

# The Distribution of African Fresh-water Fishes

by George A. Boulenger (1905)

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[[p. 413]] I think I may ascribe the honour of having been chosen to preside over this Section to the fact that I have specially applied myself to the study of a large class of the animals of the part of the world in which we are for the first time assembled. The subject of the Address which it is the custom to deliver on such an occasion was therefore not difficult to choose--a general survey of the African fresh-water fishes from the point of view of their distribution.

It has repeatedly been pointed out that no division of the world can answer for all groups of animals, differences due to the period at which they appeared and to their ability or inability to spread over obstacles, whether of land or water, precluding any attempt to make their present distribution fit into the frames of the general zoogeographer. The great divisions of the earth, as outlined by our eminent Vice-President, Dr. Sclater, nearly half a century ago, and based mainly on a study of passerine birds, have therefore varied considerably according to the standpoint of the many workers who have followed in his footsteps. Fresh-water bony fishes particularly lend themselves to a uniform treatment, their principal groups having sprung up, so far as palæontological data teach us, about the same period in the history of the earth, and branched off in many directions within a geologically speaking brief lapse of time, most of them, besides, being regulated in their distribution by the water-systems. How greatly their distribution differs from that of terrestrial animals has long ago been emphasised. Thus, latitudinal range, so striking in many African reptiles, does not exist in fishes: the key to their mode of dispersal is, with few exceptions, to be found in the hydrography of the continent; and, as first shown by Dr. Sauvage, latitude and climate, excepting of course very great altitudes, are inconsiderable factors, the fish-fauna of a country deriving its character from the head waters of the river-system which flows through it. In this way, for instance, the Lower Nile is inhabited by fishes bearing a close resemblance to, or even specifically identical with, those of Tropical Africa, and strikingly contrasting in character with the land-fauna on its banks. Such being the case, it seems at first as if the geographical divisions of the fish-fauna were a matter of extreme simplicity, and that a knowledge of the river-systems ought to suffice for tracing areas which shall express the state of things. But we must bear in mind the movements which have taken place on the surface of the earth, and owing to which the conditions we find at present may not have existed within comparatively recent times; and this is where the systematic study of the aquatic animals affords scope for conclusions having a direct bearing on the physical geography of the near past. To mention two examples, the fishes of the Nile show so many specific types in common with those of the Senegal-Niger, now more or less completely separated by the Chad basin, that we felt justified in postulating a recent communication between these water-systems, which has been fully confirmed by the study of the Lake Chad fishes; whilst, on the other hand, the greater

difference between the fishes of the Nile and those of the Congo basin, the waters of which interlock at [[p. 414]] present in such a way that it is believed possible, at certain seasons, for a man in a boat to pass from the one into the other, points to the existence, until very recently, of a more effective separation. Such problems are of the greatest interest, and a more exact knowledge of the fishes will help towards their solution.

There is another aspect of the question of geographical distribution which has assumed special importance of late, especially in the writings of Prof. Osborn, Mr. Lydekker, and Dr. Scharff, and of which Dr. A. E. Ortmann's paper on the distribution of Decapod Crustaceans, published three years ago, may be taken as an example. One of the conclusions formulated therein is that "any division of the earth's surface into zoo-geographical regions which starts exclusively from the present distribution of animals without considering its origin must be unsatisfactory." But in certain groups of animals, possibly in most, the question of their origin is not easily settled; in the case of the African fresh-water fishes, for instance, we sadly lack all direct palæontological data, such as have sprung up lately in marvellous profusion in the case of the mammals, and notwithstanding the great progress in our knowledge of the changes that have taken place in the configuration of the world in Secondary and Tertiary times, which has been conveyed to a wide circle of readers chiefly through the luminous works of Neumayr, Suess, and de Lapparent, there is still much that is open to discussion. It must be admitted--and it is well to draw special attention to this point--that Dr. Ortmann's maps of the land-areas in past periods, which render his suggestive paper so attractive, cannot be accepted as the expression of well-established geological facts, and are, in some respects, gravely misleading. If I have attempted to deal with this subject on the lines laid down by Dr. Ortmann, whilst realising the want of many necessary data, palæontological and geological, on which to base conclusions, it is with a due sense of humility, being fully aware that the suggestions now offered must be regarded as mere speculations.

The time has come for a stock-taking of our immensely increased material, the previous accounts of the distribution of African fishes given by Dambeck in 1879, by Günther and by Sauvage in 1880, and by Palacky in 1895, no longer answering, even approximately, to our present knowledge, as may be seen by comparing the lists given by these authors with the one I have quite recently published in the *Annals and Magazine of Natural History* as a basis for the sketch here attempted.

How little we knew of the fresh-water fishes of Africa when the subject was dealt with by the above-named authors is exemplified by the enormous number of genera and species which have been discovered within the last few years, thanks chiefly to the enlightened activity of the Governments of Egypt and the Congo Free State, and of the initiative of Prof. Ray Lankester in organising explorations of the great lakes of Central Africa. The waters of the French Congo and Cameroon, the Niger, Abyssinia, and the interior of East Africa, have also yielded a large number of novelties; even the Nile, comparatively so well known, has been productive of many and remarkable additions to our knowledge. The importance of a better acquaintance with the fishes of the Lower Nile, a district believed to have been particularly well explored, can be measured by comparing the present data with those to which Prof. Gregory, on the faith of Dr. Günther's list, appealed to justify his theory of a direct connection in the past of the Upper Nile

with the Jordan through a river flowing along what is now the Red Sea. To this question we shall revert presently.

Whilst the exploration of rivers and lakes has resulted in such a rich harvest, it remains a matter for serious regret that we should still be without any information as to the precursors of the African fishes. In spite of diligent search over a considerable portion of the great continent, no remains of any post-Triassic fishes have yet been discovered in Tropical and South Africa, and our acquaintance with Tertiary Teleosts generally is still almost as scanty and fragmentary as it was twenty years ago, although much has been done by Dr. Smith Woodward in elucidating the affinities of such remains as have been exhumed. In the circumstances we have to fall back on our imagination to explain the origin of the most important groups characteristic of the present African fish-fauna, and much hazardous speculation has been indulged in. Thus, without any sort of evidence, the Cichlid Perches of Africa have been supposed to emanate from ancestors inhabiting hypothetical Jurassic or Cretaceous seas extending over Central Africa, whilst connecting land areas have been too freely postulated to account for the resemblance between the fishes of Africa and Tropical America; and antarctic continents devised to explain the presence of Galaxias in South Africa. To these suggestions I shall refer further on when dealing with the distribution of the families to which they were intended to apply. Although it is highly desirable that zoologists should base their theories of geographical distribution upon geological data, I think we must regret the growing tendency to appeal to former extensions of land or sea without sufficient evidence, or even contrary to evidence, in order to explain away the riddles that offer themselves.

Twenty-five years ago a list of the African fresh-water fishes would have included the names of about 350 species (Günther gave the number as 255 only), some fifty of which have since lapsed into the synonymy, whilst at the present day we are acquainted with 976 species, referable to 185 genera and forty-three families. Of the latter five were then unknown, or unknown to have representatives in this part of the world. The forty-three families are here enumerated, with an indication of the number of genera and species according to the most recent census:--

<b>CHONDROPTERYGII.</b>	
<b>PLAGIOSTOMI.</b>	
1. Carchariidae, 1, 1.	
2. Pristidae, 1, 1.	
<b>CROSSOPTERYGII.</b>	
<b>CLADISTIA.</b>	
3. Polypteridae, 2, 11.	
<b>DIPNEUSTI.</b>	
4. Lepidosirenidae, 1, 3.	
<b>TELEOSTEI.</b>	
<b>MALACOPTERYGII.</b>	
5. Elopidae, 2, 3.	
6. Mormyridae, 11, 108.	
7. Notopteridae, 2, 2.	
8. Osteoglossidae, 1, 1.	
9. Pantodontidae, 1, 1.	
10. Phractolemidae, 1, 1.	
11. Clupeidae, 6, 7.	
12. Salmonidae, 1, 1.	
13. Cromeriidae, 1, 1.	
<b>OSTARIOPHYSI.</b>	
14. Characinidae, 20, 93.	
15. Cyprinidae, 12, 202.	
16. Siluridae, 37, 187.	
<b>APODES.</b>	
17. Anguillidae, 1, 6.	
<b>HAPLOMI.</b>	
18. Galaxiidae, 1, 2.	
19. Kneriidae, 1, 2.	
20. Cyprinodontidae, 5, 39.	
<b>CATOSTEOMI.</b>	
21. Gastrosteidae, 1, 1.	
22. Syngnathidae, 2, 3.	
<b>PERCESOCES.</b>	
23. Scombresocidae, 1, 1.	
24. Atherinidae, 2, 3.	
25. Mugilidae, 2, 13.	
26. Polynemidae, 3, 3.	
27. Sphyrænidae, 1, 1.	
28. Ophiocephalidae, 1, 3.	
29. Anabantidae, 1, 14.	
<b>ACANTHOPTERYGII.</b>	
30. Centrarchidae, 1, 3.	
31. Nandidae, 1, 1.	
32. Serranidae, 6, 8.	
33. Sciaenidae, 1, 1.	
34. Pristipomatidae, 2, 2.	
35. Sparidae, 1, 1.	
36. Scorpididae, 1, 3.	
37. Osphromenidae, 1, 1.	
38. Cichlidae, 30, 179.	
39. Pleuronectidae, 2, 2.	
40. Gobiidae, 2, 31.	
41. Blenniidae, 3, 3.	
<b>OPISTHOMI.</b>	
42. Mastacembelidae, 1, 23.	
<b>PLECTOGNATHI.</b>	
43. Tetraodontidae, 1, 4.	

In discussing the distribution of the fresh-water fishes it is necessary to divide them into four principal categories:--

(1) Those living part of the year in the sea. This category is again subdivided into anadromous forms, breeding in fresh water (ex. some Clupea), and catadromous forms, breeding in salt water (ex. Anguilla).

(2) Those living normally in the sea, but of which certain colonies have become land-locked, or have separated themselves from the marine stock still represented on the neighbouring coast (ex. some Gobiidae and Blenniidae).

(3) Those which, although entirely confined to fresh waters, have as nearest allies species living in the sea, and which there is reason to regard as more or less recently derived from marine forms (ex. Galaxiidae, Tetraodontidae).

(4) Those belonging to families entirely (ex. Mormyridae, Characinidae) or chiefly (ex. Siluridae, Cyprinodontidae) restricted to fresh waters.

[[p. 415]] The forms of the first and second categories may be entirely neglected in dealing with the distribution of fresh-water fishes. Their range is regulated by the sea, and they must be dealt with in conjunction with littoral forms. Eighty-six species in the list of African fresh-water fishes belong to these categories.

The third category is of secondary interest in the history of the fresh-water fauna; but, as in the case of Galaxias, forms referred to it may give rise to discussion.

It is with the members of the fourth category that we shall mainly deal in the portion of this Address which is devoted to the origin and mode of dispersal of the African fishes.

THE POLYPTERIDÆ.--This is incontestably the most remarkable family of African fishes. Entirely restricted to Tropical Africa and the Nile, without any known near allies, living or extinct, its history is one of the greatest riddles in ichthyology. From the evolutionary point of view, no group is of greater interest, owing to its probable relation to the Chondropterygians or Elasmobranchs, to the Osteolepid Crossopterygians, out of which the Lung-fishes seem to have been evolved, and to the earliest pentadactyle vertebrates, the Stegocephalous Batrachians. Although generally brigaded by modern systematists with the Osteolepida in the order Crossopterygii, it is still doubtful whether it should not rank as a distinct order, Cladistia of Cope, the characters which differentiate it from these early Teleostomes being perhaps of greater importance than those which separate these from the Dipneusti. Until we have some proof to the contrary, we are justified in regarding the Polypteridæ as having arisen in Africa from fresh-water ancestors, themselves derived from early Mesozoic types which are entirely hypothetical.

THE LEPIDOSIRENIDÆ.--Protopterus in Africa and Lepidosiren in South America are specialised modifications of the Ceratodontidæ, still represented by one species in Australia, which have left remains in Triassic, Rhætic, Jurassic, and Cretaceous rocks of Europe, North America, Patagonia, North and South Africa, India, and Australia. The distribution of the Ceratodontidæ has therefore been, at different periods at least, a world-wide one, and we should feel justified in assuming the living representatives of the Lepidosirenidæ to have been evolved out of this family independently in Africa and in South America. On the other hand, in view of the old age of the group, there is no reason why the Lepidosirenidæ should not have passed from one of the present continents into the other when they were connected by land. As Protopterus is a less specialised type than Lepidosiren, the probabilities would then be that the former originated in Africa. Mr. Lydekker, in his "Geographical History of Mammals," states his opinion that Lepidosiren reached its present habitat by way of Africa. The mode of life of these fishes renders them less dependent on hydrographical systems, and the distribution of the species, which cannot yet be traced in a satisfactory manner, is evidently very different from that of other groups.

THE MORMYRIDÆ.--This extraordinary group, of which so many new and remarkable types have been discovered within the last few years, especially in the Congo, is peculiar to the fresh waters of Tropical Africa and the Nile. Its morphology shows it to be highly specialised from some very lowly Teleostean ancestor. This I believed to be found in the Albulidæ, a family already represented in Cretaceous seas, and of which one species still occurs on the West Coast of Africa. But Dr. Ridewood, who has recently made a much more careful study of the cranial characters of the two families, is unable to support the suggestion of a direct descent from the Albulidæ. It nevertheless remains probable that the Mormyridæ were derived from forms more closely allied to the known Albulidæ than to any other family with which we are acquainted, and which no doubt lived in Cretaceous seas; and we may therefore assume that the Mormyridæ originated in Africa, and were evolved out of Cretaceous marine ancestors.

THE NOTOPTERIDÆ.--This is another eccentric family, having many points in common with the Mormyridæ and with the North American Hyodontidæ. It is represented by five species, three of which live in the Indo-Malay region and two in Tropical Africa. Its derivation is still a mystery. The fact that its most specialised form (*Xenomystus*) is African, and that a species differing but little from the living *Notopterus* occurs in fresh-water deposits in Sumatra, which are regarded by some geologists as of Middle Eocene age--although, as stated further on *à propos* of the Cyprinidæ, there is reason for regarding them as Miocene, or even later--justifies us in believing, until further palæontological evidence be available, that the African forms are immigrants from the East.

THE OSTEOGLOSSIDÆ.--An archaic type of Teleosteans, now represented by two genera in South America, by one in Australia and the Malay Archipelago, and by a fourth in Tropical Africa and the Nile. Excellently preserved fossils from the Middle Eocene of Wyoming (*Dapedoglossus*) are most nearly allied to, but more generalised than, the Australian-Malay genus; whilst the less satisfactorily known British Lower Eocene *Brychætus* appears nearer to the South American *Arapaima*. The African genus *Heterotis* is the most specialised form. The Osteoglossidæ are evidently an ancient group, now in process of extinction, which once had a very wide distribution. The fact of the only known fossil representatives being from North America and Europe does not seem sufficient evidence of the northern origin of the family, as suggested by Mr. Lydekker.

PANTODONTIDÆ, PHRACTOLÆMIDÆ, CROMERIIDÆ.--Three monotypic families peculiar to Africa. The first bears a near relationship to the Osteoglossidæ, and was probably derived from them; but the two others, discovered within the last few years, are so aberrant and isolated among the Malacopterygians that we are absolutely in the dark as to their possible origin.

THE CHARACINIDÆ.--This is one of the larger groups of African fishes--with ninety-three species, referred to twenty genera, mostly from the Nile and Tropical Africa, as far east as the great lakes, but only very sparsely represented in East and South Africa.

One of the most striking features of the South American fresh-water fish-fauna is the extraordinary number and variety of forms of the Characinidæ, unquestionably one of the most lowly and generalised groups of exclusively fresh-water Teleosts. There occur in that part of the world as many as 500 species (about two-fifths of the whole fresh-water fish-fauna), divided among some sixty genera. The carnivorous forms predominate, but the herbivorous or semi-herbivorous are also very numerous. The latter would evidently compete with the Cyprinids, their near but more specialised relatives, which are so numerous represented in North America; and it is a remarkable fact that not a single Cyprinid is known to extend further south than Guatemala.

Although palæontology has taught us nothing respecting the Characinids, we have reason to assume, from the morphological point of view, that they were the precursors of the Cyprinids, which, we know, were already abundantly represented in North America and Europe in Lower Tertiary times, when the Isthmus of Panama was under the sea. When, in the Miocene, North and South America became re-united, the waters of the latter part of the world must have been

already so fully stocked with Characinids as to prevent the southern spread of the Cyprinids. This is the only explanation that can be offered of the total absence of Cyprinids in South America, considerations of climate being of no avail in view of their distribution all over Africa. If, therefore, the Characinids existed in profusion in South America before the Miocene period, we are justified in claiming for them a high antiquity, and by putting it at the Upper Cretaceous we need not fear going too far back.

THE CYPRINIDÆ.--These fishes, as mentioned above, are very closely related to the preceding, and there is every reason to believe the former to be derived from the latter. Their least specialised genera (Catostominæ) are now found in North and Central America (about sixty species), whilst three species, referable to the same genera, inhabit Eastern Siberia and China. These Catostominæ are known to have had representatives in the Eocene of North America, whilst the more specialised Cyprininae, which [[p. 416]] constitute the great bulk of the family both in the new world and in the old, have left remains in the Oligocene and later beds in North America and Europe. It is, therefore, highly probable that the Cyprinids originated as a northern offshoot of the South and Central American Characinids, and thence spread to Eastern Asia, at least as early as the Upper Eocene. By the time (Miocene) they had reached India, where they now form the great majority of the fresh-water fishes, Africa had been connected with it by a wide belt of land, and no obstacle prevented their western extension. This comparatively recent migration accounts for the practical identity of the genera and the often very close affinity of the species of the Cyprinids of India and Africa. At the same period the land-area connecting India and Africa with Madagascar had disappeared, and the Cyprinids never reached that great island, where no doubt they would have thriven, if we judge by the results of the introduction by man of the gold fish, said to be in process of strongly reducing the numbers of the native Malagasy fresh-water fishes with which it is in a position to compete. Competition is always an important factor in the distribution of a group of animals, and the confinement of the Characinids to the waters of the western and central parts of Africa at the time of the immigration of the Cyprinids from the east must be the explanation of the comparative abundance of the latter and the scarcity of the former in those parts of the continent east of the Rift Valley which are not drained by rivers flowing from the central parts. The Cyprinids must have spread more rapidly than the Characinids, and being also less partial to heat they have thriven in the waters of South Africa, where at present only two species of Characinids--both carnivorous forms--are known to extend south of the Zambesi system. Of the 202 species recorded from Africa thirteen are found in North-West Africa, sixty-three in East Africa (exclusive of the Zambesi), and twenty-one in South Africa.

THE SILURIDÆ.--This large family is almost cosmopolitan in tropical and warm regions; and although the great bulk of the species are restricted to fresh waters, a certain number (chiefly of the sub-family Ariinæ) occur on the coasts and in the estuaries. Morphologically these fishes are so closely allied to the Characinidæ and Cyprinidæ that we must assume them to have been evolved from a common ancestral stock, probably in Cretaceous times; but connecting forms such as we should expect to find in deposits of that age are still unknown. The Silurids appear in the Lower Eocene estuarine beds of England and France, as forms closely related to the living Ariinæ and Bagrinæ, and further allied forms follow in the Middle Eocene of various parts of Europe and North America. In the Upper Eocene of Lower Egypt estuarine deposits contain well-preserved remains of forms which appear to be only specifically separable from the Bagrus

still living in the Nile. The general distribution of these fishes was, therefore, in early Tertiary times very much the same as it is at present, and palæontology offers us no clue as to where they originated.

The exclusively fresh-water Silurids now found in Africa are all generically distinct from the South American forms, whilst the West African species that enter the sea belong to the same genus (*Arius*). The two exclusively fresh-water Silurids found in Madagascar show closer affinity with the African than with the Indian forms, and may have immigrated from Africa in the early Tertiary times through the bridge which then existed, unless they have been derived from marine types, which is quite possible.

THE GALAXIIDÆ.--Two small fishes originally described by F. de Castelnau as Loaches, and now referred to *Galaxias*, occur on the flats near Cape Town and in the Lorenz River, some twelve miles from its mouth in False Bay. They are of special interest as belonging to a family and genus long believed to be exclusively confined to fresh waters and characteristic of the extreme south of America, New Zealand, and Southern Australia. After Dr. Steindachner had first recognised the true affinities of the Cape species, Prof. Max Weber was inclined to regard this interesting discovery as affording a new argument in favour of the past antarctic continent on which so much has been written. But Dr. Wallace was nearer the truth when he suggested that a land connection within the period of existence of one species of fish, viz. *Galaxias attenuatus*, known from Chili, Patagonia, Tierra del Fuego, the Falkland Islands, New Zealand, and Southern Australia, would have led to much more numerous and important cases of similarity of natural productions than we actually find, and that we must rather look to the transport of the ova across the southern sea to explain this very remarkable distribution. A better acquaintance with the *Galaxias* has confirmed Dr. Wallace's supposition, as it is now an established fact that some species live in the sea.

As the early Tertiary "Antarctica," as designed by Prof. H. F. Osborn, does not involve South Africa, the presence of species of *Galaxias* at the Cape cannot, even on that hypothesis of continental extension, be explained except on the assumption of their marine origin.

THE KNERIIDÆ.--A monotypic family with two species, one from Angola, the other from East Africa. These little fishes are related to the Pikes, Esocidæ; and there is no reason that I can see against their being possibly derived from them, in which case they would be of northern origin, the Esocidæ, now confined to the northern hemisphere, being known from fresh-water deposits in Europe as far back as the Oligocene.

THE CYPRINODONTIDÆ.--The members of this large family are mostly Central and South American. They are comparatively few in Africa, but have representatives in every part, and also in Madagascar and the other islands of the Indian Ocean. Although principally restricted to fresh waters, not a few species are known to live in brackish water, whilst examples are known of their occurring far out at sea.

THE OPHIOCEPHALIDÆ AND ANABANTIDÆ.--Unknown fossil, and now restricted to Africa and South-Eastern Asia, we have no means of telling in what part of the world these two

closely allied families originated. The Anabantidæ are more numerous in species, and these are of a more generalised type, in Africa than in Asia.

THE NANDIDÆ.--The recent discovery of *Polycentropsis* in the Lower Niger has added a genus to a small family previously known to be represented by three genera in South-Eastern Asia and by two in the northern parts of South America. The latter are more nearly related to the African genus than the former. Too little is known of the habits of these fishes to decide whether the hypothesis of a migration across the Atlantic, in the days when a shallow area with a string of islands connected the old world and the new, answers for their distribution. Their systematic position--specialised Perciformes--is against the assumption of their having existed in Cretaceous or early Eocene times. No fossil forms are known.

THE OSPHROMENIDÆ.--The only African representative, the genus *Micrakanthus*, with a single species in the Ogowé, is hardly separable from the genus *Betta*, which, with six other genera, is characteristic of the Indo-Malay region and China. Palæontology gives no information on the earlier distribution of these highly specialised fishes. That a type so well organised for adapting itself to all sorts of waters, and so ready to acclimatise itself in any part of the tropical or subtropical countries where it has been transported by man, should have so restricted a range seems remarkable. Were it not for the existence of this African form, far away from the other members of the family, one might have felt inclined to look upon the Osphromenidæ as a very recent group, which has not had time to spread far from its original centre in South-Western Asia.

THE CICHLIDÆ.--As regards the number of species (179) this family ranks next to the Cyprinidæ (202) and the Siluridæ (187) in the African fresh-water fish-fauna, and, like these, it has representatives nearly all over the great continent. Although Cichlids may thrive in inland waters of considerable salinity, they are not known to have ever been found in the sea, even near the mouths of rivers. The facility with which they establish themselves in isolated waters, often untenanted by other fishes, such as wells in the Sahara, salt-water pools in the interior of East Africa, &c., has long been known, but by what agency this has been effected remains unexplained. Quite recently Dr. Lönnberg has reported on the exploration of a small [p. 417] isolated lake of volcanic origin on the Cameroon mountain, a lake 200 feet above sea-level, without any outlet, and situated about twelve miles from the nearest river and twice as far from the sea-shore. This lake was found to have a fish-fauna consisting exclusively of Cichlids, belonging to three genera and five species, two of which have been described as new.

The great bulk of the family inhabits Africa, including Madagascar, and America, from Texas to Montevideo; the number of generic types is greater, although the species are only slightly in excess, in the former than in the latter part of the world. Seven species inhabit Syria, three of these being also found in the Nile, and three are known from India and Ceylon. The American and Indian genera are all distinct from the African. A great number of species (fifty-five), all but one endemic, inhabit Lake Tanganyika, of which they form a little more than two-thirds of the fish-fauna; and many of these species belong to distinct genera, showing specialisation to a remarkable degree. Out of thirty recognised genera of African Cichlids, as many as fifteen are believed to be peculiar to Tanganyika. Lake Nyassa, with the Upper Shiré, possesses also some remarkable endemic genera; but they are only four in number, and the number of species

recorded up to the present does not exceed twenty-two. The rest of the species are mostly from West Africa and the Congo basin; but a few, referable to the two most widely spread genera, are found in East and South Africa. Madagascar has only four species, two belonging to an endemic genus, whilst each of the two others is referred to a widely distributed African and Syrian genus.

No fossils are known that agree closely with any of the recent genera, but a type of Perciforms, described by Cope as *Priscacara*, from Middle Eocene fresh-water beds in North America, presents all the characters which we should expect to find in the direct ancestors of the modern Cichlids, differing from the living forms in the presence of vomerine teeth, a serrated præ-operculum, and apparently eight branchiostegal rays. It has twenty-four vertebræ, a number lower than is found in most of the recent genera; and this indication is of importance for reasons that must be explained somewhat fully.

The lower Teleosteans (*Malacopterygii* and *Ostariophysii*, often united under the term "*Physostomi*") mostly have a high number of vertebræ; but when we pass on to the higher *Acanthopterygii*, we find very frequently, among most diverse families, the number reduced to twenty-four. That this number should occur with such frequency has struck many ichthyologists since Dr. Günther first directed attention to it, more than forty years ago, pointing out at the same time that in the *Labridæ* this number is almost constant in the tropical genera, whilst those genera which are chiefly confined to the temperate seas of the northern and southern hemispheres have an increased number. It has since been shown by Dr. Gill and by Prof. Jordan that this generalisation holds true of several other families of *Acanthopterygians*, and the latter authority, when discussing the subject at some length, came to the opinion that the state of things could be explained, from an evolutionary point of view, on the assumption that competition among various marine fishes being greater within the tropics has resulted in greater specialisation, by which the originally high number of vertebræ has been reduced. It is difficult, however, on this assumption to account for the fact that in so many cases the reduction should have resulted in the number twenty-four--neither one more nor one less--and this repeated in many families belonging to the same sub-order but otherwise only remotely related to one another. Three years ago, when dealing with the affinities of the flat-fishes, *Pleuronectidæ*, I was struck by the discovery that, in the unquestionably least specialised genus, *Psettodes*, the vertebræ are twenty-four in number, the other known genera having from twenty-eight to sixty-five, and that the numbers increased along the most probable lines of evolution. A consideration of other families, and of the fossil forms in which the number of vertebræ has been ascertained, soon convinced me that this rule also applies to them, and that the order of evolution had in every case to be reversed from that assumed by Prof. Jordan, whose interpretation I had previously accepted as correct. As a result of my investigation into this question I believe that the frequent occurrence of twenty-four vertebra is due to the original *Acanthopterygians* having presented this number, that it has been retained in the more generalised members of the families which have branched off from them, and increased or, more seldom, reduced in the course of evolution.

The view which I entertained when first studying the Cichlids of Lake Tanganyika must be abandoned, and the direction of the supposed lines of evolution reversed, together with the signification given by me to the characters of increased number of dorsal and anal rays, or of multiple lateral lines which go more or less hand in hand with the increase in the vertebral segments. I must therefore repudiate the statement, first made by me in describing some of the

new genera discovered by Mr. Moore in Lake Tanganyika, that they show features of generalisation, the contrary being the case. This has been shown by Dr. J. Pellegrin, who has recently published a monograph of the whole family Cichlidæ, in which he has very ably dealt with the question of the interrelation of the various genera from the phylogenetic point of view.

Two theories have lately been put forward as to the origin of the African Cichlids.

According to Mr. Moore, to whom we owe the discovery of so many new forms in Lake Tanganyika, the Cichlids are of marine origin, and penetrated into a hypothetical Central African sea in præ-Tertiary times. But as no Perciform fish of any sort is known earlier than the Upper Cretaceous, and no Perch, in the widest sense, before the Lower Eocene (Prolates), the possible existence at that remote time of so specialised a type of Perches as the Cichlids is absolutely contrary to palæontological evidence. Further, such an explanation is unsupported by any geological data, no trace of Jurassic or Cretaceous deposits having been found on the plateau of Central Africa, notwithstanding much search over a considerable portion of the Congo State. It is impossible to imagine that such a sea could have existed without leaving any sedimentary deposits whilst its relics were being preserved in Lake Tanganyika. Besides, the distinguished Belgian geologist, Prof. J. Cornet, who has paid special attention to this question, and has himself surveyed a considerable part of the territory of the Congo State, regards the Tanganyika as by no means a very ancient lake, its formation not dating back beyond Miocene times. I may also here point out that Mr. Moore's interpretation of the affinities of the so-called "halolimnic" Mollusca has not received any support from those best able to judge of its merits. Mr. E. A. Smith, from the recent conchological, and Mr. Huddleston, from the palæontological point of view, have recently discussed his conclusions, with which they are unable to agree. I need hardly add that the discovery since the publication of the "Tanganyika Problem" of the Medusa *Limnocrnida tanganyicae* in Lake Victoria has dealt a further blow to Mr. Moore's theory.

As regards the origin of this Medusa, recent palæontological discoveries afford a much more rational explanation of the presence in Tanganyika of a Cœlenterate of unquestionably marine derivation. The highly important finds of fossils between the Niger and Lake Chad by the English and French officers of the Boundary Commission, which have been reported upon by Prof. de Lapparent, Mr. Bullen Newton, and Dr. Bather, have conclusively established the existence of Middle Eocene marine deposits over the Western Soudan, and the Egyptian and Indian character of these fossils, as well as of others previously obtained in Cameroon and Somaliland, justifies the belief in a Lutetian (Middle Eocene) sea extending across the Soudan to India. In fact, as stated by Mr. Newton, the palæontological evidence seems to prove that the greater part of Africa above the equator was covered by sea during part of the Eocene period. On this sea retreating northwards, after the Lutetian period, Medusæ became land-locked and gradually adapted themselves to fresh water: they had not far to travel to find themselves in what are now the Nile lakes, and later, through the changes which Mr. Moore himself has shown to have taken place in the drainage of Lake Kivu, they were easily carried into the Tanganyika--probably at no very remote time--and maintained themselves to the present day. I understand that the Medusa reported from Bammaku, Upper Niger, in 1895, but still [\[p. 418\]](#) undescribed, has been re-discovered by Budgett, and is now being studied. Should it prove to be related to the Tanganyika species, it would also have to be regarded as a relic of the same Eocene sea, and it would add further support to the very simple explanation which I have ventured to offer of a case

which seemed so tremendously puzzling in our previous state of ignorance of the geological conditions of Africa between the equator and the tropic of cancer.

As explained by Prof. Cornet, Tanganyika has been until very recent times without an outlet. The Lukuga, which drains into the Congo, was only formed after Lake Kivu became, owing to volcanic eruption, a tributary of the Tanganyika through the Rusisi River. The greater or less salinity of the water of a lake without an outlet is a matter of course, and therefore Tanganyika was for a long time a salt lake. Its water is still, Mr. Moore says, somewhat salt. No wonder that the Cichlids, which elsewhere in Africa show no aversion to such conditions, and which somehow or other contrive to settle into isolated waters, should have been among the first inhabitants of the lake, where, without having to face competition with other types of fishes, they thrived and became differentiated into a multitude of genera. When the hydrographical conditions changed and the water gradually lost its salinity, first on the surface and later at greater depths, an influx of other forms of fish-life (*Polypterus*, *Characinids*, *Cyprinids*, *Silurids*, &c.) penetrated into the lake, some from the Nile system through the Rusisi, others from the Congo up the Lukuga. This explains well enough the character of the Tanganyika fish-fauna. The Cichlids, the oldest inhabitants of the lake, nearly all belong to endemic species, many of which constitute genera represented nowhere else; whilst the fishes of other families, later immigrants, all belong to widely distributed genera, and several of them even to species also found either in the Nile or in the Congo, or in both these river-systems.

The other theory is that the Cichlids have originated as fresh-water fishes in Eocene times in America and have crossed the Atlantic by a bridge which then connected South America with Africa. This is the explanation given by Dr. Pellegrin. He admits that we have no indication of any near allies of these fishes before the Middle Eocene (*Green-River beds of North America*), and, basing his statement on the last edition of Prof. de Lapparent's "*Traité de Géologie*" (1900), he says it seems to be beyond doubt that during the Lutetian period, which immediately followed that at which the earliest Cichlids were known to live in the fresh waters of America, a vast continent extended between South America and Africa. Should this have really been the case, the question of the distribution of the Cichlids could be regarded as settled. But I cannot satisfy myself that there is any geological evidence to support this view.

This third hypothesis has this advantage over the two others, that it does not postulate any land-areas in late Eocene or Miocene times, for which there is at present no sufficient evidence, nor a *præ-Tertiary* and marine origin for the family *Cichlidæ*, which is wholly improbable and receives no support from palæontology.

On the other hand, it is undeniable that the hypothesis of a South Atlantic land communication in the Eocene has much in its favour, and when this is really established all difficulty in explaining the distribution of the *Cichlidæ* will have disappeared. In the meanwhile, to use an appropriate metaphor, we must not construct bridges without being sure of our points of attachment, otherwise they are liable to collapse as geological knowledge progresses.

**THE MASTACEMBELIDÆ.**--At present we are acquainted with thirty-eight species of *Mastacembelus*: fourteen from the Indo-Malay region, one from Syria and Mesopotamia, and twenty-three from Tropical Africa. The distribution of these fishes, the fossil remains of which

are still unknown, has probably once been a continuous one, climatic and hydrographic conditions possibly accounting for the present discontinuity. We have no data from which to decide whether the Mastacembelids first appeared in Asia or in Africa, or simultaneously in both parts of the world, as is quite possible on the assumption that the family originated in the Eocene sea extending from the Western Soudan to India.

This concludes our review of the affinities and past history of the principal fresh-water types which characterise the present African fish-fauna. We have endeavoured to show that a Tertiary land connection between Africa and South America is not absolutely necessary to explain the many points of agreement between the fresh-water fishes of these two parts of the world, as has been postulated by many writers. Besides, there are still some who hold, as does Prof. G. Pfeffer--whose interesting essay on the zoo-geographical conditions of South America, from the point of view of lower vertebrates, appeared after this Address had been written--that a former subuniversality of distribution will afford a solution to many of these problems without necessitating such a land-connection, as exemplified by the past distribution of the Pleurodiran Chelonians. In this review we have summarised many previous hypotheses and added a few, but in every case with a feeling of dissatisfaction, fully realising, as we do, the futility of speculations in the present state of the two great branches of knowledge, geology and palæontology, on which the solution of these questions must ultimately rest.

We may now pass on to the realm of facts, and survey in the briefest manner the waters of the great continent as they appear after the many discoveries which have of late so greatly increased our knowledge of the African fishes.

In the present state of our knowledge of the fresh-water fishes Africa may be divided into five sub-regions, the discussion of the further subdivision of which would exceed the limits of this Address:--

(1) The North-Western Sub-region, or Barbary, and the Northern Sahara, properly forming part of the Palæarctic region.

(2) The Western-Central Sub-region, with all the great rivers and lakes, extending to the Nile Delta and the mouth of the Zambesi, for which the term Megapotamian Sub-region has been suggested to me by Dr. Sclater.

(3) The Eastern Sub-region--Abyssinia, with the upper tributaries of the Blue Nile, and the countries east of the Rift Valley and north of the Zambesi.

(4) The Southern Sub-region--all the waters south of the Zambesi system.

(5) Madagascar.

The smaller islands of the Indian Ocean have a fresh-water fish-fauna so insignificant that they may be entirely neglected in a broad division of the African region.

## I. THE NORTH-WESTERN SUB-REGION.

In its deficiency in rivers of permanent flow Barbary has much in common with South Africa, and these two parts of Africa in their fish-fauna present a somewhat analogous example to that on which the now exploded theory of bipolarity was founded. Swelling to foaming torrents in the rainy season or after a storm, reduced to series of pools connected by tiny streams at other times, the watercourses are evidently unsuited to fish-life; and it is not surprising that, apart from a certain number of forms adapted to live in stagnant, often strongly saline, waters, the fishes should be so few in kind. But they make an interesting assemblage, in which it is easy to discover forms unmistakably suggestive of the præ-Pliocene times when the sea had not burst through the Straits of Gibraltar, mixed with others of decidedly Africo-Indian or Oriental affinities.

The number of species from inland waters, whether fresh or salt, hitherto recorded from this part of Africa, amounts to thirty or thirty-one only. Of these thirteen are Cyprinids, which may all be regarded as of northern or eastern immigration. Four of the Barbels show European affinities, one of them being found also in Spain, whilst the seven others belong to a section of the genus largely represented in Southern Asia and East Africa, but only known in West Africa from Cameroon. A species of *Varicorhinus*, recently discovered in Morocco, has similar affinities, the genus being known from South-Western Asia, Abyssinia, and Lake Tanganyika. A small somewhat aberrant species of the South-Western Asian genus *Phoxinellus* has been described from the Algerian Sahara, whilst an *Alburnus* from the Tell (originally placed in the genus *Leuciscus*) is also the sole representative in Africa of a genus inhabiting Europe north of the Pyrenees and [[p. 419]] Alps and South-Western Asia. With two exceptions, all the Cyprinids are confined to the northern watershed of the Atlas, in which varieties of our River Trout and our Stickleback also occur; but *Barbus callensis* and the *Phoxinellus* occur also in the Algerian and Tunisian Sahara, showing that, as in other groups of animals, no sharp delimitation can be drawn between the Palæarctic and Æthiopian regions of Barbary.

Of three Cyprinodonts one, from the high plateaux, inhabits also Spain; another, more generally distributed, is known from Sicily, Syria, and North-East Africa; whilst the third, remarkable for the absence of ventral fins, is monotypic of a genus named *Tellia*--a misnomer, as it is not found in the Tell, but on the high plateaux of Algeria, at altitudes of from 2000 to 3000 feet, not 8000, as stated by Danbeck.

Three Cichlids are known from the Northern Sahara, one, a *Tilapia*, being restricted to Eastern Algeria and Tunisia, whilst the two others, a *Hemichromis* and a *Tilapia*, extend to Lower Egypt, and are besides widely distributed in Tropical Africa. The Cichlids, along with the Cyprinodon, the *Barbus*, and the *Phoxinellus* mentioned above, are often ejected by artesian wells, and the fact has given rise to much discussion. The latest investigator of this phenomenon, the distinguished engineer, M. George Rolland, confirms the opinion, expressed by the late Sir Lambert Playfair and M. Letourneux in 1871, that these fishes normally live and breed in the lakes and wells exposed to air and light, and that their presence in the underground sheets of water with which the lakes communicate is merely an episode, and as it were an incident in the voyages which they undertake from one opening to the other. There is therefore no justification for the term "realm of the Trogloichthydæ" which has been proposed by Dambeck for North-West Africa.

The other fishes which complete the list are of direct marine derivation, as the anadromous Shad and the catadromous Eel and Grey Mulletts, or such as have recently adapted themselves to permanent existence in fresh water, like the *Syngnathus* discovered by Sir L. Playfair, the *Atherina*, which occurs also in various fresh-water or brackish lakes in Southern Europe and Egypt and in the Caspian Sea, two Gobies and a Blenny, the latter being also known from fresh waters in the South of France and in Italy. The occurrence of an otherwise strictly marine species of Blenniids (*Cristiceps argentatus*) in the fountain of Ain Malakoff, in the high plateaux of Algeria, rests on the testimony of a naturalist of Algiers and needs confirmation.

## II. THE MEGAPOTAMIAN SUB-REGION.

The Nile, the Niger, the Gambia and the Senegal, the Congo, and the Zambesi, with their numerous Mormyrids, Characinids, Silurids, and Cichlids, have much the same general character, which points to many of the generic types having radiated from a common centre of origin, no doubt in those great central lakes which are believed to have existed in Middle Tertiary times. Lake Chad, the ichthyic fauna of which was until quite recently unknown, represents the dwindling remains of a larger basin which communicated until comparatively recent times with both the eastern and western river-systems, thus accounting for the great resemblance between the fishes of the Nile and those of the rivers of the Atlantic watershed north of the Cameroons, 46 species out of 101 known from the Nile (without the great lakes by which it is now fed) being also found in the Niger, the Senegal, or the Gambia, or in all three, and most of these have been recently found in Lake Chad and the rivers emptying into it. The collection made in Lake Chad by Captain Gosling, and sent by him to the British Museum, contains representatives of twenty-four species, all of which were previously known from both the Nile and the Niger, thus strikingly confirming conclusions arrived at from a study of the fauna of those two river-systems. Collections sent to the Paris Museum by the Chevalier and Decorse Mission, and worked out by Dr. Pellegrin, add twenty-five species to the above number, two described as new, two Nilotic, eight West African five Congolese, the rest being common to the eastern and western river-systems. The Congo differs more considerably, and must therefore have been separated from the Nile-Chad-Niger for a longer period, only 15 out of its 265 species (excluding the Tanganyika) occurring also in the Nile, and eleven in the Chad. When we reach the district of the sources of the Congo, the so-called Katanga district, we find a mixture of Congo and Zambesi forms, which points to a former reversal of the drainage of parts of the elevated dividing range. Lake Mwero belongs to this district; although so near to Lake Tanganyika, it has no fish in common with it except a few of very wide distribution. Lake Bangweolo, also in the same district, is said to swarm with fishes, Silurids and Cichlids especially, but they have never been collected. The Zambesi, so far as it has been explored at present, is the poorest in fishes of the great rivers, and it differs from the others in one important point--the absence of the Polypteridæ. The great lakes differ considerably in their fishes from the river-systems into which they drain.

As pointed out eleven years ago by Prof. Gregory, the system of the head waters of the Nile must have been very differently arranged in times geologically quite recent. This is proved by what we know of the great lakes north of Tanganyika. Thus, of the species known from Lake Victoria, barely one-fourth occur also in the Nile, the rest being mostly endemic; whilst Lake Rudolf, which has now no communication with the Nile, has four-fifths of its species in common

with that system. Lakes Albert and Albert Edward are very insufficiently explored and have only yielded a few species, one-half of which are Nilotic. Two fishes, Cyprinids, are all we know from Lake Baringo, one being a widely distributed Nile species, the other an East African. We must conclude from these data that Lake Victoria has long been isolated, whilst Lake Rudolf has until very recently been in communication with the Nile.

Lake Tsana, which is now the source of the Blue Nile, has recently yielded a large collection of fishes, showing a great variety of Cyprinids, either endemic or identical with species occurring in the eastern watershed, and closely allied to those of Palestine, but with no special Nile affinities. The discovery of a Loach (*Nemachilus*), the first known from Africa, points to an immigration from the Jordan, probably through the old Erythrean Valley. The only species which Lake Tsana has in common with the Nile (*Tilapia nilotica*) occurs also in the Hawash and in the Jordan.

From the vastly increased information we now possess of the fishes of the Nile-system we are justified in believing in great changes in the hydrography of this part of Africa. The fishes of Lake Tsana would support Prof. Gregory's conclusion as to a communication with the Jordan through a river running along what is now the Red Sea, whilst those of the Lower Nile point to a direct communication between the latter and the Jordan, as advocated by Prof. Hull, migrations along two distinct channels having taken place at a time when the Mediterranean did not extend so far to the east as it does at present, and the Indian Ocean had not penetrated into the Erythrean Valley. A better knowledge of the fishes of Egypt has disposed of Prof. Gregory's arguments against a former communication between the Lower Nile and the Jordan.

The Nile in its widest sense, but without the great lakes, has 101 species, not including those that enter the sea: twenty-seven do not extend north of Khartoum, whilst only six are restricted to the river below the First Cataract. The most important additions made since Dr. Günther's account of them in "Petherick's Travels" are several Mormyrs, Barbus, and Synodontis, three Cichlids, a *Xenomystus*, a *Nannæthiops*, a *Discognathus*, a *Barilius*, a *Chiloglanis*, a *Fundulus*, an *Eleotris*, and the remarkable genera *Physailia*, *Andersonia*, and *Cromeria*, the latter the type of a new family.

Thanks to the collections made by Sir Harry Johnston and Col. Delmé Radcliffe, with the help of Mr. Doggett, and by M. Alluaud, supplementing those of Dr. Fischer, we may now draw up a list of twenty-five species from Lake Victoria. The comparative scarcity of animal and vegetable life in this great lake perhaps precludes expectation of a great increase in the number of species in the course of further exploration. Most of the species are endemic, and among the most remarkable types may be mentioned a *Discognathus*, a *Mastacembelus* (probably the [\[\[p. 420\]\]](#) fish noticed by Grant as a Stickleback), and a peculiar genus of Cichlids, *Astatoreochromis*. No *Polypterus* has yet been found.

Lakes Albert and Albert Edward, recently visited by Mr. Moore, have furnished examples of nine species, mostly Nilotic in character, the most interesting being a *Petrochromis*, on account of its close affinity to a Tanganyika species.

Lake Rudolf, as stated above, differs hardly from the Upper Nile, only three of its sixteen species being indicative of immigration from the East. Not a single form is endemic.

The Senegal must have been very thoroughly explored by Dr. Steindachner thirty-five years ago, as a large collection made a few years since by the late M. Delhez has not resulted in a single addition to the list of species. The Gambia, on the other hand, is now much better known than it was, thanks to the two visits of the late Mr. Budgett, to whom we owe the discovery of two species. But it is the Niger which, through the collections made by Dr. C. Christy, the late Captain G. F. Abadie, Mr. Budgett, and especially Dr. Ansorge, has been productive of the most important additions to our knowledge. The most striking discoveries are the type of a new family, Phractolæmus, since re-discovered in the Ubanghi, and Polycentropsis, the first representative of the Nandidæ in Africa. Leaving aside species entering the sea, we now know fifty-four species from the Senegal, forty-one from the Gambia, and ninety-six from the Niger, the lower course of the latter being the most productive. A remarkable feature of these rivers is the comparative paucity of Cyprinids, and the total absence in the first two of the genus *Barbus*, which also appears to be absent from the Chad basin.

Our knowledge of the piscine inhabitants of the rivers flowing into the Atlantic between the mouths of the Gambia and of the Niger has also made considerable progress. The fishes of Liberia, collected by Dr. Büttikofer, have been described by Dr. Steindachner, and those of the Gold Coast, collected by the late Mr. R. B. Walker, have been reported upon by Dr. Günther. Sixty-seven species are on record from this district, twenty-four of them being endemic.

Further South, North Cameroon has yielded several additions, for a knowledge of which we are indebted to Dr. Lönnberg, whilst South Cameroon, together with the Gaboon district, has been diligently explored by Mr. G. L. Bates, with the result that a great number of new species have been brought to light. This part of Africa is specially interesting from the fact that its rivers interlock with the head waters of the Sanga, which belongs to the Congo basin, and, the fishes being mostly the same in both watersheds, in that district, a sort of passage is established between the Gaboon and Congo faunas. Among the most remarkable forms discovered by Mr. Bates we may mention the genera *Microsynodontis*, *Allabenchelys*, and *Procatopus*. Since Dr. Sauvage reported, twenty-five years ago, on the fishes of the Ogowé, a small collection has been made by the late Miss Kingsley, and described by Dr. Günther, and a number of new species have been characterised by Dr. Pellegrin. The number of species now known from this part of Africa amounts to eighty-seven for South Cameroon and the Gaboon, and fifty-four for the Ogowé. Very curiously, among them we miss *Polypterus* and *Calamichthys*, which occur in the Lower Niger and Old Calabar, and again in the Chiloango--a remarkable instance of discontinuous distribution, which cannot be accounted for by physical conditions, so far as we are acquainted with them.

The Congo system (exclusive of Lake Tanganyika), from which only about ninety species of fishes were known ten years ago, proves to be far richer than any other, for, incompletely explored as it still is, it has already furnished examples of 265 species, forty-five of which have been added since the publication of the work "*Les Poissons du Bassin du Congo*" in 1901. In fact, every collection made even in its most accessible parts adds new species to the list, and many of its rivers have never yet been fished for scientific purposes. No doubt we do not know

more than two-thirds of the fishes of the Congo. The riches in Mormyrids, Characinids, Silurids, Cichlids, Mastacembelids, is something surprising, not only in the number of species, but also in their extraordinary variety of structure; and as many as seven species of Polypterids, out of the eleven that are now known, occur in this river-system. With the exception of the Cromeriidæ and Nandidæ, all the families known from the sub-region have representatives in the Congo.

Lake Tanganyika, now forming part of the same hydrographic system, has a somewhat different fauna, consisting mainly of Cichlids, to which we have specially alluded in an earlier part of this Address. But there are, in addition, a number of Silurids and Cyprinids, a few Mastacembelids and Characinids, a Cyprinodont, and a Polypterus. The latter belongs to a species otherwise restricted to the Congo, and of the four Characinids two are Congo and two are Nile forms. The total number of Tanganyikan species of fishes amounts to eighty-five, but, no doubt, many more await discovery. As I pointed out in reporting on Mr. Moore's second collection, I have reason to think that we do not know more than half the species of fishes inhabiting this extraordinary lake. The collection which has just been brought home by Mr. Cunningham will greatly add to our knowledge. I may here mention that Mormyrids, which were believed to be absent from Tanganyika, are therein represented by two species.

Lake Rukwa has recently been explored by Dr. Fülleborn, but the fishes, which have been referred to eleven species, belonging to widely distributed genera, have not been studied with a sufficient comparison-material: they appear to be mostly endemic forms.

Lake Mwero has representatives of fourteen species, five of which are endemic, the remainder being found also in the Congo or in the Zambesi, or in both.

The Zambesi, so far as we know it--and its upper parts have scarcely been explored--appears rather poor in fishes, only forty-one species having been recorded. All the genera are also represented in the Congo and in the Nile. Seven of the Zambesi species occur also in Lake Nyassa and the Upper Shiré, whilst in the present state of our knowledge twenty-seven species, mostly Cichlids, may be regarded as endemic to the lake and the Upper Shiré. It is perfectly clear, however, that Lake Nyassa differs far less from the Zambesi than Tanganyika does from the Nile or Congo; and, although the Cichlids are likewise represented by some remarkable genera, they cannot compare for variety with the other great lake the fauna of which has been such a surprise. Both the Zambesi and Lake Nyassa lack representatives of the Polypteridæ.

About forty-five years ago a collection of fishes was made in Lake Ngami, and twelve species were described in a very unsatisfactory manner by the late Count F. de Castelnau; unfortunately the types of these species are lost, and it is difficult to form an idea of their affinities. We know, however, that the lake, which is now rapidly drying up, was then inhabited by a Mormyr, a Clarias, a Characinid, and several Cichlids.

The rivers of Angola have been but imperfectly explored. They have yielded a number of Cyprinids and Cichlids, a few Silurids, Mormyrids, and Cyprinodontids, and the type of the remarkable genus *Kneria*, the second species of which inhabits East Africa.

### III. THE EASTERN SUB-REGION.

As was mentioned in the beginning of this Address, latitude goes for little in the distribution of fish-life. This is proved by the very marked difference in general character of the fish-faunas of Abyssinia and Africa east of the great Rift Valley as compared to the Nile and Central and West Africa. No Polypterids or Mastacembelids, few Mormyrids, Characinids, and Cichlids, but a great number of Cyprinids, mostly *Barbus*, characterise this sub-region. Omitting catadromous forms, the list of fishes consists of one Lepidosirenid, six Mormyrids, eight Characinids, seventy Cyprinids, twenty Silurids, one Kneriid, six Cyprinodontids, and seven Cichlids.

Lake Tsana, with the upper affluents of the Blue Nile, differs very strikingly in its fishes from the Nile, with which it has only two species in common, a Silurid (*Bagrus docmac*), and a widely distributed Cichlid (*Tilapia nilotica*), which occurs also in the Hawash and in [[p. 421]] Palestine. Nearly all the fishes are Cyprinids, mostly of the genus *Barbus*, which bear close affinity to Syrian types, as does also the recently discovered Loach (*Nemachilus abyssinicus*), so far the only known African representative of that Europæo-Asiatic group. The single species of the Cyprinid genus *Varicorhinus* is also suggestive of South-Western Asia, although a second African species inhabits Lake Tanganyika, and a third has lately been discovered in Morocco. Another Cyprinid genus, *Discognathus*, which is widely distributed over Southern Asia, from Syria and Aden to Burma, is represented by two species, whilst others are known from Abyssinia and East Africa (Gallaland, Kenya, and Kilimandjaro districts), and one each from the Nile and Lake Victoria. A remarkable negative feature is the absence, as in Syria, of *Labeo*, a genus abundantly represented in the Nile, Senegal, Niger, Congo, and Zambesi, and India, and more scantily in East and South Africa. It is a suggestive fact, tending to show that, somehow or other, Lake Tsana has only comparatively lately been in communication with the Nile, that the *Varicorhinus* and several of the *Barbus* are common to this lake and to some of the rivers of the eastern watershed; whilst not one of the Cyprinids occurs also in the Nile. The main stream of the Blue Nile has only been explored up to Rosaires, but the fishes obtained in that part of the river do not in any way differ from those of the Upper Nile.

The chief character of the rivers east of the Rift Valley is, as already stated, the number of species of *Barbus*. The Cyprinids are further represented by a few *Labeo* and *Discognathus*, by a *Neobola*, and by the only African representative of the Indo-Malay genus *Rasbora*. The Mormyrids are represented by six species only. The few Characinids belong to the genus *Alestes* and to its near allies *Micralestes* and *Petersius*. Of the twenty Silurids, some are widely distributed species, others are common to the Nile or to the Zambesi, whilst among the species with a restricted habitat we note a *Physailia*, two *Bagrus*, two *Amphilius*, a *Synodontis*, and two *Chiloglanis*--altogether a poor series as compared with other districts of Tropical Africa--and not a single autochthonous genus. A species of the remarkable genus *Kneria*, a few Cyprinodontids, and a few Cichlids of the genus *Tilapia* complete what is for a district of that extent, well watered and within the tropics, a very meagre list.

#### IV. THE SOUTHERN SUB-REGION.

Africa south of the Zambesi system has a poor fresh-water fish-fauna, but this is easily accounted for by the intermittent character of most of its rivers. The list I have drawn up from available data includes only fifty species, seven of which are partly marine. When discussing the distribution of the South African fresh-water fishes eight years ago Prof. Max Weber compiled a

list of sixty-four species; but this included a number of truly marine forms, occurring only in estuaries, besides a few of very doubtful determination, which I am obliged to leave out. The majority of the exclusively fresh-water fishes are Cyprinids, viz. seventeen *Barbus* and three *Labeo*. Characinids are represented by the widely distributed *Hydrocyon lineatus*, which occurs in the Limpopo, and the newly discovered *Alestes natalensis*, from near Durban. Three *Clarias*, an *Eutropius*, a *Gephyroglanis*, and a *Galeichthys*, the latter semi-marine, represent the Silurids. The two *Galaxias*, as distinguished by Castelnau, the most remarkable type of the South African fish-fauna, and the two *Anabas*, are confined to the south-western district of Cape Colony. A Cyprinodontid of the genus *Fundulus* has been described from False Bay. Four Gobies and five Cichlids of the genera *Hemichromis*, *Paratilapia*, and *Tilapia* complete the list.

Poor as it is in fishes, the south-western district--the *Erica* or *Protea* district of Max Weber--derives a special character from the presence of the genera *Galaxias* and *Anabas*. The western district is also poor, and has only representatives of three families: Cyprinids, Silurids, and Cichlids; whilst the eastern district, from the Limpopo system and the tributaries of the Orange River to Natal, is the richest, two families, Characinids and Gobiids, being represented, in addition to the three above named. The recent discovery in the Vaal River of a *Gephyroglanis*, a Silurid genus otherwise known only from the Congo and Ogowé, deserves notice.

Whether the subterranean reservoirs of the Kalahari are inhabited by fishes, as is the case in the Northern Sahara, is still unknown.

Excepting such forms as are believed to have been directly derived from marine types, there is every reason to regard the piscine inhabitants of the fresh waters of South Africa as comparatively recent immigrants from the North.

## V. MADAGASCAR.

It is extremely remarkable that this great island, which in most groups of animals shows so many striking features, should in its fish-fauna be one of the most insignificant districts in the whole world. For, if we exclude the numerous Grey Mulletts and Gobies, and a few Perches of the genera *Kuhlia* and *Ambassis*, which live partly in the sea, and probably mostly breed in salt water, the truly fresh-water fish-fauna is reduced to sixteen species--viz., two Silurids, two Cyprinodontids, one Atherinid, four Cichlids, and seven Gobiids, the latter, no doubt, recent immigrants from the sea. The Silurids belong to two distinct genera, *Læmonema*, allied to the African *Chrysichthys*, first discovered in Mauritius, and *Ancharius*, allied to the marine or semi-marine *Arius*, and, perhaps, also entering the sea. Of the four Cichlids two belong to a very distinct autochthonous genus, *Paretroplus*, whilst the two others are respectively referred to the African genera *Tilapia* and *Paratilapia*. The two Cyprinodontids belong to the widely distributed genus *Haplochilus*.

In concluding this sketch, whilst looking back with satisfaction upon the rapid progress which African ichthyology has lately made, and expressing our gratitude to the Governments, institutions, and collectors to whom we owe this progress, we cannot abstain from pointing out how much remains to be done. All the great lakes are insufficiently explored, and Bangweolo has never been fished for scientific purposes, whilst within the limits of this colony an extensive

collection from the Upper Zambesi is still a desideratum, and Lake Ngami is drying up without any of its fishes having been secured for study. The fishes of the Congo above Stanley Falls, and of many of its northern and all of its southern tributaries, are still unknown. But it is gratifying to observe the ever-growing interest in this hitherto somewhat neglected branch of zoology, and I may express the hope that the next decade will be productive of even greater results than have been achieved within the last.

\* \* \* \* \*

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