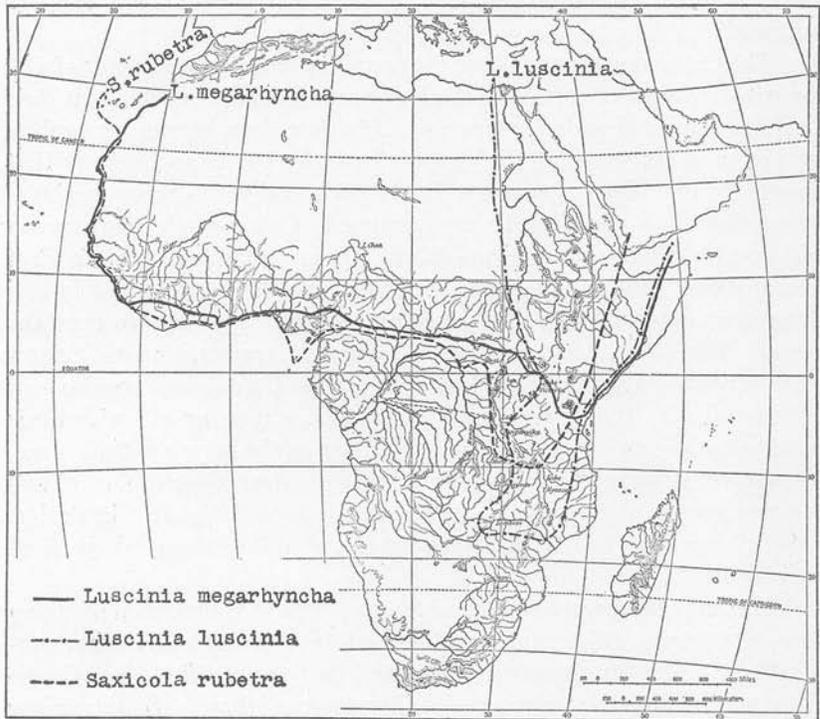


Fig. 170. Migrations of the nightingales and whinchat into Africa. In the Congo *Luscinia m. megarhyncha* stops at the northern edge of the forest; but its two Asiatic representatives, *golzii* and *africana*, go somewhat farther south in East Africa.

I am aware that some of these, like the wheatear, go farther south through East Africa; but they do not travel across the Congo forest. A few other species occasionally penetrate the Ituri forest and are found there in clearings or on rivers, although they scarcely manage to reach the southern savannas by this route. Such are:

*Querquedula querquedula*  
*Circus xeruginosus xeruginosus*  
*Cerchneis tinnunculus tinnunculus*  
*Charadrius dubius curonicus*  
*Motacilla alba alba*  
*Saxicola rubetra rubetra*

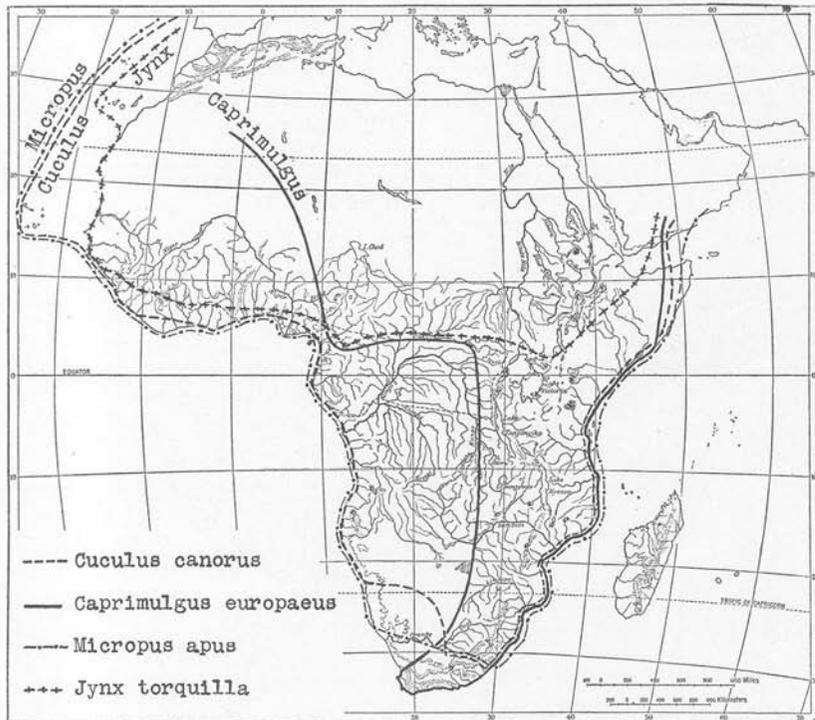


Fig. 171. Limits of migration in Africa for the Palearctic cuckoo, nightjar, swift, and wryneck. With the exception of the wryneck each species is represented by two or more races, which sometimes mingle in their winter quarters.

On the other hand, species which are found with more or less regularity in the region of forest during their travels are:

- |   |                                |
|---|--------------------------------|
| (P) <sup>1</sup> <i>Ciconia ciconia</i> | <i>Charadrius alexandrinus</i> |
| <i>Pernis apivorus</i>                  | <i>Tringa ochropus</i>         |
| (P) <i>Erythropus vespertinus</i>       | <i>Rhyacophilus glareola</i>   |
| (P) <i>Pandion haliaetus</i>            | <i>Actitis hypoleucos</i>      |
| <i>Charadrius asiaticus</i>             | (P) <i>Pisobia minuta</i>      |
| <i>Charadrius hiaticula</i>             | (P) <i>Erolia testacea</i>     |

<sup>1</sup>Species marked with a (P) are those that pass over rapidly and never spend the whole of their winter in these latitudes, not, at least, in the forest area.

- |                                  |                                       |
|----------------------------------|---------------------------------------|
| <i>Capella gallinago</i>         | <i>Budytes flavus</i> (several races) |
| <i>Capella media</i>             | <i>Budytes feldegg</i>                |
| (P) <i>Glareola nordmanni</i>    | (P) <i>Muscicapa striata</i>          |
| (P) <i>Chlidonias leucoptera</i> | <i>Phylloscopus trochilus</i>         |
| (P) <i>Cuculus canorus</i>       | <i>Phylloscopus sibilatrix</i>        |
| (P) <i>Coracias garrulus</i>     | <i>Acrocephalus schænobænus</i>       |
| (P) <i>Merops persicus</i>       | <i>Acrocephalus arundinaceus</i>      |
| (P) <i>Caprimulgus europæus</i>  | <i>Riparia riparia</i>                |
| (P) <i>Micropus apus</i>         | (P) <i>Delichon urbica</i>            |
| <i>Anthus trivialis</i>          | <i>Hirundo rustica</i>                |
| (P) <i>Motacilla cinerea</i>     | (P) <i>Enneoctonus collaris</i>       |
|                                  | (P) <i>Lanius minor</i>               |

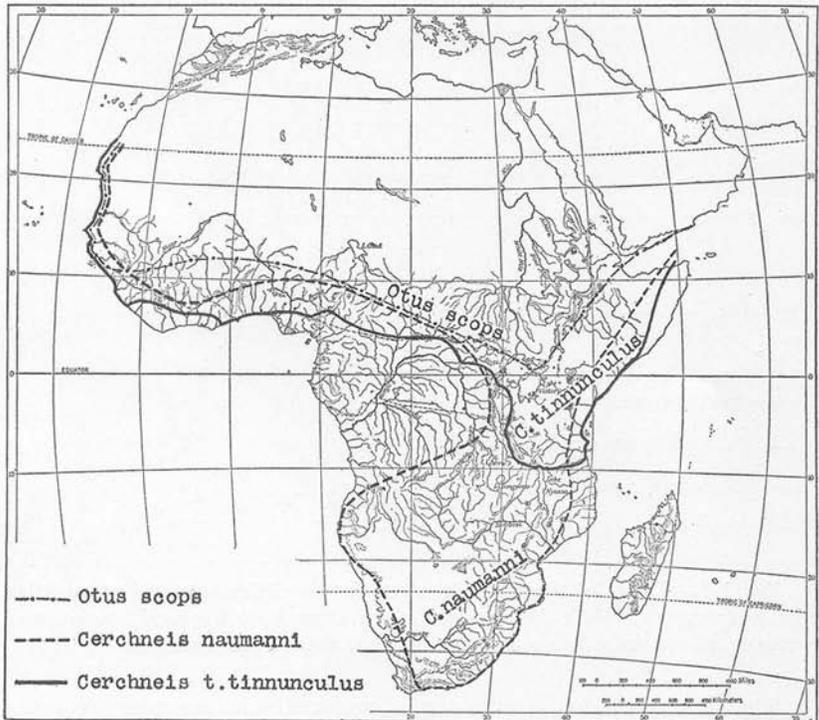


Fig. 172. Migrations of the Palearctic scops owl and two species of kestrels into Africa. Note the influence of the Lower Guinea forest.

Many of these are obviously birds of strong flight, but some of the smaller species astonish us by their endurance. The willow-wren (*Phylloscopus trochilus*) is a common migrant to tropical Africa, and winters as far south as the Cape of Good Hope. Its winter range is indeed enor-

mous, for some individuals, according to Stark and Selater, remain as far north as Greece and Asia Minor.

Other species which are to be seen in the Uelle, but which travel to South Africa by the eastern savanna countries, are:

*Circus macrourus*  
*Circus pygargus*  
*Buteo buteo vulpinus*  
*Crex crex*  
*Philomachus pugnax*  
*Merops apiaster*  
*Sylvia borin*

Other migrants from the north, belonging to several orders, but which have been found mainly on the eastern borders of the Congo, are to be added:

<i>Dafila acuta</i>	<i>Gelochelidon nilotica</i>
<i>Erythropus amurensis</i>	<i>Sylvia communis</i>
<i>Charadrius mongolus atrifrons</i>	<i>Sylvia atricapilla</i>
<i>Totanus nebularius</i>	<i>Hippolais icterina</i>
<i>Totanus stagnatilis</i>	<i>Oriolus oriolus</i>
<i>Larus fuscus</i>	

Among the remaining Palæarctic species recorded from the Congo are a few Charadriiformes which travel down the west coast. To the list of such species we have added some others which have been recorded from so near the mouth of the Congo that they must pass along the ocean front of our territory.

<i>Squatarola squatarola</i>	<i>Stercorarius parasiticus</i>
<i>Arenaria interpres</i>	<i>Stercorarius pomarinus</i>
<i>Totanus totanus</i>	<i>Sterna hirundo</i>
<i>Totanus erythropus</i>	<i>Sterna paradisæa</i>
<i>Crocethia alba</i>	<i>Sterna sandvicensis</i>
<i>Numenius arquata</i>	<i>Hydroprogne caspia</i>
<i>Numenius phæopus</i> (also on eastern border)	

Exact dates for the arrival and departure of the Palæarctic migrants are not easy to give. Our own observations are hardly extensive enough for purposes of accuracy, and last dates of occurrence, before departure, are not often noted. The earliest arrival from the northern continents is undoubtedly the common sandpiper, which I have seen as early as July 21. Soon afterward comes the swift, *Micropus apus*, for it reaches the northern edge of the Congo basin by August 11. *Rhyacophilus glareola* is on the equator by the middle of August.

By the month of September the southward migration of Eurasian birds is well under way. The curlew sandpiper (*Erolia testacea*) is a

regular transient at this time, even where there are only small bodies of water. *Glareola nordmanni*, *Hirundo rustica*, and the yellow wagtails now put in their appearance. From this time on there is a continued sorting out of species. Some continue on their way. Others, even among the early arrivals, remain throughout their winter in the neighborhood of the equator, the European swallow becoming the commonest species of its

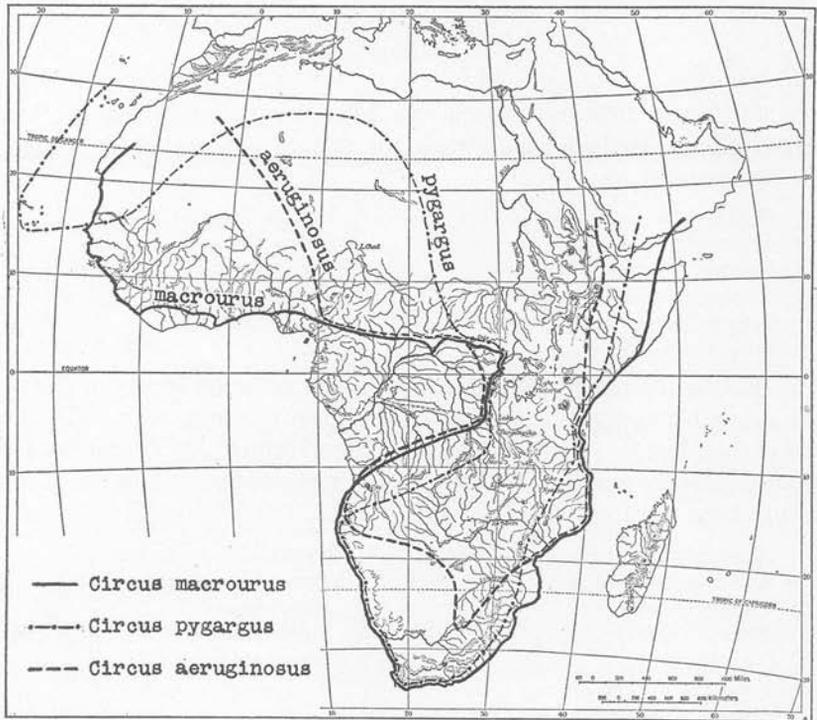


Fig. 173. Migrations of three Palearctic harriers to Africa. All avoid the greater part of the forest belt.

family in the Ituri. By the month of December the number of Palearctic species has again become rather lessened, but in February and March the northward movement recommences. The relative abundance of species is not always the same on the northern migration. I do not remember having seen a curlew sandpiper during the spring migration.

The common sandpiper remains until late in April, in small numbers at least. Swifts, too, I have taken on April 12, at Faradje. Such birds

seem as truly African as European. In the highlands of East Africa, *Actitis hypoleucos* has now been stated to breed, but these are certainly not the birds we see in the Congo.

The distance traveled by many of these migrants in visiting South Africa is enormous; white storks, according to von Lucanus, covering nearly 9000 kilometers in each direction, and many smaller birds the



Fig. 174. Migrations of three Palæartic snipe to Africa. Two species even visit clearings in the eastern Congo forest.

equivalent. Yet we must be even more astonished at the sense possessed by these strangers in a tropic land for keeping aware of the date. Changes in temperature or in length of daylight, which might assist them in their reckoning while on the northern breeding ground, are lacking when they winter on the equator. I confess my bewilderment as to an explanation.

One is sure to be surprised by the late departure of many Palæartic birds from tropical Africa. Even in South Africa, swallows are still

lingering at a date when numbers of the same species are known to be crossing the Mediterranean on their northward journey. It has been supposed that the later migrants are birds which breed farthest north, where the weather has not yet warmed enough to allow of their return. Swifts tarry in the northern Congo at a time when their arrival in France is already an accomplished fact; these again may be individuals of more boreal breeding range. The same thing is true of a number of passerine species with less remarkable powers of flight.

Accidental occurrences are occasionally noted. A specimen of *Hæmatopus ostralegus* which I shot on the Ituri River in October was clearly out of its normal habitat. A few individuals of *Larus fuscus* and *Chlidonias leucoptera* remain during the northern summer on the great lakes of central Africa. It is often noted that northern Limicolæ summering in the tropics have gonads of small size. Honey-buzzards are occasionally found in the equatorial forest when they should be nesting in Europe. We took one at Avakubi on July 4, a female without enlargement of the ovary. On July 3, 1914, at the same locality, I secured a female *Hirundo r. rustica*, likewise in non-breeding condition. Emin Pasha, many years ago, reported seeing what he took to be European swallows on the Upper Ituri in the northern summer. They must always be very rare there at that season, and certainly they do not breed. At Old Moshi on Kilimanjaro, in early June, Colonel Meinertzhagen<sup>1</sup> once secured a pair of European swallows, but they, too, were found to be in non-breeding condition.

#### CONCLUSIONS

The Palæartic migrants penetrate into tropical Africa to varying distances, depending upon their powers of flight, their feeding habits, and their preferences for certain types of vegetation or littoral feeding grounds. Not a few of them are more abundant, apparently, in South Africa than in the equatorial regions over which they must pass to reach these winter quarters. This suitability of South Africa for many Palæartic species explains why a few of them have already been found breeding in South Africa, while other birds of Eurasia are represented by distinct geographic races which became established in much the same way at an earlier time. We find no evidence of any "neutral zone" such as Charles Dixon<sup>2</sup> supposed would be found in central Africa, where certain Palæartic species would be represented by non-breeding individuals throughout the year, part of them going south to breed in the

<sup>1</sup>1922, *Ibis*, p. 32.

<sup>2</sup>1892, 'Migration of Birds,' p. 151.

southern summer, the rest repairing to their breeding quarters in Eurasia during the opposite time of year.

The accompanying maps, illustrating the extent to which many of the Palæarctic migrants penetrate the African continent, have been prepared with the aid of Reichenow's "Vögel Afrikas" and many subsequent publications, as well as our own notes from the Congo. It will be clear how many species stop abruptly as they approach the northern edge of the West African forest, and equally interesting is the manner in which many species find their way much farther southward through the more open country of East Africa, not simply because they enter Africa from the northeast, but rather because there the way lies open before them.

The true migrants among Ethiopian birds are mainly recruited from the species of the savannas and steppes. The commonest migratory movements take place on both sides of the forest belt and consist in seasonal movements, more or less north and south, from the more arid regions as they dry up after the rains, toward the more humid savanna closer to the edge of the forest. Some few species have found their way across the equator, and profiting by the reversal of season thus experienced they are thereby enabled to escape a period of complete drought, or to seek certain kinds of food only available during a part of the year in any single locality.

A parallel incentive, in the case of a number of water birds, causes them to undertake migrations away from rivers where the level is rising toward those where the water is ebbing, and consequently offering better fishing grounds. This, again, is apt to lead them to cross the equator in seeking their feeding or breeding grounds. Such migrations within the tropics prove that seasonal change of weather is sufficient to account for the origin of bird migration, without the cumulative effect of any long-continued geological change, such as the retreat of glaciers or the submersion of coasts. We must infer that bird migration originated earlier than the last Ice Age, and probably at the time when birds first developed strong powers of flight, provided there was a seasonal change of climate. Migrations are known even among short-lived dragon-flies and butterflies. Birds instinctively became masters in the art of navigation.<sup>1</sup>

The calendar to which a migratory bird adheres so exactly must be regulated largely by physiological changes within its body, perhaps in the sexual organs. Each individual goes through a physiological cycle

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<sup>1</sup>See especially Watson and Lashley, 1915, 'Homing and Related Activities of Birds,' Papers Dept. Marine Biol. Carnegie Inst. Washington, VII, pp. 1-104.

attuned to its normal life and environments. If this inner calendar fails, external influences are without avail. Minor changes of weather may hinder or accelerate the migratory journey, but they are not the stimulus that starts the bird on its way.<sup>1</sup>

Moreover, the migratory instinct of each species or race must determine the route it will follow and the distance it will go. Lest we hesitate to admit the action of selection in the building up of these instincts, let us not forget that seldom is selection more relentless than during the long migrations of northern birds.

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<sup>1</sup>See William Rowan, 1931, 'The Riddle of Bird Migration.' Bird migration within the tropics is briefly discussed on pp. 105, 106; and the difficulty of explaining trans-equatorial migrations on p. 126. R. E. Moreau, 1931, *Ibis*, pp. 553-570, gives an excellent discussion of the subject.

CHAPTER X—EVOLUTION AND RELATIONSHIPS OF THE ETHIOPIAN  
AVIFAUNA

EARLY CONDITIONS

At the time when the Congo basin was filled with a broad Triassic lake or sea, the ancestors of birds had not yet learned to fly. They doubtless had their origin in tree-climbing reptiles, and so may be expected to have arisen under a warm climate. In Bavaria, during the Jurassic, the toothed *Archæopteryx* and *Archæornis* enjoyed a habitat at least subtropical. The birds of the Cretaceous, notwithstanding the persistence of teeth, were in other ways as highly specialized as many birds of today. *Hesperornis* had undergone greater reduction of the wings than any recent diving bird; and the adaptations of the main groups of birds were early established. Gigantic ratite forms, unrelated to any of the modern ostrich-like groups, lived during the Eocene. The higher types of birds are all to be traced back to some perching ancestor like *Archæopteryx*; and some ancient anatomical features are retained in divergent forms, though they have been lost by the more progressive stem that has culminated in the Passeres.

Africa may have had many primitive birds, but they seem to have left no traces in the rocks. Even its Tertiary avifauna is all but unknown. K. Lambrecht<sup>1</sup> lists but eight species of fossil birds from the entire African continent. In conjectures on the past history of African birds, therefore, we must limit ourselves to orders of birds as they are seen to-day, and as they have certainly existed since the Eocene. In other lands there were already passerine forms, referred by palæontologists to families now extant. By virtue of their power of flight, birds could spread from one continent to another with relative ease. Many orders of birds quickly became cosmopolitan, and it is questionable whether their exact country of origin will ever be known. Many families, however, have a distribution which seems to argue for their beginning in a certain section of a continent; but the possibility of extermination is not to be ignored, and may invalidate not a few of our assumptions.

Tropical and southern Africa was entirely above water during the Tertiary; and if the Congo basin underwent another temporary flooding, it cannot have had much effect upon the modern distribution of birds, for there was a highway around it both east and west. The mountains bordering the Congo basin were already upraised, and erosion has been leveling them ever since. In the central portion of the continent the

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<sup>1</sup>1929, Abhandl. Bayer. Akad. Wiss., (New Series) IV, pp. 14-16.

topography was but a slight exaggeration of its present state, lacking the rift valleys.

The northern border of the continent, in the Eocene, was covered by the Mediterranean, then a much wider sea than now; and a connection between Africa and India, though Arabia, was becoming established. I cannot agree with those who would construct a broad land-bridge between northern South America and West Africa in the Eocene, or between Africa and Madagascar as late as the Miocene. One of the most fundamental differences between the Neotropical and Ethiopian bird faunas is the abundance and variety of "clamatorian" or lower passerine forms in South America, which are all but absent from Africa. The Eocene presumably saw the development of these very groups, and any direct connection by land with South America would have assured their representation in Africa.

As for the union of Madagascar with Africa, all that we know of the Miocene avifauna of southern Europe indicates that most of the bird families of modern Africa were then in existence. The differences of the recent Madagascan fauna are so marked that I should insist on an earlier separation for Madagascar than Miocene. Evidence for a connection with Madagascar possibly as late as the Oligocene has been offered by Lambrecht, when describing *Stromeria fajumensis* from the Lower Oligocene of Egypt. This large bird, known only from the lower half of a metatarsus, appears to be a primitive member of the *Æpyornithes*. Lambrecht suggested that these giant flightless birds of Madagascar may have come originally from the African continent.

Whether *Psammornis rothschildi* of the Eocene of Southern Algeria was likewise one of the *Æpyornithidæ*—as Professor Arldt claimed—is extremely doubtful, for its only remains are two fragments of a very large egg-shell. *Eremopezus eocænus* of the Lower Oligocene of Egypt was an ostrich-like bird, certainly not allied with the *Æpyornithidæ*, in the opinion of C. W. Andrews and of K. Lambrecht.

It is fortunate that the Tertiary fauna of Europe, especially of France, is comparatively well known, due largely to the persistent labors of Professor Milne-Edwards.<sup>1</sup> The most varied series of forms is from the Miocene; and though closely related for the most part to modern birds, they include genera seldom found to-day far outside the tropics, such as *Pelecanus*, *Threskiornis*, *Ibis*, *Leptoptilos*, *Phænicopterus*, *Sagittarius*, *Pterocles*, *Psittacus*, *Collocalia*, and *Trogon*. The last-named certainly cannot belong in the genus *Trogon* as at present restricted, but

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<sup>1</sup>1867-1871, 'Oiseaux Fossiles de la France.'

the existence of a member of the family in Europe is noteworthy. From the Upper Eocene of southern France, Milne-Edwards<sup>1</sup> later reported four humeri and a metacarpus of another bird related to the trogons, which he named *Archæotrogon venustus*. *Cryptornis*, of the Upper Eocene of the same country, was a small hornbill near *Lophoceros*; and *Necrornis*, of the Middle Miocene, was taken by the same authority to be a near ally of the Musophagidæ.

It is not far-fetched to compare a fauna leaving such remains with that of the Sudan to-day. The tropical fauna undoubtedly extended some thirty degrees farther northward than at present. Whether it extended similarly into the southern hemisphere, there is little left to tell.

The Pliocene birds of Europe are less known, but indications point to a retreat of the tropical fauna. A cooling process had begun in Europe, which was to culminate in the glacial period, and which extended its influence even to what is now equatorial Africa. That this was the equatorial region in the Pleistocene, with glaciers on Ruwenzori extending to within 4500 feet of sea level, may be harder to concede. It would involve a general cooling of our planet, a condition accepted, to be sure, by such authorities as Chamberlin and Matthew.<sup>2</sup> One alternative is to assume a shifting of poles and equator in accordance with a "Pendulations-Theorie" like that of Reibisch<sup>3</sup> and Simroth.<sup>4</sup> This handy theory, so appealing to a zoögeographer, is rejected by most physicists and geologists. More popular nowadays is the Wegener theory of continental drift<sup>5</sup>; but it has met with so many serious objections<sup>6</sup> that its validity is highly questionable.

Certainly a decided change in the climate of northeast Africa and Arabia is needed to account for the intimate relationship between the tropical faunas of the Ethiopian and Oriental regions, now separated by desert. An authoritative picture of the retreating tropical climate in Europe, from the Eocene to the Pliocene, is given by Professor Henry Fairfield Osborn, in 'The Age of Mammals,' 1910. The more temperate types of flora that succeeded each other are described (pp. 93, 94, 184, 185, 242, and 244), and especially the appearance of grasses, which probably took place in the Lower Eocene. As for the late Miocene in Europe, "This was the beginning of the period of dry, grassy plains, similar to those of recent Africa, and extending through the greater part of the Pliocene."

<sup>1</sup>1892, 'Compte-Rendu Second Congrès Orn. Internat.,' p. 64.

<sup>2</sup>1915, 'Climate and Evolution,' *Annals New York Acad. Sci.*, XXIV, pp. 171-318.

<sup>3</sup>1901, *Jahresber. Ver. f. Erdk. zu Dresden*, XXVII, pp. 105-124; 1905, *idem*, pp. 39-53.

<sup>4</sup>1907, 'Die Pendulations-Theorie.'

<sup>5</sup>See Köppen and Wegener, 1924, 'Die Klimaten der geologischen Vorzeit.'

<sup>6</sup>C. E. P. Brooks, 1926, 'Climate Through the Ages,' pp. 252-281.

North Africa in the Pleistocene, Professor Osborn tells us, was still Ethiopian in character. "It seems well established that after Upper Pliocene times Algeria enjoyed a sub-tropical climate, characterized by abruptly alternating dry and rainy seasons. At the beginning of the Quaternary Period North Africa was probably characterized by excessive rainfall which led to the formation of great alluvial or river and flood plain depositions in the Barbary and Sahara regions," (p. 430). What we lack is a record of climatic conditions in southern Africa during the same periods; but an argument may be given on faunal grounds for a large savanna area there, rather than heavy forest, during the Middle Tertiary.

In equatorial Africa there are indications of climatic conditions differing from those of to-day. Signs of glaciation low down on the slopes of Ruwenzori have been mentioned, which would suggest far heavier precipitation, if not a general cooling, during the Pleistocene. Furthermore, the present isolated distribution of many species of mountain plants and birds has suggested that they came there when the montane floral zones were regularly nearer to sea level than we find them now. Since the modern groups of birds became established, there have been fundamental changes in the climate of northern and tropical Africa, which have left their mark upon the dispersal of families and genera of birds.

#### PRESENT FAUNAL RELATIONS

The Ethiopian Region, from which I would exclude Madagascar, has only about one-fourth the number of peculiar families that can be credited to the Neotropical Region. Further, the number and the nature of the families restricted to the Malagasy region show it to have been completely isolated from Africa for a very long period. They are six in number:

Æpyornithidæ (recently extinct)  
 Mesœnatidæ  
 Dididæ (recently extinct)  
 Leptosomatidæ  
 Philepittidæ  
 Vangidæ

The ground-rollers (Brachypteraciinæ) and such aberrant genera as *Fregilupus*, *Hypositta*, *Aerocharis*, and *Falculia*, furnish additional evidence. To this must be added the absence of over twenty families which occur in Africa, including such important groups as the plantain-eaters, hornbills, colies, barbets, woodpeckers, titmice, true finches, and buntings.

Africa has only seven families entirely its own:

Balænicipidæ  
Sagittariidæ  
Musophagidæ  
Coliidæ  
Picathartidæ  
Buphagidæ  
Promeropidæ

The Struthionidæ are almost restricted to Africa to-day; and the Scopidæ and Numididæ extend only to Madagascar, where they have not developed one distinct subspecies. Some other groups like the Bucorvinæ, Phœniculinæ, Malaconotinæ, Bubalornithinæ, and Plocepasserinæ, restricted to the Ethiopian Region, add weight to its faunal peculiarities.

A large continent like Africa, closely connected in the past with great land masses in the north, cannot be expected to have retained so distinct an avifauna as Australia or South America. The Oriental (or Indo-Malayan) region is even less exclusive. The only family once believed indigenous there, the Eurylæmidæ, is now known to be represented in Africa by two genera, *Smithornis* and *Pseudocalyptomena*.

The Australian region, exclusive of New Zealand, has twelve bird families of its own, and the inclusion of New Zealand would add five more. But none of these examples approaches conditions in the Neotropical Region, which is characterized by thirty endemic families. The Neotropical Region owes its very special avifauna to the high measure of isolation it enjoyed through long periods of geologic time. At the opposite extreme stand the Nearctic and Palæarctic regions, with scarcely any valid families confined to them.

Madagascar and the Mascarene Islands, with six families, are therefore worthy of recognition as a Malagasy region. They may be said to differ more from the Ethiopian than does the Oriental Region. Thus, Madagascar is not to be regarded as the remnant of a Tertiary connection between India and Africa, even though it has a few birds of Oriental groups, such as *Collocalia*, *Copsychus*, and *Ixocincla*. If these birds found their way as far as Madagascar, perhaps over islands, they could not cross the Mozambique Channel.

The presence or absence of Ethiopian families in Madagascar is used by Professor Theodor Arldt<sup>1</sup> to reckon the age of their arrival in southern Africa. This might be justified if the actual connection of the land masses could be proved. Some of the more recent types of birds—

<sup>1</sup>1915, 'Die Ausbreitung der Vögel,' Archiv. f. Naturgeschichte, LXXXI, Abt. A, Heft 12, pp. 13-135.

Arlt himself admits—have flown over from continental Africa, and it may be questioned whether many or all of the African types, except the *Æpyornithes*, did not arrive in the same manner.

It is universally admitted that the Ethiopian fauna is closely allied to the Oriental. Has it any elements, possibly, from the Neotropical? A few ducks, a gull, the presence of trogons, barbets, and other widespread tropical families carry no great weight. The differences are far greater and more numerous.

The derivation of the African families and genera of birds has been treated at considerable length by Professor Arldt, but many of his statements are unconvincing, and have already been refuted by Dr. W. D. Matthew.<sup>1</sup> When the fossil record is so extremely fragmentary, it seems presumptuous to attempt to fix the point of origin and to outline the migrations of nearly every family and of many genera. Arldt's insistence on the southern origin of many peculiarly tropical forms in a "South Atlantis," which he would preserve virtually into the Eocene, invalidates many of his conclusions. Too much stress, furthermore, is laid upon land connections with South America and with Madagascar; the presence of a guinea-fowl in the latter, for example, being taken as an indication of communication in the Miocene. *Numida m. mitrata* must be a very recent immigrant, perhaps introduced by man, as *galeata* has been in the West Indies. One cannot help feeling that Professor Arldt's arguments would often be less dogmatic, were he better acquainted with the generic relationships of African birds. The possibilities of extinction are scarcely allowed to temper the assurance of his statements. The incompleteness of many bird fossils renders very shaky the support they give to theories of former distribution. Their rarity is a drawback even more serious.

Africa, since the Cretaceous, has doubtless had a varied endemic avifauna. Invaders from the north and the northeast have come in numbers to occupy the more open savanna areas, but the forest would be a stronghold for many older forms, and modern conditions point to an important evolutionary center for savanna birds in the southern part of Africa. Their derivation, however, from an Antarctic continent or from South America is not to be thought of.

Ornithological traces of a South American-African land connection, as late as the Eocene, are not to be discovered. The families of birds shared by the Ethiopian and Neotropical regions are either groups occurring around the world in warm countries, where they arrived very early;

<sup>1</sup>1915, *Annals New York Acad. Sci.*, XXIV, pp. 171-318.

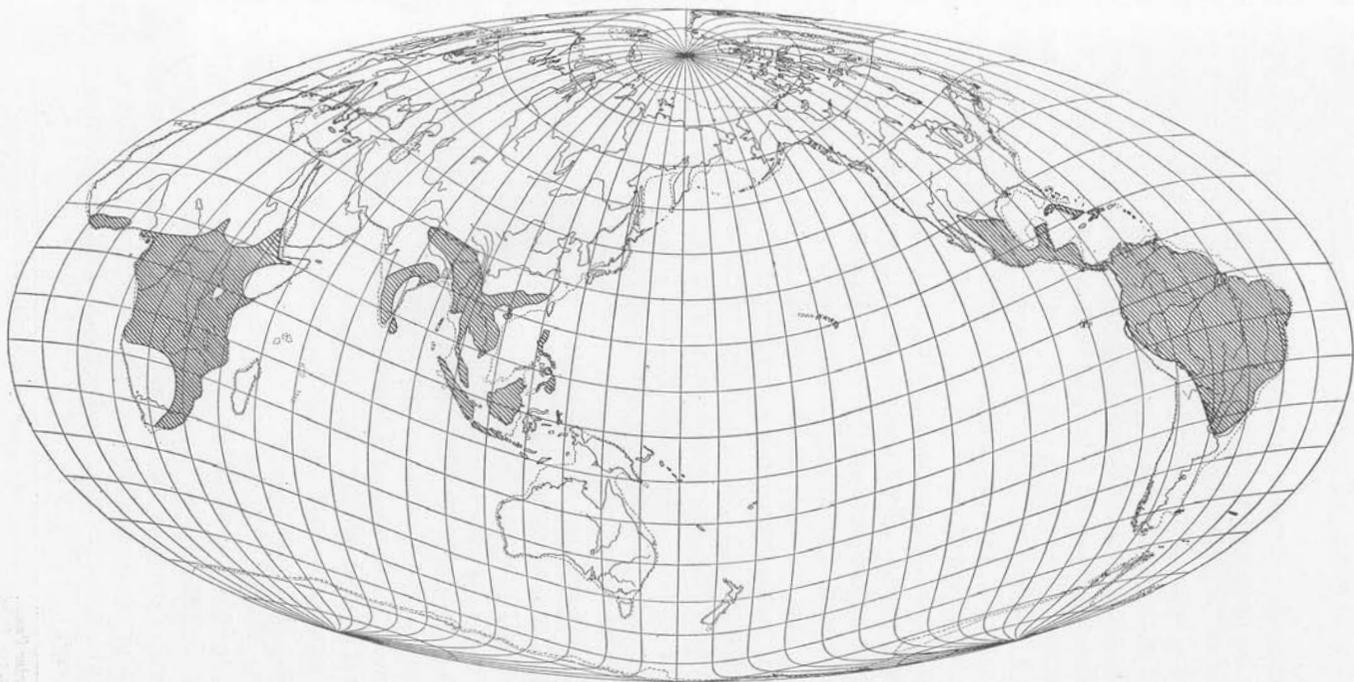


Fig. 175. Present distribution of the trogons in all the great tropical land-masses except Madagascar and the region of New Guinea. It must be supposed that they once found a route between the two hemispheres in the neighborhood of Bering Sea.

or they are families of such a distribution in the northern hemisphere that they may be presumed to have found their way across through Asia. That some of the water birds, ducks especially, should have near allies or the same species in the two regions is not surprising, in view of their powers of flight. Among land birds there are but few resemblances, and most of them can be explained by communication around the North Pacific. The entire lack of true vultures in America and of the Cathartidæ in Africa may be recalled, because neither of these groups can be of recent origin. *Plesiocathartes* of the Lower Oligocene of Europe has been referred to the Cathartidæ, and is the only alleged occurrence of the family in the Old World.

The dispersal of trogons to the tropical regions of both New and Old Worlds must have been assured during a period when parts of the northern hemisphere were much warmer than now. Two genera have indeed been reported as fossils from France. A similar case is offered by the barbets, now found in the Neotropical and Oriental regions as well as in Africa, but wanting to the northward. Their more remarkable allies, the honey-guides, are restricted to the Oriental and Ethiopian regions, whereas the Bucconidæ have no representatives in the Old World. The toucans of the Neotropical Region correspond to the hornbills only by analogy, for they are closely allied to the barbets. The hornbills, on the other hand, which show close relationship between Ethiopian and Oriental faunas, are wanting in the New World. Among the kingfishers, the Cerylinæ occupy the Neotropical, Oriental, and Ethiopian regions, being connected through the Nearctic. But the Alcedinæ and Halcyoninæ are wanting in the New World, although they have reached most regions of the Old World.

It is probably in the families of Passeres that the Neotropical Region differs most widely from the Ethiopian. South America has twenty families of this order which are not found in Africa. And of these, nine are of the non-oscine or "anisomyodian" section<sup>1</sup> of the order. Until recent years these lower groups of Passeres were believed to be all but absent from Africa. The only exception that could be cited was *Pitta angolensis*, and the three additional pittas now recognized are little more than races. In 1914, Mr. G. L. Bates<sup>2</sup> called attention to the peculiarities of *Smithornis*, a genus currently referred to the Musicapidæ, whereas he was able to prove that it belonged close to, if not actually within, the family Eurylæmidæ. Further studies by Dr. P. R. Lowe<sup>3</sup> have confirmed this discovery.

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<sup>1</sup>The suborder Passeres Anisomyodæ of Gadow, subdivided into Clamatores and Subclamatores.

<sup>2</sup>1914, *Ibis*, pp. 493-502.

<sup>3</sup>1924, *Proc. Zool. Soc. London*, part 1, pp. 279-291.

In the meantime Rudolf Grauer had collected a remarkable bird on the mountains west of the Ruzizi River. It was a small green species with wide bill, named by Lord Rothschild *Pseudocalyptomena graueri*. He stated expressly that the resemblance to a broadbill was only superficial and that its real affinities lay with the Muscicapidæ. At the Tring Museum I was invited to examine the only known specimen; and I found that its resemblance to *Calyptomena* was more real than fancied. The length of the outer primary, the fine scutellation on the back of the tarsus, and the lack of an aftershaft all pointed to a genuine affinity with the Clamatores. Professor Reichenow, I may add, also placed *Pseudocalyptomena* in the Eurylæmidæ,<sup>1</sup> a family formerly believed to be represented only in the Oriental Region. This relationship has likewise been fully confirmed from anatomical study by Dr. P. R. Lowe.<sup>2</sup>

The few non-oscine Passeres found in Africa will aid us then in appraising the relation between the Ethiopian and Neotropical faunas. South America is abundantly supplied with them; and if there had been a land connection, however hazardous, across the tropical Atlantic, these more primitive sorts of Passeres should have made their way across it. None has done so. The Pittidæ are an Oriental family, and *Smithornis* and *Pseudocalyptomena* are clearly allied to the East Indian broadbills. In short, the Anisomyodian Passeres now living in Africa can in no wise be used to justify any direct communication with South America.

During Tertiary time the one route for land birds between the Old and New World tropics was near what is now the Bering Sea. In China, many Oriental groups of birds still range northward to Chihli Province, and during the Tertiary, tropical birds lived surprisingly far north in America. I have little doubt that jacanas, cuckoos, parrots, kingfishers, goatsuckers, trogons, barbets, woodpeckers, and a number of passerine families owe their present distribution to this connection at a time when its climate was very mild. The reality of this land route is established by paleontological study, for it was used by titanotheres, proboscideans, and many other mammals.

No Antarctic continent need be called in to explain the distribution of birds. The groups which Professor Arldt led across this improbable connection are better explained as archaic forms which, though limited at present to the southern continents and islands, may once have crossed by northern land connections, despite our ignorance of their fossil remains. In most cases they are now equatorial in range rather than strictly southern.

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<sup>1</sup>1914, 'Die Vögel,' p. 181; 1918, Journ. f. Orn., p. 75.

<sup>2</sup>1931, Proc. Zool. Soc. London, part 2, pp. 445-461.

## PAST CHANGES IN CLIMATE AND VEGETATION

When the interchange of faunas is considered, we must not lose sight of the suitability of the land connections offered for the passage of animals. Forest-dwelling birds cannot be expected to wander across an arid isthmus, or desert birds across forest. That most of Africa is now so completely distinct, faunally, from Europe, we may attribute to the northern desert belt, not to the Mediterranean Sea. In the past, there may have been arid belts in the zones of the trade winds; but according to Matthew, under the moister Tertiary climate, they would have been a less effective barrier.

The Arabian desert is now the principal obstacle between Africa and India. It cannot always have been thus; there are too many affinities between the birds of the two regions. The Ethiopian and Oriental regions have no less than sixty-eight families in common; Africa and the Malagasy region only forty-four.

The resemblances between the African and Indian faunas leave little room for doubt concerning their closer association at no very remote period. Not only the savanna faunas show much in common; the resemblance is just as marked in the forest faunas. A land connection now covered by the Indian Ocean is not required. A change in climate, involving a northward extension or displacement of the equatorial forest belt, so that it stretched across southern Arabia and Baluchistan, would suffice for the interchange of rain-forest forms as well as of those of the savannas.

There is plenty of botanical evidence for this explanation, since there were Miocene forests of nearly tropical character in France, and fossil trees as well as monkeys are found in the region of Egypt. Dr. Mildbread,<sup>1</sup> botanist of the Mecklenburg Expedition, favored the pendular theory to account for the uniform distribution of forest plants in equatorial Africa, the relations between the floras of the high mountains, and the variety of localized botanical features in South Africa.

Whatever may have been the reason for changes in the Tertiary, the forest belt seems not to have reached the southern end of Africa, because of evidence offered by birds of the indigenous savanna fauna. Of the families and subfamilies already listed as most characteristic of continental Africa, not one is to be regarded as primarily a forest-dwelling group. All are more typical of the savanna areas. Some families, such as the bustards, though not confined to this continent, show such an array of species in its southern part as to lead one to conclude that the

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<sup>1</sup>1914, 'Wiss. Ergeb. Zentral-Afr. Exp. Mecklenburg (1907-1908), II, Botanik,' pp. 688-691.

forest never covered all of southern Africa. More probably there was a large savanna area, not in communication with the Oriental Region. In such an area many of the savanna forms now peculiar to Africa could have had their development.

In three papers, Professor Lönnberg<sup>1</sup> has discussed the influence of climate and vegetation upon the development of the African fauna,



Fig. 176. Present distribution of the green sunbirds of the *Cyanomitra olivacea* group. In eastern Africa their ranges are more discontinuous than the map would indicate, as a result of restriction of suitable forest areas. Compare with Figure 177.

especially its mammals and birds. Many years ago Professor Reichenow<sup>2</sup> pointed out how certain species of birds occur on the mountains of eastern Africa which have close relatives on Mount Cameroon, though they are unrepresented in the intervening territory. Dr. Sharpe<sup>3</sup> went

<sup>1</sup>1918, K. Svenska Vetensk. Arsbok, pp. 247-288; 1926, Journ. f. Orn., pp. 259-273; 1929, Arkiv. f. Zoologi, XXI A, No. 4, pp. 1-33.

<sup>2</sup>1900, 'Vögel Afrikas,' I, p. lxxxix.

<sup>3</sup>1893, Natural Science, III, pp. 100-108.

so far as to group the African mountain areas together in a "Cameroonian subregion," and this view has much to commend it.

Other investigators have added to the number of known similarities between the montane faunas; and Lönnberg told how, during his trip to British East Africa, he repeatedly observed such species, both in the Kenia forest and on the Escarpment. He wrote especially of *Poicephalus gulielmi*, *Heterotrogon vittatus*, *Alseonax minimus*, *Eurillas latirostris*, and a species of *Cryptospiza*. In his opinion, such birds required dense, dark forests, and it made little difference whether these forests grew on mountains or not. In some cases this is true, as I have shown; in others the montane environment is essential.

For the potto, black forest-hog, and bongo, among mammals, Professor Lönnberg gave a correct explanation. He assumed that a more or less continuous forest once covered the whole territory within which these animals now live, and that the scattered forests now existing are only remnants of it. Climatic conditions were once such as to cause the whole of tropical Africa to be covered with forests. Those of the mountains must have been in touch with lowland forests. We see Africa now—he thought—in a period of drought. Before this it is likely that there was a wetter stage, indeed since the Middle Tertiary there may have been several alternations of wetter and drier climates. Geologists, among them Blackenhorn and Passarge, have found evidence of a "pluvial period," both in Egypt and in Southwest Africa, during Pleistocene or glacial time. With this Lönnberg would connect the evidences of more extensive glaciation in the past, on Kenia and Ruwenzori. The restriction of the forest about Mt. Kenia has been increased by the activities of the agricultural natives, and when the forest has once been cut off, conditions now are unfavorable for its re-establishment.

Not only, in Lönnberg's opinion, may the greater part of Africa have been covered with rain forest, but it seems likely, too, that during Miocene time it was in connection with similar forests in southern Asia. As the African forests shrank in size, the newly formed plains and steppes were invaded by a fauna coming from Eurasia by the northeast, including numerous species of antelopes, buffaloes, giraffes, horses, rhinos, and even aard-varks, relatives of which have been found on Samos and at Pikermi in Greece, and near Quercy in France. The faunas of the isolated bits of forest now left in East Africa are compared by Lönnberg to island faunas. Their influence has caused the same differentiation of species and races.

Besides the invading steppe fauna—thought Lönnberg—the savannas and plains of Africa are inhabited by some vertebrates descended

from forest-dwelling forebears, which were able to survive the disappearance of their woods, and to compete with the invading animals. The African ground-squirrels and the red monkeys of the genus *Erythrocebus* were cited as examples. In much the same way he would explain the origin of the rock hyraxes from the tree hyraxes. As another effect of the restriction of the forests, the hornbills, which were originally arboreal forest birds, have not only sent out smaller, duller representatives, *Lophoceros*, into the savannas, but they have given rise to the long-legged *Bucorvus*, which walks on the ground.

Professor Lönnberg went on to show how "speciation" even in the plains faunas may have been favored by isolation through periodic extension of the forest, how large rivers like the Zambesi and Tana may segregate certain kinds of mammals, and, finally, how in dry regions local races of ostriches and antelopes were formed.

We may entertain a doubt as to the adaptability of forest birds in taking up life in the savannas, but that forest birds have been isolated in eastern Africa is plain. There are some excellent cases among species found now in the forests of Usambara. It is also clear that, since the invasion by grassland animals of Asia, there have been periods of increased rainfall that must have caused new fluctuations in the extent of the eastern forests.

Nevertheless, if the African Hylæa had ever been as extensive, at any one time, as Professor Lönnberg at first suggested, it would not have left room for any savanna fauna on the continent. He would thus be logical in assuming that the present savanna creatures are all recent arrivals, coming from Eurasia, or that they arose from forest types. But there is evidence of a surviving savanna fauna from southern Africa, which gives us just those forms by which Africa differs from India. I prefer to think, therefore, that while the forest area has decreased markedly since the Miocene, the southern part of the continent was never completely forested. Together, the mountain and lowland forests probably did extend wholly across its equatorial part, and their fauna and flora may have been expected to show a response to altitude similar to that of to-day.

The turacos were regarded by Lönnberg as a distinctive family of forest birds. Originally they occupied the whole of the widespread forest, but as it became broken up they continued to live in the remnants in various parts of the continent. From the green forest plantain-eaters like *Turacus*, there diverged a group of grayer forms, like *Crinifer*, better adapted to life in dry regions. Such a hypothesis, taken too

literally, makes it almost impossible to understand why the plantain-eaters do not now inhabit the Oriental Region, unless it is assumed that there they have been exterminated. For if we study the plantain-eaters of the rain forest more closely, we shall find them less numerous than in mixed countries of savanna and gallery forest. In the central Congo forest there are but two species, *Corythæola cristata* and *Turacus schützi*.

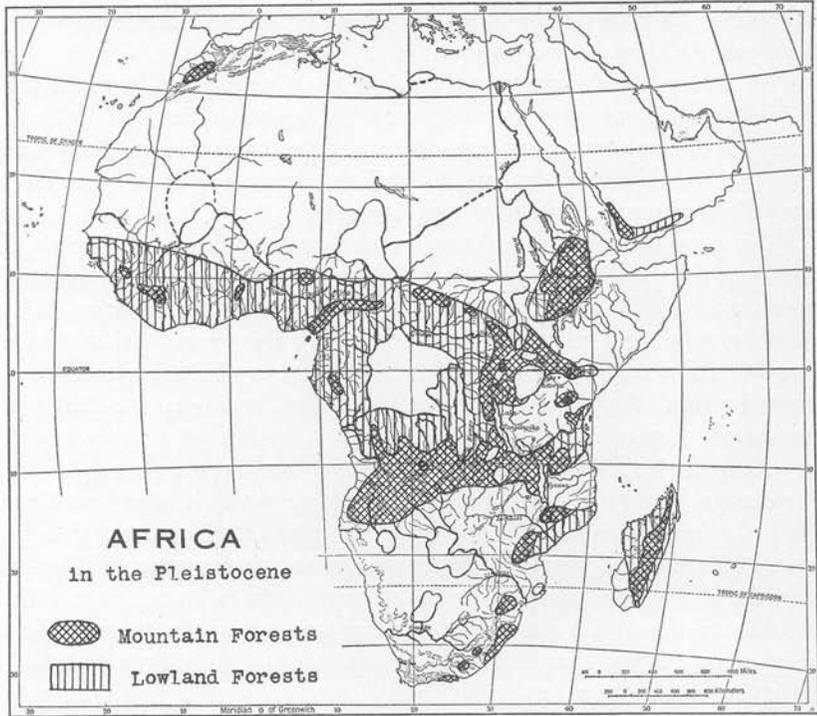


Fig. 177. A hypothetical forest map of Africa during a humid period in the Pleistocene. The possible extent of lakes is after Bequaert; and the forest areas are drawn as they might be if the rainfall were increased by fifty per cent, and montane conditions existed as low as 3000 feet near the equator.

*Corythæola* is the only genus restricted to the heavy West African forests, for *Musophaga*, as I have shown, is mainly a bird of gallery woods.

It is certain that the plantain-eaters have not arisen since the isolation of tropical Africa from Asia. Their characters are too important. The supposed plantain-eater from the Miocene of Europe is known only from a tibia and a metatarsus, so it is not impossible that the true plan-

tain-eaters were at one time restricted to the savannas south of the equatorial forest.

It must be also objected that Professor Lönnberg attributed too little importance to altitude. Most of the forest birds common on the mountains no longer have near relatives in the tropical lowlands. Contrary to his supposition, in a paper of 1911, that *Heterotrogon vittatus* would be found ranging through the forests between Ruwenzori and Mt. Cameroon, we know that it is wanting in the lowland forest. Alpine birds living above the mountain forest have their ranges still more interrupted. These, I think, are legitimate criticisms, but they do not contradict the fundamental assertion by Lönnberg of the effect of climate through the vegetation upon the distribution and evolution of the terrestrial vertebrates of Africa. After all, the mountain bird-fauna of tropical Africa hardly comprises one tenth of the total number of species.

To account for the dispersal of the peculiar mountain birds of Africa, it is far more satisfactory to suppose a cooling of the climate which rendered the intervening territories habitable for them, temporarily at least. Erosion has also reduced the heights of the elevations bordering the Congo basin, especially along the north. It is not difficult to conceive a series of mountain-forest areas, along the Congo-Nile watershed, which would have allowed the spreading of *Heterotrogon*, *Cryptospiza*, and other mountain birds as far as the Cameroon.

#### THE FOREST FAUNA

The forest fauna of West Africa, as was recognized by the earliest zoögeographers, finds its best likeness in Burma and the East Indies. We have already shown that it is not due to convergent evolution; the families, and many genera, are the same. *Tigriornis*, though resembling *Tigrisoma* of South America, is plainly closer to *Zonerodius* of New Guinea. The weak-footed, insectivorous hawk, *Aviceda cuculoides*, is but one of a large Oriental genus which reaches northern Australia. If it has allies in the Neotropical Region, such as *Chondrohierax*, they must have used the North Pacific route.

Between the Cracidae of South America and the gallinaceous families of Africa the gap is very wide. The most primitive members of the order, in Africa, are *Guttera*, *Phasidus*, and *Agelastes*, three genera of guinea-fowls found in the western forests. Why this family is lacking in India is a puzzle, unless due to the competition of the pheasants. *Francolinus*, common to both regions, has few representatives in the West African

forests. The overwhelming proportion of African species of *Francolinus*, so characteristic of plains environment, indicates that despite the possibility of origin elsewhere, they must have had a long period of development in Africa, presumably in a southern savanna, isolated by the forest belt.

The rails are a wide-ranging family, of less significance geographically. We may remark in passing that the African *Himantornis* has no close kinship to the wekas (*Ocydromus*), near which it is often placed in classifications. *Canirallus oculeus* has its relatives in Madagascar; and the small wood-rail, *Sarothrura pulchra*, has an ally in *Rallacula* of New Guinea.

The fruit-pigeons of Africa all belong to a single genus (*Vinago*) which is doubtfully separable from *Treron* and its allies in the Oriental Region. The African species inhabit both forest and savanna areas, and may be admitted to have come from India toward the end of the Tertiary. *Ceuthmochares*, among the African cuckoos, shows a strong resemblance to *Zanclostomus* of the Oriental Region. *Chalcites*, extending eastward to New Zealand, is hardly generically distinct from the African *Chrysococcyx*.

The resemblances between Oriental and African kingfishers have already been touched upon. Among the bee-eaters, *Meropogon breweri* of West Africa is to be compared with *M. forsteni* of Celebes. Many of the Bucerotidæ are localized genera, but *Bycanistes* of Africa is very similar to *Anthracoseros* of India, *Tropicranus* to *Berenicornis* of Sumatra. One of the peculiar families of Africa, the wood-hoopoes, has a deceptive name in our language. In the rain forests proper they are almost lacking, for only one or two small species of *Scoptelus* may be found in tall trees near clearings, and one *Phæniculus* along the forest margin. Otherwise they are much more typical of savanna, and may be regarded as having developed in southern Africa.

The spine-tailed swifts, though characteristic of forests in Africa, cannot be regarded as proving a Neotropical connection, for they are widely dispersed in other parts of the Old World, and one species of *Chætura* ranges to Mongolia and Japan, indicating the more likely path of communication. The Indicatoridæ were perhaps originally a forest family, though some of the members, like the best-known species, are now restricted to the savannas. The most highly developed genus is *Melichneutes*, with a lyrate tail, limited strictly to the western rain forest of Africa. The representation of the family in Asia is limited to two more ordinary species.

The scant representation of the woodpeckers in African forests gives cause for wonder. The small species of *Campethera* occurring there appear to have their nearest allies in *Chloronerpes* and *Chrysoptilus* of South America. Inasmuch as these are all among the least specialized genera of the family, we need not lay stress upon the Neotropical likeness. Parallelism and convergence are by no means rare in the present family. *Geocolaptes* of southern Africa, though slightly modified for ground feeding, is plainly much nearer the other African genera than to *Colaptes* of the New World. If we assume that the highly specialized groups of woodpeckers (such as the Campephilinæ) were of recent origin, the isolation of forested Africa after the Miocene might suffice to account for their absence. They are well represented in the Neotropical and Oriental regions, but *Mesopicos xantholophus* is the most advanced type of woodpecker in the Lower Guinea forest. The piculets (Picumnidæ) have a representative in the Ethiopian as well as others in the Oriental and Neotropical regions. But *Verreauxia* of the West African forest is clearly allied to *Sasia* of India and Malaysia, rather than to any Neotropical form.

The forest-dwelling bulbuls of Africa show a striking resemblance to those of Malaysia, belonging in some cases to the same genera, e.g., *Trichophorus*. In the case of *Pycnonotus*, however, we are dealing with a genus which prefers savannas, so the distribution is less remarkable. The relations of the Timaliidæ in the two regions parallel those among the Pycnonotidæ; some of the "babblers" are strikingly alike, and they had to have a forest connection for their passage. The West African genus *Picathartes* is certainly not a crow or jay. In some external features it suggests the Timaliidæ, and must be removed from the Corvidæ, a family with no forest representative in Africa, and only one in the clearings of the forest area, *Corvus albus*. The cuckoo-shrikes of Africa are not unlike those in the Oriental Region. In Africa they are not primarily a forest-haunting family. Two genera, however, *Cyanograucalus* and *Lobotos*, are restricted to the western forests.

A family which would formerly have been used to point a likeness to the Oriental Region is the Dicæidæ. Now we are sure that the flower-peckers have no representative in Africa. *Parmoptila*, *Lobornis*, and *Pholidornis* have in the past been cited as West African representatives of the Dicæidæ. *Lobornis* was simply the young of *Parmoptila*, and its supposed generic characters, rictal lobes and spots in the mouth, prove that *Parmoptila* belongs among the Estrildinæ, or weaver-finches. When we come to know the young of *Pholidornis*, I suspect it will point toward a similar conclusion.

Despite the reduction of its outermost primary, *Dicæum* seems related to the ancestors of the sunbirds. Many of the Nectariniidæ may come from an old forest group common to Africa and India, while others are now savanna or mountain birds. *Promerops* is not a sunbird, and may have some relationship with the Australian Meliphagidæ. It seems to be an old inhabitant of South Africa and frequents open bushy country.

The wood swallows (Artamidæ) have been said to extend from the Australian and Oriental regions to West Africa, where *Pseudochelidon eurystomina* occurs from the Gaboon to the Upper Congo. *Pseudochelidon* is, however, decidedly aberrant; and the recent discovery by Dr. Schouteden of its nests in tunnels in sand-bars seems to indicate that it may not belong near *Artamus*.

Two subfamilies of Ploceidæ extend from the Ethiopian to the Oriental Region; the Estrildinæ going as far as Australia. Perhaps their different areas of dispersal lend weight to a view that the two subfamilies are none too closely interrelated. The Ploceinæ of the Oriental Region have their nearest African relatives in *Pachyphantes*, distinctly a savanna type, and *Brachycope*, of forested rivers. Madagascar, with only *Foudia* and *Nelicurvius*, has a weak representation of the Ploceinæ, and practically no Estrildinæ.<sup>1</sup> The latter are more numerous in Malaysia and Australia than on Madagascar. Why, if the Ploceinæ are old enough to be common to the Malagasy and Ethiopian regions, did they not extend eastward to India in greater variety? An earlier localization of the subfamily in southern Africa seems to be the best explanation.

The forest-dwelling Ploceinæ of Africa are an important group today. The fact that they are obliged to be so largely insectivorous, despite their granivorous beaks, may also stamp this as a secondary adaptation to a new habitat. Likewise, the Estrildinæ now have forest-dwelling genera such as *Nigrita* and *Spermospiza* in Africa, but not in India or New Guinea. It is the grassland weaver-finches that live in all three regions.

To summarize the more salient characteristics of the forest avifauna: it is still most nearly related to that of the Oriental Region, with so little resemblance to the Neotropical that we may safely dismiss the possibility of any direct land connection, even in the Eocene. There is slight resemblance to the Palæarctic fauna; nor would more be expected, in view of the differences of climate, and the belts of varying aridity which separate them. The severing of the connection between the equatorial

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<sup>1</sup>The only exception is *Spermestes nana*.

forests of Asia and Africa resulted from a fundamental change of climate, a withdrawal to the south of forest vegetation. Though there is no family peculiar to the African forests except the Picathartidæ, it is still possible that many of the forest birds survived from an old substratum of African extraction, which has lost its individuality through past intercourse with Asia.

Professor Arldt speaks of West Africa as a "Reliktengebiet," and this can scarcely be disputed. There, forest forms survive which could no longer exist in open regions to the northward. Some of their forebears may well have come from Europe or Asia, but an old continent like Africa is sure to have had an important indigenous fauna. To a certain extent the tropics may be regarded as harboring older types of land birds than the cooler zones. To-day there can be no comparison in numbers of species between the ornithological wealth of the equatorial regions and the relative poverty of the temperate zones. The many equatorial forms could scarcely all have had their origin in the restricted area they now inhabit. Isolating influences are too few, and it would seem as though they had been crowded together, near the equator, by climatic change and the competition of species better adapted to life under conditions of aridity or cold.

The faunistic effect of a Pleistocene lake in the central Congo basin would be relatively local. It might well explain the differentiation of races within the Lower Guinea forest area. Where a form living in the eastern Congo forest differs from its representative in the Cameroon, Gaboon, or Mayombe, such a lake may have caused segregation favorable to evolutionary divergence.

#### THE SAVANNA FAUNA

The grassland fauna of Africa now surrounds the western forest on three sides. Many of its members have come from the great belt of relatively arid country that stretched from North Africa far into Asia. But others, it seems certain, are old African forms that dwelt previously in an open region of South Africa.

The most remarkable family of plains-haunting birds of Africa, barring none, are the ostriches. They cannot be said to be restricted to the Ethiopian Region, because of their occurrence in North Africa and in southwestern Asia. Ostriches are unknown in the West African forest subregion; none occurs in the Congo, and in equatorial Africa they live only on the dry plains of the east. Otherwise they are characteristic of the arid regions of both northern and southern parts

of the continent. The ostrich has still a representative in southwestern Asia, and at no very remote period there were ostriches ranging to Mongolia. Then they were not even characteristically Ethiopian. The South African race must be an invader from the north, which became localized in a suitable area far south of the forest. The Masai ostrich, in the same way, remained in a particularly arid part of East Africa.

To-day the ostriches are plains and desert birds, and are surely well adapted by their powers of locomotion to life in the open, where an enemy is visible from afar. One might hesitate to affirm, however, that the ostrich first acquired its most distinctive characters in exactly the environment where it now thrives. No modern desert type of bird is losing its power of flight. With the exception of the emu, the rheas, some of the cassowaries, and the ostriches, all the flightless birds are island-dwelling forms. There are flightless ducks, cormorants, gallinules, and rails, not to mention the penguins, the extinct great auk, the dodos, *Æpyornithes* and the moas, all of which lived on islands. They have all been able to dispense with the power of flight because of the absence of certain enemies usually present on larger bodies of land. It may be claimed that the flightless grebe of Lake Titicaca (*Centropelma microp-terum*) likewise enjoys the same protection by water, without being obliged by the climate to migrate.

The ostrich is descended from a flying bird, as even a superficial study of the wing-bones, muscles, and remiges will prove. But it has many peculiar features which indicate that it branched off from the other stems of bird evolution at an ancient period. Then it was probably less like the other Ratitæ than it is now; similar life having resulted in convergent resemblances. Reduction of wings occurred early in the history of the feathered vertebrates; and *Diatryma*, of the Eocene, had not only become flightless, but had attained the huge size which characterizes several modern ratites. The increases in size in both *Diatryma* and *Struthio* must have come after flight was abandoned. Flying birds of such size have never existed, and must be mechanically impossible.

In many osteological characters the ostrich is more primitive than *Diatryma*; but the ages by which it has survived that Eocene giant have allowed it to progress much farther in other specializations toward terrestrial life, particularly in modifications of the hind limb. Either the ancestral ostrich lost its ability to fly at a remote period when there were few predatory mammals to fear, or it may have done so while living in an insular area in the old and larger Mediterranean. Having perfected its cursorial ability, it could, on regaining a continental area of open plains, outdistance its enemies.

That the ostrich-like birds are all descended from birds that never flew, as has been stated by Dr. Percy R. Lowe,<sup>1</sup> I cannot believe. Neither can I agree that any of the flightless rails never had a flying ancestor. These rails are characteristic of oceanic islands, so how did they reach there if their forebears were incapable of true flight? The silky fowl teaches us how feathers may degenerate in a few centuries, and a rail's life on a remote island is favorable to similar change.

When I speak of savanna birds, I do not mean only the birds of dry grassland, but include all that are characteristic of countries without heavy forest. Many of them spend their lives in trees, others are aquatic, but in general they avoid the areas of unbroken forest.

Africa has a heron, *Butorides striatus*, all but identical with its South American race, but the species goes nearly around the world. *Ardea goliath*, *Ardeola ralloides*, and *Bubulcus ibis* have distinctly Oriental affinities.

*Balæniceps rex*, now living north, east, and south of the Congo forest, may once have been restricted to a southern savanna area; but a single surviving species offers little field for deductions. Personally, I regard the whale-head as much nearer the storks than the herons. The hammerhead, *Scopus umbretta*, is widely distributed in Africa, and is doubtless a recent immigrant to Madagascar. It is relatively scarce in the Congo forest region, especially in the Ituri. Unknown in Asia, it is likely to have developed in southern Africa. Although Africa is regarded by Lambrecht<sup>2</sup> as the center of dispersal of the storks, they were not restricted to southern Africa.

The fossil secretary bird reported from the Miocene of Europe forestalls any claim that the genus was characteristic of an old South African savanna. A distinct species of harrier (*Circus maurus*) in South Africa offers better grounds for belief in a persistent southern savanna. The chanting goshawks (*Meliærax*) are peculiar to Africa, and never found in forest country.

The horned guinea-fowls are doubtless the most specialized of their family. Partial isolation by the forest and non-migratory habits are the reasons for the divergence of three or four groups of forms formerly regarded as species. If the genus *Numida* was not at first confined to the southern savanna, one must wonder that it did not reach tropical Asia. The presence of *Numida sabyi* in Morocco shows its ability to cross arid country. Among the francolins the genus *Pternistis* is very nearly allied

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<sup>1</sup>1928, Proc. Zool. Soc. London, pp. 186-247.

<sup>2</sup>1931, Proc. VII Internat. Orn. Congress Amsterdam, p. 86.

to *Francolinus*, and its members all live in grasslands, mainly to the south and east of the Congo forest. It certainly has developed in the southern savannas of Africa.

The crowned cranes (*Balearica*) offer a further example of a savanna-dwelling genus strangely limited to Africa. *Bugeranus* and *Tetrapteryx*, in the same family, are still mainly restricted to the southern parts of Africa. Cranes are among the most typical birds of plains. The South African bustards indicate that the greater part of that region cannot have been covered by forests for a long time back. The family has long inhabited the northern grasslands as well, for a few species extend to the Palæarctic Region, more to the Oriental, and one to the Australian.

I cannot follow Professor Lönnberg in deriving all the savanna plantain-eaters from forest forms. *Turacus*, *Musophaga*, and *Corythæola* seem to be perhaps the most highly specialized of the group. The change of habitat may rather have been from savanna to forest. Otherwise it seems remarkable that no representative is now living in the Oriental Region.

Parrots are sparingly represented in the Ethiopian Region, both as to genera and species. There are more in the savanna regions than in the forest. None of the African genera is as closely related to the Neotropical as it may appear superficially. *Agapornis* may well have been confined at one time to the southern savanna, where most of the species are still found. Only one of the love-birds, *A. swinderniana*, has fully adapted itself to forest life. *Palæornis* is shared with India, and it must be a very recent arrival in Africa, for but one species ranges across the drier part of the northern savanna, and occurs also in India.

The ground hornbills, *Bucorvus*, are distinct enough from all other genera of their family to suggest an ancient adaptation, certainly not in a rain-forest area. Unknown in Asia, the genus may have once occupied only the southern savannas. The two well-marked species of to-day are doubtless the result of a later isolation by forest; the northern species, in the character of the casque, is the more specialized.

The hoopoes may be said to parallel the hornbills in that *Upupa* is a longer-legged terrestrial genus, whereas *Phæniculus*, *Scoptelus*, and *Rhinopomastus* are strictly arboreal. The Phæniculinæ are scarcely represented in the forest area, however, and they do not extend beyond the shores of Africa. *Upupa*, on the other hand, is distributed like a northern bird. May not the forest belt have favored the origin of the two groups?

Among the owls, *Tyto* is represented in southern Africa by a terrestrial species, *T. capensis*, as well as by the normal type of barn owl,

of a race closely allied to the bird of Europe. The latter is to be counted as part of the newer savanna fauna, and extends without variation from the Sudan to the Cape. In *Heliophilus*, Madagascar possesses a bird close to the ancestral line of *Tyto*, thanks to its long isolation from the continent. Africa's fishing owls (*Scotopelia*) differ slightly from those of the Oriental Region (*Ketupa*), but are not of independent origin. They require rivers with wooded banks, but are not restricted to heavy forests, so they may have found their way in from India.

The wide range of the Caprimulgidae throughout the world makes it likely that they spread over most of the continents so long ago as to leave no trace of their exact lines of dispersal. In the West African forest there is one peculiar genus, *Veles*, with slightly folded or vaulted tail; but on the whole the African goatsuckers are distinctly addicted to savanna life. The most conspicuous specializations in this family consist of elongated feathers in the wings and tail. *Scotornis* of Africa, with median rectrices prolonged, but closely allied to *Caprimulgus fossii*, is entirely independent from *Hydropsalis* and *Macropsalis* of South America. The males of *Cosmetornis* and *Macrodipteryx* of Africa possess remarkably elongated primaries, especially the second pair (or ninth, counting from the outer side). They are not very closely allied to *Eleothreptus* of South America. The Neotropical genus has three lengthened primaries, but the third (= eighth from outside) exceeding its fellows. *Cosmetornis* and *Macrodipteryx* seem to be old African forms, not invaders from Asia.

Among the families of small birds peculiar to Africa, the most distinct is the Coliidae, for authorities disagree as to its proper position among the Coraciiformes. Gadow and Beddard have placed it near the trogons, but Pycraft<sup>1</sup> pointed to resemblances with the swifts. In any event the colies have doubtless diverged from a primitive roller-like stem. The colies are so distinctive a part of the savanna fauna as to invite speculation on the reason why they do not also occur in the Oriental Region. A distributional map of the colies will be found to outline very accurately, by its blank areas, the extent of heavy rain forest and of desert in Africa. I believe that the final evolution of the colies took place in the southern savannas of Africa, when they were completely barred from the north by forests. Only in a comparatively recent period have the colies extended into the Sudan, and their extension to Asia has been prevented by the aridity of the region beyond the Red Sea.

The barbets of the genus *Trachyphonus* are exclusively African, but never found in the western forests. Even though the forest-dwelling

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<sup>1</sup>1907, *Ibis*, pp. 225-253.

*Trachylæmus* seems allied, there is no similar barbet in the Oriental Region; and it would appear that *Trachyphonus* dwelt in southern Africa before arid conditions began to prevail in East Africa. All the African barbets are of genera not found in India, and are still less like the South American. The most advanced type of woodpecker in Africa is *Thripias namaquus*, a bird of the savanna areas, and doubtless an immigrant from the northeast.

Besides pipits somewhat similar to those of Eurasia, Africa has two genera (*Macronyx* and *Tmetothylacus*) which differ strikingly in their bright colors and in their feet. There is no reason to suppose that they are recent immigrants from Asia, and yet they cannot have developed from any forest-dwelling ancestor.

Among the Timaliidæ, the savanna-loving genera *Turdoides* and *Argya* are common to Africa and India. *Phyllanthus* is nearly related, despite the short tail and maroon coloration, yet it lives only in the West African forests. The grass-warblers of the genus *Cisticola* are poorly represented in the Oriental and Palæarctic regions, yet numerous and varied in Africa; and the latter continent would appear to be their center of dispersal. That this genus has developed mainly in open country, not in forest, is beyond dispute.

Among the swallows the genus *Psalidoprocne* is so highly specialized that it has sometimes been made a distinct subfamily. Only a few species live in clearings in the equatorial forest, and this looks like an old African savanna group. The bush-shrikes of Africa (Malaconotinæ) include some forest-loving species but also many that prefer savannas, especially *Rhodophoneus* and *Tchagra*. The whole subfamily is wanting outside Africa, and if it really is allied to *Lanius* a good case can be made for the radiation of the whole family Laniidæ from the Ethiopian Region.

As compared with other families of Passeres, the Buphagidæ has ample claim to recognition. Everything about the oxpeckers, especially the beak and feet, suggests long specialization to a tick-hunting life, as a symbiote, if not an ectoparasite, upon large ruminants. If the large herbivores of Africa were entirely derived from the north, they may have brought *Buphagus* with them, although restriction to the African plains would argue—on purely faunistic grounds—for an origin in South Africa. The latter view appeals to me, and I am loath to believe that there was no large plains-dwelling animal in the south to provide them with a living.

The dispersal of the typical weaver-birds (Ploceinæ) to the Oriental Region has been discussed. Further evidence for their origin in southern

Africa may be had from Professor Sushkin's classification of the family. He regarded *Bubalornis* as the most archaic member of the group, and the Plocepasserinæ are likewise rather primitive. The representatives of these two subfamilies are all confined to the Ethiopian Region, yet never found in the forest regions. The sparrow-like sociable weaver (*Phile-tairus*) is South African, and the true sparrows (Passerinæ) may well have arisen in Africa. They have spread to the Oriental and Palæarctic regions, but never reached the New World.

The weaver-finches (Estrildinæ) are more typically savanna-dwelling than the Ploceinæ, and the cooler Palæarctic climate likewise prevented their northward spread, though they traveled far eastward through the tropics. Some of the African genera, *Vidua* and its allies, have outstripped all their relatives in the elongation of the middle tail-feathers. *Hypochoera* has some very close resemblances to the *Vidua* group,<sup>1</sup> yet its rectrices are not at all altered. One species of *Vidua*, in the other hand, possesses elongate tail-feathers, with the black body coloration of *Hypochoera*.

From their present habits and the preponderance of grass-seed in the diet, I feel sure that *Hypochoera*, *Vidua*, and their relatives have always been savanna birds. Restricted as they are to Africa, one may regard them as a special development of the southern savanna. The distribution of the two species of *Steganura*,<sup>2</sup> however, may be interpreted as showing that one of them early found its way to the northern savanna, though none of the group reached India.

The Fringillidæ are certainly not characteristic of the Ethiopian Region, and within the lowland rain forest they have no representative save in clearings. The way the genera *Polioptila* and *Serinus* are distributed, especially in the highlands of eastern Africa, suggests that they came in from Palæarctic countries. Typical buntings have likewise occupied the African savannas, and undoubtedly had a northern origin. The genus *Linurgus*, dwelling in the high mountains, is presumably the only fringillid of long standing in tropical Africa. Among the Fringillidæ both true finches and buntings made use of the North Pacific crossing. The family may have originated in the New World.

The savanna birds of Africa, if we except stragglers extending out from the forest region, may be regarded in fair measure as invaders from the northeast, or from the belt of grassland that was established in Tertiary times, bordering the northern limit of tropical rain forests in

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<sup>1</sup>Chapin, 1917, Bull. Amer. Mus. Nat. Hist., XXXVII, p. 257.

<sup>2</sup>See Chapin, 1922, Amer. Mus. Novitates, No. 43, p. 11; 1929, Auk, pp 474-484.

Asia and Africa. Among these are doubtless the forms with near relatives in tropical Asia. Mingled with the northern savanna forms, many of which long ago established themselves in South Africa, there are representatives of a more indigenous fauna, which had long been developing in a grass-grown area of southern Africa, isolated by the forest belt, and in consequence hardly or not at all represented in the Oriental region. The origin of this fauna is older than Miocene.

If some sort of "pendular hypothesis" were the correct interpretation of climatic change in Africa, then it would appear that the southern savanna area of Africa, toward Miocene time, had a still wider extension than it has to-day. It would have been noticeably reduced during the Pleistocene, but soon its fauna would have found grasslands in East Africa, and might have spread to those of the Sudan. As I have said, however, such an explanation is not in favor among geologists. If South America and Africa "drifted" apart, as Wegener claims, they did so at too early an age to concern us here. The formation of rift valleys during the Tertiary was not of such great importance as the desiccation of Northeast Africa and Arabia. The Red Sea, part of the rift system, is a barrier, but much less effective than the desert areas beyond it.

Variations in the forest belt toward the eastern side of the continent, during the Pleistocene, have played a notable part in the dispersal and mingling of savanna faunas from both north and south. The rift valleys had only a local influence. The drought of the western coast near Togoland has affected the subdivision of forest species, but not of savanna birds. The most distinct faunal change, as one goes eastward across the northern savannas, occurs in the region of Lake Chad and the Cameroon highlands. Some will attribute this to a Quaternary flooding of the Shari basin. In recent times some savanna birds have made their way across the Cameroon forest to the grasslands near the lower Congo River.

It may be remarked that a few Palæarctic species are apparently colonizing South Africa at the present time. Certain migrants from Europe, like the white stork, corn crake, and the bee-eater, seem to linger irregularly in small numbers, and in a few cases they have actually been found nesting. Perhaps in this way the southern races of *Botaurus stellaris* and *Coturnix coturnix* originated.

#### THE MOUNTAIN FAUNA

Less important numerically than the lowland faunas already discussed, the mountain birds of Africa have a special interest in that they appear often to be relics of an earlier day, not very remote, when the

climate of equatorial Africa was different. The mountains which harbor them are old, if we except the volcanoes, and have been losing in altitude through erosion; but reduction in height alone is not a sufficient explanation. It will hardly account for the former extension of birds' ranges between the Cameroon Mountains and East Africa. Were it not for parallel similarities in some plants and many flightless animals, one might argue that the birds had flown from mountain to mountain, as they doubtless do in some parts of eastern Africa.

The low level of glaciation on Ruwenzori, supposed to have been reached in the Pleistocene, was the result of climatic changes, we believe, which caused a wider dispersal of the montane flora and of the mountain birds. As the climate was altered to its present drier, or warmer condition, they were forced to mount higher upon the peaks, where they became isolated as we find them to-day. Sometimes segregation has resulted in slight divergent evolution, but often the time elapsed has been insufficient. So far as Africa is concerned the mountain birds have had but little independent effect upon the general course of evolution and population of the continent. The best examples are stranded, figuratively, upon their peaks, surrounded by the flood of tropical life below them.

Indications are wanting that a localized mountain form is ever enabled, without change in the climate, to extend its range downward and outward into the tropical life zone. Migratory birds of Eurasia, it will be remarked, are able to spend a large portion of the year under a tropical sun; but they do not breed there.

Relatively few of the mountain-forest birds show pronounced Palæartic affinity, because of the lack of connection with Eurasian mountain chains. Nevertheless, while the enlargement of the savannas and more arid types of country has given access to birds of Asiatic groups, the mountains of eastern Africa have aided in the spread of certain northern genera and species. A few which occur in the Congo, such as *Asio abyssinicus* and *Micropus melba*, have already been discussed. Two others which occur on the East African mountains and southward are *Gypaëtus barbatus* and *Bubo capensis* (allied to *B. bubo*). *Columba arquatrix* is related to *C. hodgsonii* of the Himalayas, and a Palæartic chough (*Pyrrhocorax*) lives in the mountains of Abyssinia.

#### CONCLUSIONS

The faunal relationships of African birds to-day are largely the result of (1) past continental connections, limiting the original inhabitants and immigrants, (2) climates and topography in the past, which

affected the vegetation and thus the ranges of birds, (3) climate and topography of the present, which determine the ranges of living birds, largely through vegetation and by the cooler temperatures on the mountains.

These are only controlling influences. The birds have reacted according to their heredity and variability. As a result, the avifauna of the Ethiopian Region bears a closer resemblance to that of the Oriental than to any other, even the Malagasy. The forest regions of West Africa, southern India, and the Sunda Islands were in communication toward Miocene time, probably because of more abundant rainfall along the coasts which lie between them. Since the climatic separation, there has been considerable divergent evolution in some groups, very little in others.

The savanna regions of Africa, still more recently, have received immigrants from Eurasia, or there has been an interchange of species. In southern Africa, on the other hand, an indigenous savanna fauna once evolved, which has supplied the more peculiarly Ethiopian savanna species. Many of them have spread northward through East Africa to the Sudan, as a result of restriction in size of the equatorial rain forest. By its isolating effects the forest belt has had a fundamental influence upon the development and distribution of savanna birds, and the forest birds tended to diverge when segregated by breaks in the forest.

The elevated plateaus of eastern equatorial Africa, favoring discontinuity of the forest belt, have aided in allowing a passage between northern and southern savannas; and upon the high mountains a characteristic avifauna has been developed.

The desert belt of the Sahara and Arabia assures the continued isolation of the Ethiopian Region. It does not bar the northern migrants; but they are not fitted to breed in tropical Africa, and only establish themselves occasionally at the southern extremity of the continent. It does exclude the less migratory birds of North Africa and of tropical India, which would be better adapted for life in tropical Africa. The arid regions of southwest Africa offer a less complete barrier between the Cape and the warmer regions, but they serve to harbor many indigenous desert-loving birds.

There is a tendency in discussing the older faunas of continents to emphasize invasions from other regions. We must remember that the earlier inhabitants of a country have many advantages in the competition for territory, and that only an extreme change in vegetation or the arrival of highly adaptable immigrants is likely to swing the balance against

them. In the increasing aridity of Africa any savanna bird of southern Africa would have been just as likely to extend its range north to the Sudan as would an Asiatic species to invade eastern and southern Africa.

To the newer experimental school of biologists it may seem doubtful whether we have a right to draw inferences from minor characters of structure and color-pattern as to the evolutionary history of a family of birds. I am ready to grant that under domestication mutations do occur which seem to produce equally conspicuous differences within a single species.

But just as paleontology proves that the evolution of skeletal parts has usually proceeded by short steps, so a broad view of living birds tends to justify the importance we attribute to relative proportions, specializations in beak or feet, and sometimes to coloration. Large mutations in color do occur among wild birds, but they are exceptional, and seldom have they seemed to influence the gradual progress of evolution.

The most successful mutations are those which produce only small visible changes. These are favored by geographic isolation and natural selection; and to them, rather than any direct effect of climate, we must attribute the evolutionary progress which has resulted in the varied avifauna of the present.

SECTION B.—SYSTEMATIC LIST OF SPECIES AND RACES,  
WITH NOTES ON DISTRIBUTION, HABITS, AND FOOD

Names of forms known to occur within the Belgian Congo or Mandated Territory are printed in heavy type. Those enclosed in square brackets have been reported from adjacent areas, so that a number of them may be expected to reach our territory.

The references in the synonymies are complete to the end of 1930, and include a few records from just outside our limits, as well as a few references to publications in 1931.

ORDER STRUTHIONIFORMES

[FAMILY STRUTHIONIDÆ. OSTRICHES]

No wild ostrich has ever been collected within the limits of the Belgian Congo. As Schubotz has shown,<sup>1</sup> Emin's belief that they would be found in the Mabode (=Mabudu) country was entirely without foundation. So, too, was the remark by L. de Grandpré<sup>2</sup> that ostriches were present, in very small numbers, inland from the Loango Coast. The nearest point from which the North African ostrich (*Struthio camelus camelus* Linnæus) is known is north of Lado, on the west side of the Bahr-el-Jebel.<sup>3</sup> The Masai ostrich (*Struthio camelus massaicus* Neumann) of Tanganyika Territory also extends to within a relatively short distance of the boundary of Urundi, in the Ujiji district, but has not reached the western side of Lake Tanganyika.

In recent years domestic ostriches of Sudanese origin have been kept here and there in the Uelle district, and they have even been reared at the Mission at Buta.<sup>4</sup>

ORDER COLYMBIFORMES

FAMILY **PODICIPIDÆ**. GREBES

KEY TO THE SPECIES OF GREBES IN THE CONGO

Larger: wing more than 150 mm. long; in the full adult plumage there are patches of lengthened feathers at sides of throat and tufts of narrow feathers pointing back from the temporal region. . . . . *Podiceps cristatus*.  
Smaller: wing less than 110 mm.; no lengthened feathers about the head in any plumage. . . . . *Poliiocephalus ruficollis*.

<sup>1</sup>1916, 'Die Tagebücher von Dr. Emin Pascha,' VI, p. 43.  
<sup>2</sup>1801, 'Voyage à la Côte Occidentale d'Afrique,' I, p. 14.  
<sup>3</sup>Stigand, 1923, 'Equatoria: the Lado Enclave,' p. 45.  
<sup>4</sup>Schouteden, 1927, Bull. Cercle Zool. Congolais, IV, p. 39.

***Poliiocephalus ruficollis capensis* (Salvadori)**

*Podiceps capensis* SALVADORI, 1884, Ann. Mus. Civ. Stor. Nat. Genova, (2) I, p. 252 (type locality: Shoa<sup>1</sup>). MOURITZ, 1914, Ibis, p. 30 (Inkosakapenda on the Loömbwa R.). LÖNNBERG, 1917, Arkiv. f. Zool., X, No. 24, p. 3 (Lake Edward). DE RIEMAECKER, 1927, Rev. Zool. Afr., XIV, p. 257 (Elisabethville).

*Podiceps minor* DUBOIS, 1886, Bull. Mus. Roy. Hist. Nat. Belgique, IV, p. 150 (region of L. Tanganyika).

*Colymbus fluviatilis* EMIN, 1894, Journ. f. Orn., p. 165 (old Irumu).

*Colymbus capensis* REICHENOW, 1900, 'Vögel Afrikas,' I, p. 18 (Ituri); 1911, 'Wiss. Ergeb. D. Zentr.-Afr. Exp. Mecklenburg,' III, p. 237 (Lakes Mohasi and Karago). SCHOOTEDEN, 1914, Rev. Zool. Afr., III, p. 261 (Kilo); 1918, idem, V, p. 213 (Mukoto; Kilo; Bolombo).

*Podicipes capensis* DUBOIS, 1905, Annales Mus. Congo, Zoologie, I, fasc. 1, p. 23 (Tanganyika; Kisantu; Lower Congo).

*Podiceps ruficollis capensis* HARTERT, 1920, 'Vögel Paläarkt. Fauna,' II, p. 1453 (tropical Africa). GYLDENSTOLPE, 1924, K. Svenska Vet. Akad. Handl. Stockh., (3) I, No. 3, p. 302 (Warma).

Niangara, 2 ♂, Apr. 18, 24; ♀, May 12.

ADULTS OF BOTH SEXES.—Iris dark brown, lores blackish; bill blackish with whitish tip and mottled slightly with buff at sides; soft skin at corners of mouth and base of mandible very light green; feet greenish-black on outer side, lighter green on inner.

The male taken on April 24 has pale cheeks as though in "winter" plumage and is not very young. The other specimens are in adult breeding plumage.

As compared with three adults from Karkloof, Natal, these from the Uelle have the rufous of the fore-neck a trifle lighter, and the black chin-patch smaller. The bases of their primaries, too, are more whitish than those of the South African specimens. The amount of white on the secondaries is variable, and usually the outer webs have more or less gray. Among four adults of *P. r. capensis* from southern India in the American Museum, one has many pure-white secondaries, while in the deep chestnut color of the fore-neck they agree with South African examples. Indian birds are sometimes separated from the African as *P. r. albipennis* (Sharpe).

The race of tropical Africa intergrades with typical *ruficollis*. A breeding female from Abu Zabal, Egypt, collected by Mr. William Raw and now in the American Museum, is referable to the European race, though showing a slight approach to *capensis* in having a little more white on the secondaries than European birds. Their shafts are gray.

DISTRIBUTION OF THE SPECIES.—From Europe to Japan, the Philippines, Australia, India, and the intervening islands, as well as Africa and

<sup>1</sup>*P. capensis* Lichtenstein, 1854, 'Nomencl. Av. Mus. Berol.,' p. 104 (South Africa) is a *nomen nudum*.

Madagascar. Seven races are listed by Dr. Hartert (1920), of which *P. ruficollis capensis* occupies tropical and southern Africa, with the exception of the western forests. Within the Ethiopian Region it is probably commonest in South Africa, where it is the most abundant and widely spread member of the family, and resident throughout the year.

In the Congo basin it is much less common, perhaps because of the wooded banks of the streams, but more likely because of the scarcity of quiet ponds or lakes. In addition to the Congo specimens referred to in the synonymy, there is an adult in the Congo Museum at Tervueren from Baaba, Kwango district, procured by Charliers. Father Calleweart has also sent us two adults from Luluabourg and Kaniinda Boni in the Kasai District.

During our Congo Expedition we saw only the three examples we collected. Two of them were shot in small ponds, the other was captured alive in a swamp where there was little open water. This bird generally sat on the whole metatarsus, but could stand up, too; and it even ran rapidly along the ground beating its wings, so that it would probably have succeeded in taking flight but for a string tied to the foot. In the stomach of one individual we found insect remains. The state of the reproductive organs indicated that our three specimens were approaching the breeding season in April and May.

On Lake Bunyoni in British Ruanda, I found both newly hatched and half-grown young in the first half of April. The nests are built exactly as they are in Europe. Dr. van Someren believes that adult dabchicks in equatorial East Africa may not have any pale non-breeding plumage.

The European dabchick drops all its remiges simultaneously during the postnuptial molt. At the Berlin Aquarium on September 9, 1921, Dr. Heinroth showed me a captive bird with both wings practically bare, the coverts having been shed with the quills. An adult male of *P. r. capensis* in the American Museum, obtained by R. E. Symons in Natal on September 3, shows all the primaries and secondaries in both wings just sprouting anew, but most of the wing-coverts had not yet been molted. Otherwise the plumage is that of the breeding season. In that region, moreover, Mr. Symons states that the species nests in December and January.

The western grebe, *Aechmophorus occidentalis* (Lawrence), is stated by Bent<sup>1</sup> to lose all the remiges at once during the postnuptial molt; but this is the only case he cites among North American grebes.

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<sup>1</sup>1919, 'Life Histories of North American Diving Birds,' Bull. U. S. Nat. Mus., No. 107, p. 6.

**Podiceps cristatus infuscatus** Salvadori

*Podiceps infuscatus* SALVADORI, 1884, *Annali Mus. Civ. Stor. Nat. Genova*, (2) I, p. 251 (type locality: L. Kilolé, S. Abyssinia). LÖNNBERG, 1917, *Arkiv. f. Zool.*, X, No. 24, p. 3 (Rutshuru).

*Colymbus infuscatus* REICHENOW, 1911, 'Wiss. Ergeb. D. Zentr.-Afr. Exp. Mecklenburg,' III, p. 236 (L. Mohasi).

*Podiceps cristatus* MOURITZ, 1914, *Ibis*, p. 30 (Inkosakapenda on the Loömbwa R.).

*Podiceps cristatus infuscatus* HARTERT, 1920, 'Vögel Paläarkt. Fauna,' II, p. 1447 (Africa S. of the Sahara).

The African great crested grebe, while regarded as a subspecies of *P. cristatus* (Linnæus) of the Palæarctic Region, differs markedly in that the brown of the crown extends down to the eye, leaving no light superciliary stripe.

DISTRIBUTION.—Senegal and Abyssinia, south through eastern Africa to Cape Colony and Southwest Africa; but not known to occur in forested western Africa. Within our limits it is found in the highland lakes of the Kivu region and in the Upper Katanga. The habits resemble those of the European bird, and Dr. J. C. Phillips collected a downy young bird with streaked neck on Lake Chahafi, British Ruanda, in the month of April. Dr. van Someren has satisfied himself that the adults in Kenya Colony have no distinct non-breeding plumage. Both in South and East Africa it has been found that several pairs are apt to nest close together, the sets of eggs numbering three to four.

## ORDER PROCELLARIIFORMES

## FAMILY HYDROBATIDÆ. STORM-PETRELS

## KEY TO THE SPECIES OF HYDROBATIDÆ TO BE EXPECTED OFF THE CONGO COAST

1.—Metatarsus about 35 mm. long, distinctly longer than middle toe; webs between toes with yellowish central patches; wing about 150 mm. long.

*Oceanites oceanicus*.

Metatarsus only 20–24 mm., and approximately equal to middle toe with claw; webs between toes entirely black . . . . . 2.

2.—Wing less than 120 mm. long; tail square . . . . . *Hydrobates pelagicus*.

Wing 150 to 170 mm.; tail square or very slightly forked . . . . . *Oceanodroma castro*.<sup>1</sup>

[*Hydrobates pelagicus* (Linnæus)]

*Procellaria pelagica* LINNÆUS, 1758, 'Syst. Nat.,' 10th Ed., p. 131 (type locality: "in albo Oceano," restricted by Hartert to the coast of Sweden).

The storm-petrel breeds on islands in the north Atlantic and Mediterranean and migrates southward, reaching the Strait of Bab-el-

<sup>1</sup>*Oceanodroma l. leucorhoa* Vieillot, which also occurs in the Atlantic Ocean and has been taken off the Gold Coast and in the Cape seas, differs in its more deeply forked tail, the notch being about 19 mm. deep.

Mandeb and the African coasts from the Gold Coast to the Cape and the mouth of the Zambesi. It is, therefore, to be expected off the mouth of the Congo, though no specimen has yet been secured from that vicinity.

[*Oceanodroma castro castro* (Harcourt)]

*Thalassidroma castro* HARCOURT, 1851, 'Sketch of Madeira,' p. 123 (type locality: Desertas Is., Madeira).

Breeds on islands in the Atlantic, from the Azores to Cape Verde Islands and St. Helena. It is represented by another race in the Pacific and occurs in the Gulf of Guinea, having been taken at least twice on São Tomé, and may, therefore, be expected off the mouth of the Congo.

*Oceanites oceanicus oceanicus* (Kuhl)

*Procellaria oceanica* KÜHL, 1820, 'Beitr. Zool. Vergl. Anat.,' part 1, p. 136 (type locality: S. Atlantic, off Rio de la Plata).

Off coast of Gaboon, north of Loango, ♀, June 20.

From off the coast of Spain to Sierra Leone, between June 6 and June 15, 1909, petrels of this species were seen following the ship every day. Three more were seen on the 20th, and at about 8:30 that evening this bird flew aboard.

As Dr. R. C. Murphy has shown,<sup>1</sup> this individual is still in juvenal plumage, with a prominent white spot in the lores, but the white margins on the belly are inconspicuous because of wear. Other marks of immaturity are the weaker bill, with a less pronounced unguis, slighter bones in the tarsi and wings, and smaller claws on the toes. Dr. Murphy, after a careful study of the molts and observations on migrating birds from New York to South Georgia, proves conclusively that the birds of the north Atlantic all come from the southern ocean, and do not represent, as Mathews believed, a distinct form nesting perhaps on some of the West Indian or North African islands.

DISTRIBUTION OF THE SPECIES.—Rears its young on the Antarctic continent and islands of the southern ocean and wanders far to the northward. The typical race breeds during a period of nearly five months on oceanic islands: Kerguelen Island, South Georgia, the South Orkneys, and presumably others. It migrates northward in the Atlantic to the British Isles and the coast of Labrador, also visiting the Australian seas and the Indian Ocean. It is a common bird during its migration and northern sojourn on the west coast of Africa, from the Cape to Upper Guinea, and it has been taken off the Gaboon (Verreaux) and Landana

<sup>1</sup>1918, Bull. Amer. Mus. Nat. Hist., XXXVIII, p. 119.