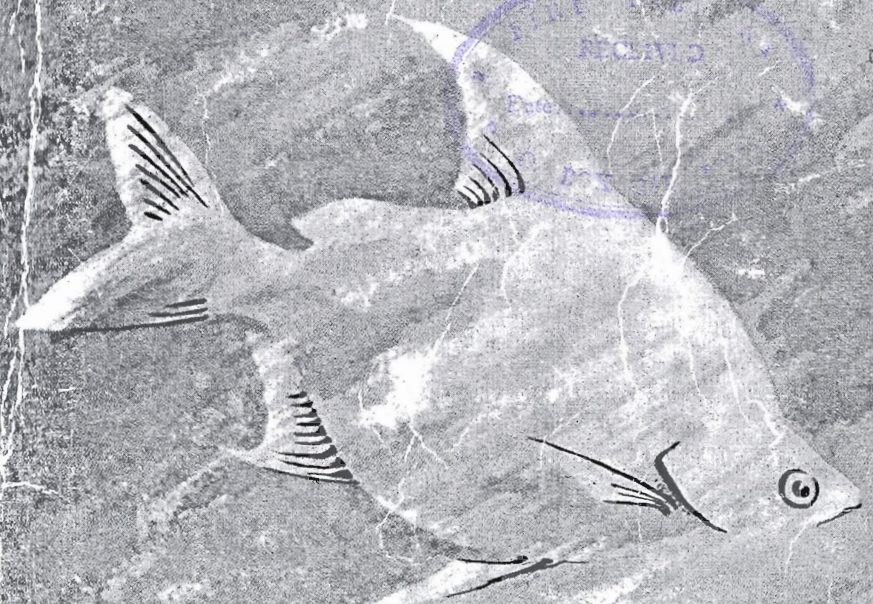
THE FISHES OF UGANDA

P. H. Greenwood



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THE FISHES OF UGANDA

By
P. H. GREENWOOD
British Museum (Natural History), London;
formerly
East African Fisheries Research Organization, Jinja, Uganda.

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PREFACE TO THE SECOND EDITION

In the seven years since this book first appeared, a great deal of new information on the fishes of Uganda has been published. The first edition was soon out of date, and I was very pleased to be asked by the Uganda Society to prepare a revised edition. Much of the new material has been incorporated into the present edition but inevitably it too will need adjustment as research now under way is completed or, as is the nature of research, fans out into many different lines of investigation.

The last seven years have also seen a very considerable zoogeographical revolution within the waters of Uganda; this man-made revolution is, perhaps, only eclipsed by the natural faunal interchange which took place during the Pleistocene period more than half a million years ago.

Many species have now been put into lakes and streams in which they are not native inhabitants. In most cases the action was deliberate, but inevitably some species have been carried unintentionally with the others. Undoubtedly the motives behind these introductions are admirable, being directed towards an increase in the available food resources of the country. The full effects of introductions, either in terms of increased productivity or of the effect on the established fauna, are still unknown. Whatever happens in the future it is essential that the situation be kept under careful observation and that it be fully documented.

Looked at in purely zoological terms, these faunal changes could provide an opportunity to study evolution in action. Thus, some light may be thrown on the fascinating evolutionary phenomena which have intrigued generations of ichthyologists investigating the unique fish faunas of the African Great Lakes. But, as one of those ichthyologists, I can only regret that the introductions were made before we had got a more complete picture of the natural faunas. These were of infinite complexity before the addition of man-made complications.

P. H. Greenwood

London, April, 1965.

THE FISHES OF UGANDA

Contents

CHAPTER		PAGE
I	Introduction	1
II	Families Mormyridae, Characidae and Citharinidae ...	21
III	Family Cyprinidae: The Genera Labeo, Garra, Barilius and Engraulicypris	50
IV	Family: Cyprinidae, (continued)	58
V	The Sub-order Siluroidea (Cat-fishes)	74
VI	Order: Microcyprini	96
VII	Order: Percomorphi, Sub-order: Percoidea	102
VIII	Sub-order: Percoidea, (continued)	106
IX	Sub-order: Anabantoidea	120
X	Order: Opisthomi	122
XI	The Fossil Record	124
	Acknowledgements	127
	Addendum	128
	Index	129

CHAPTER I

INTRODUCTION

THE fishes of Uganda have been subject to considerable study. Apart from many purely descriptive studies of the fishes themselves, three reports have been published which deal with the ecology of the lakes in relation to fish and fisheries (Worthington (1929a, 1932b); Graham (1929)). Much of the literature is scattered in various scientific journals dating back to the early part of the century and is difficult to obtain in Uganda. The more recent reports also are out of print and virtually unobtainable. The purpose of this present survey is to bring together the results of these many researches and to present, in the light of recent unpublished information, an account of the taxonomy and biology of the many fish species which are to be found in the lakes and rivers of Uganda. Particular attention has been paid to the provision of keys, so that most of the fishes may be easily identified.

It is hardly necessary to emphasize that our knowledge of the east African freshwater fishes is still in an early and exploratory stage of development. Much that has been written is known to be over-generalized, as conclusions were inevitably drawn from few and scattered observations or specimens.

From the outset it must be stressed that the sections of this paper dealing with the classification and description of the fishes are in no sense a full taxonomic revision although many of the descriptions are based on larger samples than were previously available. No changes have been made in the nomenclature as at present accepted but, where personal observations indicate that changes may have to be made, notes to that effect are included.

Before describing the species of fish individually, some attempt must be made to view the east African ichthyofauna in its geographical and historical perspective. Each of the five major lakes in Uganda contains numerous endemic fish species; that is to say, species which are found only within clearly circumscribed geographical limits. In a majority of cases the geographical unit is a single lake or lake basin. Not only is the number of these endemic species notable, but it is at once apparent that the lakes differ widely in the numbers of endemic species occurring within their boundaries. A further peculiarity is the absence from certain Uganda lakes of fishes which occur in many other parts of Africa. *Lates* spp. (Nile perch), *Hydrocynus* spp. (Tiger fish) and *Polypterus* spp. exemplify this chequered distribution. All three genera occur in Lake Albert and are widely distributed throughout tropical Africa (including Lakes Tanganyika and Rudolf), but are absent from Lakes Edward, George, Kyoga and Victoria. Further examples are provided by the genera *Mormyrops, Hyperopisus, Barilius, Auchenoglanis, Malapterurus, Heterobranchus, Distichodus* and *Citharinus* which are all widely distributed in Africa, but likewise missing from all the Uganda lakes except Lake Albert. The fishes of Lake Albert as compared with those of other Uganda lakes are outstandingly of genera widely distributed in Africa. Also, fewer endemic species occur in Lake Albert than in the

other lakes. There is, however, evidence of greater uniformity in earlier geological periods of the fish fauna in the area occupied by the modern lakes, at least as regards genera. For example, fossils from the lower Pleistocene (Kaiso) deposits on the shores of Lake Edward, show conclusively that the genera *Lates* and *Hydrocynus* were then present there; similar fossils also occur in Kaiso deposits on the shores of Lake Albert (Fuchs (1934); White (1926)). Going even further back in time, the fossil record shows that *Lates* and *Polypterus* lived during the Miocene in the area now occupied by Lake Victoria (Greenwood, 1951b). A short account of fossil fishes from Uganda is given in Chapter XI.

The history of Uganda's lakes is intimately bound up with the earth movements which contributed to the formation of the Rift Valleys. Prior to their formation, Uganda was drained by a series of east-west flowing rivers which ultimately emptied into the Congo (Wayland, 1931). It was probably from these rivers that the present lakes were first populated. Little is known of the fishes which inhabited the rivers of that period.

Worthington (1954b) has suggested that the early history of the pre-rift, east-west flowing rivers was such that considerable interchange of fishes could have taken place across their more-or-less closely connected headwaters. Thus, it is not unreasonable to suppose that at first the lakes were populated by similar complexes of fishes. The basic similarity in the fish faunas of the Nile, Congo, and Niger, may be considered as evidence of contacts between these systems at an early period. It may also indicate that the fishes of the pre-rift river systems were fundamentally of the same complex, which may be geographically named, from its recent distribution, Nilotic. What few fossils have been found would seem to strengthen this argument (see above; also Greenwood, 1959).

The Pliocene and Pleistocene (together of about 11,000,000 years' duration) were critical phases in the development of the present-day lakes and the evolution of their fish faunas from the more widely distributed African species which first colonized them. In east Africa during this period there was considerable volcanic activity and earth movements were intense. These disturbances, together with phases of increased rainfall or aridity, must have affected considerably the general topography, the sizes and the drainage systems of the lakes. Once spatial isolation had been effected by these agencies, the stage was set for the evolutionary processes which have led to the development of fish faunas peculiar to the several lakes and river systems (Greenwood, 1965a).

The fishes of different lakes may be isolated by various natural barriers which efficiently prevent the interchange of species, even though the lakes may be interconnected. Predominant amongst these physical barriers are the Murchison Falls, which isolate the Lake Victoria fishes from those of Lake Albert and the Nile, and the Semliki Rapids which though less spectacular nevertheless separate the Lake Edward and the Albertine-Nilotic faunas. On the other hand, although the Ripon Falls did provide some degree of separation between Lakes Victoria and Kyoga, their efficiency was less marked; there are only slight differences between the faunas of the two lakes (Tables I and II).

In Uganda's larger lakes, the majority of the endemic species belong to the Cichlidae, a family which includes *Tilapia* and *Haplochromis*. This most interesting family has long attracted the attention of ichthyologists and students of evolution, and as a result there is a considerable body of literature dealing with the evolutionary aspects of the numerous cichlid 'species flocks' found in the different lakes. (For summaries see Worthington (1954a); Brooks (1950);

Greenwood (1958a and 1965a)). It will suffice to mention here that, from the viewpoint of specific predominance, Lakes Edward and George (with 20 endemic cichlid species) and Lakes Victoria and Kyoga (with over 90 endemic cichlid species) can be classified as 'cichlid lakes'.

Faunal relationships of the fishes occurring in the larger Uganda lakes

Because of the excessive endemic speciation of the Cichlidae, faunal relationships can only be determined with certainty from the non-cichlid fishes, and so discussion will first be confined to non-cichlid species.

Lake Albert. With only two exceptions, all the non-cichlid species (37) occurring in Lake Albert are found also in the Nile (Table II) and, although sixteen typically Nilotic genera are absent, there is a greater number of Nilotic genera in Lake Albert than in any other Uganda lake. Thus, if one compares the number of Nilotic genera and species in Lake Albert with the numbers present in the other lakes, it is apparent that the fish fauna of Lake Albert must be classified as Nilotic. As such, it has relationships with the faunas of Lakes Rudolf and Tana.

Lakes Victoria and Kyoga. In Lakes Victoria and Kyoga, there are slightly more endemic than non-endemic non-cichlid species (58 per cent endemism; Table II). Also, the number of typical Nilotic genera which are absent is almost twice the Lake Albert number. Of the twenty-one non-endemic species, nine are Nilotic and twelve east African in distribution. If percentage endemism is considered, together with the distinctiveness of endemic species, then the fishes of Lake Victoria constitute a faunal type, the Victorian. The ultimate derivation of these fishes is most probably Nilotic.

Lakes Edward and George. Worthington (1954b), on the basis of the affinities of endemic species, includes the fishes of Lake Edward in the Victorian category, but this relationship is only obvious when the Cichlidae are included. Non-cichlid species are not so readily classified. The percentage endemism of Lakes Edward and George (16 per cent) is low in relation to that of Victoria (58 per cent). Of the twenty-one non-endemic species, eight are Nilotic but five of these eight Nilotic species do not occur in Lake Victoria. Divergence from the Nilotic assemblage of genera is indicated by the absence of four genera besides those which are absent also from Lake Victoria.

When the Cichlidae are considered, a somewhat different picture is obtained. The Lake Albert *Tilapia* species are with one exception Nilotic. The exceptional species, *T. leucosticta* Trewavas, occurs otherwise only in Lake Edward. In contrast, four of the five Lake Albert *Haplochromis* species are endemic, the fifth species having a fairly wide distribution in east and north Africa.

The cichlids of Lake Victoria are unique among those of Uganda lakes. Both species of *Tilapia* are endemic; over ninety endemic *Haplochromis* are known, and five of the six non-endemic *Haplochromis* have a relatively narrow range of distribution. In addition, there are four endemic genera allied to *Haplochromis*. This complex species flock undoubtedly deserves the status of a type fauna.

Most Lake Edward cichlids are related to Lake Victoria species. The *Tilapia* species, however, are found also in the Nile or in a single instance in Lake Albert. Although nineteen Lake Edward *Haplochromis* are considered endemic, their close affinity to similar species in Lake Victoria cannot be denied (Green-

wood, 1951a, 1965a). Furthermore, four *Haplochromis* species and one related genus occurring in Lake Edward are otherwise only known from Lake Victoria and the small Koki lakes. Thus, although the percentage endemism is high (71 per cent, Table II), the cichlid fauna does not warrant the separation of a Lake Edward faunal type.

Lake Nabugabo. Physically, Nabugabo does not qualify as a large lake. It is only about five miles long, and the water is not more than twenty feet deep. But, from the view-point of faunal relationships and evolution, it deserves to be mentioned. Lake Nabugabo was cut off from Lake Victoria about 4,000 years ago; before that it was a large bay in the western shore of the parent lake. Its fauna was thus originally that of Lake Victoria. Many of these species have since disappeared, and the present-day Nabugabo fauna is a very depauperate one. Apart from two species of *Tilapia* (both present in Victoria) there are only eight other species of Cichlidae. Seven of these species are *Haplochromis*, of which five are endemic to Lake Nabugabo; that is, they have evolved within the lake during the last 4,000 years. No endemics are found among the non-cichlid species (Greenwood, 1965b), which are proportionately much better represented than are the cichlids (see Table III, p. 20).

Notes on the superficial anatomy of fishes

To avoid circumlocution in the keys and descriptions, it is desirable to give some notes on the superficial anatomy of fishes and the terms used.

Length. Two measures of length are used: First, total length—measured from the tip of the snout to the tip of the tail fin, and second, standard length—measured from the tip of the snout to the junction of the body and tail fin (Fig. 1). Standard length will be used exclusively in the description of genera and species.

Terms used to describe the general body form are self-explanatory.

Head. The posterior boundary of the head is formed by the bony operculum; this bone is the largest element in a series of four bones which together form the gill cover (Fig. 1). The head length is measured, with the mouth closed, from the tip of the snout to the posterior edge of the operculum, but excluding opercular spines if these are present.

In fishes, the jaws consist of a number of separate bones, *viz*. the paired pre-maxillae and maxillae in the upper jaw, and the paired dentaries in the lower jaw (mandible). When the mouth is shut, the premaxilla lies immediately below the upper lip, the maxilla lying above and at a slight angle to it. The greater part of the maxilla is covered by the pre-orbital bone, only its hindermost tip being visible.

Protractile and non-protractile jaws are recognized. The former term describes jaws which can be protruded and expanded away from their position at rest; non-protractile jaws are those which cannot be so protruded.

The premaxillae and dentaries carry teeth, except in the family Cyprinidae (Carps). The number and form of teeth show considerable variation within the various families.

The eye diameter is measured from the anterior to the posterior rim of the orbit. The inter-orbital width is the least distance between the upper orbital margins. Lying between the lower margin of the orbit and the maxilla is a flattened bone, the pre-orbital; the pre-orbital depth is measured from the orbit across the greatest depth of the bone (Fig. 1).

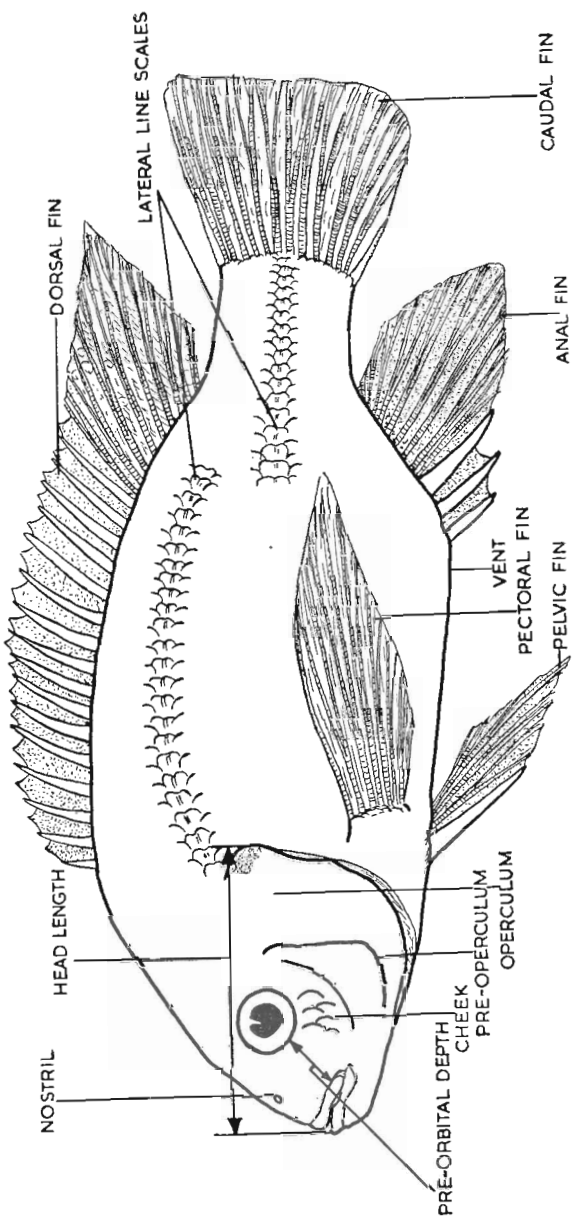

Fig. 1
Sketch showing the more important counts, measurements and characters used in the keys.

The nostrils appear as small openings lying in front of the eye and are an important character for distinguishing between the Percomorph families Cichlidae and Anabantidae. Unlike the nostrils in higher vertebrates, those of fishes do not open into the mouth, but lead into a blind sac containing the olfactory organs. An important exception is the lung-fish (*Protopterus aethiopicus* Heckel) in which there is a passage connecting the external nostrils and mouth.

The gills, carried on bony gill arches, lie in the posterior part of the 'throat' and can be examined by lifting the operculum. In most of the fishes described here, only the first four gill arches carry functional gills, the fifth arch being variously modified, often bearing well-developed teeth, the pharyngeal teeth.

Gill rakers sometimes afford important characters for distinguishing closely related species. The rakers are small bony projections on the anterior part of each gill arch. Interdigitation between the gill rakers of adjacent arches provides a sieve-like mechanism which serves the double function of retaining food and protecting the delicate gill filaments from coarse objects passing out with the exhalent respiratory current. When counting gill rakers, only those lying below the angle between the upper and lower parts of the first arch are included.

Fins. Fins may be paired (the lateral pectoral and the ventral pelvic fins), or unpaired (the vertical dorsal, anal and caudal fins). Structurally, a fin consists of a membrane supported by a number of rays, which can be either simple (and often spinous), or branched and soft. When describing fins, the number of rays is expressed as a formula, in which roman numerals denote unbranched, and arabic figures the number of branched rays. Thus, 'dorsal fin XVI, 8' means that the fin has sixteen unbranched rays followed by eight soft, branched, rays.

The positions of the paired fins, particularly the pelvics, afford important key characters. When the pelvic fins are situated between the pectoral and anal fins, they are described as being abdominal in position. Pelvic fins are said to be thoracic in position when situated immediately below the pectoral fins. The position of the pelvic fins reflects an underlying skeletal difference; the pelvic girdle is attached to the pectoral girdle in fishes with 'thoracic' fins, but is well separated from the pectoral girdle in those fish with 'abdominal' fins. The terms used to describe the shape of the caudal fin are self-explanatory.

Special mention must be made of the fins in the Lepidosirenidae and Polypteridae. In the former, supporting rays are not visible externally, so that the fins appear to be without rays. The paired fins in this family are unique amongst living fishes, being composed of a central, articulated axis which is flanked, at least in the pectoral fin, by short rays borne on one margin; consequently, the external form is that of an elongate and narrow filament with a variably developed membrane along one margin. The dorsal fin of the Polypteridae is distinctive; it is in the form of several separate, flag-like, finlets each composed of a spine with several small rays attached near its dorsal tip (Fig. 2). The pectoral fins of *Polypterus* show several anatomical peculiarities which need not be described, except to note the well-defined, arm-like peduncle connecting the membranous fin to the body.

An adipose dorsal fin, present in the families Characidae, Citharinidae and in certain cat-fishes, has the general appearance of a fin but, with very few exceptions, is without supporting rays; it is in fact merely a flattened sheet of fatty tissue, covered by skin.

Scales. Excepting in the Lepidosirenidae (lung-fishes) and in the Polypteridae,

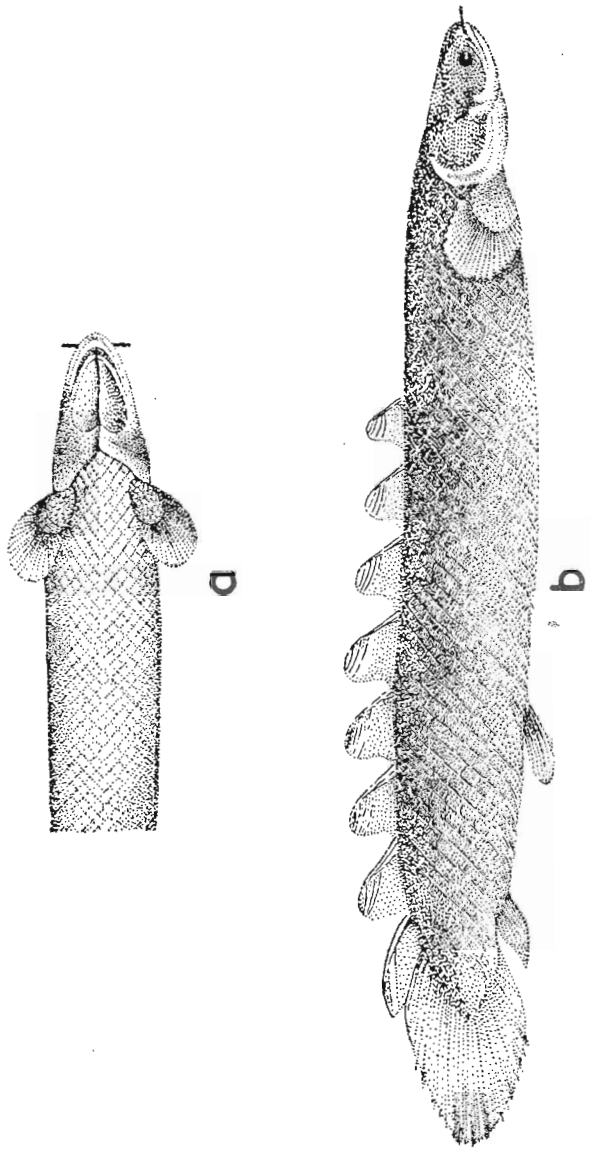

FIG. 2

Polypterus senegalus. (a) Ventral view of head, showing the characteristic gular plates and the pectoral fins. (b) Lateral view; both ×¼. (Drawn by W. C. Lewis, after Boulenger.)

scales are of two morphological types, *cycloid* and *ctenoid*. Cycloid scales have the exposed, visible surface, smooth, whilst ctenoid scales are covered with minute denticulations which make the scale rough to the touch. A simple test for the presence of ctenoid scales is to rub one's finger gently along the fish's flank, from tail to head; if the scales are ctenoid, the fish will feel rough. However, it is always advisable to check this character by the appearance of the scales under a low-power lens.

A longitudinal series of scales on each flank is pierced by small pores and appears as a distinct but narrow line; this is the lateral line scale series. The number of scales in the lateral line series is often of importance in separating closely related species. Beneath these perforated scales lies a series of sense organs which are in contact with the exterior through the pores in the scales.

The scales of the lung-fish *Protopterus* (Lepidosirenidae) are small, thin and deeply embedded in the skin. Thus, unless examined closely, the fish appears scaleless. On the other hand, the scales of *Polypterus* (Polypteridae) are thick and bony, with a glistening, enamel-like, surface.

Systematic list of Uganda fishes

The scheme of classification here adopted is essentially that of C. Tate Regan (1929a).

Class:	**PISCES**
Sub-class:	**DIPNEUSTI**
Order:	DIPNOI (Lung-fishes)
Family:	Lepidosirenidae
Genus:	*Protopterus*
Sub-class:	**PALAEOPTERYGII**
Order:	CLADISTIA
Family:	Polypteridae
Genus:	*Polypterus*
Sub-class:	NEOPTERYGII
Order:	ISOSPONDYLI
Sub-order:	Mormyroidea
Family:	Mormyridae (Elephant-snout fishes)
Genus:	*Hyperopisus*
	Mormyrus
	Mormyrops
	Petrocephalus
	Marcusenius
	Gnathonemus

Order:	OSTARIOPHYSI
Sub-order:	Cyprinoidea
Family:	Characidae (Tiger-fishes)
Genus:	*Hydrocynus*
	Alestes
Family:	Citharinidae (Moon-fishes)
Genus:	*Distichodus*
	Citharinus
Family:	Cyprinidae (Carps)
Genus:	*Labeo*
	Garra
	Barilius
	Engraulicypris
	Barbus
	Varicorhinus
Sub-order:	Siluroidea (Cat-fishes)
Family:	Bagridae
Genus:	*Bagrus*
	Auchenoglanis
Family:	Schilbeidae
Genus:	*Schilbe*
	Eutropius
Family:	Clariidae
Genus:	*Clarias*
	Clariallabes
	Xenoclarias
	Heterobranchus
Family:	Mochokidae
Genus:	*Synodontis*
Family:	Amphiliidae
Genus:	*Amphilius*
Family:	Malapteruridae (Electric cat-fishes)
Genus:	*Malapterurus*
Order:	MICROCYPRINI
Family:	Cyprinodontidae (Mosquito-fishes)
Genus:	*Nothobranchius*
	Aplocheilichthys
	Hypsopanchax
	Cynopanchax
Order:	PERCOMORPHI
Sub-order:	Percoidea (Perch-like fishes)
Family:	Centropomidae (Nile perch)
Genus:	*Lates*



Family:	Cichlidae
Genus:	*Tilapia*
	Astatoreochromis
	Schubotzia
	Macropleurodus
	Hoplotilapia
	Platytaeniodus
	Paralabidochromis
	Haplochromis
Sub-order:	Anabantoidea
Family:	Anabantidae (Climbing perches)
Genus:	*Ctenopoma*
Order:	OPISTHOMI
Family:	Mastacembelidae (Spiny eels)
Genus:	*Mastacembelus*

KEY TO THE FAMILIES OF UGANDA FISHES

(NOTE on the use of keys. In this key, some of the more obvious external characters are presented as a series of contrasting couplets, one or other of which will be applicable to the fish being identified. A fish is first examined to determine the form of its fins, which are contrasted in the first pair of couplets. One of these couplets leads straight to the family of Lepidosirenidae: the other is followed by a figure, in this instance 1. The figure indicates to which pair of couplets (numbered in the left-hand margin) one next proceeds. Having located these, it is then necessary to eliminate one possibility; the number associated with the other group of characters then shows to which succeeding pair one must proceed. This procedure is repeated until a group of characters associated with a family is reached.)

(Subsequent keys will be of a similar type.)

Paired fins expanded, not filamentous, with distinct rays supporting the membrane; dorsal, anal and caudal fins separate (except in the family Mastacembelidae and in some Clariidae) 1

Paired fins slender and filamentous; dorsal, anal and caudal fins confluent Lepidosirenidae (p. 12)

1 Dorsal fin not divided into a series of separate finlets; scales present or absent; when present, thin and overlapping 2

Dorsal fin divided into a number of separate finlets, each composed of a spine with several rays supporting the membrane; scales thick and bony, rhomboidal in outline Polypteridae (p. 11)

2 Scales present 8

Scales absent, circum-oral barbels present and well-developed (Sub-order Siluroidea) 3

3 Rayed dorsal fin present 4

Rayed dorsal fin absent, well-developed adipose dorsal fin present Malapteruridae (p. 93)

4 Dorsal fin short 5

Dorsal fin long Clariidae (p. 80)

5 Anal fin short, with 6-10 branched rays, equal to or somewhat shorter than the dorsal fin 6

Anal fin long, with 54-70 rays Schilbeidae (p. 78)

Scales. Excepting in the Lepidosiren[illegible]

6 Dorsal fin with the first ray spinous

Dorsal fin with the first ray soft Amphiliidae (p. 93)

7 Mandibular barbels not branched Bagridae (p. 75)

Mandibular barbels branched Mochokidae (p. 88)

8 Anal fin without spines. Ventral fins abdominal in position, without spines and usually with more than five rays 9

Anal and dorsal fins with spines supporting their anterior portions. Ventral fins (when present) thoracic in position, with one spine and five rays 13

9 Jaws with teeth 10

Jaws without teeth Cyprinidae (p. 50)

10 Adipose dorsal fin absent 12

Adipose dorsal fin present 11

11 Teeth fine and slender Citharinidae (p. 44)

Teeth large and fang-like or, if short, with stout bases and three-pointed crowns Characidae (p. 35)

12 Opercular bones hidden beneath skin; no scales on the head; caudal fin forked, mouth not protractile Mormyridae (p. 21)

Opercular bones not hidden beneath skin; scales present on the head; caudal fin rounded; mouth protractile, oblique. Dorsal surface of head flattened Cyprinodontidae (p. 96)

13 Ventral fins present 14

Ventral fins absent. Soft dorsal and anal fins confluent with caudal; spinous part of dorsal fin represented by numerous separate spines. Body eel-like Mastacembelidae (p. 122)

14 Dorsal fin undivided. Lateral line divided posteriorly into upper and lower portions 15

Dorsal fin deeply notched, so as to give the appearance of two fins, the anterior part completely spinous, the posterior with one spine and several branched rays Centropomidae (p. 102)

15 One nostril on each side of the head. Edge of operculum smooth Cichlidae (p. 106)

Two nostrils on each side of the head. Edge of the operculum serrated Anabantidae (p. 120)

Order: CLADISTIA

Family Polypteridae

Polypterus Geoffr. 1802.

Since only one species of this genus occurs in Uganda waters, a combined description of the genus and species can be given.

Polypterus senegalus Cuvier, 1829.

Bichir (English); Mtonta (Lugungu); Otell (Alur).

Polypterus senegalus is immediately recognizable by the form of its dorsal fin which is composed of 8-11 separate finlets, each consisting of a single spine with several articulated rays supporting the membrane. The first finlet is widely separated from the tip of the pectoral fin. Further diagnostic characters are the thick bony, rhombic scales, with an enamel-like covering, the paired gular plates

which lie between the rami of the lower jaw, and the distinct, scaly peduncle of the pectoral fin. In young fish there is developed a true external gill which lies immediately behind and above the operculum.

Coloration: Adult fish, uniform olive-grey, almost khaki. Boulenger (1909) states that very young fish are conspicuously marked with dark longitudinal bands, which disappear at an early age.

Size: The total length of the largest recorded specimen from Uganda was 42 cm.

Distribution: Uganda; Lake Albert, Victoria Nile below the Murchison Falls, Albert Nile. *Elsewhere;* Lake Rudolf, the White Nile, the Senegal, Gambia and Niger and Lake Chad. During the Miocene (about 25,000,000 years ago) *Polypterus* occurred within the Lake Victoria basin. Fossil remains of the genus have been found in the Kavirondo Province of Kenya and in the Lake Edward basin (Greenwood, 1951b and 1959).

Biology: Surprisingly little is known of the ecology of *P. senegalus*. From existing records it would appear to live in the marginal regions of lakes and rivers, particularly where there is emergent vegetation. Likewise, there are few data on the food of this species; in the few specimens examined (length range 30-50 cm.) fish and small frogs apparently predominated as food.

Budget (1901) records *P. senegalus* as ready to spawn during the rainy season, July to September, but nothing is known as to the place or mode of spawning. Since cement glands—which secrete an adhesive mucus—occur on the head of larval fishes, it would seem likely that the young are attached to submerged plants.

Polypterus is of no economic value, but has excited considerable scientific interest. When first described, the Polypteridae were placed in the order Crossopterygii, an ancient group which has attracted great interest recently through the discovery of a living representative, the Coelacanth, *Latimeria*. Further research on the Polypteridae, however, has revealed that the resemblances between *Polypterus* and the Crossopterygii are only superficial.

The anatomy and skeleton of *Polypterus*, show a combination of archaic and specialized characters. The air-bladder which in most bony fishes functions as a hydrostatic device, in *Polypterus* serves also as an accessory respiratory organ.

Bibliography: Boulenger (1909); Bridge (1904); Daget (1950); Worthington (1929a).

Order: DIPNOI

Family Lepidosirenidae

Protopterus Owen, 1839.

A single species, *P. aethiopicus*, occurs in Uganda.

Protopterus aethiopicus Heckel 1851. (Fig. 3.)

Lung-fish (English); Mamba (Lunyoro, "Swahili"); Lut (Jonam, Lango).

Description: Body elongate, sub-cylindrical, the tail pointed and confluent with the long dorsal and anal fins. Dorsal fin originating at an equal distance from occiput and vent, or nearer the latter. Pectoral and pelvic fins slender and filamentous. There are no individual teeth in the jaws, the dentition consisting of upper and lower tooth-plates, in the form of sharp cutting ridges. Scales, thin

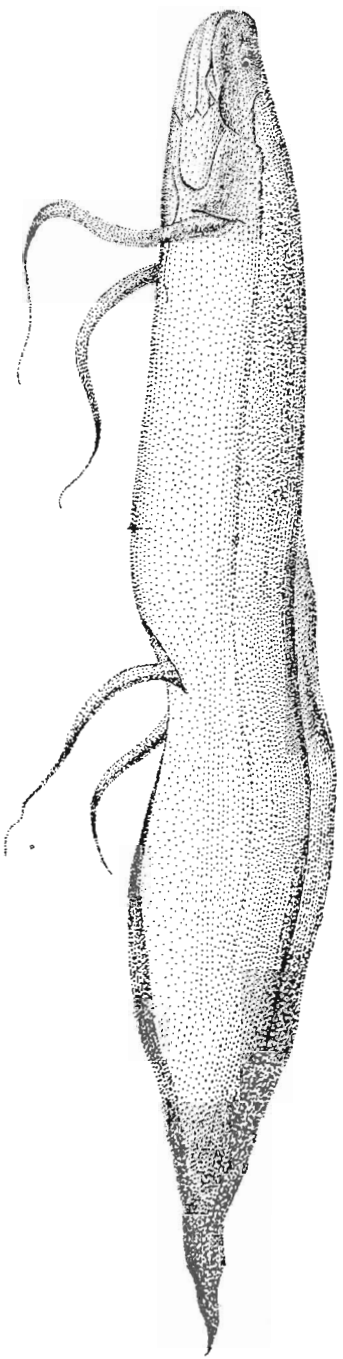

FIG. 3

Protopterus aethiopicus, lateral view, $\times \frac{1}{3}$. (Drawn by W. C. Lewis, after Boulenger.)

and deeply embedded in the skin; 55-70 scales can be counted in a longitudinal series from immediately behind the head to above the vent. Ribs, 37-40 pairs.

True external gills occur in young fishes, but are usually absent in fishes over 15 cm. length.

Length: The largest recorded specimen was seven feet (2 m.) long; most individuals caught by commercial fishermen are in the size range 100-130 cm.

Coloration: Dark slaty-grey above, yellowish grey or pinkish below; often with numerous dark spots or flecks on the fins and body. The sensory canals on the head and body are conspicuously outlined in black.

Distribution: Uganda; Lakes Victoria, Nabugabo, Albert, Edward and George, the Victoria and Albert Niles, small streams and swamps associated with the major rivers and lakes; it is apparently absent from Lakes Nakavali, Kachira and Kijanebalola. *Elsewhere;* the Nile, the Sudan, Lake Tanganyika, Katanga, Lake No, Stanley Pool (Congo).

Biology: As the common name implies, *Protopterus* breathes by means of well-developed, paired lungs as well as by its rather degenerate gills. In fact it would seem that except in the youngest stages, these fishes are entirely dependent on atmospheric oxygen, since *Protopterus* kept in aquaria are asphyxiated if prevented from rising to the surface. In Lake Victoria on calm days large numbers of fish may be seen surfacing to breathe. The movements following surfacing are characteristic; the fish remains with the snout protruded for some seconds before flipping the greater part of its tail out of the water and plunging downwards.

Passing mention may be made of the known aestivating habits of *Protopterus,* although dormant *P. aethiopicus* encased in their mud-cocoons have not been recorded from Uganda. With the onset of a dry season, and before the exposed mud has hardened, the fish burrows into the mud to a depth of between six inches and two feet. There it coils itself into a sac-like enlargement at the bottom of the burrow. This enlargement is lined by a capsule of hardened mucus secreted from glands in the skin. The fish is protected from extreme dehydration by the copious mucus secretion which fills the capsule. Breathing is apparently effected through a funnel-like opening in the chamber, one end of which is inserted into the fish's mouth.

Since most populations of *P. aethiopicus* in Uganda live in permanent bodies of water, the need to aestivate does not arise. Those populations that do live in areas subject to a seasonal and partial drying out seem to overcome the problem in a rather different way from that usually associated with *Protopterus* species. Wasawo (1959) has described two burrows which he discovered in a partly dried-out swamp in the Teso district. The entrance to the burrow was a few inches above the water surface in a swamp pool; from the entrance hole, the burrow ran horizontally for about four feet and then turned sharply downwards. The sloping part was about nine feet long, and was filled with water (probably by seepage from the surrounding soil). At the bottom of each burrow was a large *P. aethiopicus*. Wasawo described the fishes as being lethargic, pale coloured and with much mucus surrounding the body. Because the discovery was made at the end of a dry season, it seems very likely that the fishes had lain-up in their burrows since the water level fell. *Protopterus aethiopicus* has not lost the ability to form mucus-mud cocoons. Cocoons have been found in Katanga, and specimens from Lake Victoria and elsewhere have been induced, under laboratory conditions, to aestivate. In these experiments typical cocoons were produced.

In Lakes Victoria, Nabugabo, Kyoga, Albert, Edward and George, *P. aethiopicus* occur most abundantly in the shallow inshore regions, especially in the vicinity of swamps, but they have been seen occasionally in deep water. As the lung-fish must surface for breathing at fairly frequent intervals, depth of water is probably an important factor determining its distribution within a lake. In Lake Victoria, young *P. aethiopicus* from 5-30 cm. long are very common in the matted roots of papyrus (Graham, 1929 and personal observations), although Poll and Damas (1939) record that in a similar habitat in Lake Edward (the large papyrus swamps at the mouth of the Luka River) . . . "La recherche fut vaine". In Lake Kyoga, Worthington (1929a) records that "the lung-fish is present throughout the swampy lakes and rivers, but was not observed to be nearly so abundant as in the shallow gulfs of Lake Victoria".

Food: Numerous references to the food of *P. aethiopicus* indicate that molluscs (both gastropods and bivalves) predominate in the diet. Small fish are also eaten —*Haplochromis* and young *Clarias, Synodontis* and *Bagrus* (Graham (1929); Worthington (1932); Poll (1939); Corbet (1961)). Poll (1952) lists crabs among the food of *P. aethiopicus* in Lake Tanganyika.

Breeding: Parental care is well-developed in the African lung-fishes. The male parent prepares a pit or hole nest, and after spawning has taken place he guards the young for nearly eight weeks. Not only does the male attack any would-be intruders but he constantly aerates the water in the nest. This he does through stirring the water by his body movements. Often the male takes up a head-down position in the nest, and then slowly flaps his tail, breaking the water surface at each stroke.

The nature of the nest is, apparently, very variable. Around the northern shores of Lake Victoria nests have been found excavated in the matted roots of papyrus, among the plants in a shallow, grass-swamp, and in the sand beneath a fallen 'ambatch' tree.

More than one female may spawn in a nest, but successive spawning takes place within a very short period of time. Once the eggs are laid, the female leaves the nest and does not return; all parental duties are then assumed by the male. The young hatch about fourteen days after the eggs are fertilized; they leave the nest about forty days later. At this time the young are from 30 to 35 mm. long, and possess well-developed external gills. For a fuller account of reproduction in *P. aethiopicus,* see Greenwood (1958b).

Graham (1929) suggested that young lung-fishes pass through a quiescent period buried in the roots of papyrus. The duration of this quiescent period (if one does exist) is unknown; certainly small *P. aethiopicus* (up to 25 cm. long) are common amongst papyrus roots, but there is little about their behaviour to suggest that they are in a quiescent state.

As far as can be determined, the principal breeding season in the northern waters of Lake Victoria is from November to April, but a subsidiary season may occur in September if the rainfall has been sufficiently heavy (Greenwood, *op. cit.*)

Economic Value: The economic importance of the lung-fish in Uganda waters is considerable, but varies from lake to lake. In Lakes George and Kyoga—particularly Lake George—it forms an important element in the fisheries (Uganda Government, 1947-53), whilst in Lakes Victoria, Edward and Albert, the species contributes only slightly to the total catch. By destroying fish already caught in gill-nets, lung-fish may be of indirect importance, although much of the damage attributed to them may actually be caused by otters.

Protopterus is a living representative of a fish group which attained pre-eminence during the Palaeozoic (about 300,000,000 years ago). Although the living lung-fishes retain many characteristics peculiar to the now almost extinct order Dipnoi, they must be considered as a relatively specialized end-point in evolution. Anatomically and osteologically, *Protopterus* shows considerable divergence from the typical bony fishes. Special mention may be made of the well-developed lungs and the consequent specialization of the blood-vascular system, which foreshadows the condition found in the Amphibia; the almost completely cartilaginous skeleton, particularly the incomplete vertebrae and persistent notochord; and the urino-genital system which, like the blood-vascular system, approaches the amphibian level of organization.

Bibliography: Boulenger (1909, 1916); Poll (1939, 1946, 1952a); Poll and Damas (1939); Jackson (1916); Graham (1929); Worthington (1929a, 1932b); Bridge (1904); Young (1950); Uganda Government (1947-1952); Johnels and Svensson (1954); Trewavas (1954); Greenwood (1958); Wasawo (1959); Norman (1963).

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TABLE I

Distribution of families of fishes in the five major Uganda lakes. A=absent. For each lake the number of genera within a family is given, followed below by first, the number of non-endemic species belonging to the various genera, and, second, the number of endemic species, indicated by the suffix 'e'. Lakes Victoria and Kyoga are considered together and species indicated 'e' occur in both lakes; those endemic to Lake Victoria are suffixed 'eV', and those known only from Lake Kyoga 'eK'. Figures for the Cichlidae are provisional until taxonomic studies on all five lakes are completed. The table is compiled from the data of Graham (1929), Worthington (1929a, b; 1932a, b), Trewavas (1933, 1938), Poll (1939) and from reports of the East African Fisheries Research Organization.

Family		Lakes Victoria and Kyoga	Lakes Edward and George	Lake Albert
Lepidosirenidae ..	Genus	1	1	1
	Species	1	1	1
Polypteridae	Genus	A	A	1
	Species			1
Mormyridae	Genera	4	1	5
	Species	5+2e	2	7
Characidae	Genera	1	A	3
	Species	2e		5
Citharinidae	Genera	A	A	2
	Species			4
Cyprinidae	Genera	4	2	4
	Species	7+5e+3eK	4	5
Bagridae	Genera	1	1	2
	Species	1+1eV	1	3
Schilbeidae	Genera	1	A	2
	Species	1		2
Clariidae	Genera	3	2	2
	Species	4+3eV	5	2
Mochokidae	Genus	1	A	1
	Species	2e		3
Amphiliidae	Genus	A	1	A
	Species		1	
Malapteruridae ..	Genus	A	A	1
	Species			1
Cyprinodontidae ..	Genera	3	1	1
	Species	2+1eV	2+2e	1 or 2
Centropomidae ..	Genus	A	A	1
	Species			2e
Cichlidae	Genera	3+4eV	4+1e	2
	Species	6+14e±100eV+2eK	3+20e	5+4e
Anabantidae	Genus	1	1	A
	Species	1	1+1e	
Mastacembelidae ..	Genus	1	A	A
	Species	1		

TABLE II

Analyses of data in Table I.

Lakes		Victoria and Kyoga	Edward and George	Albert
	Families	12	9	14
Non-cichlids	Genera	20	10	26
	Endemic genera	Nil	Nil	Nil
	Species	50	25	37
	Endemic species	29	4	2
	Percentage endemism	58	16	5
Cichlidae	Genera	6	4	2
	Endemic genera	4	1	0
	Species	127	28	9
	Endemic species	124	19	4
	Percentage endemism	98	71	44

TABLE III

Distribution of fishes in the small lakes of Uganda. Worthington's investigation (1931), and subsequent collections indicate that there are no indigenous fishes in Lake Bunyoni; of the three *Tilapia* species introduced, only one, *T. nilotica*, has apparently survived. The fishes of Lake Nabugabo are essentially those of Lake Victoria, from which the lake was separated by a sand-spit of recent geological age. The table is compiled from the data of Worthington (1929b), Trewavas (1933), Uganda Government (1947, 1948), and of collections made by the East African Fisheries Research Organization, by Makerere College Biology Department (1954), and by the Cambridge University expedition of 1962.

Family	Lakes Kachira, Nakavali and Kijanebalola	Lake Nabugabo	Lake Bunyoni
Lepidosirenidae ..	Absent	*Protopterus aethiopicus*	Absent
Mormyridae	Absent	*Gnathonemus longibarbis* *Petrocephalus catostoma* *Marcusenius nigricans*	Absent
Characidae	Absent	*Alestes jacksonii*	Absent
Cyprinidae	Absent	*Barbus spp.* *Engraulicypris argenteus*	*Barbus sp.*
Clariidae	*Clarias mossambicus* *C. werneri*	*Clarias mossambicus* *C. werneri*	*Clarias carsonii* (introduced)
Schilbeidae	Absent	*Schilbe mystus*	Absent
Mochokidae	Absent	*Synodontis afrofischeri*	Absent
Cyprinodontidae ..	*Aplocheilichthys pumilis*	Absent	Absent
Cichlidae	*Tilapia nilotica* (introduced) *T. esculenta* (introduced, Lake Kijanebalola only) *Haplochromis nubilis* *Hemihaplochromis multicolor* *Astatoreochromis alluaudi*	*Tilapia esculenta* *T. variabilis* *Haplochromis* spp. (2+5 endemic) *Hemihaplochromis multicolor* *Astatoreochromis alluaudi*	*Tilapia nilotica* (introduced) *T. nigra* ,, ,, *Haplochromis spp.* ,, ,,
Mastacembelidae ..	Absent	*Mastacembelus frenatus*	Absent

CHAPTER II

FAMILIES MORMYRIDAE, CHARACIDAE AND CITHARINIDAE

DESCRIPTIONS of families and genera given in this and succeeding chapters are based on external or other readily-determined characters exhibited by species occurring in east Africa. In this respect they cannot be considered fully diagnostic for all species referable to any particular family over the full range of its distribution.

Likewise, data on habitats, food, breeding habits and abundance refer specifically (unless stated otherwise) to investigations made in the waters of Uganda and neighbouring countries. A word of warning must be sounded here. Although much of the ecological information may seem to be complete and precise, that is rarely so. Indeed, it is the very lack of exhaustive studies which enables such apparently succinct accounts to be given. At present our knowledge is too imperfect for true generalizations to be made.

Table IV summarizes the distribution in Uganda of species dealt with below. When considering this distribution, it is important to differentiate between various sections of the Nile, especially those reaches above and below the Murchison Falls. As mentioned earlier, these Falls provide a sharp demarcation between fish faunas of so-called Nilotic and Victorian types. Throughout this account, the river above the Murchison Falls is referred to as the 'Victoria Nile', whilst that section between the falls and its delta in Lake Albert is called the 'Murchison Nile'. The term 'Albert Nile' is retained for the stretch between Lake Albert and Nimule.

Order: ISOSPONDYLI

Family: Mormyridae

Body somewhat elongate ($3\frac{1}{2}$-$6\frac{1}{2}$ times longer than deep); caudal peduncle narrow and distinct. Snout variable, from short and rounded to elongate and trunk-like. Opercular bones hidden beneath the skin, the opening of the branchial cavity reduced. Eyes small and covered by skin. Head naked, its skin thick and well-supplied with mucus glands. Mouth non-protractile; teeth invariably present. Scales small and cycloid; the lateral line complete. Fins without spines. Generally only the left gonad is developed. Muscles of the caudal peduncle modified to form an electric organ.

Some preliminary studies have been carried out on the nature and function of the electric organ in *Mormyrus kannume*. These show that a continuous stream of electrical impulses is discharged from the organ, at a variable frequency. With the fish at rest discharge frequency is at its lowest, but rapidly increases to between 80 and 100 impulses per minute when the fish is disturbed.

Any electrical conductor entering the electro-magnetic field set up around the fish evokes an immediate response. In this way, the organ may be likened to

a radar warning device, which would be of considerable value to a fish whose life is spent in muddy waters with poor visibility.

The means whereby disturbances in the electrical field are detected by the fish is still undetermined. Certain neuro-glandular epidermal cells, the so-called 'mormyromasts', are possibly associated with the perception of such changes.

Besides the electric organ, members of this family show many anatomical, osteological and histological peculiarities. The brain is especially noteworthy for its great size. Boulenger (1904) states that in these fishes brain weight equals 1/52-1/82 of the total weight "a thing unparalleled among lower vertebrates". Since greatest hypertrophy is found in the cerebellum and acoustico-lateralis areas of the hind brain, it is not unreasonable to suppose that its functional significance may be related to the co-ordination of sensory impulses detected through organs other than the eyes, and therefore indirectly, to the presence of an electric organ.

The Mormyridae are entirely African in distribution; six genera occur in Uganda.

KEY TO THE GENERA

Anal fin five or more times longer than the dorsal fin — *Hyperopisus* (p. 22)
Anal fin from three-fifths to twice as long as the dorsal fin — 1
Anal fin less than half the length of the dorsal fin — *Mormyrus* (p. 23)

1 10-36 teeth implanted along the entire edge of both jaws — (a)
3-10 teeth, confined to the middle of each jaw — (b)

(a) (i) Body elongate (5-6 times longer than deep); mouth terminal, anterior to the eyes; nostrils of each side separated from one another and distant from the eye — *Mormyrops* (p. 28)
(ii) Body short ($3\frac{1}{2}$ times longer than deep); mouth inferior and situated below the eyes; nostrils of each side close together and placed near the eye — *Petrocephalus* (p. 28)

(b) (i) Mouth inferior, situated well below the horizontal level of the eye; snout rounded — *Marcusenius* (p. 30)
(ii) Mouth terminal, not, or only slightly, below the horizontal level of the eye; snout not rounded — *Gnathonemus* (p. 32)

Hyperopisus Gill 1862

Body elongate and compressed. Dorsal fin very short, anal long; pelvic fins much nearer the pectoral than the anal fin. Nostrils nearer the tip of the snout than the eye. Mouth terminal, situated below eye level. Teeth in both jaws small and notched; never more than six in either jaw. Tongue and roof of the mouth with large, rounded and contiguous teeth, which form a crushing mill.

Only one species is known, but at least two geographically restricted sub-species are recognized (Daget 1954; see below).

Hyperopisus bebe (Lacépède) 1803. (Fig. 4)

Native name: Ngai (Jonam).

Description: Depth of body contained $3\frac{1}{2}$-$5\frac{1}{2}$ times in standard length, length of head $4\frac{1}{2}$-$5\frac{3}{4}$ times. Dorsal head profile strongly curved. Eye small, diameter

$\frac{1}{8}$ (in young fishes) to 1/9 of head length in adults. Mouth small and terminal; teeth notched, 3-5 and 4-6 in the upper and lower jaws. Dorsal fin with 12-16 rays, of which the first two or three are unbranched. Anal fin with 54-64 rays. Lateral line with 90-120 scales.

On the basis of its possessing fewer dorsal and more anal fin rays, and on other counts, Daget (1954) recognizes a west African sub-species, *Hyperopisus b. occidentalis* (Günther). The local sub-species is accordingly *H. b. bebe* (Lacépède).

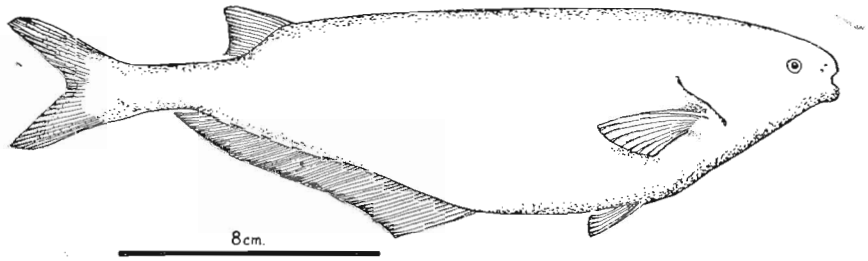

FIG. 4

Hyperopisus bebe. (Drawn by Barbara Williams after Boulenger.)

Coloration: Silver, the dorsal surface iridescent grey-olive or purple.

Size: The largest recorded specimen was 47 cm. long (*ex* Niger; Daget, 1954.)

Habitat: Fluviatile (Worthington 1929a, Greenwood 1963). Daget (*op. cit.*) mentions *Hyperopisus b. occidentalis* as being common in swamps and other areas inundated during seasonal flooding of the Niger.

Food: There is no information on the food of *H. bebe* in Uganda. For the west African sub-species, molluscs (Marcusen, 1864), and insects (Daget, *op. cit.*) are recorded.

Breeding: No data from Uganda. In west Africa, *Hyperopisus* spawns in swamps during the rainy season. The nest attributed to *H. bebe* by Budget (1901), has subsequently been shown to be that of *Tilapia melanopleura* (Svensson, 1933).

Abundance: Apparently rare.

Distribution: Uganda: Albert and Murchison Niles, Aswa river. *Elsewhere:* Nile basin, Senegal, Niger, Volta, Gambia and Lake Chad.

Mormyrus Linn. 1758

Body relatively elongate ($3\frac{1}{2}$-5 times longer than deep). Snout form very variable, from short and rounded to elongate and trunk-like. Dorsal fin long, its basal length at least twice that of the anal fin; pelvic fins equidistant from the pectoral and anal fins or slightly nearer the former. Mouth terminal. Teeth

small and notched; from 3-16 and 6-22 in the upper and lower jaws respectively. Teeth occurring on the tongue and roof of the mouth are fine and pointed.

Certain species of *Mormyrus* were venerated by the ancient Egyptians and were frequently represented on hieroglyphs and murals. To quote from Günther's *An Introduction to the Study of Fishes*—"They (the ancient Egyptians) abstained from eating it because it was one of the three different kinds of fishes accused of having devoured a member of the body of Osiris, which therefore, Isis was unable to recover when she collected the rest of the scattered members of her husband."

In Uganda there is a widespread belief in the pre-natal influence exerted by *Mormyrus* flesh. It is held that if eaten by women, embryonic development will be so disturbed as to produce infants with a *Mormyrus*-like cast of countenance. Another present-day belief is that eating *Mormyrus* induces sterility in both men and women.

Key to the Species

Snout elongate and trunk-like (its length about equal to the post-ocular part of the head) 1

Snout short and stout (about half the post-ocular part of the head) *M. macrocephalus* (p. 24)

1 (i) Dorsal fin originating above a point about midway between the pectoral and pelvic fins; more than 75 rays in the dorsal fin (a)

(ii) Dorsal fin originating above a point only slightly in advance of the pelvic fins; less than 75 rays in the dorsal fin *M. kannume* (p. 25)

(a) (i) Snout inclined downwards *M. caschive* (p. 27)

(ii) Snout straight *M. niloticus* (p. 27)

Mormyrus macrocephalus Worthington 1929. (Fig. 5)

Native names: Ngolobo (Lunyoro and Luruli); Kimenge (Lunyoro); Nsulusu (Lukenyi); Kiswala (Ludope); Menya (Lango).

Description: Depth of body contained 4-5 times in standard length, length of head 3½-4 times. Head with straight or slightly convex upper profile; snout about half as long as the post-ocular part of the head. Eye diameter ½-⅓ the interorbital width. Mouth terminal; teeth notched, 8-12 and 12-16 in the upper and lower jaws respectively. Dorsal fin with 62-71 branched rays, its origin in advance of the pelvic fins; 4-5 times longer than the anal fin which has from 17-20 branched rays. Lateral line with 85-98 scales; 30-34 scales round the caudal peduncle.[1]

This species is closely related to *Mormyrus hasselquisti* Val. from the Lower Nile (Worthington 1929b). When more material of the two species is available for comparison, it is possible that *M. macrocephalus* may have to be regarded as only sub-specifically distinct from *M. hasselquisti*.

[1] The caudal peduncle is that region of the body between the origin of the caudal fin (determined by bending this fin until it is at right angles to the fish's long axis) and the last dorsal or anal ray, whichever fin is situated more posteriorly.

Coloration: Dull bronze above, paler below.

Size: The largest recorded specimen was 42 cm. long.

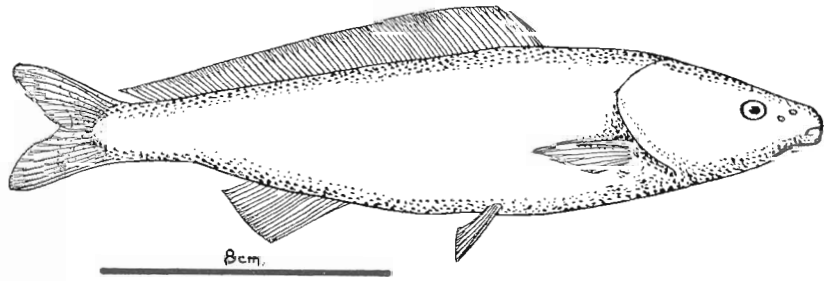

Fig. 5

Mormyrus macrocephalus. (Drawn by Barbara Williams.)

Habitat: Found in most areas of the lakes and rivers from which it has been collected (Worthington 1929a).

Food: Predominantly insect larvae, with prawns, oligochaet worms and fishes occurring less frequently (Worthington 1929a, Corbet, 1961).

Breeding: No data available.

Abundance: Rare.

Distribution: Known only from Uganda, occurring in Lakes Kyoga and Kwania, the Victoria Nile, Aswa river and dams in the Teso district (Worthington 1929a, and E.A.F.R.O. unpublished reports).

In 1957, shortly after the Ripon Falls were submerged, a number of *M. macrocephalus* were caught in nets set off a papyrus swamp near Jinja. However, the species does not seem to have become established in Lake Victoria because no further specimens have been obtained (personal communication from Mr. R. L. Welcomme).

Mormyrus kannume Forsk. 1775. (Fig. 6)

English: Elephant-snout fish. *Native names:* Kasulubana, Kasamene (Lunyoro); Kobia (Jonam); Ntanant (Lunyankole); Kasulubana (Uganda waters of Lake Victoria).

Description: Depth of body contained 3½-5 times in standard length, length of head 4-5 times. Dorsal head profile straight or somewhat curved, sloping steeply. Snout produced into a stout trunk whose thickness and angle to the face are variable; its length equal to, or slightly shorter than, the post-ocular part of the head. Eye small, its diameter contained 1½-2½ times in the interorbital width. Mouth small and terminal, lips thick. Teeth notched, 4-7 in the upper, and 8-10 in the lower jaw. Dorsal fin with 55-75 rays, originating above or in front of the pelvic fins. Anal fin short, with 17-22 rays. Caudal fin almost entirely covered with small scales. Lateral line with 80-116 scales; 26-32 scales round the caudal peduncle, which is from 1½ to twice as long as deep.

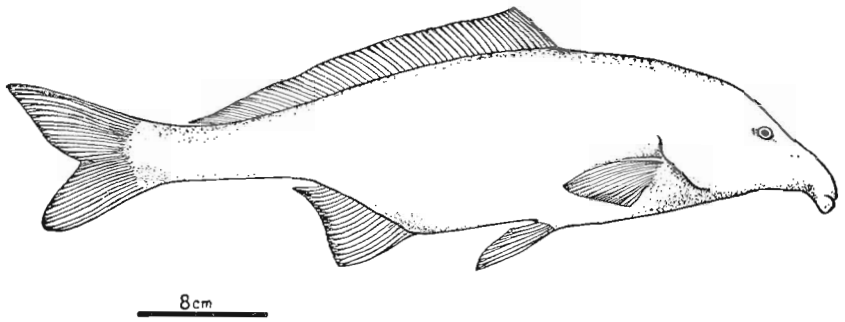

FIG. 6

Mormyrus kannume. (Drawn by Barbara Williams.)

Coloration: Dull bronze above, lighter below.

Size: Largest specimen recorded was 80 cm. long (E.A.F.R.O.); the size range of adult fishes caught by fishermen in Lake Victoria is usually between 40-60 cm.

Habitat: Lake Victoria: Widespread in both coastal and off-shore waters at depths down to 120 feet; since little exploratory work has been carried out in deeper water this figure should not at present be considered as indicative of a depth limit for the species. (Graham 1929 and E.A.F.R.O., unpublished investigations.)

Lake Kyoga: Open off-shore waters, and less frequently in areas of dense plant growth (Worthington 1929a).

Lake Albert: Very little information is available from this lake, as previous surveys have not distinguished between the three *Mormyrus* species occurring there. I am told by Mr. A. Anderson, Fisheries Officer, Uganda Game Department, that *Mormyrus* are relatively common in the delta areas of Lake Albert.

Lakes Edward and George: Mormyrus kannume is apparently restricted to the Kazinga Channel and to the northern, papyrus-fringed shores of Lake George (Worthington 1932b; Poll and Damas 1939). It is interesting to note that these authors have found that a slight difference exists between scale counts of *M. kannume* occurring in Lake Edward and those from other localities. There are 32 instead of 26-30 scales round the caudal peduncle of fishes from this region.

Food: Predominantly insect larvae, particularly larval lake-flies (Chironomidae). (Worthington 1929a and 1932b; Graham 1929; E.A.F.R.O. 1954/55 and Corbet, 1961).

Breeding: Neither the spawning sites nor larvae of *M. kannume* have been found. In Lake Victoria it seems probable that any one population of the species may have an annual reproductive cycle, but that spawning times vary in different geographical areas of the lake (E.A.F.R.O. records). Corbet (1960) suggests that the species may spawn on wave-washed rocky shores.

Abundance: In Lakes Victoria and Kyoga, the species may be considered common; it contributes substantially to commercial fisheries. On the other hand, the rather confused records indicate its rarity in Lakes Albert, Edward and George.

Distribution: Uganda: Lakes Victoria, Kyoga, Albert, Edward and George; the Victoria and Murchison Niles. *Elsewhere:* The whole Nile system as far as the delta. Probably also in the Athi River system, Kenya (Boulenger 1909).

Mormyrus caschive Linn. 1757.

Native names: Apparently no distinction is made between this species and *M. kannume;* the same dialect names are therefore used.

Description: Similar to *M. kannume* except that the dorsal fin has more rays (75-90) and that its origin is above a point midway between the pectoral and pelvic fins. Also, the scales are smaller and more numerous in *M. caschive,* there being 100-130 in the lateral line series. In many individuals, the snout gives the appearance of being more slender than in *M. kannume.*

Coloration: Dark bronze above, lighter below.

Size: Largest individual recorded from Uganda was 100 cm. long.

Habitat: Lakes Edward and George: Similar to *M. kannume. Lake Albert:* Probably like that of *M. kannume.* Worthington (1929a) is of the opinion that, to a large extent, *M. caschive* replaces *M. kannume* in this lake.

Food: Insects, particularly chironomid larvae (Worthington, op. cit.) .

Breeding: No satisfactory data available.

Abundance: Not common in any Uganda lakes.

Distribution: Uganda: Lakes Edward, George and Albert, Aswa river, Albert and Murchison Niles near the delta. *Elsewhere:* Lower Nile and Bahr-el-Jebel.

Mormyrus niloticus (Bloch-Schneid). 1801. (Fig. 7)

Native name: Unknown.

Description: Similar to *M. caschive,* except that the snout is straighter and prolonged in the axis of the body, not curved ventrally.

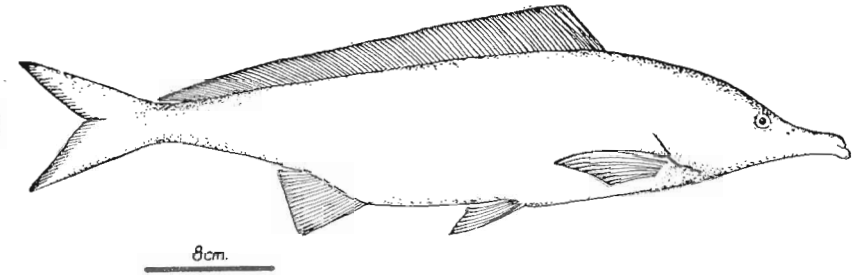

FIG. 7

Mormyrus niloticus. (Drawn by Barbara Williams after Boulenger.)

Coloration: Probably similar to *M. caschive.*

There is little ecological information for this inadequately studied species.

Distribution: Uganda: Lake Albert basin. *Elsewhere:* Lower Nile and Bahr-el-Jebel.

Mormyrops Müller 1843

Body elongate (5-6½ times longer than deep), not strongly compressed Dorsal fin much shorter than the anal; pelvic fins equidistant from the pectoral and anal fins, or slightly nearer the former. Nostrils distant from one another; situated nearer the eye than the snout. Mouth terminal. Teeth conical or slender and notched; 10-36, implanted in a single series along the entire edge of both jaws; teeth on the tongue and roof of the mouth minute and conical.

A single species occurs in Uganda.

Mormyrops anguilloides (Linn.) 1764. (Fig. 8)

Native names: None known.

Depth of body contained 5-6½ times in the standard length, length of head 4 times. Upper head profile slightly concave; snout rounded, its length ⅕-¼ that of the head, projecting somewhat beyond the mouth. Teeth notched or slender and conical, 20-24 in each jaw. Eye small, its diameter 2½-3 times length of the snout. Dorsal fin with 25-28 rays; its origin twice as far from the snout as from the caudal fin origin. Anal fin with 39-42 rays, its origin considerably in advance of the dorsal. Caudal fin small, the lobes rounded and almost completely covered with small scales. Lateral line with 87-96 scales; 20 round the caudal peduncle which is nearly twice as long as deep.

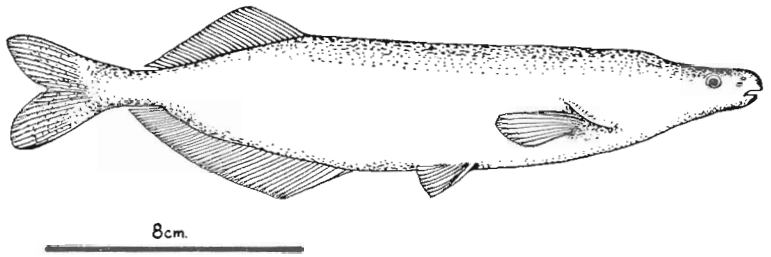

FIG. 8

Mormyrops anguilloides. (Drawn by Barbara Williams after Boulenger.)

Coloration: Unknown in life; preserved specimens are olive or greyish-brown above, whitish below.

Size: The maximum length attained is about 60 cm. although one authority mentions 100 cm. as the maximum (*vide* Sandon, 1950).

Little has been learned of the ecology of this species and nothing is known regarding it in Uganda.

Distribution: Uganda: Lake Albert basin (a single specimen from Panyamur (Worthington 1929a) and one other from Pakwach, (collected by Miss R. Osborn, 1956). *Elsewhere:* Lower and Upper White Nile.

Petrocephalus Marcusen 1854

Body short and laterally compressed. Dorsal and anal fins almost equal in length, or the latter somewhat longer. Nostrils very close to one another and

situated near the orbit. Mouth inferior, lying almost vertically below the eye. Teeth bicuspid; 6-26 in the upper, and 13-36 in the lower jaw. Teeth on the tongue and roof of the mouth minute and conical.

One species occurs in Uganda.

Petrocephalus catostoma (Günther) 1866. (Fig. 9)

Native name: Unknown.

The Lake Victoria populations of this species were thought to represent a distinct species, *Petrocephalus degeni* Blgr., 1906. A recent study (Whitehead and Greenwood, 1959) showed, however, that *P. degeni* was indistinguishable from *P. catostoma* (Gnthr.), a species with a scattered but wide distribution in east, central and south Africa.

Description: Depth of body contained 3-3½ times in the standard length, length of head 3½-4 times. Snout very short, ¼-⅙ length of head, rounded and projecting beyond the mouth which lies immediately below the eye. Eye small, its diameter ¼-⅕ head length. Teeth notched, 10-14 and 17-22 in the upper and lower jaws respectively. Dorsal fin with 19-24 rays, its origin above the first anal fin ray. Anal fin with 25-30 rays, equally distant from the origins of the pelvic and caudal fins. Caudal fin with pointed lobes, scaled on the basal part only. Lateral line with 34-39 scales; 12 scales around the caudal peduncle which is 2-3½ times longer than deep, and about as long as the head.

Coloration: Dusky silver above, whitish below.

Size: Maximum recorded length 90 mm.

Ecology: The habitat of *P. catostoma* in Lakes Victoria and Nabugabo has not been determined; in the Victoria Nile it is found amongst rocks in areas where the current is fast.

Distribution: Uganda: Lakes Victoria and Nabugabo; the Victoria Nile. *Elsewhere:* Kenya (Tana river where it is represented by a distinct subspecies *P. catostoma tanensis*); Tanzania (Rovuma and Kingani rivers); Congo drainage basin (two subspecies, *P.c. congicus* and *P.c. haullevilli*); Lake Nyasa; Zambia and Rhodesia; South Africa.

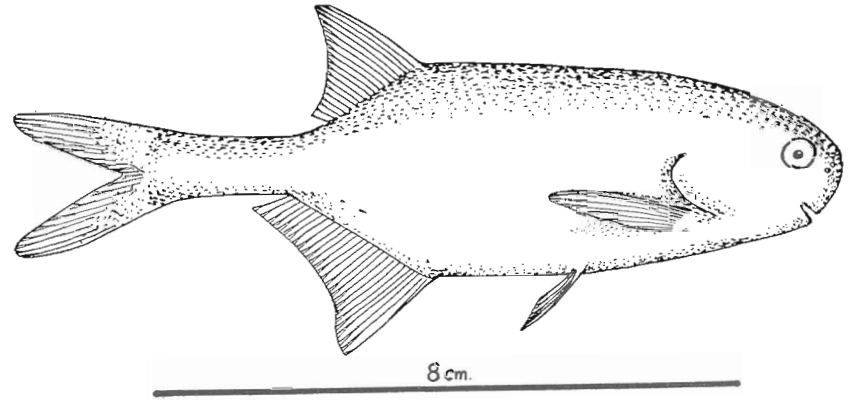

FIG. 9

Petrocephalus catostoma. (Drawn by Barbara Williams.)

Marcusenius Gill 1862

Body 3 to 4 times longer than deep, and laterally compressed. Anal fin length variable, from shorter, to longer than the dorsal fin. Nostrils distant from one another, their position on the snout variable. Mouth situated well below the horizontal level of the lower orbital margin, terminal or sub-terminal in position. Teeth in a single series and restricted to the middle of each jaw; conical, truncated or notched; 3-10 in both jaws.

Three species occur in Uganda.

KEY TO THE SPECIES

Dorsal fin originating well in advance of the first anal ray 1
Dorsal fin originating above or slightly behind the first anal ray *M. nigricans* (p. 30)

1 Dorsal fin with 33-36 rays, its basal length equal to or slightly shorter than its distance from the head *M. petherici* (p. 31)
Dorsal fin with 28-31 rays, its basal length less than its distance from the head *M. grahami* (p. 32)

Marcusenius nigricans Blgr. 1906. (Fig. 10)

Native name: Unknown.

Depth of body contained 3-3½ times in standard length, length of head 3½-4⅓ times. Snout ⅓-¼ head length, rounded and slightly projecting beyond the mouth, which is situated below the nostrils. Anterior nostril mid-way between the eye and the end of the snout. Teeth notched; implanted in a single series restricted to the middle of each jaw; 5-7 in the upper and 5-9 in the lower jaw. Dorsal fin with 15-18 rays; anal with 21-25 rays. Caudal fin with rounded lobes, the basal part covered with small scales. Lateral line with 46-53 scales; 16-20 round the caudal peduncle, which is 2 to 3 times longer than deep.

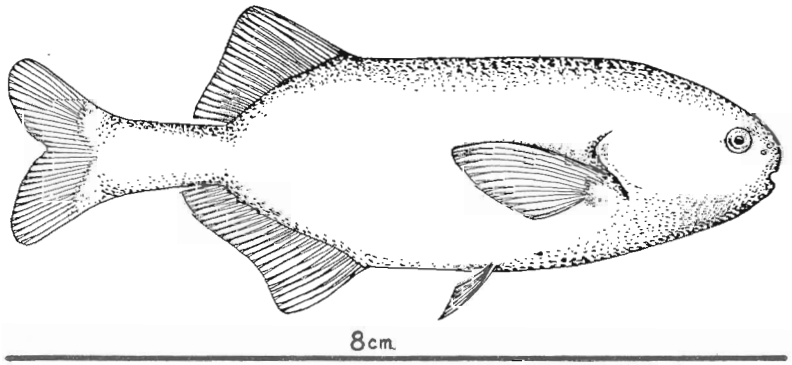

FIG. 10

Marcusenius nigricans. (Drawn by Barbara Williams.)

Coloration: Uniformly dark brown, or lighter ventrally.

Size: The largest known specimen was 93 mm. long; sexually mature individuals are usually between 80-90 mm. in length.

Habitat: Marginal vegetation and the fringes of papyrus swamps (Worthington 1929a and E.A.F.R.O. unpublished).

Food: Insects, particularly chironomid larvae (Corbet, 1961).

Breeding: Larval *M. nigricans* have been found in a temporary stream flowing into Lake Victoria, thus suggesting that the species spawns in such places during the rainy seasons.

Abundance: M. nigricans is rarely encountered. Its small size and restricted habitat tend to bias any estimate of abundance.

Distribution: Uganda: Lakes Victoria, Nabugabo and Kyoga; the Kiruni river (Semliki valley). (Worthington 1929a and E.A.F.R.O. collections.) Graham (1929) lists *M. nigricans* as also occurring in east Africa, but with the qualifying remark that there is some doubt about its supposed wider distribution. Subsequent collections indicate that it may occur in the Malagarasi river and even Lake Tanganyika. (Personal observations; Worthington and Ricardo 1936b.)

Marcusenius petherici Blgr. 1898. (Fig. 11)

Native name: Unknown.

Depth of body contained 2⅔-3¼ times in standard length, length of head 4⅔-5 times. Snout ⅓-¼ length of head, rounded and projecting beyond the mouth, which is situated below the nostrils. Teeth notched in young fishes but worn and truncated in adults; 5-6 in the middle of each jaw. Dorsal fin with 34-36 rays; anal fin with 24-36, its origin below the middle of the dorsal. Lateral line with 55-65 scales; 12 round the caudal peduncle, which is 2½-3 times longer than deep.

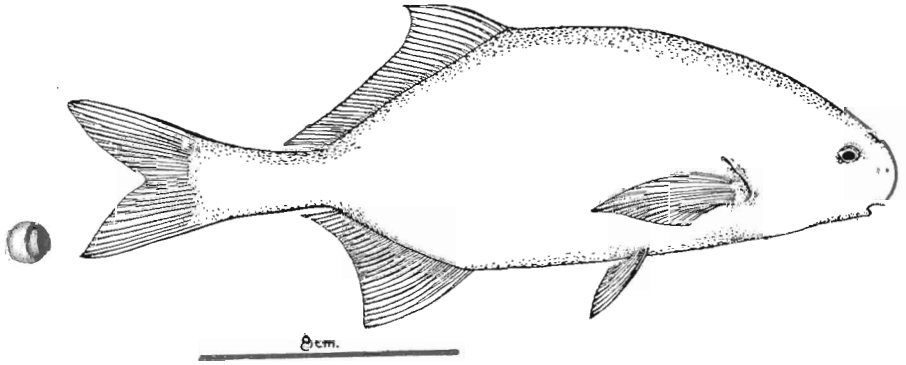

FIG. 11

Marcusenius petherici. (Drawn by Barbara Williams after Boulenger.)

Coloration: Dark brown above, silvery-white below.

Size: Largest recorded specimen was 22 cm. long.

No ecological data are available for this species.

Distribution: Uganda: The Murchison Nile. *Elsewhere;* Lower White Nile and the Blue Nile.

Marcusenius grahami Norman 1928. (Fig. 12)

Native names: Kamtontoru (Lunyoro); Ndonge (Lukenyi); Adol (Ludope); Dono (Lango); apparently none for this species in Uganda waters of Lake Victoria.

Similar to *M. petherici;* differing principally in having fewer dorsal fin rays (29-31). The basal length of the dorsal fin is clearly shorter than its distance from the head. Also, the scales are smaller and more numerous, with 60-69 in the lateral line series.

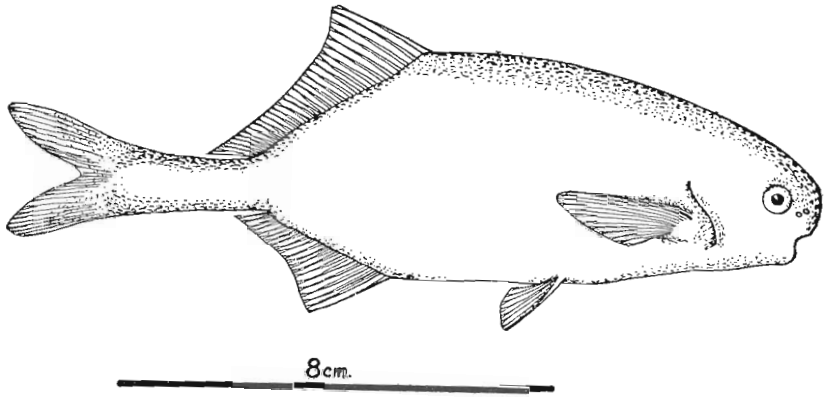

FIG. 12

Marcusenius grahami. (Drawn by Barbara Williams.)

Coloration: Golden brown above, lighter, almost yellow, below.

Size: Adult fishes are usually between 15 and 20 cm. long.

Habitat: Lake Victoria: Common in shallow coastal waters, particularly where the bottom is sandy (E.A.F.R.O., unpublished).

Lake Kyoga: Especially common in areas overgrown by water-lilies. (Worthington 1929a.)

Food: Insects, particularly chironomid larvae.

Breeding: Unknown.

Abundance: Fairly common.

Distribution: Known only from Lake Victoria, its affluent rivers and the Kyoga basin.

Gnathonemus Gill 1862

Body moderately elongate (3-4½ times longer than deep) and compressed. Dorsal and anal fins almost equal in length, or the anal fin noticeably longer. Nostrils distant from one another and from the eye. Mouth terminally situated slightly below the horizontal level of the lower orbital margin. Teeth restricted to the middle of each jaw; conical, truncated or notched; not more than ten teeth in either jaw. Teeth on the tongue and roof of the mouth minute and conical.

Three species occur in Uganda.

KEY TO THE SPECIES

Chin not produced into a long, tapering, fleshy appendage 1

Chin so produced *G. longibarbis* (p. 33)

1 Dorsal fin with 25-30 rays, anal with 30-37. Lateral line with 70-92 scales *G. cyprinoides* (p. 33)

Dorsal fin with 22-25 rays, anal with 27-31. Lateral line with 60-70 scales *G. victoriae* (p. 34)

Gnathonemus longibarbis Hilgend. 1888. (Fig. 13)

Native names: Nkoiro (Lunyoro, Lunyara, Ludope and Lango); Mpumbi (Lukenyi); Ekumbi (Bukakata area, Lake Victoria).

Depth of body contained 3⅔-5 times in standard length, length of head (excluding lower lip) 4-4½ times. Head with gently curved upper profile. Snout ½-¾ length of post-ocular part of the head. Chin produced into a long, cylindrical and fleshy appendage which is as long as, or longer than the snout. Mouth terminal. Teeth in a single series restricted to the middle of each jaw, small and notched; 3-5 and 4-6 in the upper and lower jaws respectively. Dorsal fin with 22-25 rays; anal with 28-31, its origin slightly in advance of the dorsal. Caudal fin almost entirely covered with small scales, the lobes pointed. Lateral line with 58-64 scales; 10-12 round the caudal peduncle, which is from 2-2½ times longer than deep.

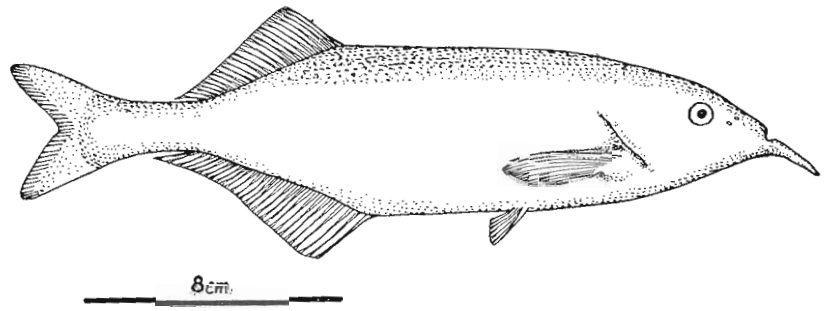

FIG. 13

Gnathonemus longibarbis. (Drawn by Barbara Williams.)

Coloration: Dark brown, lighter ventrally.

Size: Sexually mature fishes are between 23-36 cm. long.

Habitat: Lake Victoria: Shallow inshore waters over both sandy and rocky bottoms; the species is nowhere common (Graham 1929, and E.A.F.R.O. unpublished). *Lake Kyoga:* Abundant in or near water-lily swamps (Worthington 1929a).

Food: Insect larvae, especially Chironomidae, Polymitarcidae and Odonata (Worthington *op. cit.* and Corbet, 1961).

Breeding: Unknown.

Distribution: Uganda: Lakes Victoria, Kyoga and Nabugabo.

Gnathonemus cyprinoides (Linn.) 1764

Native name: Unknown.

Depth of body contained 3-4 times in standard length, length of head 4-5½

times. Upper head profile gently curved. Snout $\frac{1}{3}$-$\frac{1}{4}$ length of head. Eye $\frac{1}{2}$-$\frac{2}{3}$ length of snout. Mouth small; a globular, fleshy swelling on the chin. Teeth small and conical, arranged in a single series confined to the middle of each jaw; 5-6 in both jaws. Dorsal fin with 25-30 rays, its origin above the 6th-9th anal fin ray. Anal fin with 30-37 rays, caudal fin partly covered with small scales, its lobes pointed. Lateral line with 70-92 scales; 16-18 round the caudal peduncle, which is from 2-3 times longer than deep.

Coloration: Dark bluish-green dorsally, almost silver ventrally.

Size: Maximum length about 30 cm.

Scarcely any information has been published on the ecology of this species. In the Nile, Stubbs (quoted by Sandon 1950) observed that *G. cyprinoides* provides the main catches in fish traps set on the toiches, where spawning takes place during flood seasons.

Abundance: Apparently rare in Uganda.

Distribution: Uganda: A single specimen was collected by Worthington from the Albert Nile at Pakwach but many more were collected in the Aswa river (Greenwood, 1963). *Elsewhere:* Nile, from the delta to Bahr-el-Jebel; in west Africa from the Niger, Chad basin and upper Congo.

Gnathonemus victoriae Worthington 1929. (Fig. 14)

Native name: Unknown.

Similar in general appearance to *G. cyprinoides*, from which species it is distinguished by having fewer rays in the dorsal and anal fins (22-25 and 27-31 in the two fins respectively), and by its larger scales (60-70 in the lateral line series).

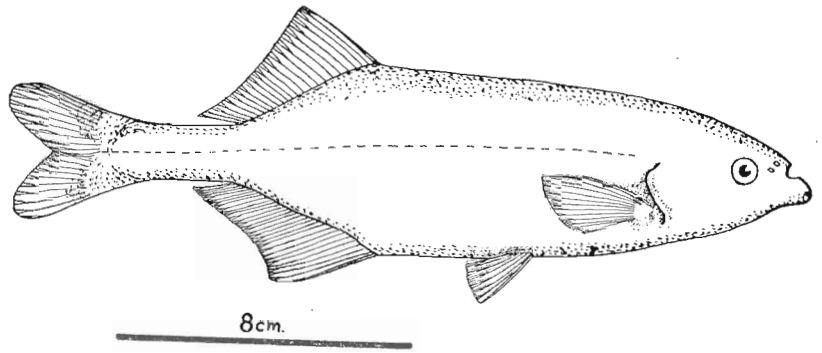

FIG. 14

Gnathonemus victoriae. (Drawn by Barbara Williams.)

Coloration: Golden-brown dorsally, yellow or golden ventrally.

Size: Adult fishes are between 13 and 16 cm. long.

Habitat: Lake Victoria: Similar to that of *G. longibarbis* with which species it usually occurs. *Lake Kyoga:* In or near water-lily swamps (Worthington 1929a).

Food: Insect larvae, chiefly Chironomidae (Corbet, 1961).

Distribution: Known only from Lakes Victoria and Kyoga, and from the Victoria Nile.

The taxonomic status of this species is under review. Worthington (1929b) mentions its close affinity with *G. macrolepidotus*, whose wide distribution includes the Zambesi, Kafue, Rovuma and Malagarasi rivers, as well as Lakes Bangweulu and Rukwa.

Fowler (*Acad. nat. Sci. Philadelphia*, **88**, 250, 1936) described a new species of *Gnathonemus*, *G. rehni*, from Lake Victoria. There is little doubt that the two specimens on which his description is based are slightly atypical *G. victoriae*.

Order: OSTARIOPHYSI

Family: Characidae

Body slender and fusiform, covered, except for the head, by cycloid scales. Cheek partly or completely covered by the sub-orbital bones. Lateral line running below the mid-line of the flank and caudal peduncle. Fins entirely composed of soft rays; an adipose dorsal fin is present. Mouth not protractile. Teeth always present and firmly fixed to the underlying bone.

The Characidae are restricted to fresh waters of Africa, Central and South America. In Uganda, where two genera are represented, absence of this widespread family from Lakes Edward and George is noteworthy and at present unexplained. One genus, *Hydrocynus*, was, however, present in the Lake Edward basin during the lower Pleistocene period.

KEY TO THE GENERA

(i) Teeth large and fang-like — *Hydrocynus* (p. 35)
(ii) Teeth stout, with three or more cusps — *Alestes* (p. 38)

Hydrocynus Cuvier 1817

Myers (1950, *Proc. Calif. Zool. Club*, **1**, No. 9, 45-47) has shown that the name *Hydrocyon* Cuvier, 1819, by which this genus is more widely known, is incorrect and that it must be replaced by *Hydrocynus* Cuvier, 1817.

Body elongate (4-5 times longer than deep). Scales cycloid. Mouth large, and laterally expansible. Teeth firmly fixed, large and fang-like, visible when the mouth is shut. A second series of teeth lies below the exposed and functional outer teeth; these may be considered as replacements and are sometimes visible in the course of eruption. Cheek covered by the thin sub-orbital bones. Nostrils close together, separated by a flap of skin. Dorsal fin placed above the pelvic fins; adipose dorsal fin small.

An African genus, with two species occurring in Uganda.

KEY TO THE SPECIES (See Fig. 15)

(i) Distance between the origin of the adipose fin and the base of the last dorsal fin ray contained $1\frac{1}{2}$-$1\frac{3}{4}$ times in the distance between the snout tip and the first dorsal ray. Adipose fin grey. Lateral line with 48-53 scales — *H. forskahlii* (p. 36)
(ii) Distance between adipose and dorsal fins contained 2-$2\frac{1}{2}$ times in the distance between snout tip and first dorsal ray. Adipose fin black. Lateral line with 45-48 scales — *H. vittatus* (p. 37)

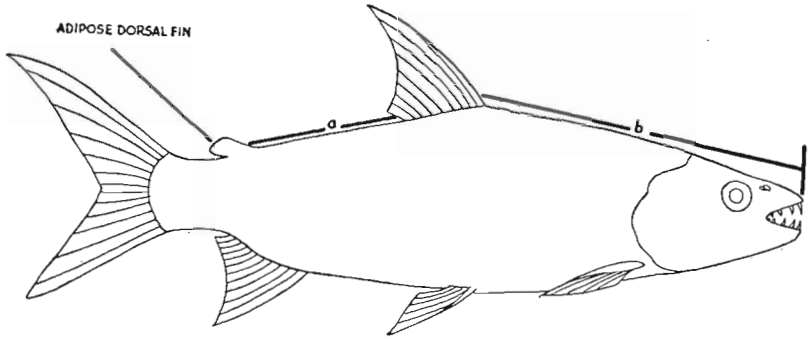

FIG. 15

Hydrocynus, showing the two measurements used in determining species: (a) is the distance between the adipose dorsal fin and the base of the last dorsal ray; (b) is the distance between the snout tip and the first dorsal ray.

Hydrocynus forskahlii Cuvier 1819

English: Tiger-fish. *Native names:* Ngassa (Lunyoro and Lugungu); Ngasia (Alur); Ngala (Jonam).

Depth of body contained 4-5½ times in standard length, length of head 4-5 times; the head 1⅘-2½ times as long as broad. Snout ⅓-¼ head length. Eye with vertical adipose lids, its diameter ⅓-⅙ of head. Mouth extending to below the nostrils or as far back as the anterior orbital margin, the maxilla to the centre or posterior border. Teeth large, 10-12 and 8-12 in the upper and lower jaws. Dorsal fin with 9-11 rays, the first two unbranched. Caudal fin deeply forked, the lobes long and pointed. Lateral line with 48-53 scales; 2 scales between the lateral line and a scale-like process at the base of the pelvic fin.

Coloration: Silver or silvery-yellow; a dark longitudinal line running through each scale row above (and including) the lateral line and often through the line immediately below. Dorsal and adipose fins grey; pectoral and pelvic fins flushed with orange-yellow, as are the inferior caudal lobe and the anterior part of the anal fin. Both caudal lobes are outlined in black along their posterior margins.

Size: Adults are between 26-59 cm. long. The average weight of individuals caught in Lake Albert during 1953 was 1·6 lb. (Uganda Government, 1953).

Habitat: In- and off-shore waters, including those of considerable depth (Worthington 1929a). Mr. Anderson tells me that he has often seen large shoals swimming at the surface some miles from shore.

Food: Chiefly small fishes (*Lates* fry, *Barilius niloticus* and *Haplochromis* spp.), but also insect larvae and Crustacea (Worthington, 1929a and Anderson, personal communication).

Breeding: Spawning sites in Lake Albert are still undiscovered. Worthington (*op. cit.*) records breeding *H. forskahlii* (i.e., fishes ready to spawn) in various in- and off-shore areas of this lake, but he failed to find any larval fishes.

Abundance: Fairly common.

Distribution: Uganda: Lake Albert, the Albert and Murchison Niles. *Elsewhere:* Nile, Volta, Niger, Senegal, Gambia, Lakes Rudolf and Chad.

Hydrocynus vittatus Castelnau 1861. (Fig. 16)

This species is widely known as *H. lineatus* Bleeker, 1862, but its correct name is *H. vittatus* as was shown by Barnard, 1948 (*Ann. S. Afr. Mus.*, 36, 407-458).

English: Tiger-fish. *Native name:* Wagassa (in general use). Similar in most respects to *H. forskahlii*, except that the body is somewhat deeper and stouter (3¼-4½ times longer than deep) and that the distance between dorsal and adipose fins is less (see key to species). The scales of *H. vittatus* are also slightly larger (45-48 in the lateral line).

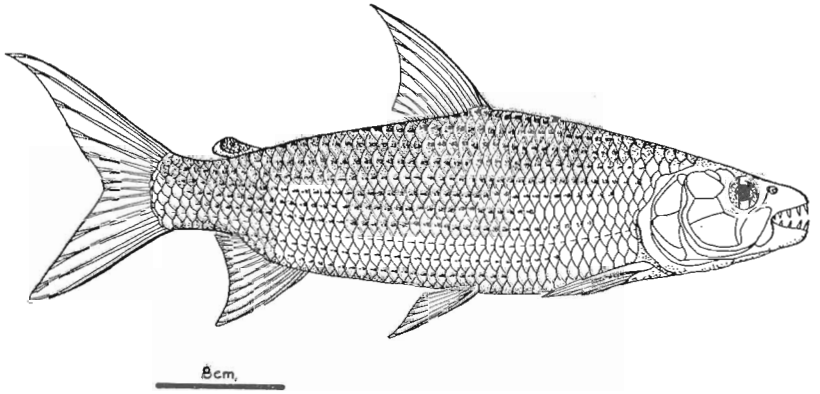

FIG. 16

Hydrocynus vittatus. (Drawn by Barbara Williams.)

Coloration: Like that of *H. forskahlii*, but with a tendency towards a less yellow and more silver ground colour. Also, the longitudinal stripes, especially those below the lateral line, are generally more intense in this species.

Size: Worthington (*op. cit.*) says that specimens up to 63 cm. and weighing 2 kg. were taken by his expedition. None of these was sexually mature. Although fish weighing 35 lb. (length unspecified) are recorded from net catches, the average weight of individuals caught in Lake Albert is approximately 3·5 lb. (Uganda Government, 1953).

Habitat: Shallow inshore waters of Lake Albert, and in the Murchison and Albert Niles. Although *H. vittatus* occurs in the same habitats as *H. forskahlii*, the numbers of either species at any one place tend to show an inverse relationship, so that in certain areas *H. vittatus* may appear relatively scarce (Anderson, personal communication).

Food: From published stomach analyses, it would seem that fishes are the principal food of *H. vittatus* (Worthington 1929a; Poll 1952a; Worthington and Ricardo 1936a, Ricardo 1939).

Breeding: No data from Uganda. Poll (1952a) is of the opinion that, in Lake Tanganyika, *H. vittatus* probably spawns in the delta areas of affluent rivers.

Distribution: Uganda: Lake Albert, the Albert and Murchison Niles. *Elsewhere:* Lakes Tanganyika and Rudolf; the Nile, Niger, Volta, Senegal, Katanga, the Congo basin, Zambesi and Limpopo systems.

Hydrocynus vittatus and *H. forskahlii*, together with other species of this

genus, are held in high regard by anglers for their sporting qualities. A devotee of *Hydrocynus,* Leander J. McCormick, expressed the opinion of many fishermen when he wrote "I have stated heretofore in print, and am still ready to maintain my pronouncement, that the tiger-fish of Africa is the fiercest fish that swims. Let others hold forth as advocates for the mako shark, the barracuda, the piranha of the Amazon, or the blue fish of the Atlantic. To them I say, 'Pish and tush!' " (in *Game Fish of the World*).

Indeed, there are few accounts of African sporting fishes which have not their purplest patches almost breathlessly eulogizing the tiger-fish.

Nevertheless, divergent opinions exist on the palatability of these fishes. The view most commonly expressed is that the flesh "tastes like cotton wool filled with needles". On the other hand, I have been told by Europeans and Africans alike, that tiger-fishes make very good eating, provided that some care is taken with their preparation.

Accounts of a giant *Hydrocynus*-like fish from Lake Albert are not infrequent, although only one such specimen has been seen by a European. Worthington (1929a) discusses the available evidence for the identity of these fishes and fairly conclusively overrules the possibility of their being *Lates* (Nile perch), the only fishes known to reach a considerable size in Lake Albert.

In fact, one is forced to conclude that a very large tiger-fish does occur in these waters. Three guesses may be made as to its identity: that it is an undescribed species of *Hydrocynus,* that it is a large deep-water form of *H. vittatus,* or finally, that *H. goliath* Blgr., a giant species at present known only from Lake Tanganyika and the Congo basin, may also occur in Lake Albert.

Alestes Müller and Troschel 1846

Body slender (3-5 times longer than deep), scales cycloid. Snout short. Mouth small, non-protractile. Teeth firmly fixed, those of the outer series stout and not compressed basally. Two series of functional, multi-cuspidate teeth in the upper jaw, the outer series usually tri-cuspid and less massive than the stout, many-cusped teeth in the inner series (see Fig. 17). The lower jaw has an outer series of tricuspid teeth and an inner row of two small, unicuspid and recurved teeth. Nostrils close to the eye, separated by a flap of skin. Cheek covered by sub-

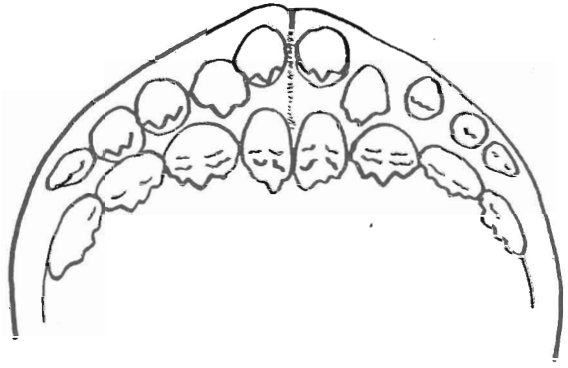

FIG. 17

Upper jaw of *Alestes macrolepidotus,* showing the tricuspid outer teeth and the multi-cuspid inner teeth.

orbital bones. Dorsal fin situated above or behind the pelvic fins.

The genus is restricted to Africa; six species occur in Uganda.

KEY TO THE SPECIES

Lateral line with 40-50 scales 1
Lateral line with 22-34 scales 2

1 20-26 gill rakers on the lower part of the first gill arch *A. dentex* (p. 39)
30-38 gill rakers on the lower part of the first gill arch *A. baremose* (p. 39)

2 Origin of the dorsal fin almost equidistant from the snout and the origin of the caudal fin; jaws equal anteriorly (a)
Origin of dorsal fin nearer the caudal fin than the snout; upper jaw projecting beyond the lower *A. macrolepidotus* (p. 40)

(a) 27-32 scales in the lateral line series; $4\frac{1}{2}$-$5\frac{1}{2}$ scales between the lateral line and the first dorsal fin ray. No bright silver longitudinal stripe. Dorsal, caudal and anal fins yellow, orange or red. (i)

31-34 scales in the lateral line series; $6\frac{1}{2}$ or 7 scales between the lateral line and the first dorsal fin ray. A bright silver longitudinal stripe. All fins colourless *A. sadleri* (p. 43)

(i) Anal fin with 11-14 rays *A. nurse* (p. 41)
Anal fin with 18 or 19 rays *A. jacksonii* (p. 42)

Alestes dentex (Linn.) 1757

Native name: Unknown.

Depth of body contained $3\frac{1}{2}$-$4\frac{3}{4}$ times in standard length, length of head $4\frac{1}{2}$ (in young) to 6 times. Head $1\frac{1}{2}$ to twice as long as broad; a well-defined fronto-parietal fontanelle is present. Eye diameter contained $3\frac{1}{4}$ (in young) to 4 times in head length; well-developed adipose lids. Snout as long as the eye, not projecting beyond the lower lip. Maxilla not reaching the anterior orbital margin. 6 and 8 teeth in the outer and inner series of the upper jaw, 8 and 2 in these series in the lower jaw. Gill rakers long and slender, 20-26 on the lower limb of the first gill arch. Dorsal fin with 10-11 rays, the first two unbranched; its origin above the pelvic fin insertions. Anal fin with 22-26 rays, the first three unbranched. Lateral line with 44-50 scales.

On the basis of slight differences in body proportions, and in its lower modal fin-ray and scale counts, Daget (1954) distinguishes a west African sub-species *Alestes d. sethente* (Val.). Uganda fishes should be referred to the sub-species *Alestes d. dentex* (Linn.).

Coloration: Silver, bluish-grey above. Dorsal fin grey, lower caudal lobe red, the posterior margin of both lobes outlined in black. In adult fishes, the pelvic and anal fins have an orange-red flush.

Size: Adult fishes are from 30-55 cm. long, and weigh about one pound.

No ecological data are available for this species in Uganda, where it is apparently rare. Daget (*op. cit.*) discusses the biology of *Alestes d. sethente* at some length.

Distribution: Uganda: Lake Albert and the Murchison Nile. *Elsewhere:* Lower Nile, White Nile, Chad basin, Senegal, Gambia, Niger, and probably Lake Rudolf.

Alestes baremose (Joannis) 1835. (Fig. 18)

Native name: Ngara (in general use; probably also covers *A. dentex*).

Very similar to *A. dentex*. The principal difference lies in the gill rakers, which are both more numerous (27-38) and more slender in this species.

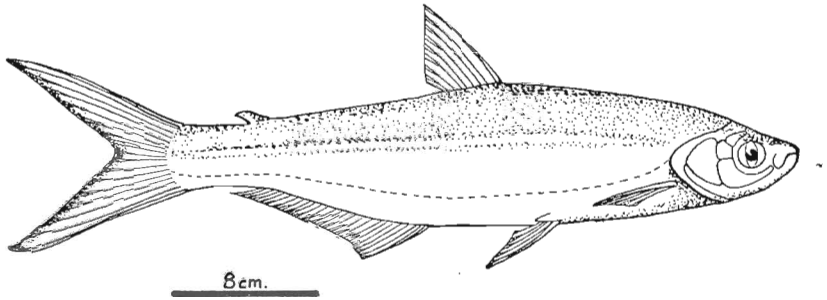

FIG. 18

Alestes baremose. (Drawn by Barbara Williams.)

Coloration: As for *A. dentex*.

Size: Adult fishes are between 30-55 cm. long, with an average weight of about one pound (Worthington 1929a and Uganda Government 1953).

Habitat: Probably limited to the inshore regions of Lake Albert. In any one locality, their numbers are inversely related to those of *Hydrocynus* spp. occurring in that area (Uganda Government, 1953). *A. baremose* forms an important element in the seine net catches of African fishermen.

Food: Apparently omnivorous, with small Crustacea, insects and, less frequently, fishes predominating (Worthington 1929a; Worthington and Ricardo 1936a).

Breeding: Spawning sites and seasons are unknown. Worthington (*op. cit.*) states that breeding fishes of both sexes were found in sheltered bays around the lakeshore, as well as below the Murchison Falls and in the Albert Nile at Pakwach.

Abundance: Common.

Distribution: Uganda: Lake Albert, the Albert and Murchison Niles. *Elsewhere:* Lower Nile, Blue and White Niles, Lake Rudolf, the Chad basin, Senegal, Gambia and Niger.

Alestes macrolepidotus (Valenciennes) 1849. (Fig. 19)

Native names: Waraga (Lunyoro and Lugungu); Gowa (Alur); Owaro (Jonam).

Depth of body contained 3½-4½ times in standard length. Length of head 3½-4¾. Head much flattened dorsally, 1¾ to twice as long as broad; frontoparietal fontanelle absent. Snout pointed, clearly projecting beyond the lower jaw; as long as (in young fishes) to twice the diameter of the eye (in adults). Eye contained 3¼ (in young) to 5 times in head length (in adults), the adipose lids very feebly developed. Maxilla not reaching the anterior orbital margin. 8-10 teeth in each of the upper jaw series, 6-8 and 2 in the outer and inner lower jaw series. Gill rakers long and slender, 15-22 on the lower limb of the first gill arch. Dorsal fin with 9 or 10 rays, the first two unbranched; its origin considerably

nearer the caudal fin than the snout. Anal with 15-17 rays, the first three unbranched. Lateral line with 22-26 scales; 4½ scales between the lateral line and the origin of the dorsal fin.

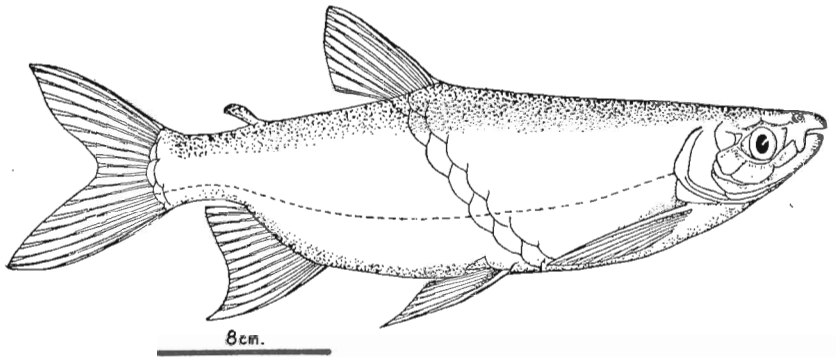

FIG. 19

Alestes macrolepidotus. (Drawn by Barbara Williams.)

Coloration: Silver, bluish-grey dorsally; a dark blotch above the pectoral fin in young fishes, as well as a dark, narrow longitudinal band on the flank. Both these markings are intensified after death, but are faint in life. Dorsal, caudal and adipose fins orange-red or pinkish. In adults, the pectoral and pelvic fins, together with the operculum, are suffused with a pinkish flush.

Size: Adult fishes are from 40-55 cm. long.

Habitat: Inshore regions of Lake Albert; also in rivers.

Food: Insects, bottom debris and small fishes (Worthington 1929a, and Anderson, personal communication).

Breeding: Spawning sites and seasons unknown. Worthington (*op. cit.*) records breeding individuals (i.e. fishes ready to breed) from below the Murchison Falls and at Pakwach, but not in the lake itself.

Abundance: Common.

Distribution: Uganda: Lake Albert, the Albert and Murchison Niles, Aswa river. *Elsewhere:* The Nile, Omo River, Senegal, Niger, Volta, Chad basin, Congo.

Alestes nurse (Rüppell) 1832

Description: In general appearance *A. nurse* closely resembles *A. jacksonii*. It differs from the latter species principally in having fewer anal fin rays (11-14 compared with 18 or 19 in *A. jacksonii*), and in the coloration of the fins. The dorsal, pelvic and anal fins are tinged with vermilion, and the caudal lobes are a vivid red. There is also a difference in the size of the body scales; although the number of lateral line scales in the two species overlap, the usual number in *A. nurse* is higher (30) than in *A. jacksonii* (27).

Ecology: Nothing is known about this species in Uganda.

Distribution: Uganda: Lake Albert; the Aswa river. *Elsewhere:* Lakes Rudolf and Chad, the Nile, Niger, Volta, Gambia, Senegal; also in Liberia and the Cameroons.

Alestes jacksonii Blgr. 1912. (Fig. 20)
Native name: Nsoga (in general use).

For many years this species was confused with the more widely distributed *A. nurse*. However, the two species are distinct (see Greenwood, 1959, and below).

Depth of body contained 3-4 times in standard length, length of head 3½ (in young) to 4 times. Head 1½ to twice as long as broad; fronto-parietal fontanelle absent. Snout rounded, equal to or slightly longer than the eye, whose diameter is contained 2½ (in young fishes) to 4 times (in adults) in the head length; adipose lids barely visible. Maxilla not reaching the anterior orbital margin. 8 teeth in each series of the upper jaw, 8 and 2 in the outer and inner lower jaw series. Gill rakers moderately long, 16-18 on the lower limb of the first gill arch. Dorsal fin with 10 rays, the first two unbranched; its origin above the pelvic fin insertion. Anal fin with 18-19 rays, the first three unbranched. Lateral line with 25-29 scales; 4½-5½ between the lateral line and the origin of the dorsal fin.

An interesting example of sexual dimorphism is seen in the anal fin of this species. The fin-margin is straight or very slightly concave in females, whereas it is markedly convex in males; in consequence the fin is much larger in this sex. Further, in males, the individual rays are stouter and coarser than those in the anal fin of females.

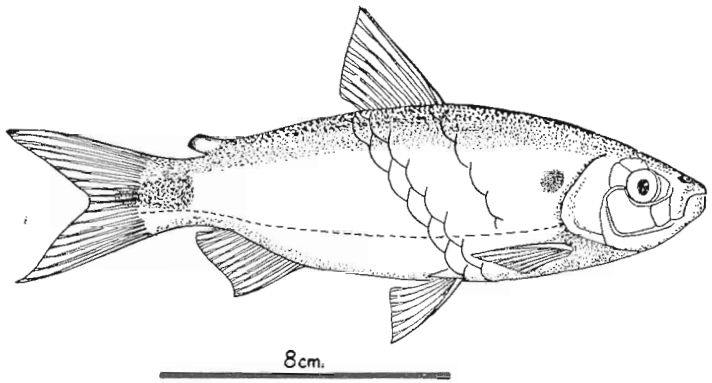

FIG. 20

Alestes jacksonii. (Drawn by Barbara Williams.)

Coloration: Silver, bluish-grey to blue-black dorsally. A large black blotch on the caudal peduncle, with a narrow extension onto the caudal fin; a round black spot behind the head, often faint or invisible in life but intensified after death. Dorsal fin grey, anal and pelvic fins with a faint orange or yellow tinge; adipose fin orange; caudal yellow or orange.

Size: Adults between 15-23 cm. long, occasionally as large as 27 cm.

Habitat: The shallow coastal areas of Lake Victoria, in water less than sixty feet deep (Graham 1929, and E.A.F.R.O. investigations). No data are available from the Victoria Nile.

Food: Varied, with insects, especially chironomid pupae, predominating; small fishes (chiefly *Haplochromis* spp. and *Engraulicypris argenteus*) occur less frequently. Fragments of plants found in the stomachs of many individuals suggest that plants may contribute to the diet of *A. jacksonii*. (Corbet, 1961, and Graham 1929.) Occasionally specimens are found which have fed almost exclusively on snails. (Graham *op. cit.* and Corbet, 1961.)

Breeding: The precise spawning seasons and habitats of *A. jacksonii* have not been determined although in Lake Victoria, the species is known to run up rivers and streams during the rainy seasons (E.A.F.R.O. unpublished).

Abundance: Common; often in large shoals.

Distribution: Uganda: Lakes Victoria and Nabugabo, the Victoria Nile (but apparently absent from Lake Kyoga), Malawa river.

Alestes sadleri Blgr. 1906
Native name: Confused with *A. jacksonii*, hence Nsoga.

In general appearance very similar to *A. jacksonii*, with which species it is generally confused. *Alestes sadleri* differs in the following characters: smaller scales (31-34 in the lateral line series and 6½ or 7—usually 7—between the lateral line and the origin of the dorsal fin) and the greater number of rays in the anal fin (20-21).

It should be noted however, that in a small sample of nine fishes from Lake Nabugabo only three had 6 or 6½ scales between the lateral line and dorsal fin; the remainder had 5½ scales along this line. In all other respects these fishes agreed closely with the description of *A. sadleri*.

Sexual dimorphism in the anal fin is as described for *A. jacksonii*.

In life, the presence in *A. sadleri* of a narrow, intensely silver longitudinal band running the whole length of the body serves immediately to distinguish the two species. After death this band rapidly darkens; in preserved specimens it is black. The post-mortem black blotch behind the head of *A. jacksonii* is absent in *A. sadleri*.

The adult size range of *A. sadleri* is less than that of *A. jacksonii;* sexually mature individuals measure between 8 and 10 cm. long.

Coloration: Silver, bluish to black dorsally; an intensely silver lateral streak runs from behind the operculum to the caudal peduncle, where it merges with an irregular black blotch which extends onto the caudal fin base. All fins grey.

Habitat: Shallow coastal waters of Lake Victoria; also amongst the marginal vegetation of Lakes Kyoga and Nabugabo. Because of their small size, *A. sadleri* are rarely caught by fishermen, except when large shoals are netted in seines.

Food: Insects, chiefly chironomid pupae (Corbet, 1961).

Breeding: Unknown, but probably similar to that supposed for *A. jacksonii* (see above).

Distribution: Known only from Uganda: in Lakes Victoria, Nabugabo and Kyoga; also from the Victoria Nile and the Aswa river. (Graham 1929, Worthington 1929a, E.A.F.R.O. collections and Greenwood, 1959).

Reference must also be made to another *Alestes* species which has been tentatively recorded from Lake Albert. Cunnington (1920) doubtfully lists *Alestes macrophthalmus* as occurring in Lake Albert. Its presence there has never been confirmed.

Family: Citharinidae

Body short, deep and laterally compressed ($1\frac{3}{4}$-$3\frac{1}{2}$ times longer than deep). Scales ctenoid or cycloid. Lateral line running along the middle of the flank and caudal peduncle. Mouth not protractile. Teeth slender and movably implanted. Cheek covered, or partly covered, by the sub-orbital bones. Fins with soft rays only; an adipose dorsal fin is present.

The Citharinidae are restricted to African fresh-waters; two genera occur in Uganda.

KEY TO THE GENERA

Scales ctenoid; teeth strong and bicuspid — *Distichodus* (p. 44)
Scales cycloid; teeth minute and conical — *Citharinus* (p. 46)

Distichodus Müller and Troschel 1854

Body short, deep (2-$3\frac{1}{2}$ times longer than deep), and compressed. Scales small and ctenoid. Teeth bicuspid, usually in 2 series. The two halves of the lower jaw are broadly united (see Fig. 21a). Dorsal fin situated above the pelvic fin insertion. Adipose dorsal and caudal fins covered with small scales.

Two species occur in Uganda.

(i) Lateral line with 90-112 scales; 18-21 scales between the lateral line and the origin of the dorsal fin — *D. niloticus*
(ii) Lateral line with 80-98 scales; 15-17 between the lateral line and the origin of the dorsal fin — *D. rostratus*

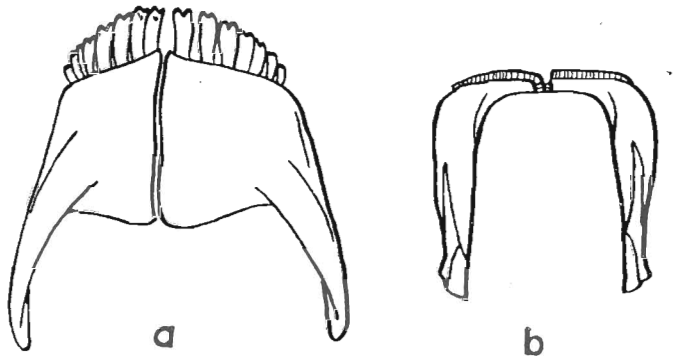

FIG. 21

(a) Lower jaw of *Distichodus niloticus*, ventral view.
(b) Lower jaw of *Citharinus latus*, ventral view.

Distichodus niloticus (Linn.) 1762. (Fig. 22)

Native name: Wachone (in general use).

Depth of body contained $2\frac{1}{2}$-$3\frac{1}{2}$ times in standard length, length of head 3 times (in young fishes) to 5 times in adults. Snout rounded, slightly projecting beyond the mouth. Maxilla extending to below the nostrils. Upper surface of the head, and the operculum ridged with low, radiating striations. Teeth in two series, outer with 24-36 teeth. Dorsal fin with 22-26 rays, the first 3-6 unbranched. Adipose dorsal covered with small scales. Anal fin with 13-15 rays, the first 3 or 4 of which are unbranched. Caudal fin forked, its rounded lobes almost entirely scaled. Lateral line with 90-110 scales; 18-20 between the lateral line and the origin of the dorsal fin; 15-18 between the insertion of the pelvic fin and the lateral line.

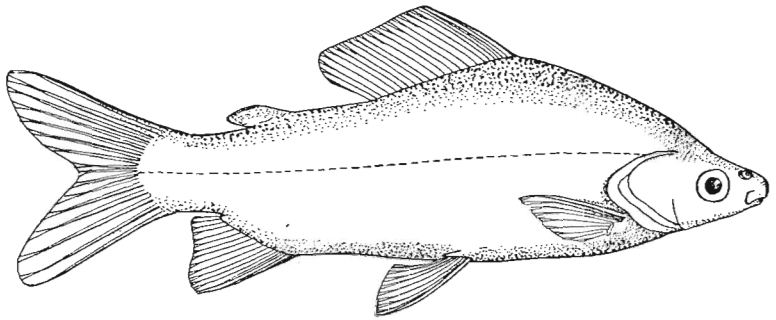

FIG. 22

Distichodus niloticus. (Drawn by Barbara Williams.)

Coloration: Purplish-silver above, silver below; young fishes with several vertical dark bars on the flank.

Size: The largest recorded individual was 83 cm. long (Worthington 1929a).

Habitat: Shallow inshore waters of Lake Albert, especially in the region of deltas; also in rivers.

Food: Submerged plants, molluscs and small Crustacea (Worthington 1929a).

Breeding: Unknown.

Abundance: Fairly common. The species forms an important element in the catches of 8″ mesh gill nets.

Distribution: Uganda: Lake Albert and Murchison Nile. *Elsewhere:* Nile, White Nile, Lakes Rudolf and No.

Distichodus rostratus Günther 1864

Native name: Unknown, but probably included in Wachone (=*D. niloticus*). Very similar to *D. niloticus*, differing mainly in having larger scales (80-98 in the lateral line and 15-17 between the lateral line and the dorsal fin), and an apparently coarser and deeper head.

Until recently, the inclusion of this species in the faunal list of Lake Albert depended solely on a head of an adult fish collected by J. S. Budget from the Murchison Nile in 1902. A second specimen was obtained in April 1956 by Miss R. Osborn while collecting for Yale University.

Reference should be made to Daget (1954) for ecological data on this species in the Upper Niger.

Distribution: Uganda: Murchison Nile. *Elsewhere:* Lower Nile, Bahr-el-Jebel, Lake Chad, Senegal, Niger and Gambia.

Citharinus Cuvier 1817

Body short, deep ($1\frac{3}{4}$-$2\frac{1}{3}$ times longer than deep) and strongly compressed. Scales cycloid and small. Mouth large; a single row of minute teeth. The two halves of the lower jaw are narrowly united (see Fig. 21b). Dorsal fin situated behind the insertion of the pelvic fins. Adipose dorsal large and scaled. Caudal fin scaled on its basal part only.

Two species occur in Uganda.

(i) Base of adipose dorsal fin shorter than its distance from the posterior margin of the dorsal fin; lateral line with 77-92 scales *C. citharus*

(ii) Base of adipose fin longer than its distance from the posterior margin of the dorsal fin; lateral line with 60-77 scales *C. latus* (p. 47)

Citharinus citharus (Geoffr.) 1809

Native names: Mpoi (Lunyoro, Lugungu and in general use); Aporo (Alur and Jonam).

Depth of body contained $1\frac{3}{4}$-$2\frac{1}{3}$ times in standard length, length of head 3-4 times. Upper head profile deeply concave and steeply sloping. Snout short, $1\frac{3}{4}$ to twice as long as broad, projecting slightly beyond the mouth. Eye with narrow, vertical adipose lids. Teeth minute and numerous, arranged in a single series. Gill rakers short, fine and closely set. Dorsal fin with 18-21 rays, the first 4-6 of which are unbranched; adipose dorsal large, its base $\frac{1}{2}$-$\frac{2}{3}$ its distance from the dorsal fin. Anal fin with 25-31 rays, the first 3 or 4 unbranched. Lateral line with 77-92 scales; 20-25 between the lateral line and the origin of the dorsal fin.

Coloration: Silver, base of adipose dorsal fin dark grey. Pelvic and anal fins orange-red except at the base. Inferior lobe of the caudal fin with a distinct orange flush; all other fins grey.

Size: Sexually mature fishes are between 50 and 78 cm. long. Worthington's records suggest that males reach maturity at a somewhat smaller size than do females.

Habitat: Shallow inshore waters of Lake Albert; absent or rare in deeper open water. Its off-shore range is probably somewhat greater than that of *Distichodus niloticus*.

Food: Macroplankton, particularly those elements such as Crustacea and diatoms which settle on the lake bottom. The species has often been seen swimming at the surface and apparently feeding on the scum collected there (Worthington 1929a).

Breeding: No information is available on the breeding habits of *C. citharus* in Lake Albert. In the rivers Niger and Gambia, spawning takes place in swampy areas during the season of heavy rainfall (Daget 1954; Svensson 1933). Young fishes less than 20 mm. long are quite unlike adults. The body is more slender (depth about $\frac{1}{4}$ standard length) and the characteristic, steep adult profile is wanting. Typical adult body-form is acquired when the young have reached

30 mm. standard length (*vide* Svensson, *op. cit.*). According to this author early growth is rapid, about 10-12 cm. in two months.

Abundance: Common. *C. citharus* is an important commercial fish in Lake Albert, although there has been a marked decline in the numbers caught since 1944. (Uganda Government, 1952.)

Distribution: Uganda: Lake Albert, the Albert and Murchison Niles. *Elsewhere:* Lower Nile, Blue and White Niles, Lake No, Chad basin, Senegal, Niger and Gambia.

Worthington (1932a) has described a sub-species, *Citharinus c. intermedius*, from Lake Rudolf, which, as its name implies, is intermediate in some characters between *C. c. citharus* (the sub-species in Uganda) and *C. latus* M. and T. (see below).

Citharinus latus Müller and Troschell 1845. (Fig. 23)

Native name: Unknown.

Similar to *C. citharus* except that the adipose dorsal fin is longer (its basal length greater than the distance separating it from the dorsal fin), and the scales somewhat larger (lateral line with 60-77 scales). Coloration of the two species is identical.

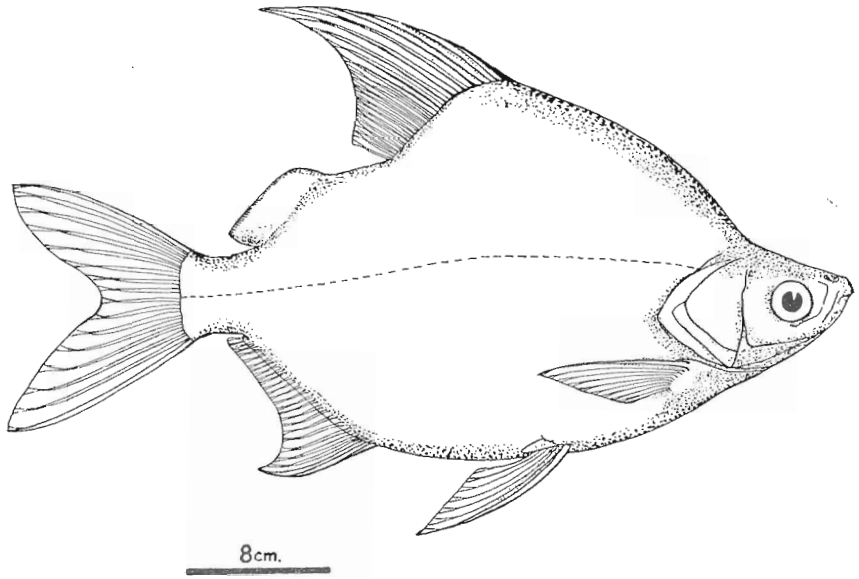

FIG. 23

Citharinus latus. (Drawn by Barbara Williams.)

In Lake Albert the ecological requirements of the two *Citharinus* species are probably similar. Certainly this is so in the Niger (Daget 1954). It will probably be found, however, that in Lake Albert, *C. latus* is less common than *C. citharus*.

Distribution: Uganda: Lake Albert. *Elsewhere:* Lower Nile to Bahr-el-Jebel,

Senegal, Niger and Old Calabar. Boulenger (1909) also lists the Kingani river (East Africa).

TABLE IV

Distribution in Uganda of fishes of the families Mormyridae, Characidae and Citharinidae. An interrogation mark indicates that the species probably occurs in that area also.

LAKES	Victoria	Kyoga	Nabugabo	Edward and George	Albert	Elsewhere
Mormyridae						
Hyperopisus bebe ..					P	Albert and Murchison Niles, Aswa river
Mormyrus macrocephalus	P	P				Lake Kwania; Victoria Nile, dams in Teso district, Aswa river
Mormyrus kannume ..	P	P		P	P	Victoria and Murchison Niles
Mormyrus caschive ..				P	P	Aswa river
Mormyrus niloticus ..					P	
Mormyrops anguiloides					P	Albert and Murchison Niles
Petrocephalus catostoma	P		P			Victoria Nile
Marcusenius nigricans ..	P	P	P			Kivuni river (Semliki valley)
Marcusenius petherici ..					?	Murchison Nile
Marcusenius grahami ..	P	P				Affluent rivers of Lake Victoria
Gnathonemus longibarbis	P	P	P		P	Albert Nile, Aswa river
Gnathonemus cyprinoides						
Gnathonemus victoriae	P	P				Victoria Nile
Characidae						
Hydrocynus forskahlii ..					P	Albert and Murchison Niles
Hydrocynus vittatus ..					P	Albert and Murchison Niles
Alestes dentex					P	Murchison Nile
Alestes baremose ..					P	Albert and Murchison Niles
Alestes macrolepidotus ..					P	Albert and Murchison Niles
Alestes jacksonii ..	P		P			Victoria Nile, Malawa River
Alestes nurse					P	Aswa River
Alestes sadleri	P	P	P			
Citharinidae						
Distichodus niloticus ..					P	Albert and Murchison Niles
Distichodus rostratus ..					P	Murchison Nile
Citharinus citharus ..					P	Murchison and Albert Niles
Citharinus latus					P	Murchison and Albert Niles

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CHAPTER III

Family Cyprinidae: the Genera *Labeo, Garra, Barilius* and *Engraulicypris**

Family: Cyprinidae

Body covered by cycloid scales, the head naked. Jaws completely devoid of teeth. One or two pairs of circum-oral barbels, which are, however, absent in some species. No adipose dorsal fin; the last unbranched dorsal ray sometimes enlarged and spine-like. Well-developed sickle-shaped paired pharyngeal bones each carrying 1-3 series of teeth. In many species, wart-like protuberances develop on the snout during the breeding season, or at sexual maturity.

This family, comprising numerous genera and species, is widespread in the fresh waters of Europe, Africa, Asia, Northern and Central America. Indigenous species are notably absent from South America, Australia and Madagascar.

Five genera are found in the lakes and rivers of Uganda.

Key to the Genera

Cheek below eye naked, not covered by the sub-orbital bones. Lateral line situated along the middle of the flank, or slightly nearer the ventral outline, always running along the middle of the caudal peduncle 1

Cheek below eye covered by the thin sub-orbital bones. Lateral line situated below the middle of the flank and caudal peduncle 2

1 Greater part of the dorsal fin in advance of the pelvic fin base (a)

Origin of the dorsal fin above the pelvic fin base, or very slightly in advance of, or behind this point *Barbus* (p. 58)

(a) (i) A flap of skin immediately in front of the upper lip; opening to the gill-chamber extending to below the pectoral fin base *Labeo* (p. 50)

(ii) No flap of skin in front of the upper lip; opening to the gill-chamber not extending below the pectoral fin base; a well developed, almost circular disc on the chin and confluent with the lower lip *Garra* (p. 53)

2 Greater part of the dorsal fin situated in advance of the anal fin *Barilius* (p. 54)

Almost the entire dorsal fin situated above the anal fin *Engraulicypris* (p. 56)

Labeo Cuvier 1817

Scales usually large. Lateral line running along the middle of the flank and caudal peduncle. Dorsal fin with three unbranched rays, none spinous, its origin well in advance of the pelvic fin insertions. Mouth large, inferior and protractile, the lips well developed; immediately in front of the upper lip there is a flap of skin dependent from the snout. Both jaws provided with horny cutting edges. Barbels hidden.

*See also Addendum, page 128.

The genus occurs in Africa and southern Asia; in Uganda it is represented by four species.

Key to the Species

Inner surface of the lips with numerous small transverse folds 1

Inner surface of lips smooth *Labeo horie* (p. 51)

1 Eyes equally visible from above and below (a)

Eyes easily visible from above but barely if at all visible from below *L. forskalii* (p. 51)

(a) (i) Snout swollen and fleshy; caudal peduncle as long as, or slightly longer than deep *L. coubie* (p. 52)

(ii) Snout not noticeably swollen or fleshy, caudal peduncle longer than deep *L. victorianus* (p. 52)

Labeo horie Heckel 1846

Native name: Karuka (Lunyoro); Posso (Lugungu and Alur); Nduka (Jonam).

Description: Depth of body contained 3-4 times in standard length, length of head 4-6 times (relatively longer in small fishes). Snout broadly rounded, about $\frac{1}{3}$ head length and shorter than the post-ocular part of the head. Eye visible from above and below, its diameter contained 3-6 times in head length (relatively larger in small fishes). Lips with numerous rows of papillae. A minute barbel is present but hidden in folds of skin at the angle of the mouth. Dorsal fin with III, 12-14 rays, its upper margin straight or slightly convex. Lateral line with 40-44 scales. Caudal peduncle as long as deep.

Coloration: Greenish-brown above, golden below; young fishes have a distinct but ill-defined dark spot on the lateral line scales above the pectoral fin.

Size: Worthington (1929a) gives 72 cm. as the length of the largest fish recorded from Lake Albert.

Habitat: Restricted to the inshore waters and sheltered bays of Lake Albert. (*id., ibid.*)

Food: Virtually unknown; a colourless slime, mud and sand have been recorded from the guts of this species (Worthington, *op. cit.*).

Distribution: Uganda: Lake Albert, Murchison Nile. *Elsewhere:* Nile.

Labeo forskalii Rüppell 1835. (Fig. 24)

Native name: Omoruma (Lunyankole).

Description: Depth of body contained 3-4$\frac{1}{2}$ times in standard length, length of head 4-5 times. Snout rounded, more or less fleshy and swollen, with a distinct curved transverse groove on the upper surface; snout length about half that of the head and somewhat longer than the post-ocular part. Eye not visible from below, its diameter $\frac{1}{4}$-$\frac{1}{8}$ head length (relatively larger in small fishes). Inner surface of the lips with numerous transverse folds. Barbels minute and hidden. Dorsal fin with III, 9-11 rays, its upper margin concave. Lateral line with 37-42 scales. Caudal peduncle 1$\frac{1}{2}$-1$\frac{1}{4}$ times longer than deep.

Coloration: Olive-green above, lighter, almost yellow below; scales of the flanks with pinkish centres.

Size: The largest specimen from Lake Edward was 48 cm. long (Worthington *op. cit.*).

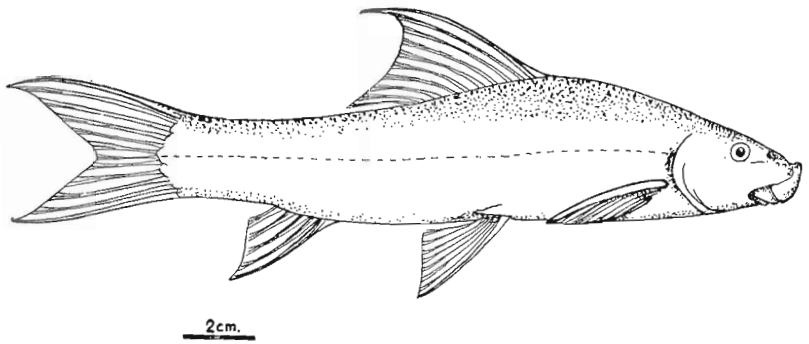

FIG. 24

Labeo forskalii. (Drawn by Barbara Williams.)

Habitat: In Lake Edward, the deep water close to rocky shores. (Worthington, *op. cit.*, Poll and Damas, 1939.)
Food: Plant debris and mud.
Distribution: Uganda: Lake Edward, Agoye river, West Nile (a tributary of the Ala river which flows into the Nile).

Labeo coubie Rüppell 1832
Native name: Kwangurameli (Lunyoro).
Description: Similar to *Labeo forskalii* except that the body is usually somewhat deeper, the eye is visible both from above and below, the caudal peduncle is as deep as or slightly longer than deep, and the dorsal fin has III, 12-14 rays.
Coloration: Grey-blue above, silvery-white below; scales on the flanks have deep mauve centres. Young fishes are greyish-silver, with numerous wavy black lines on the flanks, and a large black spot at the base of the caudal fin.
Size: The largest recorded specimen from Lake Albert was 74 cm. long and weighed 9 lb.
Habitat: The inshore waters of Lake Albert, particularly in sheltered bays (Worthington, 1929a).
Food: Plant debris and mud (*id., ibid.*).
Distribution: Uganda: Lake Albert, Murchison Nile. *Elsewhere:* Nile system, Niger, Volta and Lake Chad.

Labeo victorianus Boulenger 1901. (Fig. 25)
Native name: Ningu (Lake Victoria); Nsuku (Lunyoro and Lunyara); Okok (Ludope); Apok (Lango).
Description: Depth of body equal to or slightly greater than length of head, which is contained 4-5 times in the standard length. Snout rounded; as compared with *L. forskalii and L. coubie* it is neither fleshy nor swollen; snout length from $\frac{1}{3}$-$\frac{1}{2}$ of the head, and less than the post-ocular part. Eye equally visible from above and below, its diameter contained 5-7 times in the head length (relatively larger in small fishes). Lips with transverse folds on the inner surface. Barbels minute and hidden. Dorsal fin with III, 9-10 rays, its upper margin concave. Lateral line with 37-39 scales. Caudal peduncle $1\frac{1}{2}$ times longer than deep.

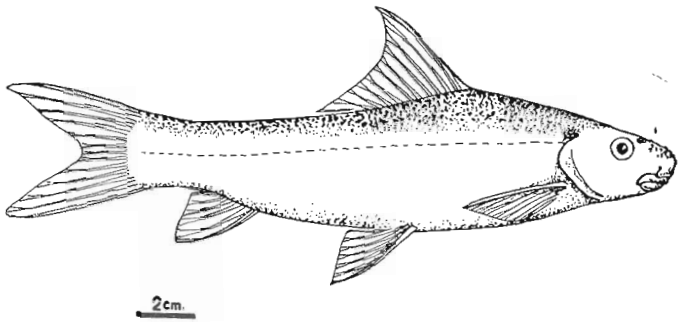

FIG. 25

Labeo victorianus. (Drawn by Barbara Williams.)

Coloration: Olivaceous above, lighter or creamy-white below. Dorsal, anal and pelvic fins often tipped with orange.
Size: The largest specimen, recorded by Graham (1929) was 41 cm. long, but the usual size for fishes caught by African fishermen is between 20 and 30 cm.
Breeding: At least in Lake Victoria, the species spawns in temporary streams and flood pools during the rainy seasons (see Fryer and Whitehead, 1959).
Habitat: Lake Victoria: shallow inshore waters. Lake Kyoga: open waters away from the water-lily zone. *L. victorianus* also occurs in the major affluent rivers of Lake Victoria and in the Victoria Nile.
Food: Mud, plant debris and unidentifiable slime. Specimens kept in aquaria have been seen to graze on epizootic rotifers and fungi growing on the scales and bodies of other fishes (Fryer, *et al.*, 1955). Mr. Copley, Fish Warden, Kenya, informs me (*in litt.*) that in a film taken underwater he has seen *Labeo cylindricus* Peters grazing on the backs of submerged Hippopotamus.
Economic Importance: Smoked *ningu* are relished by most Africans. In many parts of Lake Victoria the species forms the basis of a flourishing fishing industry carried out with small mesh nets.
Distribution: Lakes Victoria and Kyoga; the Victoria Nile, and major rivers flowing into Lake Victoria.

Garra Hamilton Buchanan 1822

Body feebly compressed, somewhat rounded; covered by moderately large scales. Lateral line running along the middle of the flank and caudal peduncle. Mouth inferior and protractile. Lips thickened; a large, nearly circular suctorial disc developed on the chin. One or two small barbels on each side. Gill opening not extending below the level of the pectoral fin base. Dorsal fin with 9-11 rays, 6-8 of which are branched.
The genus occurs in southern Asia and north-east Africa; a single species is recorded from Uganda.

Garra johnstonii (Boulenger) 1901. (Fig. 26)
Description: Depth of body equals length of head, which is contained $4\frac{1}{2}$-5 times in the standard length; head somewhat depressed and flattened above. Snout rounded and projecting above the mouth. Eye near the upper profile of

the head, its diameter contained $3\frac{1}{2}$-5 times in the head length (relatively larger in small fishes) and $1\frac{2}{3}$-$2\frac{3}{4}$ times in the inter-orbital width; the pupil situated in the second half of the head. Width of mouth contained $2\frac{1}{2}$-$2\frac{4}{5}$ times in head length. Lips moderately well-developed, the upper with a weak fringe of papillae, the lower in contact with the suctorial disc. Two minute barbels on each side. Dorsal fin with III, 6-7 rays, its position equally distant from the nostrils and the caudal fin origin. Pectoral fin from $\frac{4}{5}$, to as long as the head, widely separated from the pelvic fins which are situated below the posterior $\frac{1}{3}$ of the dorsal fin. Lateral line with 35-37 scales; 5-$5\frac{1}{2}$ scales between this line and the first dorsal ray $3\frac{1}{2}$-4 between the lateral line and the pelvic fin base. Caudal peduncle as long as, to $1\frac{1}{3}$ longer than, deep.

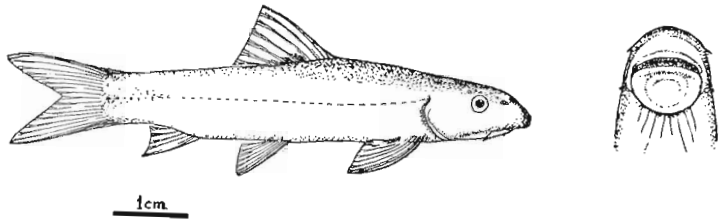

FIG. 26

Garra johnstonii. (The mouth, viewed ventrally, is inset.) (Drawn by Barbara Williams.)

Size: Rarely longer than 110 mm.

Coloration: Dark grey-brown to bronze above, creamy-white below. Fins greyish; 2-4 black spots at the base of the dorsal fin. In males, the dorsal, anal and caudal fins are tipped with orange.

Habitat: The species is abundant in the turbulent waters of the Victoria Nile near Jinja. Specimens have also been taken from wave-washed rocky shores near Entebbe (Corbet, 1960).

Food: Algae and insect larvae, probably scraped from the surface of rocks.

Distribution: The Victoria Nile and Lake Victoria. A single record from the Nairobi river, Mount Kilimanjaro (Boulenger 1909) requires confirmation.

Barilius Hamilton Buchanan 1822

Body fairly compressed, the ventral surface rounded; scales small. Lateral line low down, approximately following the ventral outline and running along the lower part of the caudal peduncle. Cheek almost covered by the sub-orbital bones. Mouth large, terminal and rather oblique. Lips undeveloped; circum-oral barbels absent. Dorsal fin placed behind the pelvic fins but entirely in advance of the anal fin.

A genus of wide distribution in Asia and Africa; two species occur in Uganda.

KEY TO THE SPECIES

Dorsal fin entirely in advance of the anal fin; lateral line with 36-40 scales; no vertical bars on the flanks *B. niloticus*

Dorsal fin partly above the anterior part of the anal fin; lateral line with 50-58 scales; several vertical bars on the flanks *B. loati*

Barilius niloticus (Joannis) 1835. (Fig. 27)

Description: A small species rarely exceeding 100 mm. in length.

Depth of body contained 4-5 times in standard length, length of head contained $3\frac{3}{4}$-$4\frac{1}{2}$ times. Snout pointed, as long as the eye (at least in adults) which is contained $3\frac{1}{4}$-4 times in the head length. Mouth large, extending to below the centre of the eye. Barbels absent. Sub-orbital bones covering nearly the entire cheek. 4-6 gill rakers on the lower part of the first gill-arch. Dorsal fin III, 7-8, situated entirely in advance of the anal fin. Lateral line with 36-40 scales; $5\frac{1}{2}$-$6\frac{1}{2}$ scales between this line and the first dorsal ray; $1\frac{1}{2}$ or 2 scales between the pelvic fin base and the lateral line.

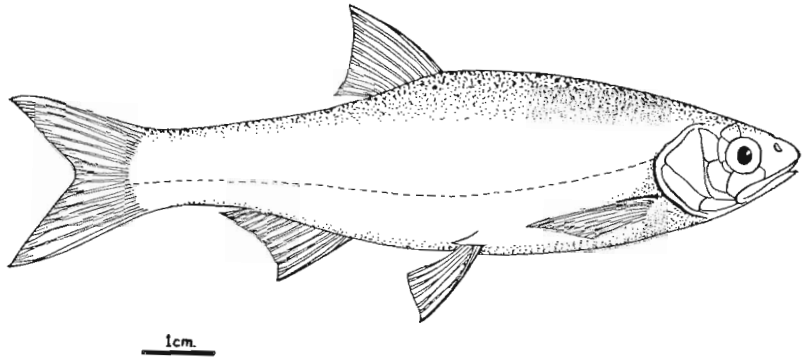

FIG. 27

Barilius niloticus. (Drawn by Barbara Williams.)

Young *B. niloticus* are sometimes confused with *Engraulicypris*. However, the species are immediately distinguishable by the position of the dorsal fin relative to that of the anal.

Coloration: Bright silver; fins colourless. In young fishes, a dark mid-lateral stripe may develop after death.

Habitat: The extreme inshore waters of Lake Albert, often in water only a few inches deep (Worthington, 1929a).

Food: Zooplankton (Worthington *op. cit.*).

Distribution: Uganda: Lake Albert. *Elsewhere:* Nile and Niger.

Barilius loati Boulenger 1901

Description: In general appearance, *B. loati*, is similar to *B. niloticus*. However, the species may be distinguished by *B. loati* having more scales in the lateral line series (50-58), the posterior part of the dorsal fin situated above the anterior part of the anal fin, and in having more anal fin rays (III, 12-15). The coloration also differs since there are numerous short, vertical black bars on the flank in *B. loati*.

Nothing is known about the ecology of this species in Uganda. The largest specimen recorded in Uganda was 17.5 cm. standard length (see Greenwood, 1963).

Distribution: Uganda: Aswa river. *Elsewhere:* Lower Nile, Bahr-el-Gebel, the Blue Nile, Omo river, and from west Africa.

Engraulicypris Günther 1893

Body strongly compressed, scales moderately large. Lateral line situated low on the body and running along the lower part of the caudal peduncle. Dorsal fin inserted almost entirely above the anal fin. Mouth large, terminal and rather oblique; without lips or circum-oral barbels. Cheek covered by the thin sub-orbital bones.

This genus is confined to Africa; two species occur in Uganda.

KEY TO THE SPECIES

(i) Lateral line with 36-39 scales; anal fin with 11-13 branched rays. Known only from Lake Albert *E. bredoi*

(ii) Lateral line with 48-52 scales; anal fin with 14-17 branched rays. Occurs in Lakes Victoria, Nabugabo and Kyoga *E. argenteus*

Engraulicypris bredoi Poll 1945

Description: Depth of body contained 4-5 times in standard length, length of head $3\frac{3}{4}$-$4\frac{1}{4}$ times. Snout pointed, somewhat shorter than the eye which is contained $3\frac{1}{2}$-4 times in the head length. Mouth large and terminal, extending to below the anterior border of the eye. 10 or 11 gill rakers on the lower part of the first gill-arch. Dorsal fin with II-III, 7 or 8 rays, its origin above that of the anal which has II-III, 11-13 rays. Lateral line with 35-39 scales; many scales in this series are without pores.

Size: Rarely exceeding 45 mm.

Coloration: Intensely silver, surface of head darker; a dark mid-lateral stripe appears after death.

Habitat: Imperfectly known, but probably restricted to the surface zone of inshore waters.

Distribution: Endemic to Lake Albert.

Engraulicypris argenteus (Pellegrin) 1904. (Fig.28)

Native name: Mukene (Lake Victoria).

Description: Similar to *E. bredoi,* except that there are 48-52 scales in the lateral line (which is always complete), more gill rakers (16) on the first arch and slightly more branched rays in the anal fin (14-17).

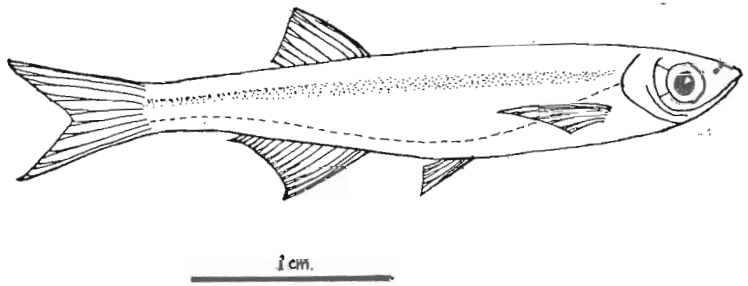

FIG. 28

Engraulicypris argenteus. (Drawn by Barbara Williams.)

Size: Rarely exceeding 80 mm.

Coloration: Intensely silver, often with an overall nacreous sheen. After death a fairly distinct dark mid-lateral stripe appears. Caudal fin yellow, other fins colourless.

Habitat: The distribution of *E. argenteus* within Lake Victoria is poorly known. Most records are from the surface of inshore and coastal waters, although there are some from surface waters over great depths (Graham, 1929 and E.A.F.R.O.). In Lake Kyoga, *E. argenteus* inhabits the open water away from water-lily swamps. The species is also caught in the more turbulent regions of the Victoria Nile.

Breeding: The information available suggests that *E. argenteus* spawns in the lake and produces floating eggs (Graham *op. cit.*). This habit is unusual amongst freshwater fishes, whose eggs are generally heavier than water.

Food: Mainly planktonic Crustacea. In turn, *E. argenteus* is heavily preyed upon by birds and several species of predatory fishes including some *Haplochromis* spp., *Bagrus docmac, Clarias mossambicus* and *Schilbe mystus.* (Corbet, 1961 and Graham, 1929.)

Distribution: Lakes Victoria, Nabugabo and Kyoga; the Victoria Nile.

TABLE V

Distribution in Uganda of species of the genera *Labeo, Garra, Barilius* and *Engraulicypris* (Cyprinidae)

Lakes	Victoria	Kyoga	Edward and George	Albert	Elsewhere
Labeo horie			P	P	Murchison Nile
Labeo forskalii					Agoye River, West Nile
Labeo coubie				P	Murchison Nile
Labeo victorianus	P	P			Victoria Nile; major rivers flowing into Lake Victoria
Garra johnstonii	P				Victoria Nile
Barilius niloticus				P	?Murchison Nile
Barilius loati					Aswa river
Engraulicypris bredoi				P	
E. argenteus	P	P			Victoria Nile

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Greenwood, P. H. (1963). A collection of fishes from the Aswa river drainage system, Uganda. *Proc. zool. Soc., London,* **140**, 61-74.

CHAPTER IV

FAMILY: CYPRINIDAE, *continued*

Barbus Cuvier and Cloquet 1816

Body somewhat compressed, the scales generally large. Cheeks not covered by the sub-orbital bones. Lateral line usually situated nearer to the ventral than to the dorsal body profile, but always running along the middle of the caudal peduncle. Mouth terminal in position, the lips showing considerable variation in their degree of development. No flap of skin anterior to the upper lip. Circum-oral barbels present, or, less frequently, absent. Dorsal fin with the last unbranched ray often strong and spine-like. Pharyngeal teeth in three series, the majority being hooked or spoon-shaped, although one or more anterior teeth in the inner series may be molar-like.

Undoubtedly more species have been referred to *Barbus* than to any other freshwater, non-cichlid genus in Africa. Intra-specific variability in this genus is, however, extremely high, with the result that many so-called species should probably be considered as geographical variants, or, atypical specimens of some other species.

A recent revision of certain east African *Barbus* species (Greenwood, 1962 and 1963b) has shown that several species were listed under the wrong names in the first edition of this book. Briefly, the changes incorporated below are:

(i) The species-complex previously referred to as *Barbus* cf. *B. amphigramma* is now resolved into two species, *Barbus amphigramma* and *Barbus paludinosus*.
(ii) *Barbus portali* Blgr. 1906 is a synonym of *B. neumayeri* Fischer 1884.
(iii) *Barbus minchini* Blgr. 1906 is a synonym of *B. kerstenii* Peters 1868.
(iv) *Barbus nummifer* Blgr. 1904 is a synonym of *B. jacksonii* Günther 1889.
(v) *Barbus doggetti* Blgr. 1904 is a synonym of *B. radiatus* Peters 1853.

In addition to these changes, three species (*Barbus nyanzae, B. cercops* and *B. yongei*) described by Whitehead (1960) are included in the text and key.

Very little is known about the ecology and feeding habits of the small species of *Barbus* (those belonging to the sub-group with radiately striate scales). Most of the information given here is based on the examination of very few specimens.

The key given below is, in many respects, inadequate. However, it should enable the commoner species of Uganda *Barbus* to be identified with a fair degree of certainty.

KEY TO THE SPECIES

This key is based on adult fishes and may prove misleading if used to identify young individuals. For example, two important 'key-characters', the barbels and the last unbranched ray of the dorsal fin, change with the size of the fish. Barbels tend to be relatively shorter in young fishes whilst the ray is but slightly enlarged and weakly, if at all serrated in young fishes.

Lateral line present 1
Lateral line absent, or, represented only on a few anterior scales 2

1 Exposed surface of the scales with numerous longitudinal striae A
Exposed surface of the scales with radiating striations which converge at a point near the scale centre B

A Last unbranched ray of the dorsal fin strong and bony but shorter than the head; depth of body not markedly greater than the head length *B. altianalis*[1] (p. 60)
Last unbranched ray of the dorsal fin, strong, bony and as long as, or, longer than the head; depth of body greater than the head length *B. bynni* (p. 63)

B Last unbranched ray of the dorsal fin spine-like and serrated on its posterior face (a)
Last unbranched ray of the dorsal fin spine-like but without serrations on its posterior face (b)
Last unbranched ray of the dorsal fin thin and flexible, not spine-like (c)

(a) 34-38 scales in the lateral line series (i)
23-30 scales in the lateral line series (ii)
(i) Tubules on lateral line scales outlined in black; a black spot at the base of the caudal fin *B. amphigramma* (p. 64)
Tubules not outlined in black; no black spot at base of caudal fin *B. paludinosus* (p. 65)
(ii) Six branched rays in the dorsal fin *B. sexradiatus* (p. 65)
More than 6 branched rays in the dorsal fin (oc)
(oc) Base of pelvic fin almost or completely in advance of the dorsal fin origin (oa)
Base of pelvic fin entirely below that of dorsal fin *B. neumayeri* (p. 65)

(oa) Orange blotch on operculum; dorsal, caudal and anal fins orange; pelvic fin base partially in advance of dorsal fin origin *B. kerstenii* (p. 67)
No orange blotch on operculum; all fins colourless; pelvic fin base completely in advance of dorsal fin origin *B. nyanzae* (p. 67)

(b) Dorsal fin with 8 branched rays; 36-39 scales in the lateral line series *B. jacksonii* (p. 68)
Dorsal fin with 10 branched rays; 33-34 scales in the lateral line series *B. somereni* (p. 69)

(c) Barbels well-developed (i)
Barbels short, anterior pair sometimes absent (ii)
(i) Cheek with radiating rows of pits *B. cercops* (p. 69)
Cheek without radiating rows of pits (r)
(r) Three dark spots on the flank 5-5½ scales between lateral line and dorsal fin origin *B. perince* (p. 69)
Broad silver band running above the lateral line; 3½ or 4 scales between lateral line and dorsal fin; caudal peduncle deep (ca. 20 per cent of standard length) *B. neglectus* (p. 70)

[1] See under *B. altianalis* in the text for notes on three Lake Kyoga species, *B. obesus; B. kiogae;* and *B. longirostris*.

Black band from tip of snout, through eye to base of caudal fin; caudal peduncle slender, its depth 10-13 per cent of standard length *B. yongei* (p. 70)

(ii) Anterior barbel minute, posterior only slightly longer; raised lines on dorsal surface of head, cheek and operculum; lateral line almost straight; 3½ scales between the lateral line and the first dorsal fin ray *B. radiatus* (p. 70)
Anterior barbel absent, posterior barbel from minute to ¼ of eye diameter; no raised lines on head, cheek or operculum; lateral line curved downwards; 5½ or 6 scales between the lateral line and the first dorsal fin ray *B. magdalenae* (p. 71)

2. Lateral line absent; a single barbel on each side of the mouth; last unbranched dorsal fin ray spine-like and weakly to strongly serrated on its posterior face *B. apleurogramma* (p. 72)

Barbus altianalis Boulenger 1900. (Fig. 29)

English: Barbel (particularly Ripon Falls Barbel) or Barbus. *Native names:* Kisinja, Nkuyu (Lake Victoria); Ngambwa (Lunyoro, Luruli, Lukenyi, and Lunyara); Sanga (Ludope); Changa (Lango).

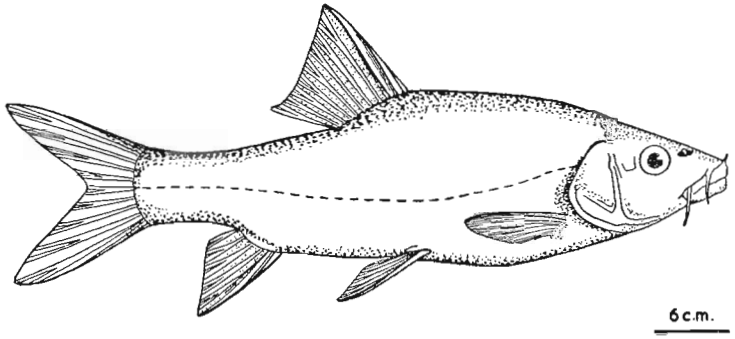

FIG. 29

Barbus altianalis: adult. (Drawn by Barbara Williams.)

Description: Depth of body equal to, or slightly greater than the length of the head, which is contained 3-4⅓ times in the standard length. In some fishes the head does not pass imperceptibly into the body; instead, there is a well-marked hump at the nape. Two pairs of barbels present, the anterior somewhat shorter than the eye, the posterior as long as the eye. Snout rounded or somewhat acute, its length contained 2½-3½ times in the head length. Mouth inferior; lips varying in shape and size from thin to fleshy, the latter type often produced into larger upper and lower lobes. Fishes with well-developed lips often have the snout rather fleshy. This variation in lip size is not a sexual difference, but it does seem likely that thickened lips are more pronounced in older and larger fishes. Eye diameter contained 3 (in young) to 7 times in head length. Dorsal fin with III-IV, 8-9 rays, the last unbranched ray strong and bony, from ½ to ¾ the length of the head. The base of the pelvic fins is situated below the anterior rays of the dorsal fin. Lateral line with 32-39 scales; 5½-6½ scales between the lateral line and the first dorsal ray; 2½-3½ scales between the lateral line and the pelvic fin base.

Young *B. altianalis* do not closely resemble the adults. (Fig. 30)

Barbus pietschmanni and *B. hollyi* described by Karl Lohberger in 1929 (*Anz. Akad. Wiss., Wien*, No. 11) are synonyms of *B. altianalis.*

Three sub-species of *B. altianalis* are recognized (Worthington, 1932a), namely: *B. a. altianalis* Blgr. (Lake Kivu and the Ruzizi River), *B. a. radcliffii* Blgr. (Lakes Victoria and Kyoga, and the Victoria Nile) and *B. a. eduardianus* Blgr. (Lakes Edward and George). The characters separating these sub-species are slight, and for the purpose of this paper it is sufficient to use geographical distributions as diagnostic characters.

Coloration: Tarnished silver in young fishes, becoming golden-green in adults.

Size: The largest recorded specimen caught by angling was 90 cm. long and weighed 19 lb. (E.A.F.R.O.). Fishes weighing over 40 lb. have been caught in gill-nets and on long-lines (Uganda Government, 1948).

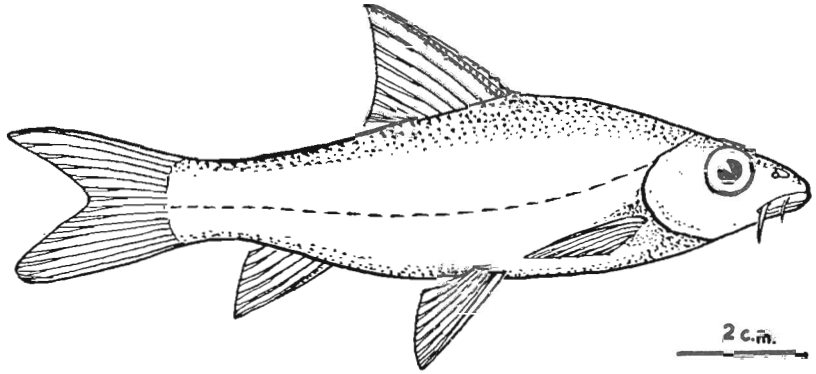

FIG. 30

Barbus altianalis: juvenile. (Drawn by Barbara Williams.)

Habitat: Lake Victoria: Inshore waters and in the affluent rivers (E.A.F.R.O. and Graham, 1929). The species is particularly abundant in the Victoria Nile. Before the Ripon Falls were submerged, large numbers of *B. a. radcliffii* congregated in the turbulent waters at the foot of the falls. Many individuals could be seen leaping and attempting to leap the falls. Nowadays a similar concentration of fishes is found at the Owen Falls Dam. It is not known whether there was ever an important movement of fishes from the river to the lake, although this has been suggested.

An interesting idea, held by some African fishermen, is that the *Barbus* ascended the falls and moved to the Kagera river (Tanzania-Uganda boundary) to spawn. The fishes were believed to find their way by following the stream of water which flowed into the lake from the river and maintained its individuality until it passed over the Ripon Falls.

Lake Kyoga: The more open waters of the lake. (Worthington, 1929a).

Lakes Edward and George: Shallow water. Common in Lake George and the Kazinga Channel. (Worthington, *op. cit.*)

Food: Varied, including Mollusca, aquatic vegetation, fishes (particularly small *Haplochromis*) and insect larvae (Graham, *op. cit.*, and E.A.F.R.O. for *B. a. radcliffii*, and Worthington, *op. cit.*, for *B. a. eduardianus*).

Breeding: There is no positive evidence on the breeding sites or seasons of *B. altianalis*. Indirect evidence suggests that, at least in Lake Victoria, the species breeds in rivers and large streams during flood periods.

Sport: Barbus altianalis radcliffii, the so-called Ripon Falls Barbel, provides excellent sport. An abundance of small bones detracts from its palatability.

Economic importance: Although contributing to the catches of commercial fishermen, the species is not of great economic importance.

Distribution: Uganda: Lakes Edward, George, Victoria and Kyoga. *Elsewhere:* Lake Kivu, the Ruzizi river.

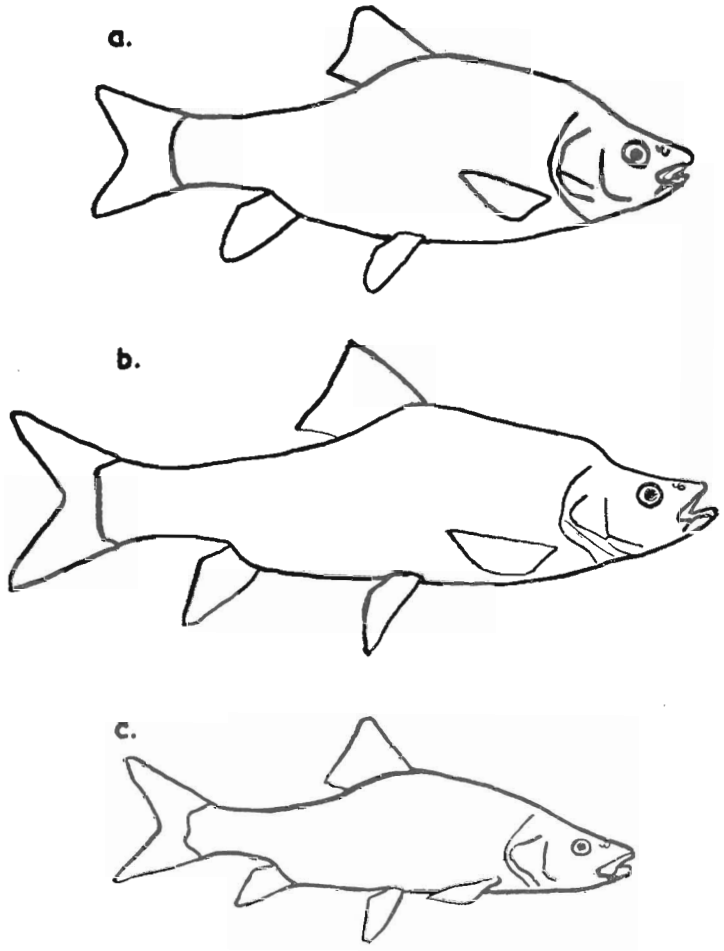

FIG. 31

a. *Barbus obesus;* b. *B. kiogae;* c. *B. longirostris;* outlines from Worthington (1929b)

Barbus obesus Worthington 1929; *B. kiogae* Worthington 1929, and *B. longirostris* Worthington 1929, (Fig. 31).

These three species were described by Worthington (1929b) from specimens caught in Lake Kyoga, where the species are apparently endemic.

Compared with typical *Barbus altianalis radcliffii, Barbus obesus* has a deeper body (2 times in body length) and consequently differs in outline. *Barbus kiogae* and *B. longirostris* differ, respectively, in having a marked hump at the nape and a slightly longer snout. In both species the mouth is terminal.

The validity of these species can only be checked when more specimens, together with data on their ecology, are available from Lake Kyoga. At present it can be said that specimens of *B. altianalis* showing many of the prominent characters of *B. kiogae* and *B. longirostris* have been caught in Lake Victoria.

Barbus obesus is known from a single specimen and it is possible that this species, together with *B. kiogae*, and *B. longirostris* may only represent more extreme variants of the highly variable species, *B. altianalis*.

Barbus bynni (Forsk.) 1775. (Fig. 32)

English: Barbel. *Native names:* Kisinja (Lunyoro and Lugungu); Sirri (Alur); Oshoi (Jonam).

Description: Similar to *Barbus altianalis* except that the body is deeper (its depth contained $2\frac{1}{3}$-$3\frac{1}{3}$ times in the standard length) and the last unbranched dorsal ray is stouter and from $1\frac{1}{4}$-$1\frac{3}{4}$ longer than the head; in a few exceptional specimens the spine was found to be slightly shorter than the head.

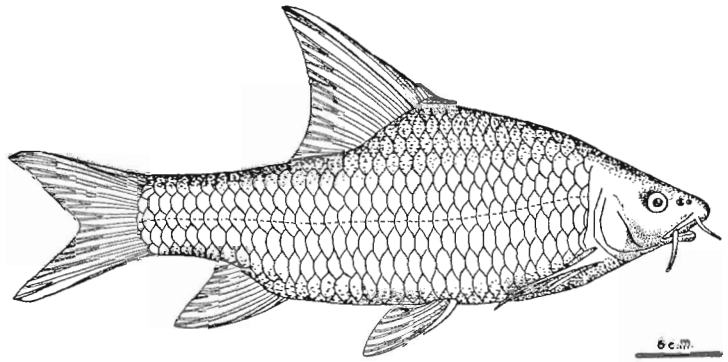

FIG. 32

Barbus bynni. (Drawn by Barbara Williams.)

Coloration: Silvery to yellowish. Anal and caudal fins tinged with pink, all other fins yellow-orange.

Size: The largest recorded fish was 82 cm. long and weighed $12\frac{1}{2}$ pounds (Worthington, 1929a).

Habitat: Inshore waters of Lake Albert; also in the Murchison Nile. Worthington remarks that *B. bynni* was not found in large numbers in Lake Albert, and that it was apparently more abundant in rivers.

Food: Aquatic plants, mollusca and insects (Worthington, *op. cit.*).
Breeding: Unknown.
Sport: Hurcomb (*Angling in the Sudan*; n.d.) does not write enthusiastically on the sporting qualities of this species.
Economic importance: B. bynni contributes to the catches of native fishermen, but, like *B. altianalis*, it cannot be rated a species of great commercial value.
Distribution: Uganda: Lake Albert, the Murchison and Albert Niles. *Elsewhere:* Nile and Lake Rudolf. A distinct sub-species, *B. b. rudolfianus* has been described from the latter locality (Worthington, 1936).

Barbus amphigramma Boulenger 1903.
Native name: Included in 'Kisinja' the general term for all small *Barbus*.
Description: Depth of body contained $3\frac{1}{3}$-$4\frac{1}{2}$ times in standard length, length of head $3\frac{1}{2}$-$4\frac{1}{2}$ times; often a distinct hump developed at the point where the head passes into the body. Snout moderately acute or even slightly rounded, its length equal to the eye diameter and contained $3\frac{1}{2}$-4 times in the head length. Anterior barbels $\frac{1}{3}$-$\frac{4}{5}$ of eye; posterior barbels from $\frac{1}{2}$ eye to slightly longer than eye. Dorsal III, 7, last unbranched ray bony, strongly serrated on its posterior face, its length variable from slightly shorter to somewhat longer than the head. Pelvic fin base entirely or mostly in advance of the first dorsal ray; tip of pectoral fin reaching the base of the pelvic fin. Lateral line with 33-38 scales (usually 35 or 36); 6-8 (usually 7) scales between the lateral line and the first dorsal fin ray; 3-5 (usually 4) scales between the lateral line and the pelvic fin base.
Size: Rarely exceeds 80 mm.
Colour: Olive-green dorsally, silvery below the midline; a small black spot at the caudal fin base and a faint dark, mid-lateral line. *Small concentrations of black pigment around the tubule on each lateral line scale.* A black mark present at the base of the first five anal fin rays. All fins colourless.
Food: Unknown.
Habitat: Small streams. It seems very probable that the species also occurs in Lake Victoria, but its precise habitat there is unknown.
Distribution: Uganda: Streams flowing into Lake Victoria; streams on Kadam Mountain. *Elsewhere:* Kenya and Tanzania.

Barbus paludinosus Peters 1852. (Fig. 33)
Native name: Unknown, probably included in the general term 'Kisinja'.
This species is very similar to *B. amphigramma* in general appearance and coloration. The chief diagnostic characters are: lack of black pigment around the tubules of the lateral line scales, no black spot at the caudal fin base and no spot at the anal fin base. For a more detailed discussion of these two species see Greenwood (1962).
Size: Barbus paludinosus reaches a larger adult size than does *B. amphigramma*. Specimens 130 mm. long are known from Lake Victoria but the modal size is about 110 mm.
Food: Varied, including small snails and adult insects (Corbet, 1961).
Habitat: Small streams and rivers flowing into Lake Victoria, and in shallow, inshore areas of the lake especially where the bottom is sandy.

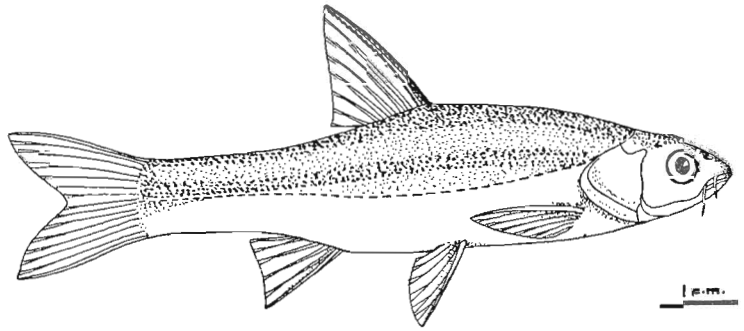

FIG. 33
Barbus paludinosus (Drawn by Barbara Williams.)

Breeding: Apparently *B. paludinosus* spawns in streams and rivers during the rainy season.
Distribution: Uganda: Lakes Victoria and Kyoga, and their affluent rivers and streams. *Elsewhere:* The species is widely distributed in Africa, extending from Ethiopia in the north, through east and central Africa, westwards into Angola and reaching the southernmost limits of its distribution in Natal, South Africa.
Barbus sexradiatus Boulenger 1911.
This is a very rare species, at present known only from one specimen.
Depth of body equal to head length and contained about $3\frac{3}{4}$ times in the standard length. Snout very blunt, slightly longer than the eye diameter which is contained about 4 times in the head length. Mouth inferior. Anterior barbel slightly longer than the eye, the posterior barbel $1\frac{1}{2}$ times longer than the eye. Dorsal fin with III, 6 rays, the last unbranched ray stout, bony and serrated on its posterior face. The origin of the pelvic fin is immediately below the first dorsal fin ray. Lateral line with 28 scales; $4\frac{1}{2}$ scales between the lateral line and the first dorsal ray.
Coloration and Ecology: Unknown.
Distribution: Known only from Lake Victoria (Kisumu Bay, Kenya).

Barbus neumayeri Fischer 1884. (Fig. 34)
Native name: Unknown, probably included in the general term 'Kisinja'.
Description: A small species, rarely exceeding 110 mm. standard length.
Depth of body contained $3\frac{1}{4}$-$3\frac{3}{4}$ times in the standard length, length of head $3\frac{1}{4}$-4 times, Snout somewhat rounded, its length equal to the diameter of the eye and contained $3\frac{1}{4}$-4 times in the head length. Mouth terminal. Anterior barbels equal to the diameter of the eye in small fishes and $1\frac{1}{3}$-$1\frac{2}{3}$ times longer than the eye in larger individuals, extending to about mid-way along the posterior barbel; posterior barbels $1\frac{1}{2}$ to $2\frac{1}{2}$ times longer than the eye. Dorsal fin with III, 7 rays, the last unbranched ray bony and strongly serrated on its posterior face. Pelvic fin base entirely below the first few dorsal rays. Lateral line with 26-31 scales; $4\frac{1}{2}$-5 scales between the lateral line and the first dorsal ray; $3\frac{1}{4}$ or 4 scales between the pelvic fin base and the lateral line. It is interesting to note that *B. neumayeri* from the Waisoke river system have fewer scales in the lateral line (26-28) than have specimens from streams flowing into Lake Victoria (30-31 scales).

The three smallest specimens examined (27-31 mm. standard length) were recognizable as *B. neumayeri* on adult characters. However, the serrations on the dorsal fin spine are relatively weak, and, in one fish, the anterior barbel extended only to the origin of the posterior barbel and not to about mid-way along it.

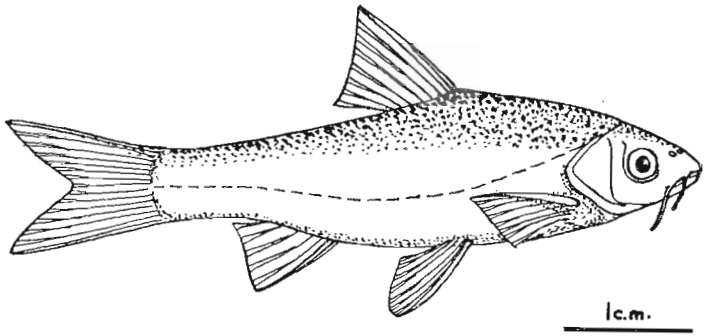

FIG. 34

Barbus neumayeri. (Drawn by Barbara Williams.)

Coloration: Brownish olive-green above, silver below. Fins faint brownish-green except the caudal which is pinkish-brown. In young fishes there are three conspicuous spots or blotches on the flanks. These spots are less intense in larger individuals, and may even be absent.

Food: Principally insect larvae and aquatic plants (Corbet, 1961).

Habitat: B. neumayeri occurs in both permanent, fast flowing streams and in seasonal streams running into Lake Victoria. Its sudden appearance in these temporary streams indicates that the species also occurs in Lake Victoria, where its habitat is unknown.

Distribution: Lake Victoria and affluent streams; Lake Albert, Mpanga river; Waisoke river and tributaries (flowing into Lake Albert); Kirima and Mongiro rivers (Bwamba district, flowing into the Semliki river); Hima and Malawa rivers. (Boulenger, 1911 and 1915; E.A.F.R.O., collections made by P. Hainsworth; Percy and Ridley, 1955). *Elsewhere:* Kenya (widely distributed); Tanzania (Lake Tanganyika, Lake Basuto); for a more detailed distribution list see Greenwood, 1962.

Barbus kerstenii Peters 1868. (Fig. 35)

Native name: Unknown, but probably included in the general term 'Kisinja'.

Description: Depth of body contained $3\frac{1}{3}$-$3\frac{2}{3}$ times in standard length, length of head $3\frac{1}{2}$-$3\frac{2}{3}$ times. Snout somewhat rounded, a little shorter than, or as long as the eye which is contained $3\frac{1}{2}$-4 times in head length. Mouth terminal, the anterior barbels from $\frac{1}{2}$-$\frac{4}{5}$ eye diameter and reaching the origin of the posterior barbels which are as long as the eye to $1\frac{1}{2}$ times longer. Dorsal fin with III, 7 rays, the last unbranched ray bony and serrated on its posterior face. Pelvic fin base entirely in advance of the first dorsal rays. The pectoral fins of male fishes are more expansive and longer than those of females. Lateral line with 23-27 (usually 25) scales; $4\frac{1}{2}$ or 5 scales between the lateral line and the first dorsal ray.

Note: Barbus kerstenii closely resembles two other species occurring in Uganda, namely *B. neumayeri* and *B. nyanzae*. From *B. neumayeri* it is readily distinguished by its coloration, especially the absence of well-developed lateral

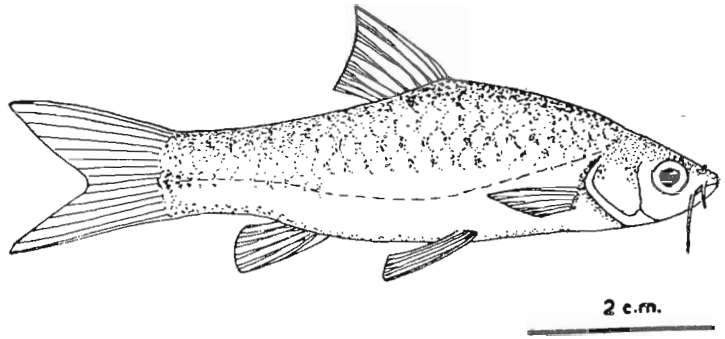

FIG. 35

Barbus kerstenii. (Drawn by Barbara Williams.)

spots, blotches or mid-lateral band, and the absence of a dark spot at the base of the anterior dorsal fin rays. Also, in *B. kerstenii* the dorsal fin origin is clearly behind the origin of the pelvic fins but in *B. neumayeri* the dorsal origin (i.e. the first dorsal ray) is immediately above the first pelvic ray. From *Barbus nyanzae, B. kerstenii* is distinguished by the more anterior origin of its dorsal fin (in *B. nyanzae* the *entire* pelvic base is in front of the first dorsal fin ray), its longer barbels and fewer lateral line scales (23-27, usually 25 in *B. kerstenii,* and 26-28, usually 27 in *B. nyanzae*).

Lohberger's species *Barbus viktorianus* (*Anz. Akad. Wiss., Wien,* No. 17, 208; 1929) is probably a synonym of *B. kerstenii.*

Size: Not known to exceed 90 mm. in standard length.

Coloration: Golden-silver above, shading to silver below; the scales above the lateral line with dark centres. A bright orange spot on the operculum, the rest of the head bright silver. Caudal and anal fins clear orange, dorsal fin faintly orange; other fins colourless.

Food: Predominantly insect larvae.

Habitat: Streams, both fast flowing and sluggish. Since the species occurs in temporary streams connected with Lake Victoria it must also live in the lake.

Distribution: Uganda: Lake Victoria and Edward basins including the Kyoga system; Lakes Bunyoni and Mutanda. *Elsewhere:* Kenya, Tanzania, Rwanda and Burundi.

Barbus nyanzae Whitehead 1960

Native name: Unknown.

In general appearance this species closely resembles *B. kerstenii.* Unfortunately the live coloration of *B. nyanzae* is not known.

The characters which most readily serve to distinguish *B. nyanzae* from *B. kerstenii* are its shorter barbels (anterior barbels 2.6-3.7 per cent of standard length, posterior barbels 3.9-5.0 per cent compared with 4.9-9.4 per cent for the anterior, and 8.0-13.0 per cent for the posterior barbels in *B. kerstenii*), the entire base of the pelvic fin being in advance of the first dorsal fin ray, and the

shallower caudal peduncle (length/depth ratio 1.8-2.1 in *B. nyanzae*, 1.3-1.7 in *B. kerstenii*).

Size: Small, few individuals exceeding 60 mm. in standard length.

Ecology: Little is known about the ecology of *B. nyanzae*. It is thought to live both in Lake Victoria and in the affluent streams and rivers. Spawning apparently takes place in the flood-water pools of rivers and streams during the rainy seasons (Whitehead, 1960).

Distribution: Known only from Lake Victoria (Nyanza Province, Kenya) and rivers in that area.

Barbus jacksonii Günther 1889. (Fig. 36)

Native name: Unknown.

Description: A small species, not exceeding 135 mm. standard length.

Depth of body contained $3\frac{1}{2}$-4 times in the standard length, length of head 4-$4\frac{2}{3}$ times. Snout somewhat rounded, as long as, or slightly longer than, the eye, which is contained $3\frac{2}{3}$-$4\frac{1}{4}$ times in the head length. Mouth terminal or slightly inferior, the anterior barbels as long as the eye; posterior barbels from $1\frac{1}{4}$-$1\frac{1}{2}$ times longer than the eye. Dorsal fin with III, 8 rays, the last unbranched ray very strong, bony but not serrated on its posterior face. Base of the pelvic fins below, or partly in advance of, the first dorsal rays. Lateral line with 36-39 scales; 5-$6\frac{1}{2}$ scales between this line and the first dorsal ray; 4 scales between the pelvic fins and the lateral line.

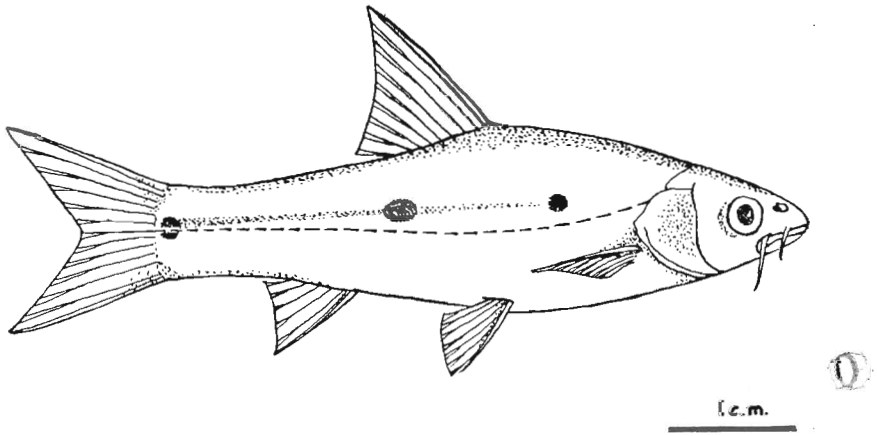

FIG. 36

Barbus jacksonii. (Drawn by Barbara Williams.)

Coloration: Sandy above, silvery below. Three well-defined black spots on the flanks, the first spot slightly in advance of the dorsal fin, the second somewhat behind this fin and the third near the origin of the caudal fin.

Habitat: Streams, both temporary and permanent; also in Lake Victoria, where its habitat is unknown.

Food: Insect larvae and bottom debris.

Distribution: Uganda: Lake Victoria and its affluent streams; Malawa river. *Elsewhere:* Bubu river (flowing into Lake Manyara), Pangani river and, probably, Lake Rukwa, Tanzania.

Barbus somereni Boulenger 1911

Native name: Unknown.

Description: Depth of body contained $3\frac{2}{3}$-4 times in the standard length, length of head 4-$4\frac{1}{4}$ times. Snout rounded, $1\frac{2}{3}$ times longer than the eye, which is contained 5 times in the head length. Mouth terminal, the anterior barbel as long as the eye, the posterior barbel from $1\frac{1}{4}$-$1\frac{1}{2}$ times longer than the eye. Dorsal fin with III, 10 rays, the last unbranched ray, bony and enlarged but not serrated on its posterior face. Pelvic fin base entirely behind the first dorsal ray. Lateral line with 33-34 scales; $5\frac{1}{2}$ scales between this line and the first dorsal ray; 3 scales between the pelvic fin and the lateral line.

Coloration: Sandy above, silver below.

Distribution: This species is known only from a few specimens collected in the following Ruwenzori streams; Sebwe river, Tokwe river; Kirimia river (Boulenger, 1916; Percy and Ridley, 1955). It does not apparently ascend above 5,500 ft. *B. somereni* reaches a larger size (235 mm.) than other Uganda *Barbus* belonging to the sub-group with radiately striate scales.

Barbus cercops Whitehead 1960

Native name: Unknown.

Description: Depth of body contained 4-5 times in standard length, length of head $3\frac{1}{3}$-5 times. Snout fairly acute, its length about equal to the eye diameter. Mouth nearly inferior. Anterior and posterior barbels of equal length, $1\frac{1}{3}$-$1\frac{1}{2}$ times diameter of eye. On the cheek there are five or six rows of small pores, the rows radiating out over the cheek from the lower rim of the orbit. Dorsal fin with III, 8 rays, the last unbranched ray thin and flexible. Pelvic fin base below the dorsal fin, the first pelvic ray lying below the first branched dorsal ray. Tip of pectoral fin not reaching to the base of the pelvic fin. Lateral line with 29-32 scales; $4\frac{1}{2}$-$5\frac{1}{2}$ scales between the lateral line and the first ray of the dorsal fin.

Size: Not exceeding 60 mm. in standard length.

Coloration: The colours of live fishes are unknown. Preserved specimens are dark above and white below. A thin, dark mid-lateral line runs from the caudal fin base to a point above the pectoral fin base; three small black spots lie on this line, the first spot below or slightly in front of the dorsal fin, the second below the last few rays of this fin, and the third spot at the base of the caudal fin. *N.B.* Juveniles of *B. cercops* resemble the young of *B. jacksonii* (i.e. at a size before the third unbranched dorsal ray has ossified), but the latter are distinguished by the absence of radiating pit lines on the cheek.

Ecology: Little is known about the habitat or food of *B. cercops;* it is apparently confined to streams and rivers (Whitehead, 1960).

Distribution: Uganda: Malawa river. *Elsewhere:* Kenya (rivers of the Nyanza Province).

Barbus perince Rüppell 1837

Native name: Unknown.

Description: A small species, not known to exceed 110 mm. in length.

Depth of body contained $2\frac{3}{4}$-$3\frac{1}{2}$ times in the standard length, length of head 3-$4\frac{1}{2}$ times. Snout rounded, shorter than the eye, which is contained 3-$3\frac{1}{2}$ times in the head length. Mouth terminal; the anterior barbels from $\frac{1}{2}$ to as long as the eye, posterior barbels equal to, or, $1\frac{1}{4}$ times greater than the eye diameter. Dorsal

fin with III, 7-8 rays, the last unbranched ray not enlarged and not bony. Pelvic fin base below the first dorsal ray. Lateral line with 28-32 scales; 5-5½ scales between this line and the first dorsal ray; 2 or 3 scales between the pelvic fins and the lateral line.

Coloration: Greenish-silver above, silver below. Three distinct black spots on the flanks; in life these spots are less intense and may even be absent. Fins pale yellow.

Ecology: Unknown.

Distribution: Uganda: Kazinga Channel, Lake Edward (Worthington, 1932b); Lake Albert (E.A.F.R.O. collection), Aswa river (Greenwood, 1963). *Elsewhere:* Semliki river (Poll and Damas, 1939); the Nile.

Barbus neglectus Boulenger 1902

Native name: Unknown.

Description: A small species not known to exceed 55 mm. standard length, and similar to *B. perince*, except for the presence of a broad, silver lateral stripe and only 3½ or 4 scales between the lateral line and the dorsal fin.

The occurrence of this species in Uganda is based on a single specimen collected by E.A.F.R.O. in the Albert Nile at Rhino Camp. Otherwise, *B. neglectus* is known from the lower and Blue Niles.

Barbus yongei Whitehead 1960

Native name: Unknown.

Description: Depth of body contained 3-4 times in standard length, length of head 3⅓-4⅘ times. Snout moderately acute, its length equal to the eye which is contained 3½-4⅕ times in the head length. Mouth nearly terminal. Anterior barbels ½-¾ diameter of eye, posterior barbels ¾ to slightly longer than eye. Dorsal fin with III, 8 or 9 rays, the last unbranched ray thin and flexible. Base of pelvic fins below dorsal fin. Tip of pectoral fin almost reaching, or reaching, the origin of the pelvic fins. Lateral line with 27 or 28 scales; 4½ scales between the lateral line and the first dorsal fin ray.

Size: A small species, not known to exceed 60 mm. standard length.

Coloration: Unknown for live fishes. Preserved specimens are dark above, white below; a broad, black mid-lateral stripe runs from the tip of the snout to the base of the caudal fin. All fins are colourless.

Ecology: Very little is known about the habits or habitat of this species; it is apparently confined to streams and rivers. Breeding takes place during the rainy seasons, probably in flood-water pools (Whitehead, 1960).

Distribution: Uganda: Malawa river. *Elsewhere:* Kenya (rivers and streams of Nyanza Province).

Barbus radiatus Peters 1853.

A small species known in Lakes Victoria and Nabugabo from only a few specimens. *Barbus radiatus* is immediately recognisable by the presence of numerous, irregular and raised lines of small pits which extend over the cheek, dorsal surface of the head, the pre-orbital region and across the operculum. These fine lines give the head a decidedly cicatrixed appearance. The anterior barbels are very small (about 1/7 of eye diameter), the posterior barbels are somewhat larger (about ⅓ of eye). The dorsal fin has III, 8 rays, the last unbranched ray is thin and flexible. The first dorsal ray is above or slightly

behind the first pelvic ray. The lateral line has 25-27 scales; there are 3½ scales between the lateral line and the first dorsal fin ray.

Coloration: No data are available for fishes from Uganda, but specimens from Beira were described as being reddish olive-brown with a violet, bluish-red and purple iridescence; a black lateral stripe extends from the tip of the snout to the base of the caudal fin (see Greenwood, 1962).

Ecology: Nothing is known.

Distribution: Uganda: Lake Victoria and certain affluent rivers and streams; Lake Nabugabo; Aswa river. *Elsewhere:* Tanzania (near Dar es Salaam); Portuguese East Africa (Beira); the Zambezi river; Lakes Nyasa and Bangweulu; South Africa.

Barbus magdalenae Boulenger 1906. (Fig. 37)

Native name: Unknown, but probably included in the term 'Kisinja'.

Description: A small species, not known to exceed 70 mm. in standard length.

Depth of body contained 3⅕-4 times in standard length, length of head contained 4-5 times. Snout variable, from strongly to moderately rounded, its length contained 4-4⅔ times in the head length. Eye large, its diameter contained 2⅔-3 times in the head length. Mouth terminal, no anterior barbel, the posterior barbel varying in length from minute to ⅔ as long as the eye. Dorsal fin with III, 8 rays, the last unbranched ray neither enlarged nor bony. Pelvic fin base slightly anterior to the first dorsal ray. Lateral line with 29-32 scales; curved, its course on the flanks nearer the ventral than the dorsal outline; 5-6 scales between the lateral line and the first dorsal fin ray; 1 or 2 scales between the lateral line and the pelvic fin base.

The shape of individual *B. magdalenae* is variable, but the figured specimen can be considered typical.

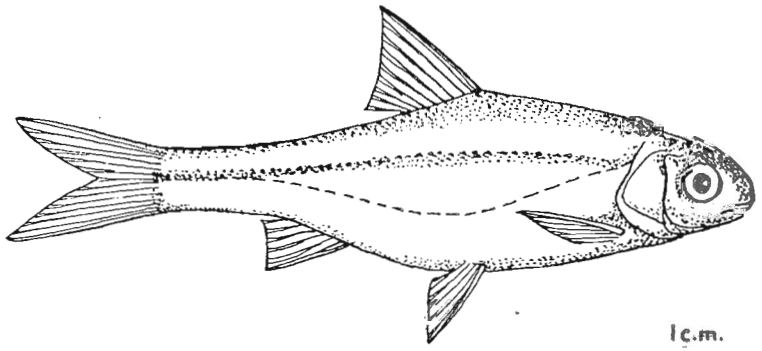

FIG. 37

Barbus magdalenae. (Drawn by Barbara Williams.)

Coloration: Tarnished silver, with an intensely silver mid-lateral stripe which darkens after death and is often black in preserved specimens.

Habitat: Marginal water-lily swamps of Lakes Victoria and Nabugabo, but running up temporary streams (possibly to breed) during the rainy seasons.

Food: Unknown.

Distribution: Known only from Lakes Victoria and Nabugabo.

Barbus apleurogramma Boulenger 1911. (Fig. 38)

Native name: Included in the general term 'Kisinja'.

Description: A small species rarely exceeding 55 mm. in length.

Depth of body contained 3-3½ times in the standard length, length of head 3½-4 times. Snout rounded, as long as, or slightly shorter than, the eye which is contained 3⅓-3⅔ times in the head length. Mouth terminal; no anterior barbels, the posterior barbels from ½-⅔ the length of eye diameter. Dorsal fin with III, 7-8 rays, the last unbranched ray strong and bony, weakly or strongly serrated on its posterior face. Pelvic fin base below, or, slightly anterior to the first dorsal rays. No lateral line pores, 23-25 scales in a longitudinal series counted along the line normally occupied by the lateral line scales; 7 scales between the dorsal and pelvic fins.

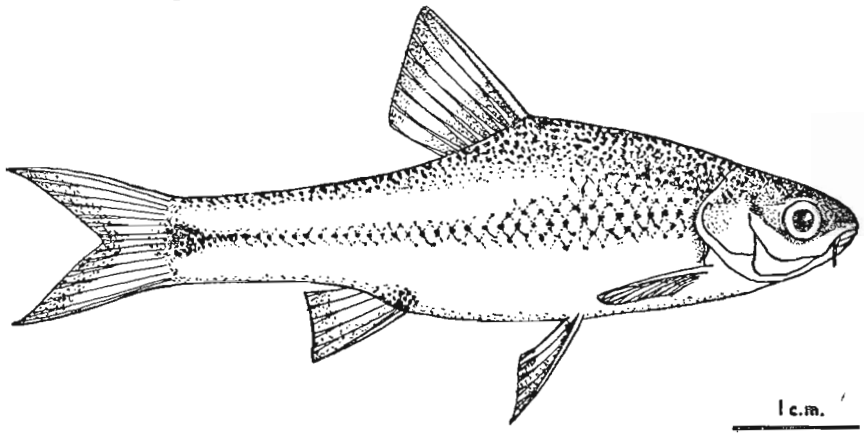

FIG. 38

Barbus apleurogramma. (Drawn by Barbara Williams.)

Coloration: Tarnished silver, darkest dorsally; flank scales with dark centres. A dark spot at the base of the caudal fin. Dorsal and anal fins black, but with a large, orange blotch in the centre. Caudal fin tinged with orange.

Habitat: This attractive little species is perhaps the most common *Barbus* occurring in temporary and permanent streams flowing into Lake Victoria. In the lake it inhabits the marginal water-lily swamps. It has found its way into many dams and ponds near Lake Victoria.

Food: Insect larvae (E.A.F.R.O.)

Breeding: In the temporary streams which connect with the lake during the rainy seasons. (E.A.F.R.O.)

Distribution: Uganda: Lakes Victoria and Edward, and associated streams; Aswa river. *Elsewhere:* Rwanda and Burundi; Tanzania (various localities including the coastal region near Dar es Salaam and Lake Tanganyika). The most northerly limit of the species is Aoué in the Ennedi plateau region of the Chad Republic; a surprising feature in the distribution of this species is its absence from Kenya.

RECORDS WHICH REQUIRE CONFIRMATION

Barbus tetraspilus Pfeffer 1896, and *B. trispilopleura* Boulenger 1902, have both been recorded from Lake Victoria (see Cunnington, 1920). It seems likely that *B. tetraspilus* was included as a result of its locality, which is given as Kavalli River, Bukoba, Upper Ituri (Congo system), being confused with Bukoba (Tanzania) on the shore of Lake Victoria.

The record of *B. trispilopleura* (Pellegrin, 1910. *Mem. Soc. Zool. France* **22**, 286) has never been confirmed. The species is otherwise known only from Abyssinia. In this case, Pellegrin's fish may have been a specimen of *Barbus cercops*.

TABLE VI

Distribution of *Barbus* species in Uganda

LAKES	Victoria	Kyoga	Edward and George	Albert	Elsewhere
Barbus altianalis	P	P	P	P	Victoria Nile
Barbus bynni					
Barbus amphigramma	?P				Streams in Victoria basin; Kadam Mountain
Barbus paludinosus	P	P			Streams flowing into these lakes
Barbus sexradiatus	P				
Barbus neumayeri	P			P	Mpanga, Waisoke, Kirima, Mongiro, Hima, Malawa rivers
Barbus kerstenii	P	P	P		Lakes Bunyoni & Mutanda
Barbus nyanzae	P				Affluent rivers of Lake Victoria
Barbus jacksonii	P				Affluent rivers of Lake Victoria
Barbus somereni					Ruwenzori streams below 5,500ft.
Barbus cercops					Affluent rivers of Lake Victoria; Malawa river
Barbus perince			P	P	?Semliki river
Barbus neglectus					Albert Nile
Barbus yongei					Affluent rivers of Lake Victoria; Malawa river
Barbus radiatus	P				Lake Nabugabo; Aswa river
Barbus magdalenae	P				Lake Nabugabo; affluent rivers of Victoria.
Barbus apleurogramma	P		P		Aswa river.

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CHAPTER V

The Sub-order Siluroidea (Cat-fishes)

In addition to the general notes on counts and measurements used in identification, and outlined in Chapter I, the following are used when identifying siluroid fishes.

(i) The circum-oral barbels are named as follows: Nasal (situated on the dorsal surface of the head, near the nostrils); maxillary (originating from the upper lip); inner and outer mandibulars (situated on the lower jaw).

(ii) The posterior extension of a barbel is determined by laying it back along the head.

(iii) With the exception of the Clariidae, head length is measured as for the other fishes. In the Clariidae it is measured along the *dorsal* surface of head, from the snout tip to the most posterior point of a triangular projection from the hind-end of the skull. This process is called the supra-occipital process.

(iv) In the Mochokidae, reference is made to the 'humeral process'. This is a bony, triangular projection from the pectoral girdle. Measurements are made as shown in Fig. 39.

(v) The vomerine tooth band lies immediately behind the band of premaxillary teeth (upper jaw).

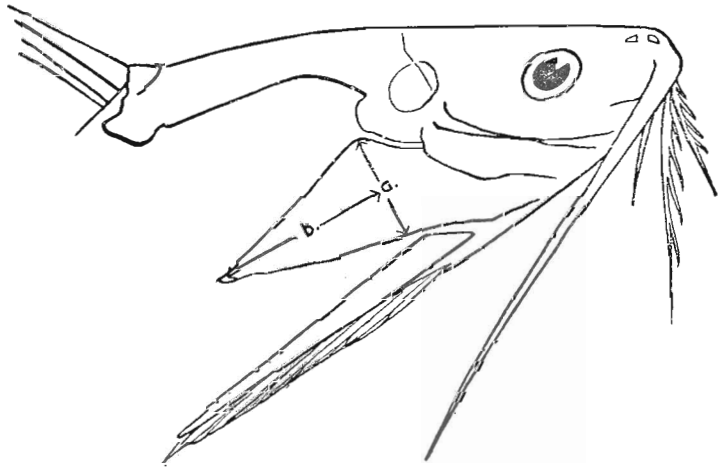

Fig. 39

Sketch showing the measurements of length and depth of the humeral process in *Synodontis*. a=depth; b=length.

Family: Bagridae

Body scaleless, moderately elongate. Adipose dorsal fin present. Dorsal and anal fins short. the former with a well-developed spine. Three or four pairs of unbranched circum-oral barbels.

Fishes of this family are found in Africa and Asia; two genera occur in Uganda.

Key to the Genera

(i) Four pairs of circum-oral barbels *Bagrus*

(ii) Three pairs of circum-oral barbels (nasal barbels absent) *Auchenoglanis*

Bagrus Cuvier 1817

Body moderately elongate, slightly compressed. Dorsal and anal fins short, the former comprising a spine and 8 to 11 branched rays. Adipose dorsal fin long. Four pairs of circum-oral barbels present.

At least two species occur in Uganda.

Key to the Species

Head broad, its width contained $1\frac{1}{3}$-$1\frac{3}{5}$ times in the head length, last ray of the dorsal fin in advance of the vertical from the *last* ray of the pelvic fin *B. docmac*

Head narrower, its width contained $1\frac{3}{5}$-$1\frac{3}{4}$ times in the head length; last ray of the dorsal fin behind the last ray of the pelvic fin *B. bayad* (p. 76)

Bagrus docmac (Forsk.) 1775. (Fig. 40a)

Native names: Semutundu (Lunyoro, Luruli and Lake Victoria); Mboli (Lunyara, Lukenyi, Ludope); Obanga (Lango); Omukora (Lunyankole); Oreko (Lugungu); Ombala (Jonam).

Description: Little formal description of this species need be given (see generic description, key, and figure) except to note that the barbels show great variation in length, being proportionately longer in small fishes. Also, the filamentous extension of certain rays in the caudal fin may be absent.

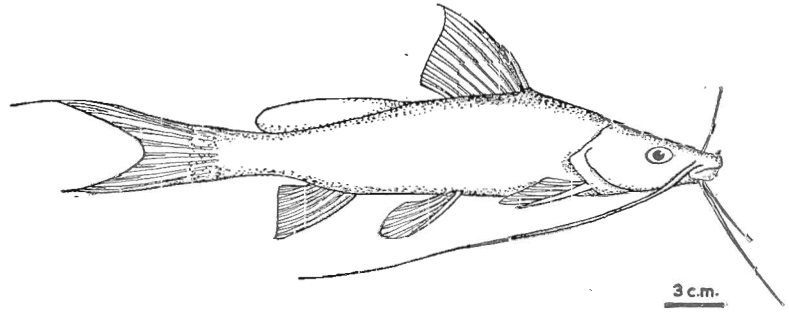

Fig. 40a

Bagrus docmac. (Drawn by Barbara Williams.)

It seems likely that *Bagrus degeni* Boulenger 1906, a species known only from Lake Victoria, is identical with *B. docmac*. The characters supposedly separating *B. degeni* from *B. docmac* are slight and specimens showing integradation between the two 'species' are common (see also Graham, 1929).

Coloration: Dark grey-black above, creamy-white below.

Size: Bagrus docmac attains a large size; specimens measuring over 100 cm. long and weighing 50 lb. have been recorded from Lakes Victoria and Edward. Poll and Damas (1939) record seeing the head (more than 40 cm. long) of a large *Bagrus*, which they estimate to have weighed 75 kg.

Habitat: Lake Victoria: Widespread in both deep and shallow water (Graham, *op. cit.*; E.A.F.R.O.).

Lake Edward: Common in shallow water (Worthington, 1932b). Also found in the Kazinga Channel and Lake George.

Lake Albert: Inshore and open waters (Worthington, 1929a).

Lake Kyoga: Open waters.

Lake Nabugabo: Ubiquitous (Worthington, *op. cit.*).

Food: Bagrus docmac is a predator, feeding mainly on small fishes, particularly *Haplochromis*. Insect larvae and Crustacea (prawns) are also eaten, the former especially by young fishes. (Worthington, *op. cit.* and 1929a; Graham, *op. cit.*; Poll and Damas, 1939; Hulot, 1956; Corbet, 1961).

Breeding: Unknown. Corbet (1960) suggests that, in Lake Victoria, *B. docmac* may spawn on wave-washed rocky shores.

Economic importance. Although not abundant in any Uganda lake, *B. docmac* does contribute significantly to the catches of African fishermen in most lakes except Lake Kyoga (see Uganda Government; and Lake Victoria Fisheries Service, 1948 *et seq.*).

Periodic mortality of B. docmac in Lake Victoria: At irregular intervals, numbers of *B. docmac* are found floating at the surface, either dead or moribund. Theories put forward to explain this phenomenon are varied and include epidemic diseases and underwater eruptions of volcanic gases. At present there is little or no evidence to support any of these ideas.

Distribution: Uganda: Lakes Victoria, Kyoga, Nabugabo, Albert, Edward and George; the Semliki river; the Victoria Nile; Murchison and Albert Niles; *Elsewhere:* Nile, Nigeria, Ghana, Lake Tanganyika.

Daget (1954) recognizes a distinct sub-species, *Bagrus d. niger* for fishes from the Upper Niger.

Bagrus bayad (Forsk.) 1775. (Fig. 40b)

Native names: Lanya (Lunyoro and Alur); Oreko (Jonam).

Description: Similar to *Bagrus docmac*, but readily distinguished by its narrower head, more slender body and by the position of the dorsal fin. Also, whereas in *B. docmac* the dorsal surface of the head is smooth, in *B. bayad* it is often ridged.

Coloration: Dark grey-black above, creamy-white below.

Size: Smaller than *B. docmac;* most individuals are about 40 cm. long.

Food: Predatory on small fishes and insect larvae (Worthington, 1929a).

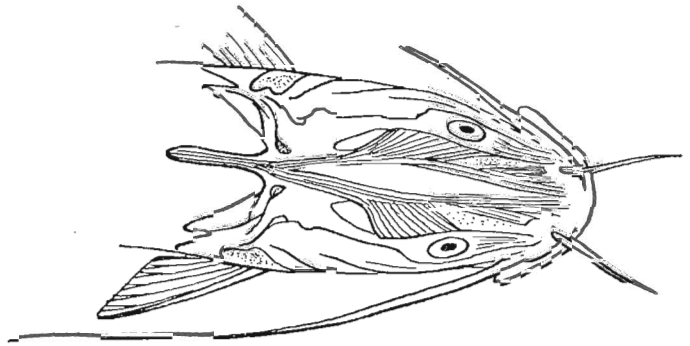

FIG. 40b

Dorsal surface of the head of *B. bayad*. (Drawn by Barbara Williams.)

Habitat: Common in the deeper waters of Lake Albert (Worthington, *op. cit.*) but also occurring inshore.

Breeding: Unknown.

Distribution: Uganda: Lake Albert. *Elsewhere:* Nile, Niger, Senegal, the Chad basin.

Auchenoglanis Günther 1865

Body moderately elongate, feebly compressed. Head massive, the heavily sculptured bones clearly visible beneath the skin. Dorsal fin short, comprising a spine and 7 or 8 rays. Adipose dorsal fin long. Only three pairs of unbranched circum-oral barbels are present (the nasal barbels are absent).

One species occurs in Uganda.

Auchenoglanis occidentalis (Val.) 1840. (Fig. 41)

Native names: Bubu (Lunyoro, Lugungu, Alur); Orukwe (Jonam).

Description: Depth of body contained $3\frac{1}{2}$ to 5 times in the standard length, length of head $2\frac{3}{4}$ to $3\frac{1}{2}$ times. Mouth small and terminal, the lips thickened and papillose. Snout long and pointed, about half the length of the head. Maxillary barbel reaching to the middle of the eye, or, in small fishes, as far as the posterior border. Outer mandibular barbels as long as, or somewhat longer than the maxillary barbels, almost twice as long as the inner mandibular barbels. Dorsal fin with I, 7 rays, the spine rough on its anterior face. Pectoral spine strong, granulate (or even with a few low spines) on its outer face, strongly serrated on the inner face.

Coloration: Olivaceous brown, darker above. Often with large, black, or dark spots which extend onto the dorsal and caudal fins. Spotting is more intense in small fishes, and is invariably present.

Size: Specimens one metre long have been recorded (see Daget, 1954) but in Uganda the average length of large specimens is about 50 cm.

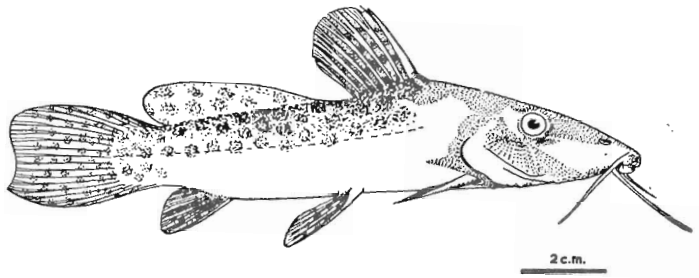

FIG. 41

Auchenoglanis occidentalis. (Drawn by Barbara Williams.)

Habitat: Inshore areas of Lake Albert, and in the Murchison Nile. Daget (1954) records that in the Upper Niger, *A. occidentalis* is common in the swamps of the flood plains.

Breeding: Virtually unknown in Uganda. Worthington (1929a) suggests that breeding may take place in the Murchison Nile and around the shores of the lake, but the evidence on which he based his opinion is rather slender. In the Niger, Daget (*op. cit.*) says that breeding takes place during the flood seasons.

Food: Insect larvae, worms and small Crustacea (Worthington 1929a).

Economic importance: Slight; the species contributes to catches in seine nets and 5-inch-mesh nets of fishermen on Lake Albert. Worthington (*op. cit.*) records that most Africans refuse to eat 'Bubu' as they believe the flesh to be poisonous. There is no evidence to support this notion.

Distribution: Uganda: Lake Albert, the Murchison and Albert Niles, Aswa river. *Elsewhere:* Blue and White Nile, Lake Rudolf, Lake Chad, Senegal, Niger, Congo, Lakes Mweru, Bangweulu and Tanganyika.

Family: Schilbeidae

Body scaleless, moderately elongate and strongly compressed. Dorsal fin short, or, absent (present in the two genera occurring in Uganda), anal fin very long. Generally four pairs of circum-oral barbels.

The Schilbeidae are found in the fresh waters of Africa and Asia. Two genera occur in Uganda. Lake Edward is peculiar in that no members of this family are present.

KEY TO THE GENERA

Adipose dorsal fin absent	*Schilbe* (p. 78)
Adipose dorsal fin present	*Eutropius* (p. 79)

Schilbe Cuvier 1817

Body strongly compressed. Dorsal fin very short, comprising a spine and 5 or 6 branched rays. No adipose dorsal fin. Anal fin long, extending from the vent almost to the origin of the caudal fin. Four pairs of short, circum-oral barbels.

One species occurs in Uganda.

Schilbe mystus (Linn.) 1762. (Fig. 42)

Native names: Karakogere (Lunyoro); Nzere (Lake Victoria); *English:* Butterfish.

Description: The figure, together with the generic description given above, will suffice to identify this species.

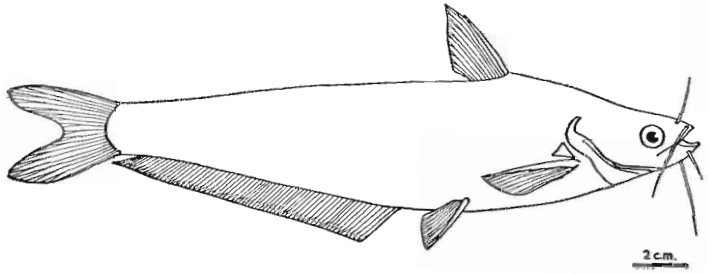

FIG. 42

Schilbe mystus. (Drawn by Barbara Williams.)

Coloration: Silver-grey, somewhat darker above. The young are marked with three longitudinal black bands, the upper and lower of which are continued onto the caudal fin.

Size: A small species, rarely exceeding 30 cm. in length.

Food: Principally small fishes (*Haplochromis* spp.) although insect larvae are also eaten (Graham, 1929; Worthington, 1929a; Corbet, 1961).

Habitat: Lake Victoria: Shallow inshore waters (E.A.F.R.O.; Graham, *op. cit.*). *Lake Kyoga:* Open waters (Worthington, 1929a). *Lake Albert:* Probably confined to inshore waters (E.A.F.R.O.).

Breeding: Unknown in Uganda. Records collected by E.A.F.R.O. suggest that *Schilbe mystus* in Lake Victoria may breed during the rainy seasons. In the Niger, the species spawns during the flood seasons. (Daget, 1954.)

Economic importance: Slight, seasonally high catches are made in Lake Victoria. The flesh is very palatable.

Distribution: Uganda: Lakes Victoria, Kyoga, Nabugabo and Albert; the Victoria Nile; Semliki and Aswa rivers. *Elsewhere:* The Nile; rivers of west Africa; the Chad basin; the Congo and Zambesi.

Eutropius Müller and Troschel 1849

Closely resembles *Schilbe*, but differs in possessing a small adipose fin. One species occurs in Uganda.

Eutropius niloticus (Rüpp.) 1829

Native name: Taitai (Lunyoro, Lugungu, Alur and Jonam).

Description: Very similar to *Schilbe mystus* in all respects, including coloration, but easily recognized by the presence of a small adipose dorsal fin situated near the caudal fin.

Size: Somewhat larger than *Schilbe mystus*; large fishes average about 35 cm. standard length.

Food: Small fishes and insect larvae (Worthington, 1929a).

Habitat: Bays and shallow inshore areas of Lake Albert; Worthington (*op. cit.*) is of the opinion that in Lake Albert *Eutropius* occupies the ecological niche held by *Schilbe* in the other large lakes. Little is known of its ecology.

Economic importance: Very slight. According to published accounts, the flesh of *Eutropius niloticus* has a muddy flavour.

Distribution: Uganda: Lake Albert and the Albert Nile; Semliki river. *Elsewhere:* Nile; the rivers of west Africa; the Chad basin.

Family: Clariidae

Body scaleless and elongate. Head bony, broad and flattened. Dorsal fin long, without a spine. Anal fin long, extending to, or, almost to the caudal fin. Adipose dorsal fin sometimes present. Four pairs of unbranched circum-oral barbels.

The Clariidae are widely distributed in Africa, Syria and south-east Asia. Four genera occur in Uganda.

Superficially, three of these genera are very similar. The characters distinguishing them are mostly anatomical ones, and require some dissection before they can be checked. To examine the suprabranchial region, part of the skull-roof above the gills must be removed. With large specimens of *Clarias* (over 40 cm. long) dissection is not always necessary; the suprabranchial organs become visible if the opercular region is lifted and the gill arches are pulled downwards.

Key to the Genera

Long adipose dorsal fin present — *Heterobranchus* (p. 87)
No adipose dorsal fin — (a)

(a) Sides of head (especially behind the eyes) bony; usually the dorsal, caudal and anal fins separate — (i)
Sides of head soft; dorsal, caudal and anal fins confluent — *Clariallabes* (p. 80)

(i) Arborescent respiratory organs present, lodged in a large chamber above the gills — *Clarias* (p. 81)
No arborescent organs; gills fill the entire branchial cavity — *Xenoclarias* (p. 81)

Clariallabes Blgr. 1900

Superficially, this genus is very like *Clarias* but with the bony sides of the skull greatly reduced, and the dorsal, caudal and anal fins confluent. Adult *Clariallabes* (at least in Uganda) are small, rarely exceeding 80 mm. in standard length. The genus is fairly widespread, with the greatest number of species occurring in western Africa. A single species occurs in Uganda.

Clariallabes petricola Greenwood 1956

At first sight, *Cl. petricola* may easily be confused with small specimens of *Clarias* species. However, the soft lateral aspects of the head, very small eyes, and the confluent dorsal, caudal and anal fins should enable the species to be recognized on closer inspection. A full description, with figures, is given in Greenwood (1956), *Proc. zool. Soc. London*, 127, 555-64.

Coloration: Dark brown, almost black, shading to light brown below.

Size: Not known to exceed 85 mm.; females are mature when 40 mm. long.

Food: Insect larvae (Corbet, 1961).

Distribution: Lake Victoria and the Victoria Nile near the Owen Falls dam.

Habitat: Among stones and shingle of the river bed, and in similar places on wave-washed rocky shores of the lake.

Xenoclarias Greenwood 1958

Superficially very similar to *Clarias* but without the suprabranchial arborescent organs of that genus. In *Xenoclarias* the gill-filaments fill the entire upper part of the gill chamber whereas in *Clarias* there is a large cavity above the gills in which the arborescent organs are housed. Also, unlike *Clarias*, the uppermost gill-filaments of each arch in *Xenoclarias* are not joined together by a membrane to form a fan-like structure.

The absence of accessory, air-breathing respiratory organs in this genus is interesting, and suggests an adaptation to life in deeper waters than those inhabited by species of the otherwise similar genus *Clarias* (see Greenwood, 1958).

At present, *Xenoclarias* is known only from Lake Victoria, where two species are recognized (Greenwood, *op. cit.*).

Key to Species

Nasal barbels 1.0-1.5 times head length, maxillary barbels 1.7-2.0 times head length; width of mouth 38.0-41.0 per cent of head length — *X. holobranchus.*
Nasal barbels shorter than head, maxillary barbels less than 1½ times head length; mouth broader, its width almost half the head length — *X. eupogon.*

Apart from the characters outlined in the generic diagnosis and in the key to the species, *Xenoclarias eupogon* (Norman, 1928) and *X. holobranchus* Greenwood, 1958, closely resemble one another and *Clarias* species of the *C. alluaudi* group (see p. 86).

Little is known of their ecology. The three available specimens of *X. holobranchus* were trawled in water 120 feet deep, while the single specimen of *X. eupogon* came from water between 40 and 85 feet deep. The food remains in the gut of *X. holobranchus* suggest that the species is insectivorous. Neither species is known to exceed a standard length of 18 cm.

Clarias Scopoli 1777

Head flat and broad. Body elongate. Eyes small. Dorsal fin long, extending from slightly behind the head to the caudal fin, from which it is narrowly separated. Anal fin long. No spine in the dorsal fin.

At least five species occur in Uganda. The *Clarias* species of Africa are in urgent need of taxonomic revision. Intra-specific variability is high and many so-called species will undoubtedly prove to be merely geographical, or even individual variants of a single, widespread species.

The hardiness of *Clarias* is almost legendary, and, although some of the stories may be exaggerated, there is no doubt that *Clarias* can and do tolerate conditions which would kill other fishes. That *Clarias* manage to survive in foul, stagnant water is due mainly to their possessing an elaborate accessory breathing organ which enables these fishes to utilize atmospheric oxygen. The accessory organs are in the form of much branched bodies developed from two

of the gill arches on each side. These arborescent bodies are contained within an expansion of the gill-chamber, which is lined with a highly vascular skin and protected by the bones of the skull. The entrance to the chamber is guarded by four fan-like processes from the gill arches. Both the tissue covering the arborescent organ and the skin lining the suprabranchial chamber have the same microscopical structure as the normal gill-filaments. It is across these surfaces that oxygen is absorbed from the air. The gill-filaments are well-developed, but it appears that *Clarias* is dependent on the additional supply of atmospheric oxygen. Fishes prevented from gaining access to the surface are 'drowned'.

There are many records, from other parts of Africa, of *Clarias* moving from one body of water to another, but, to the best of my knowledge, this has never been reported from Uganda. When temporary streams and swamps dry out, *Clarias* are reputed to burrow into the mud and remain there until the area is again flooded. However, further study of this supposed aestivation is required. Certainly in a damp environment *Clarias* can live out of water for over eighteen hours (personal observations on *C. mossambicus*). It would be no exaggeration to say that there is hardly any water in Uganda which is without a population of *Clarias*. In many cases, new dams far removed from a stream or pond are rapidly populated. The amphibious habits of *Clarias* may explain this mystery.

KEY TO THE SPECIES

Pelvic fin bases about midway between the tip of the snout and the origin of the caudal fin, or slightly nearer the snout — 1
Distance between the pelvic fin bases and the snout contained $1\frac{1}{2}$-2 times in the distance between the bases of the fins and the origin of the caudal fin — 2

1 Vomerine tooth-band as broad as the band of premaxillary teeth — *C. mossambicus*[2] (p. 82)
Vomerine tooth-band from $1\frac{1}{2}$ to twice as broad as the band of premaxillary teeth — *C. lazera*[3] (p. 85)

2 Nasal barbels shorter than the head; maxillary barbels not reaching the first dorsal fin ray. Distance between the tip of the supra-occipital process and the first dorsal ray contained $1\frac{2}{3}$-$2\frac{1}{2}$ times in the head length — *C. carsonii*[4] (p. 85)
Nasal barbels as long as, or, slightly longer than the head; maxillary barbels reaching the first dorsal fin ray or somewhat beyond. Distance between the tip of the supra-occipital process and the first dorsal ray contained $2\frac{3}{5}$-4 times in the head length — *C. alluaudi* group (p. 86)

Clarias mossambicus Peters 1852. (Fig. 43)

Native names: Mali (Lunyoro, Luruli, Lunyara, Lukenyi); Nyaki (Ludope); Twang (Lango); Mali or Kasonzi (Lake Victoria). *English:* Cat-fish, Barbel, Mud-fish.

Jubb (1961) is of the opinion that *Clarias mossambicus* Peters 1852 cannot be considered specifically distinct from *C. gariepinus* (Burchell) 1822, a species from southern Africa. Jubb's evidence is impressive but until a thorough

[2] See text for note on *C. anguillaris*.
[3] See text for note on *C. moorii*.
[4] See text for note on the closely related *C. phillipsi*.

revision of all Clariidae is undertaken it is advisable to retain *C. mossambicus* as a separate species, especially since its relationship with *C. lazera* Val. 1840 has yet to be investigated.

Description: Depth of body contained 6-8 times in the standard length, length of head 3-$3\frac{3}{4}$ times. Head width contained $1\frac{1}{2}$ to $1\frac{2}{3}$ times in the head length; upper surface coarsely granulate in adult fishes, smooth in the young. Eyes small. Teeth on the premaxillae and lower jaw small, fine and arranged in several rows. Vomerine tooth-band composed of several rows of granular teeth; width of this band equal to that of the premaxillary tooth band. Nasal barbels from $\frac{1}{5}$-$\frac{1}{2}$ as long as the head in fishes longer than 12 cm., and from $\frac{1}{2}$ to $\frac{4}{5}$ of the head length in smaller individuals; maxillary barbels rarely shorter than the head, usually somewhat longer and reaching to a point midway between the origin of the dorsal fin and the insertion of the pelvic fins (as is usual in *Clarias*, the barbels are proportionately longer in small fishes). Outer mandibular barbels longer than the inner pair. Gill rakers long, fine and close set, their number increasing with the size of the fish; from 25 (in small fishes) to 100 on the first arch. Dorsal fin with 62-80 rays, anal fin with 50-65; both fins distinct from the caudal fin.

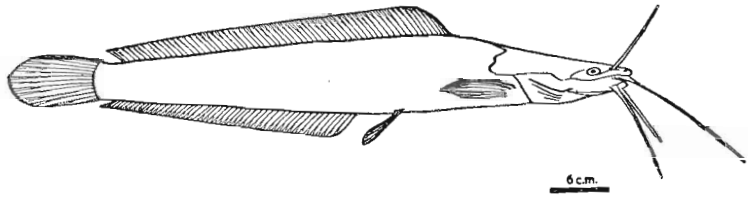

FIG. 43

Clarias mossambicus. (Drawn by Barbara Williams.)

Coloration: Generally dark greyish-black above, creamy-white below; a fairly distinct black longitudinal band on each side of the ventral surface of the head. Young fishes less than 9 cm. long have a similar coloration except that the black bands on the head are absent; larger young (10-30 cm.) are mottled, grey-khaki above. This marbled coloration may persist in larger individuals. It is likely that coloration varies with habitat; fishes kept in an aquarium with a sand bottom are always very lightly coloured.

Size: In Lake Victoria, *C. mossambicus* reaches a large size. Most individuals caught by African fishermen are between 80 and 90 cm. long, although fishes 120 cm. long are occasionally caught. In Lake Kyoga, on the other hand, the individuals are smaller. Whereas in Lake Victoria sexually mature fishes, of either sex, less than 50 cm. long are rare, in Lake Kyoga sexually mature females of 25-40 cm. are common. Fishes weighing 75 lb. have been recorded (Uganda Government, 1948).

Food: Omnivorous, but predominantly a predator on small fishes (particularly *Haplochromis*). Other food includes insect larvae, molluscs and plants. The very fine and numerous gillrakers enable the fish to filter the microscopic organisms of the phyto- and zooplankton from the water; however, only a few fishes have been recorded as feeding exclusively on plankton. *Clarias* living near

cormorant breeding colonies feed almost exclusively on regurgitated fish dropped by the birds. Fledglings and unhatched eggs are also eaten. (Corbet, 1961.)

Small *Clarias* (less than 5 cm. long) feed mainly on insect larvae, but the fish-eating habit is developed by the time the young fish are 6 cm. long. (Corbet, *op. cit.*)

Habitat: Lake Victoria: Widely distributed, but more common in shallow, inshore waters; also found in the marginal water-lily and papyrus swamps. During cormorant breeding seasons *Clarias* are particularly abundant around the islands on which the birds breed.

Lake Kyoga: Open water and in the water-lily swamps.

Lake Nabugabo: Ubiquitous.

Clarias mossambicus is also common in the major affluent rivers of Lake Victoria, and in the Victoria Nile.

Breeding: In Lake Victoria, *C. mossambicus* is known to breed in small, temporary streams which flow into the lake during the rainy seasons (Greenwood, 1955.) Although these streams may be connected with the lake for some months, it seems that breeding fish run up on one or two nights only, in April and again in December.

Clarias eggs are small (about 2 mm. in diameter) and are attached by an adhesive disc to plants and debris in the bottom of the stream. Early development is rapid, and the young fishes hatch within thirty-six hours after fertilization. Despite their small size, larval *Clarias* are remarkably hardy and can withstand considerable and rapid change in temperature; also, they are able to utilize atmospheric oxygen at an early age, even though the supra-branchial organ is not fully developed. The young remain in the stream for about six weeks and then apparently swim down to the lake. During their first year, or even two, the young reappear in the streams whenever these are connected with the lake.

Pitman (*in litt.*) has described an interesting invasion by large *Clarias* (probably *C. mossambicus*) of temporarily inundated swampy ground south of the western end of Lake Nakavali. The invasion took place in October, and, although there is no positive evidence, it is probable that these fishes were breeding in the temporary swamp.

Economic importance: Slight in Lakes Victoria and Kyoga. During spawning runs large numbers of *Clarias* are speared by Africans, but this is only a temporary affair. The flesh of *Clarias* makes good eating and is readily accepted by most tribes.

Distribution: Uganda: Lakes Victoria, Kyoga, Nabugabo, Kachira, Nakavali and Kijanebalola; the major affluent rivers of Lake Victoria and the Victoria Nile, Aswa river. *Elsewhere:* Rivers of East Africa; Lake Tsana, at the headwaters of the Blue Nile; the Zambesi and Lake Tanganyika.

Clarias anguillaris (Linn.), a Nilotic species is thought to occur in Lake Victoria. Externally, this species resembles *C. mossambicus*. It differs, however, in having fewer gill rakers in the adult (20-30 on the first gill-arch) and having the vomerine teeth pointed and not granular. No specimens of *C. anguillaris* have been caught by E.A.F.R.O., nor were any taken by Michael Graham's survey (Graham, 1929). It is likely, therefore, that the record of this species from Lake Victoria was based on the misidentification of a specimen of *C. mossambicus*.

Clarias lazera Val. 1840

Native names: Mali (Lunyoro and in general use); Nyai (Jonam).

Description: Similar to *Clarias mossambicus;* the principal difference lies in the broader band of vomerine teeth (1⅓ to twice as broad as the band of premaxillary teeth).

Size: Specimens 140 cm. long have been recorded.

Food: Omnivorous, but mainly a predator on small fishes (*Haplochromis* and young *Tilapia*) (Worthington, 1932b; Poll, 1939). Poll (*op. cit.*) records a *Tilapia* 35 cm. long recovered from the stomach of a large *C. lazera*. Insect larvae, molluscs, planktonic organisms and water-weed are also eaten by this species. (Worthington, *op. cit.*)

Habitat: Lake Albert: Shallow water (Worthington, 1929a). *Lake Edward:* Widely distributed, but especially common at the mouths of rivers and near papyrus swamps (Worthington, 1929a; Poll and Damas, 1939). *Lake George:* Ubiquitous (Worthington, 1932b).

Breeding: Unknown in Uganda.

Economic importance: Of little importance in the fisheries of Lakes Albert and Edward, but ranks fourth amongst the commercially important fishes of Lake George (Uganda Government).

Distribution: Uganda: Lakes Edward, George and Albert; the Semliki river; Kirima river. *Elsewhere:* The Nile; rivers of west Africa, including the Congo; the Chad basin; Syria and Palestine.

Clarias moorii Boulenger 1901, known only from a single specimen from Lake Edward, is almost certainly an aberrant *C. lazera*. According to the description the principal difference between the two species is that the vomerine tooth-band of *C. moorii* is narrower than the premaxillary band, and the vomerine teeth are conical and not granular.

Clarias carsonii Boulenger 1903

Native names: Usually included in 'Mali' the general term for cat-fishes; also known as Nsonzi (Lunyoro, Lukenyi).

Description: Depth of body contained 6-9 times in the standard length, length of head 4-5 times. Head smooth above, its width contained 1⅓-1¼ times in the head length. Eye contained 3½-5 times in snout length. Nasal barbels shorter than the head; maxillary barbels shorter than the head, usually reaching the gill-opening. Outer mandibulars 1⅓-1½ times longer than the inner pair. Gill rakers coarse, 10-12 on the first gill-arch. Dorsal fin with 62-80 rays; the distance between the first ray and the supra-occipital process is contained 1⅓-2½ times in the head length. Anal fin with 55-65 rays. Pelvic fins situated markedly nearer the snout than the origin of the caudal fin.

Coloration: Grey-black, lighter below.

Size: Rarely exceeding 35 cm.; most individuals are about 20 cm. long.

Food: Principally insectivorous (Worthington, 1932b; E.A.F.R.O.), although larger individuals are piscivorous.

Breeding: Unknown.

Habitat: Lake Victoria: Marginal water-lily swamps, and in papyrus swamps. *Lake Edward:* Papyrus fringe of Lake George and the Kazinga Channel. *Lake Bunyoni:* Marginal weed-beds.

Economic importance: Only in Lake Bunyoni (where the species was introduced) does *C. carsonii* contribute to a commercial fishery. It is frequently caught in dams.

Distribution: Widespread in the streams (both temporary and permanent) of Uganda, and in Lakes Victoria, Kyoga and Edward. *Elsewhere:* Lake Mokoto (near Lake Kivu).

Worthington (1929a) records *Clarias phillipsi* Norman 1925 from Lake Kyoga. This species closely resembles *C. carsonii* but is differentiated by its slightly longer maxillary barbels (from as long as, to $1\frac{1}{3}$ times longer than, the head); it was previously known from the Kigezi district of south-west Uganda and Lake Kivu. The specific status of *C. phillipsi* is doubtful; it may represent a variant of *C. carsonii*.

Clarias alluaudi group. (Fig. 44)

Native names: Nsonzi (Lunyoro, Luruli, Lukenyi); Mali (Lake Victoria).

Description: Clarias alluaudi Boulenger 1906, and *C. werneri* Boulenger 1906, are included in this description. The two species are distinguished by the length of their nasal and maxillary barbels. However, these characters show considerable individual variability and specimens intermediate between *C. werneri* and *C. alluaudi* are common. There can be little doubt that *C. werneri* and *C. alluaudi* are, in fact, one species (see also Poll, 1939).

Depth of body contained 6-8 times in the standard length, length of head 4-5 times. Head smooth above, its width contained $1\frac{1}{4}$-$1\frac{1}{2}$ times in its length. Eye small. Nasal barbels longer than the head, variable in length, reaching at least to a point mid-way between the origin of the dorsal fin and the supra-occipital process, but often extending to well beyond the first dorsal fin rays. Maxillary barbels usually longer than the head and extending to the first dorsal rays or somewhat beyond. Outer mandibular barbels longer ($1\frac{1}{4}$-$1\frac{2}{3}$) than the inner pair. 12-20 gill-rakers on the first gill-arch. Dorsal fin with 65-90 rays, its distance from the supra-occipital process contained $2\frac{3}{5}$-4 times in the head length. Anal fin with 55-72 rays. Both the dorsal and anal fin are separated from the caudal by a very narrow space.

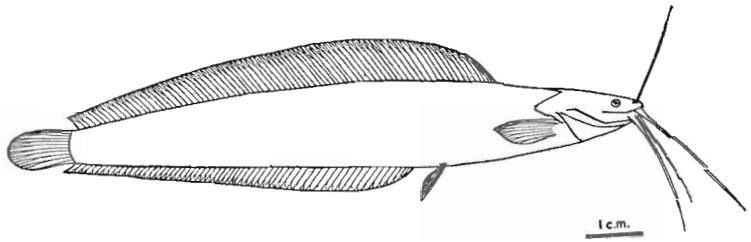

FIG. 44

Clarias alluaudi. (Drawn by Barbara Williams.)

Coloration: Dark khaki, occasionally greyish-black; lighter below.

Size: Small fishes, rarely exceeding 15 cm. in length; most adult individuals are about 11 cm. long.

Food: Mainly insectivorous (Corbet, 1961).

Habitat: Lake Victoria: marginal grass, water-lily and papyrus swamps. Habitats in Lakes Kyoga and Edward are probably similar. According to Worthington (1929a), *C. alluaudi* and *C. werneri* reach a larger size (23-25 cm.) in Lake Kyoga than in Lake Victoria.

Breeding: Unknown.

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Differs from *Clarias* mainly in possessing an adipose dorsal fin. One species occurs in Uganda.

Heterobranchus longifilis Val. 1840. (Fig. 45)

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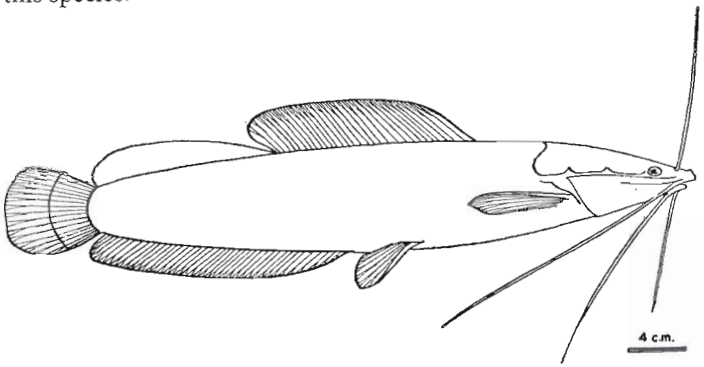

FIG. 45

Heterobranchus longifilis. (Drawn by Barbara Williams after Boulenger.)

Coloration: Dark greyish-black above, lighter below.

Ecology: No data are available for this species in Uganda, where it is rarely encountered. Worthington (1929a) records *H. longifilis* only from the turbulent waters below the Murchison Falls.

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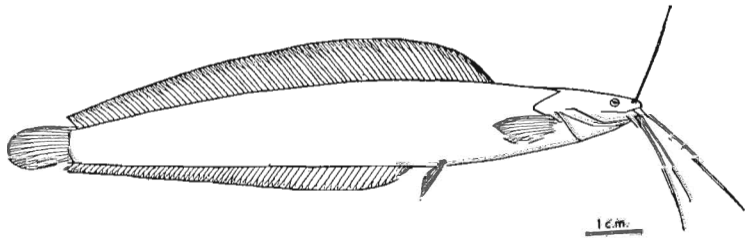

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Habitat: Lake Victoria: marginal grass, water-lily and papyrus swamps. Habitats in Lakes Kyoga and Edward are probably similar. According to Worthington (1929a), *C. alluaudi* and *C. werneri* reach a larger size (23-25 cm.) in Lake Kyoga than in Lake Victoria.

Breeding: Unknown.

Economic importance: Nil.

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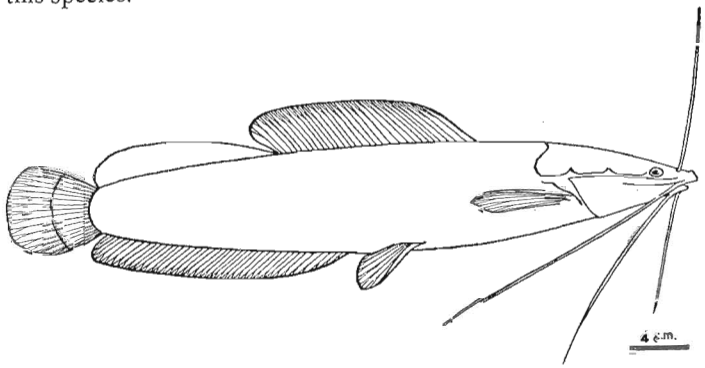

FIG. 45

Heterobranchus longifilis. (Drawn by Barbara Williams after Boulenger.)

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Ecology: No data are available for this species in Uganda, where it is rarely encountered. Worthington (1929a) records *H. longifilis* only from the turbulent waters below the Murchison Falls.

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Distribution: Uganda: Murchison Nile; Lake Edward. *Elsewhere:* Nile; Congo; Niger; Gambia; Zambesi; Lakes Tanganyika and Chad.

Family: Mochokidae

Body scaleless. Head heavily 'armoured'. Dorsal fin short, with a well-developed spine. Adipose dorsal fin long. Anal fin short. Mandibular barbels branched.

One genus occurs in Uganda. The Mochokidae are absent from Lake Edward.

Synodontis Cuvier 1817

Dorsal fin short, comprising a strong spine and 6 or 7 branched rays. Adipose dorsal fin large. Pectoral fin with a strong spine. Three pairs of barbels (the nasal barbels are absent), of which the two mandibular pairs are branched.

The pectoral spine is articulated by means of a complicated joint, so arranged that the spine can be firmly locked into its erected position. The serrated spines can inflict a painful wound, and these fishes should be handled with great care, even when dead. Although the spines seem to provide a powerful defensive mechanism, young *Synodontis* are eaten by predatory fishes and birds, whilst large adults have been found in crocodile stomachs (E.A.F.R.O., 1952).

Synodontis are sometimes referred to as 'talking fish' because of the grunts and squeaks produced when the fish is taken from the water. These sounds are produced by movements of the pectoral fin spine.

KEY TO THE SPECIES

It is extremely difficult to produce a simple and trenchant key to the species of *Synodontis*. The one given below is inadequate and should be used only as a guide; a detailed check should then be made by using the descriptions given for the species.

Outer mandibular barbels with slender branches 1

Outer mandibular barbels with short, tuberculate branches *S. nigrita*

1 16-21 mandibular teeth; eye contained $2\frac{1}{3}$-$2\frac{1}{2}$ times in interorbital width; humeral process as long as, to $1\frac{1}{2}$ times longer than it is deep *S. victoriae*

18-21 mandibular teeth; eye contained $1\frac{1}{3}$-$1\frac{3}{4}$ times in interorbital width; humeral process $1\frac{1}{2}$-2 times longer than deep *S. macrops*

23-36 mandibular teeth; eye contained $1\frac{3}{4}$-$2\frac{1}{4}$ times in interorbital width; humeral process at least twice as long as deep *S. schall*

30-48 mandibular teeth; eye contained $1\frac{2}{3}$-$1\frac{2}{5}$ times in interorbital width; humeral process $1\frac{1}{3}$-$1\frac{2}{5}$ times as long as deep *S. frontosus*

32-54 mandibular teeth; eye contained $1\frac{3}{4}$-$2\frac{1}{3}$ times in interorbital width; humeral process $1\frac{1}{2}$ times to twice as long as deep *S. afrofischeri*

Synodontis nigrita Val. 1840

Native name: Unknown.

Description: Depth of body contained 3-$3\frac{1}{2}$ times in the standard length. 30-35 mandibular teeth. Maxillary barbels with broad membranes proximally; extending to about the middle of the humeral process. The internal and external mandibular barbels with short, tuberculate branches. Humeral process $1\frac{1}{4}$ times longer than deep. Dorsal fin with a strong spine, serrated on its posterior face, and 7 or 8 branched rays; distance between the last dorsal ray and the origin of the adipose fin contained 1-$1\frac{1}{4}$ times in the length of the adipose fin. Pectoral spines weakly serrated on the outer face, strongly serrated on the inner.

Coloration: Dark brown to blackish, often with irregular black spots. Caudal fin spotted. The young are somewhat lighter in colour and covered with black spots and blotches, which extend onto all the fins; the caudal fin has from 4-6 sinuous, black bars.

Food: Unknown for Uganda fishes. Daget (1954) records plant debris and insects for specimens from the Niger.

Habitat: Unknown in Lake Albert. In the Upper Niger, the species is found in swamps, but not in the river itself (Daget, *op. cit.*). *S. nigrita* is apparently uncommon in Lake Albert. A number of young were collected by E.A.F.R.O. in the Semliki delta area.

Distribution: Uganda: Lake Albert. *Elsewhere:* Nile; Niger; Senegal; Gambia; Volta.

Synodontis victoriae Boulenger 1906

Native names: Nkolongo (Lake Victoria); Kigogole (Lunyoro and Luruli); Takutaku (Lunyara); Kaitampio (Lukenyi); Okoke (Ludope); Gologolo (Lango).

Description: Depth of body contained $3\frac{3}{4}$-$4\frac{1}{2}$ times in the standard length. 16-21 manibular teeth. Maxillary barbels reaching the posterior tip of the humeral process, or occasionally, somewhat beyond. Mandibular barbels with slender branches. Depth of humeral process contained once to $1\frac{1}{2}$ times in its length. Dorsal fin consisting of a spine, weakly serrated on its posterior face, and 6 or 7 branched rays. Distance between the last dorsal ray and the origin of the adipose fin contained $1\frac{1}{3}$-2 times in the length of the adipose fin. Pectoral spine moderately serrated on its outer face in small fishes and only feebly so in larger individuals; strongly serrated on the inner face.

Coloration: Greyish-silver, with dark spots of variable size. Caudal fin occasionally spotted. Coloration of juveniles unknown.

Size: Rarely exceeding 35 cm. standard length. Sexually mature females 11 cm. long are known from Lake Victoria. Worthington (1929a) is of the opinion that in Lake Kyoga the species is smaller than in Victoria.

Food: Mollusca (particularly bivalves) and insect larvae (Graham 1929; Worthington 1929a and Corbet, 1961). It seems likely that *S. victoriae* is a facultative feeder, and that the diet varies both with the habitat of the fish and the abundance of the food organisms.

Habitat: Lake Victoria: Little precise information is available. *S. victoriae* is apparently most common in water more than 40 feet deep, although the species does occur in shallow water (E.A.F.R.O.; Graham, 1929). *Lake Kyoga:* Almost completely restricted to the open waters (Worthington, 1929a).

Breeding: Unknown.

Economic importance: Slight.

Distribution: Known only from Lake Victoria and its affluent rivers, Lake Kyoga and the Victoria Nile.

Synodontis macrops Greenwood 1963

Native name: Unknown.

Description: In general appearance this species resembles *Synodontis schall*, but it is easily distinguished by its larger eye (see key to the species).

Depth of body contained 3⅓-4 times in standard length. Skin on the anterior part of the body villose (i.e. 'hairy' in appearance). 18-21 mandibular teeth. Maxillary barbels reaching a point at least midway along the humeral process. Outer mandibular barbels with slender branches, the inner mandibular pair with short, tuberculate branches on the anterior third, the other branches short but slender. Humeral process acutely pointed, its depth contained 1½-2 times in its length. Dorsal fin consisting of a spine (weakly granulate on its anterior face and weakly serrated behind) and 6 or 7 branched rays. Distance between the adipose dorsal fin and the last dorsal ray contained 2½-4⅓ times in the length of the adipose fin. Pectoral spine with small but distinct serrations on its anterior face and larger, stronger serrations on its posterior face.

Coloration: Unknown in live fishes. In preserved specimens, light grey above, light brownish-grey below, the head and upper part of the body with a spaced peppering of small black spots.

Size: The largest recorded specimen is 12.6 cms. standard length.

Ecology: Nothing is known, except that the species has only been recorded from a river.

Distribution: Known only from a tributary of the Aswa river in the Teso district.

Synodontis schall (Bloch-Schneider) 1801. (Fig. 46)

Native names: Wahrindi (Lunyoro, Lugungu, and in general use); Kamuduli (Alur); Lungu (Jonam).

Description: Depth of body contained 3-4 times in the standard length. 23-35 mandibular teeth. Maxillary barbels reaching to a point mid-way along the humeral process, or, to the posterior tip of this process. Outer mandibular barbels with slender branches, the inner pair with somewhat stouter branches. Depth of the humeral process contained 1⅘-2 times in its length. Dorsal fin consisting of a spine (granulated on its anterior face, weakly serrated behind) and 6 or 7 branched rays. Distance between the adipose dorsal fin and the last dorsal ray contained 2⅓-4 times in the length of the adipose fin. Pectoral spine granulate on its anterior face, strongly serrated on the posterior face.

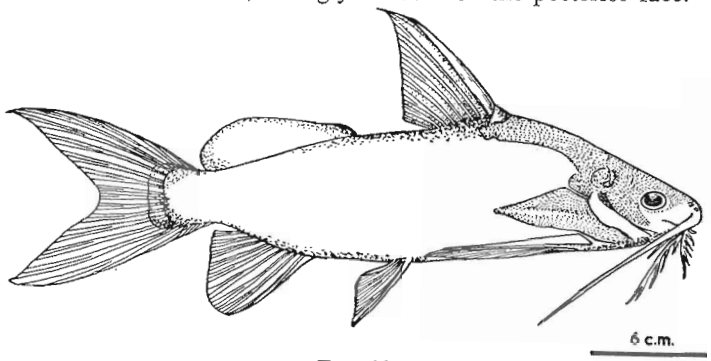

FIG. 46
Synodontis schall. (Drawn by Barbara Williams.)

Coloration: Olivaceous above, lighter (somewhat creamy) below; irregular spots sometimes occur on the body. Young fishes lighter, marbled by yellowish, irregular and sinuous bands.

Size: Attains a length of over 40 cm. according to Sandon (1950) and Worthington (1929a).

Food: Predominantly molluscs, but also insect larvae and even small fishes (Worthington, 1929a).

Habitat: Lake Albert: Deep, open waters and also in shallower water nearer the shore (Worthington, *op. cit.*; Uganda Government; E.A.F.R.O.).

Breeding: Unknown.

Distribution: Uganda: Lake Albert, the Albert and Murchison Niles; Semliki river. *Elsewhere:* Nile; Lake Rudolf; Lake Chad; Niger; Senegal.

Synodontis frontosus Vaill. 1895. (Fig. 47)

Native name: Kwoke (Lunyoro, Alur, Jonam).

Description: Depth of body contained 3-4 times in the standard length. 30-48 mandibular teeth. Maxillary barbels usually reaching the posterior tip of the humeral process, but occasionally only as far as its origin. Outer mandibular barbels with slender branches, inner pair with shorter, tuberculate branches. Depth of the humeral process contained 1⅓-1⅔ times in its length. Dorsal fin consisting of a spine, smooth on its anterior face, strongly serrated on its posterior face, and 7 branched rays. Distance between the last dorsal ray and the origin of the adipose fin contained 2¼-4 times in the length of the adipose fin. Pectoral spine with a strongly serrated inner face; smooth anteriorly in fishes more than 20 cm. long, but serrated in smaller individuals.

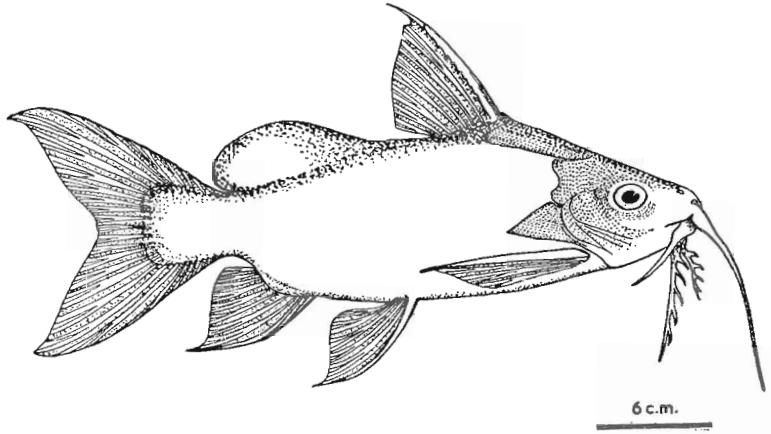

FIG. 47
Synodontis frontosus. (Drawn by Barbara Williams.)

Coloration: Dark olivaceous or brown, peppered with small black spots.

Size: Attains a length of 35 cm. in Lake Albert.

Food: Little information available; from Worthington's data (1929a) *S. schall* is a bottom feeder.

Habitat: Deep (120 feet) open waters and shallow inshore areas of Lake Albert (Worthington, 1929a; E.A.F.R.O.)

Breeding: Unknown.

Economic importance: Negligible.

Distribution: Uganda: Lake Albert; the Albert and Murchison Niles. *Elsewhere:* The White Nile; Omo river; Lake Rudolf.

Synodontis afrofischeri Hilgend. 1888. (Fig. 48)

Native name: Unknown.

Description: Depth of body contained $3\frac{1}{2}$-$4\frac{1}{2}$ times in the standard length. 32-54 mandibular teeth. Maxillary barbels reaching almost to the origin of the pelvic fins in some fishes, and to the posterior tip of the humeral process in others. Outer mandibular barbels with slender branches, inner pair with shorter, but slender, branches. Depth of humeral process contained $1\frac{1}{2}$-2 times in its length. Dorsal fin consisting of a spine, smooth anteriorly and serrated on its posterior face, and 7 branched rays. Distance between the last dorsal ray and the origin of the adipose fin contained once to $1\frac{1}{3}$ times in the length of the adipose fin. Pectoral spine strongly serrated on its anterior face, very strongly serrated on the posterior face.

Coloration: Marbled yellowish-brown. The extent of the marbling is extremely variable, and uniformly brown fishes have been seen. In many fishes, scattered dark spots occur on the body.

Size: A small species rarely exceeding 15 cm. standard length.

Food: Molluscs and insect larvae, especially the latter (Corbet, 1961).

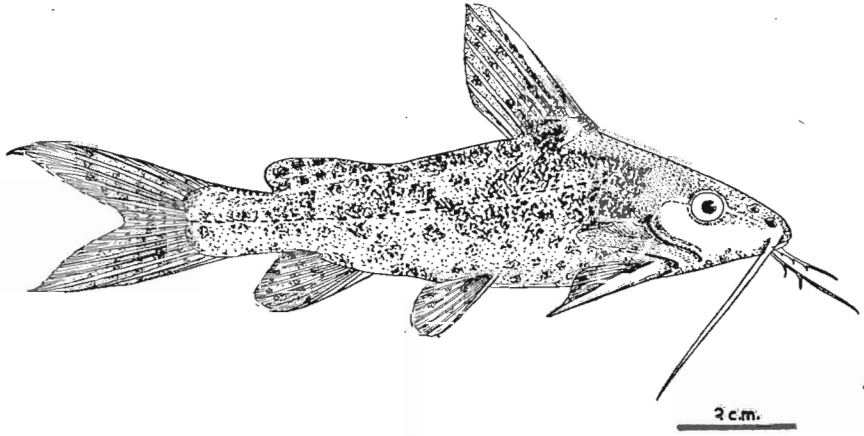

FIG. 48

Synodontis afrofischeri. (Drawn by Barbara Williams.)

Habitat: There are few data available from either Lake Victoria or Lake Kyoga. It seems likely that in Lake Victoria, *Synodontis afrofischeri* replaces *S. victoriae* in the shallow waters. The species has not been caught in water over 60 feet deep. It is common in the marginal vegetation of the Kagera river.

Breeding: Unknown.

Economic importance: Nil.

Distribution: Known only from Lakes Victoria, Nabugabo and Kyoga; the affluent rivers of Lake Victoria, and the Victoria Nile.

Family: Amphiliidae

Body scaleless. Head and anterior part of the body somewhat flattened. Dorsal and anal fins short, the former without a spine. Adipose dorsal fin short. Outer ray of pelvic fin thickened but not bony. Three pairs of unbranched circum-oral barbels (the nasal barbels absent).

This family of small cat-fishes is confined to Africa. A single genus occurs in Uganda.

Amphilius Günther 1864

Diagnostic characters as for the family. Only one species is recorded from Uganda.

Amphilius jacksonii Boulenger 1912. (Fig. 49)

Native name: Unknown.

Description: Depth of body contained $6\frac{1}{2}$-7 times in the standard length, length of head $4\frac{2}{3}$-5 times. Head flattened, slightly longer than broad. Snout rounded. Eye small, its diameter contained 5-6 times in the length of the head. Posterior nostril nearer the eye than the end of the snout. Maxillary barbels shorter than the head, reaching to slightly beyond the first, thickened, pectoral ray. Dorsal fin with one unbranched and six branched rays. Pelvic fins situated behind the last dorsal ray.

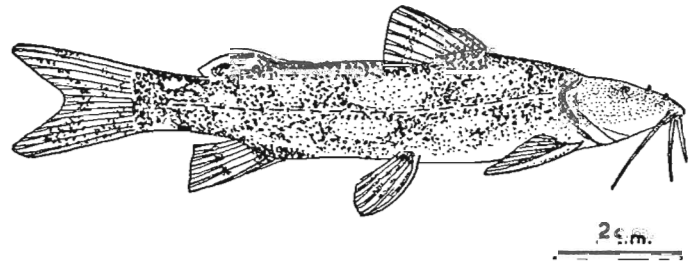

FIG. 49

Amphilius jacksonii. (Drawn by Barbara Williams.)

Coloration: Marbled and blotched yellowish-brown above, lighter and uniform below. Fins yellowish; caudal spotted; dorsal and anal fins with a dark base and an interrupted black line near the tip.

Size: Small fishes, not known to exceed 10 cm. in length.

Food: Unknown.

Habitat: Fast flowing streams.

Distribution: Uganda: Hima river (flowing into Lake George); Awuka and Agoye rivers (E.A.F.R.O. collected by P. Hainsworth). *Elsewhere:* Rutshuru river (flowing into Lake Edward) Congo Republic.

Family: Malapteruridae

Body scaleless, cylindrical and somewhat bloated in appearance. Head covered with thick skin. Rayed dorsal fin absent; a moderately developed

adipose fin present and situated near the caudal fin. Anal fin short, situated below the adipose dorsal fin. Three pairs of unbranched circum-oral barbels (nasal barbels absent). A well-developed electric organ encases most of the body.

This family is found only in Africa, where it is represented by a single genus and species.

Malapterurus electricus (Gmelin) 1789. (Fig. 50)

Native names: Ntera (Lunyoro); Adinga (Alur); *English:* Electric cat-fish. The Arabic name, 'Raad', meaning thunder, is singularly appropriate.

Description: The diagnostic characters given above, together with the figure, will serve to identify this altogether repulsive fish. The electric organ is capable of giving a powerful shock and the fish should be handled with great care, preferably through some non-conducting medium. Previously, the electric organ of *Malapterurus* was thought to be developed from certain elements in the skin. Recent research (Johnels, 1956) strongly suggests, however, that the organ, like that of other electric fishes (see Chaper II), is derived from modified muscle-fibres. The function of the electric organ is unknown. It undoubtedly serves as a powerful means of defence and may also stun and immobilize the fish's prey. Despite the unpleasant appearance of *M. electricus,* its flesh is reputed to make good eating.

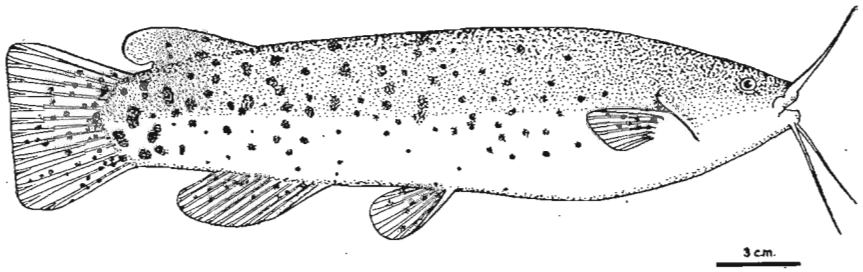

FIG. 50

Malapterurus electricus. (Drawn by Barbara Williams.)

Coloration: Greyish-silver above, dead-white below, the body and fins covered with irregular and often large black blotches. The caudal and anal fins are outlined with a pinkish band.

Size: Specimens 120 cm. long are known from the Niger (Daget, 1954) but no data are available from Uganda.

Ecology: No information has been collected for this species in Uganda. In the Malagarasi river (Tanzania) *M. electricus* was caught in the reed-beds flanking the fast-flowing sections of the river. These fishes had been feeding on other fish.

Distribution: Uganda: Lake Albert. *Elsewhere:* The whole Nile system; Chad basin; Lake Rudolf; rivers of west Africa; the Zambesi; Lake Tanganyika and the Malagarasi river.

TABLE VII

Distribution of Siluroid fishes in Uganda

LAKES	Victoria	Kyoga	Edward and George	Albert	Elsewhere
Bagrus docmac	P	P	P	P	Lake Nabugabo, Semliki river, Albert, Victoria and Murchison Niles
Bagrus bayad				P	
Auchenoglanis occidentelis ..				P	Murchison and Albert Niles, Aswa river
Schilbe mystus	P	P		P	Lake Nabugabo, Victoria Nile, Semliki river, Aswa river
Eutropius niloticus				P	Albert Nile; Semliki river
Clarias mossambicus	P	P			Lake Nabugabo; the Koki lakes, Rivers flowing into Victoria, Aswa river
Clarias lazera			P	P	Semliki and Kirima rivers
Clarias carsonii	P	P	P		Widespread in streams
Clarias alluaudi group ..	P	P	P		Lake Nabugabo; the Koki lakes; widespread in streams, Aswa river
Synodontis nigrita				P	Semliki river
Synodontis victoriae ..	P	P			Victoria Nile
Synodontis schall				P	Albert and Murchison Niles
Synodontis frontosus ..				P	Albert and Murchison Niles
Synodontis afrofischeri ..	P	P			Lake Nabugabo, Victoria Nile Aswa river
Synodontis macrops					Hima, Aduka and Agoye rivers
Amphilius jacksonii					
Malapterurus electricus ..				P	
Heterobranchus longifilis ..			P (Edward)		Murchison Nile
Clariallabes petricola ..	P				Victoria Nile
Xenoclarias holobranchus ..	P				
Xenoclarias eupogon	P				

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CHAPTER VI

ORDER: MICROCYPRINI

FAMILY: CYPRINODONTIDAE (MOSQUITO-FISHES)

Body and head covered by scales. Mouth protractile and directed obliquely upwards. Lateral line absent. Dorsal, anal and pelvic fins without spines. No circum-oral barbels.

The Cyprinodontidae are a family of small fishes, often brightly coloured and greatly favoured by aquarists. The African members of the family are oviparous and carnivorous.

The identification of cyprinodonts is not simple, and, as in many other families of fishes occurring in Uganda, there is still much to be learned of their ecology and taxonomy.

KEY TO THE GENERA

First dorsal fin ray situated above or very slightly in advance of the first anal ray — *Nothobranchius* (p. 96)
First dorsal fin ray situated well behind the first anal ray — 1

1 Body slender, not deepening markedly in the abdominal region (depth of body contained $3\frac{1}{2}$-$5\frac{3}{4}$ times in the standard length) — *Aplocheilichthys* (p. 98)
Body deep (depth contained less than $3\frac{1}{2}$ times in the standard length), abdomen compressed (at least in males) — A

A Teeth in several irregular rows, those of the outer rows in both jaws enlarged and more widely spaced than the teeth of the inner series. Anal fin with 19-21 rays — *Hypsopanchax* (p. 99)
Teeth in several irregular rows, but some teeth in the outer rows of each jaw greatly enlarged and canine-like. Anal fin with 15 or 16 rays — *Cynopanchax* (p. 100)

Nothobranchius Peters 1868

Origin of the dorsal fin in the same vertical line as the origin of the anal fin, or slightly anterior to it.

This genus is widely distributed in Africa; its range extends from Somaliland to Natal and from the Great Lakes to northern Nigeria, with species in the Seychelles and Zanzibar. One species occurs in Uganda.

Nothobranchius taeniopygus (Hilgendorf) 1888. (Fig. 51)

Native name: Unknown.

Description: Small fishes not exceeding 5 cm. in length. Depth of body contained $3\frac{1}{2}$-$3\frac{3}{4}$ times in the standard length. Body 'chubby'. Upper surface of head curved from between the eyes posteriorly, but somewhat flattened anteriorly. Snout short and broad. Mouth directed upwards; the space between

the eye and the lip narrow. Dorsal fin with 16 or 17 rays, its origin slightly in advance of the first anal ray. Anal fin with 16-18 rays. Caudal fin rounded. 30 or 31 scales in a longitudinal series (lateral line pores absent, but indicated by an interrupted line of pits). 22-24 scales around the body immediately in front of the pelvic fins.

Coloration: Males brightly coloured, the body and fins reddish, flecked with turquoise or green; a bright orange band, bordered ventrally with black, on the anal fin. Females rather drab, bluish-grey.

Ecology: Since this species is rarely encountered in Uganda, nothing is known of its ecology in this country. Some notes on *N. taeniopygus* in Tanzania

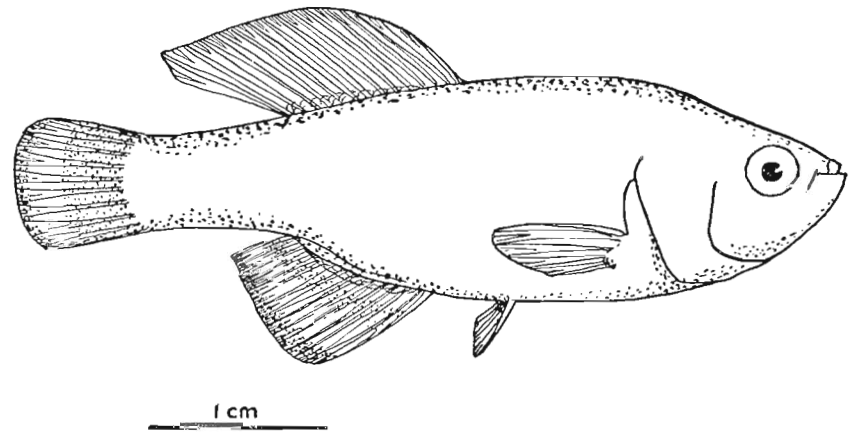

FIG. 51

Nothobranchius taeniopygus. (Drawn by Barbara Williams.)

have been published (Vanderplank, 1941). In Tanzania the species lives in temporary streams; breeding takes place during the rainy season. Drought resistant eggs are deposited in the mud, where they remain throughout the dry season; when the streams are filled again, the embryos resume and complete their development. According to Vanderplank, young *N. taeniopygus* feed on Protozoa, and the adults on crustaceans and insect larvae.

Further studies on this species would be of particular interest since few African fishes are known to produce drought-resistant eggs. *Nothobranchius taeniopygus* is tolerant of a wide temperature range (Vanderplank, *op. cit.*) and lives well in aquaria.

Distribution: In Uganda, the species has been found in streams near Lake Victoria and in the Soroti district (E.A.F.R.O.) including the Aswa river. *Elsewhere:* it is recorded from streams, rivers and small lakes in Tanzania.

Aplocheilichthys Bleeker 1863

Body relatively slender, its depth contained $3\frac{1}{2}$-$5\frac{3}{4}$ times in the standard length. Origin of the dorsal fin behind the first anal ray. Dorsal surface of the head flattened. Teeth in several rows, those of the outermost row somewhat enlarged.

The genus is widely distributed in tropical Africa, extending as far south as Zululand and Angola. Four species, and possibly a fifth, are recorded from Uganda.

KEY TO THE SPECIES

24-30 scales in a longitudinal series	1
36-39 scales in a longitudinal series	*A. pelagicus*
1 Dorsal fin with 7-8 rays	*A. kassenjiensis*
Dorsal fin with 9-11 rays	(i)
(i) Caudal fin shorter than the head	*A. pumilus*
Caudal fin longer than the head	*A. eduardensis*

Aplocheilichthys pelagicus (Worthington) 1939

Description: Body markedly elongate, its depth contained 5-5¾ times in the standard length. Dorsal fin with 9-11 rays, anal fin with 14-16 rays. Caudal fin somewhat truncated. Scales relatively small, 36-39 in a longitudinal series; 22-24 scales around the body in front of the pelvic fins.

Coloration: Bright yellow, a dark mid-lateral streak; caudal fin edged with black.

Size: Not exceeding 5 cm. standard length.

Ecology: Aplocheilichthys pelagicus is unique amongst the east African members of the genus in that it inhabits the surface layers of the deep, open waters of a lake (Worthington, 1932a). Other species are generally confined to shallow, inshore water and to rivers.

The food of *A. pelagicus* consists of planktonic crustaceans and some insect larvae (Worthington, 1932b).

Worthington (*op. cit.*) is of the opinion that *A. pelagicus* spawns in the open waters.

Distribution: Known only from Lake Edward.

Aplocheilichthys kassenjiensis (Ahl) 1924

Description: Depth of body contained 3-4 times in the standard length. Dorsal fin with 7 or 8 rays, anal fin with 15 rays; 24-26 scales in a longitudinal series, 18-20 around the body in front of the pelvic fins.

Coloration: Yellow, with a thin, black mid-lateral stripe.

Size: Not known to exceed 32 mm. standard length.

Ecology: No data are available.

Distribution: Known only from Lake Albert.

Note: Poll (1952b) is of the opinion that this species may be identical with *Aplocheilichthys loati* (Blgr.), which occurs in the White Nile.

Aplocheilichthys pumilus (Boulenger) 1906. (Fig. 52)

Description: Depth of body contained 3¾-4¾ times in the standard length. Dorsal fin with 10 or 11 (rarely 9) rays, anal fin with 13-16 rays. 25-29 scales in a longitudinal series, 16-18 around the body in front of the pelvic fins. Caudal fin shorter than the head (rarely almost as long as the head).

Coloration: Orange-yellow above, turquoise below. Fins faint orange-yellow. An iridescent blue spot on the operculum. When seen from above, the eyes are bright silver.

Size: Not exceeding 5 cm.

Habitat: Lake Victoria: Marginal vegetation, including papyrus swamps. The species has also been found in temporary streams flowing into the lake.

Food: Insect larvae and small crustaceans (E.A.F.R.O.).

Distribution: Uganda: Lakes Victoria, Nakivali and George; the affluent streams of Lake Edward (including those in the Congo Republic); the Victoria Nile. *Elsewhere:* Lake Tanganyika and its affluent streams.

Note: Poll (1952b) draws attention to the great similarity between *A. pumilus* and *A. mahagiensis* (David and Poll), a species known only from Lake Albert. *A. mahagiensis* differs from *A. pumilus* mainly in its slightly deeper body (3-3½ times in standard length) and longer caudal fin (as long as the head). More specimens of *A. mahagiensis* are required before the relationship of the two species can be determined satisfactorily.

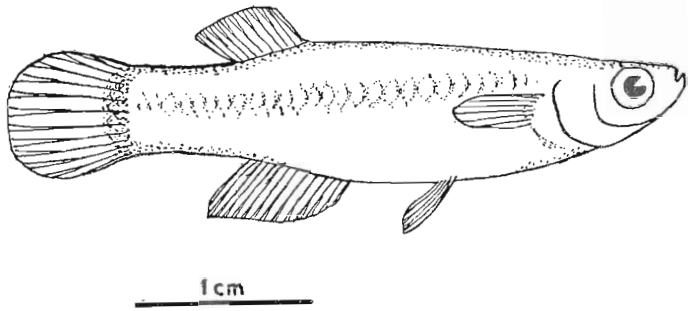

FIG. 52

Aplocheilichthys pumilus. (Drawn by Barbara Williams.)

Aplocheilichthys eduardensis (David and Poll) 1937

Description: Depth of body contained 3½-4½ times in the standard length. Dorsal fin with 9 or 10 (rarely 8 or 11) rays, anal fin with 14-16 rays. 28-30 scales in a longitudinal series, 20-26 scales around the body in front of the pelvic fins. Caudal fin longer than the head.

Coloration: Olivaceous-yellow, the scales with dark borders; a fine black line mid-laterally.

Size: Not exceeding 5 cm. standard length.

Ecology: No data available.

Distribution: Lake Edward, its affluent rivers (including those in the Congo Republic), and the Semliki River. Percy and Ridley (1955) consider that some cyprinodont fry collected by them at the edge of the Niansimbi Hot Swamp (Bwamba) should be referred to this species. A single specimen was also obtained by the same party in the Mongiro River, near the Mbuga Hot Spring.

Three *Aplocheilichthys*, which agree with *A. eduardensis* in all characters, were caught in Lake Victoria at Bugungu near Jinja (E.A.F.R.O.); further specimens are awaited with great interest. The shoals from which these specimens were obtained were smaller than the shoals of *A. pumilus* in the same habitat, and were not seen to swim near the surface, as is typical of *A. pumilus*.

Hypsopanchax Myers 1924

Resembles *Aplocheilichthys*, but with a markedly deeper body especially in the abdominal region, which is compressed in males. Teeth in several irregular rows, those of the outer rows in both jaws somewhat enlarged and more widely

spaced than the teeth of the inner series. In Uganda, at least for the present, this genus may be recognized easily by the high number (19-21) of anal rays.

One species occurs in Uganda.

Hypsopanchax deprimozi (Pellegrin) 1928

Description: Depth of body, in adult males, contained $2\frac{1}{2}$-3 times in the standard length, and, in females $3\frac{3}{4}$-4 times. Dorsal fin with 12 or 13 rays, anal fin with 19-21 rays. 30-33 scales in a longitudinal series, 22-26 around the body in front of the pelvic fins.

Coloration: Pale yellow, the edges of the scales darker in males; fins pale.

Ecology: The species is apparently confined to rivers (Poll, 1939; Worthington, 1932b).

Distribution: Affluent rivers of Lake Edward (including those in the Congo Republic) and the Semliki River.

Note: *Haplochilichthys analis* Worthington 1932, is considered to be a synonym of *H. deprimozi* (Poll, 1939).

Cynopanchax Ahl 1928

Resembles *Hypsopanchax* and *Aplocheilichthys;* the teeth are in three series in each jaw, with those of the outermost row greatly enlarged, curved and canine-like.

A single, apparently rare species is known, and is recorded only from Bukoba Tanzania, Lake Victoria.

Cynopanchax bukobanus (Ahl) 1924

Description: Body moderately deep, strongly compressed. Dorsal fin with 10 or 11 rays, its origin above the middle of the anal fin, which comprises 15 or 16 rays.

The only specimens of *C. bukobanus* are those from which the species was described; no others have been collected subsequently.

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TABLE VIII

Distribution of species of the families Cyprinodontidae, Anabantidae and Mastacembelidae in Uganda.

LAKES	Victoria	Kyoga	Edward	Albert	Elsewhere
Cyprinodontidae					
Nothobranchius taeniopygus					Streams near Lakes Victoria, Kyoga, and Aswa River
Aplocheilichthys pelagicus ..			P		
Aplocheilichthys kassenjiensis				P	
Aplocheilichthys pumilus ..	P	?			Lakes George and Nabugabo; streams flowing to L. Edward.
Aplocheilichthys eduardensis	P		P		Semliki and Mongiro rivers. Affluent streams and rivers of L. Edward
Hypsopanchax deprimozi ..					Semliki river; affluent streams and rivers of L. Edward
Cynopanchax bukobanus ..	P				
Anabantidae					
Ctenopoma muriei ..	P	P	P		Affluent streams of these lakes
Ctenopoma damasi ..			P		Affluent streams of L. Edward
Mastacembelidae					
Mastacembelus frenatus ..	P	P			Victoria Nile, Aswa river

CHAPTER VII

ORDER: PERCOMORPHI

SUB-ORDER: PERCOIDEA

Family: Centropomidae

Head and body covered by scales. Mouth protractile, the maxilla large and not completely covered by the pre-orbital bone. Two nostrils on each side. Lateral line continuous.

Most members of the Centropomidae are marine fishes; one genus, *Lates*, is found in the fresh waters of Africa.

Lates Cuvier 1828

Body deep, somewhat compressed; scales small and ctenoid. Small villiform teeth in the jaws and on the vomer, palatines and ectopterygoids (bones forming part of the roof of the mouth). Pre-orbital and pre-opercular bones armed with spines; a large spine on the free edge of the operculum. Dorsal fin almost completely divided into two parts by a deep notch; the anterior part comprises 7 or 8 spines and the posterior part one spine and 10-14 branched rays.

The Nile Perch *Lates niloticus* (Linné) has long excited the interests of man. Over two thousand five hundred years ago, *L. niloticus* was worshipped by the Egyptians. A special *Lates* cult was centred at Esneh, on the Upper Nile, where numerous mummified *Lates* have been recovered from a burial ground near the town (Gudger, 1947). *Lates* were also recovered from an animal-cemetery at Gurbo, about sixty miles south of Cairo. Although other animals were found in this burial ground, it is clear that preferential burial was given to the *Lates*, thus suggesting that these fishes were of more than usual significance (Gudger, *op. cit.*). A brief account of *Lates* in the religious life of early Egypt is given by Gudger in the paper referred to above.

At present, interest in *Lates* is mainly confined to anglers and fishermen. As might be expected, there are decided schools of thought on the angling qualities of the fish (see Kinloch, 1956; Anderson, 1956 and McCormick, 1949), but there is no disagreement regarding the high palatability of its flesh.

The student of African freshwater fishes too, has a special interest in *Lates* because of its distribution in the Great Lakes, and of the effect it may have or have had, on the other fishes in these lakes. Again, opinions are divided (see Worthington, 1954; Fryer and Iles, 1955; Fryer, Greenwood and Jackson, 1965).

Lates are found in the Nile from Lake Albert to the Delta region, but no *Lates* occur naturally in present-day Lakes Edward, George, Victoria or Kyoga. The genus also occurs in Lake Tanganyika and in the Senegal, Niger and Congo river systems, but is absent from the Zambesi and other rivers of southern Africa.

Lates were, however, present in the Lake Victoria basin during the Miocene period (about 25,000,000 years ago) and persisted until comparatively recent

times in Lake Edward (Greenwood, 1959). It is not yet possible to determine what factors were responsible for the extinction of *Lates* in these lakes; that the genus was prevented from recolonizing Lakes Edward and Victoria is undoubtedly due to the barriers offered by the Semliki rapids and the Murchison falls.

It is still uncertain whether one or two species of *Lates* occur in Uganda. Worthington (1929b) described two endemic species from Lake Albert. One of these species, *L. macrophthalmus*, was thought to inhabit open waters, 60-120 feet deep, and the other species *L. albertianus*, was thought to be restricted to inshore and shallow waters. Later, Worthington (1940) expressed the opinion that the two "species" were not distinct and that they should be considered as subspecies. This was the view adopted by David and Poll (1937), and was followed in the first edition of this book. However, evidence collected by Mr. M. J. Holden during a recent survey of Lake Albert seems to confirm Worthington's original ideas that two species are present, one in deep water, the other in shallow water. I am extremely grateful to Mr. Holden for discussing this unpublished information with me.

KEY TO SPECIES

Length/depth ratio of the caudal peduncle $1\frac{1}{3}$-$1\frac{2}{3}$	*Lates albertianus*
Length/depth ratio of the caudal peduncle $1\frac{1}{2}$-2	*L. macrophthalmus*

Lates albertianus Worthington 1929. (Fig. 53)

Native names: Mputa (Lunyoro and in general use); Gurr (Alud and Jonam). *English:* Albert Perch.

Description: The generic description, together with the figure, should enable

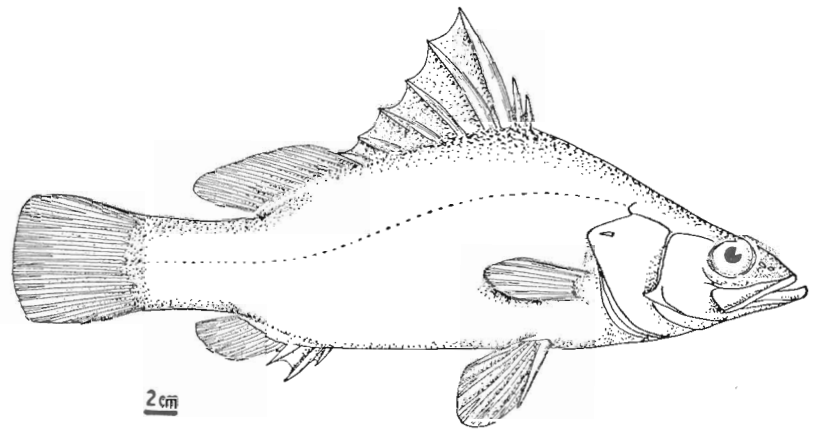

FIG. 53
Lates albertianus. (Drawn by Barbara Williams.)

the species to be identified immediately. It differs from the other species of Lake Albert in having a relatively deeper caudal peduncle and the eye appears to be somewhat smaller, but this character cannot be relied upon as eye-size is variable in adult fishes and is proportionately greater in small fishes.

Coloration: Silvery, darker above and almost white below. Young fishes, particularly those caught amongst reeds, are mottled with irregular dark-brown blotches.

Size: The largest recorded specimen weighed 360 lb. and was caught in a seine-net; the heaviest fish caught by angling weighed 226 lb. and was six feet long (Kinloch, 1956).

Economic importance: Lates albertianus is of considerable importance in the fisheries of Lake Albert, particularly in the catches made by nine-inch mesh gill-nets and in seine nets.

Ecology: Despite the great importance of this fish, very little is known of its ecology in Lake Albert. Breeding habits are unknown and no detailed analysis of its food and feeding habits is yet available. Worthington's original study (1929a) remains the most comprehensive published account. According to Worthington (*op. cit.*) young *Lates* feed mainly on invertebrates, particularly prawns (*Caridina nilotica*) and insect larvae. Larger individuals (75-170 cm. long) feed almost exclusively on other fishes, but it is not known whether any particular genus, or group of genera, forms the main item in the diet. Worthington (*op. cit.*) considered that *L. albertianus* is restricted to the shallow, inshore waters of Lake Albert and to the Murchison Nile, but that it occasionally moved into deeper waters. The species is abundant in sheltered bays.

Sport: Lates albertianus can certainly be ranked amongst the premier sporting fishes of Uganda. Full accounts of tackle, baits and good fishing areas are given by Kinloch (1956) and Anderson (1956). Further accounts of angling for 'Perch', and some statistics of catches, are given by Margach (1948) and McCormick (1949).

Distribution: Known only from Lake Albert, the Albert and Murchison Niles. The closely related *Lates niloticus* is widely distributed in Africa, occurring in the Nile system, the Congo, Niger, Volta and Senegal, and in Lake Chad. Recently, the Uganda Game and Fisheries Department introduced *L. albertianus* into Lake Victoria, the Victoria Nile (below the Owen Falls dam) and Lake Kyoga. It seems that the species has become established in Lake Victoria; the ecological consequences, and especially the effect on the local fish fauna, have still to be seen.

Lates macrophthalmus Worthington 1929

Native name: Apparently no distinction is made between this fish and *L. albertianus;* consequently the term 'Mputa' is used to cover both species.

Description: Very similar to *L. albertianus,* but distinguished by its more slender caudal peduncle (length/depth of caudal peduncle $1\frac{1}{2}$-2 cf. $1\frac{1}{3}$-$1\frac{2}{3}$) and by the longer third dorsal spine. The principal difference between the two species is thought to be ecological, namely, that *L. macrophthalmus* occurs offshore in deep waters whereas *L. albertianus* is found inshore and in shallow water.

Coloration: Similar to *L. albertianus.* Worthington (1929b) notes that the young of *L. macrophthalmus* are not mottled or blotched, but this may be a consequence of the habitat in which they were caught (see above).

Ecology: Apparently confined to water more than 60 feet deep (Worthington, 1929a and b). The food of adult fishes is probably similar to that of large *L. albertianus* (Worthington, *op. cit.*). No precise data on breeding habits are available. Worthington (*op. cit.*) believes that *L. macrophthalmus* breeds

in deep water. This view was based on the capture of sexually active adults, and of fry 4-9 cm. long, in the open waters of Lake Albert.

Distribution: Known only from Lake Albert.

Periodic mortality of *Lates* in Lake Albert

The occurrence of periodic mass mortalities of *Lates* in Lake Albert has been known for many years, but there is still no positive explanation for the phenomenon. A peculiar aspect of these mortalities is the fact that apparently only *Lates* are affected and that more large than small fishes are killed.

A recent explanation for these sudden and widespread deaths is based on a combination of certain physiological peculiarities of the fishes coupled with certain hydrological changes taking place in the lake (see Fish, 1956 and Beauchamp, 1956). *Lates* are intolerant of moderately deoxygenated water and die of asphyxiation if the oxygen content of the water falls below a level which would not seriously affect many other species (Fish, *op. cit.*). At certain times of the year the main inflow of water to Lake Albert (from the Semliki River) is cooler than the lake; this relatively cold water, being denser than the warm lake-water, sinks to, and flows along the bottom of the lake without mixing with the upper layers of water. The cool lower layer is in contact with the bottom deposits of the lake, and could therefore become deoxygenated more rapidly than the upper layers, especially since these are agitated by wind action.

Because their oxygen requirements are greater, *Lates* living in deep water would be affected by this deoxygenation more severely than would the other fishes.

Other factors, such as heavy parasitization of the gills (to which *Lates* is particularly prone) and the general condition and age of the fishes, are undoubtedly contributory factors in a mass mortality.

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CHAPTER VIII

SUB-ORDER: PERCOIDEA, *continued*

Family: Cichlidae

Body-form variable; scales ctenoid or cycloid. Head not completely covered by scales. Mouth protractile; teeth variable in form and number; no teeth on the vomer, palatines or pterygoids (bones forming part of the roof of the mouth). Well-developed lower pharyngeal teeth are carried on a triangular bone. A single nostril on each side. Lateral line interrupted, usually in two parts.

This family is widely distributed in the fresh waters of Africa, Central and South America, and in Syria, Israel, Madagascar, India and Ceylon. Certain species inhabit brackish waters.

In Africa, the Cichlidae are the predominant freshwater percomorph fishes and have long attracted the attention of biologists, both from the scientific and economic viewpoints. Although no cichlid species attains the great size of the Nile Perch (*Lates*), the family is of great economic importance in most east African lakes; for example major fisheries in Lakes Victoria and George are based on the exploitation of *Tilapia* species.

Certain east and central African genera, in particular the genus *Haplochromis*, provide interesting problems in evolution. In each major lake there is a unique flock of species exhibiting a wide range of adaptive types which have evolved within the lake basin during geologically recent times (Brooks, 1950; Greenwood, 1951a, 1956a and b, 1965a).

The phenomenon of parental care is well developed in the majority of African cichlids. In most species the female carries the fertilized eggs and, subsequently, the young larvae in her mouth. Even when the young are free-swimming, the female guards the shoal and takes the brood back into her mouth at the first signs of approaching danger. Those species which do not practise mouth brooding guard their eggs and young for some time after spawning.

The identification of most cichlid species is far from simple and much research remains to be carried out on almost every genus in the family. Since many species are small and of no great interest, except to the specialist, the account of the family given below is of necessity somewhat abbreviated.

Cichlidae occurring in Uganda may be divided into two groups, namely, the *Tilapia* species and the *Haplochromis* generic complex. The latter group contains eight genera, of which the genus *Haplochromis* is the most widespread and alone has numerous species. The seven other genera are each represented by a single species.

The many species of *Haplochromis* can only be identified with considerable difficulty and by reference to large collections of specimens; a simple key to the species has yet to be devised. Morphological differences between the species are slight and individual variability within a species is high. Consequently, this genus and the related monotypic genera will be described here in general terms.

References to papers dealing in detail with the *Haplochromis* of various lakes in Uganda are, however, given.

Since the species of *Tilapia* are fewer in number, are of considerable economic importance and of more general interest, greater attention will be paid to them than to the *Haplochromis*.

Difficulties may be experienced when identifying individual *Tilapia*; usually it is simpler to identify several specimens from one place than to attempt the identification of a single fish. In cases of doubt it can only be recommended that the specimen be referred to a specialist, rather than hazarding a guess as to its identity. Much disappointment in the past could have been avoided if an expert diagnosis had been given before *Tilapia* were introduced into ponds and dams where it was hoped that they would flourish.

KEY TO THE GENERA

Scales cycloid — *Tilapia*[1] (p. 107)
Scales ctenoid — 1

1 Anal fin with four or more spines — *Astatoreochromis* (p. 116)
Anal fin with three spines — A

A Outer teeth close set, enlarged and with strongly incurved, flattened crowns with rounded edges — *Schubotzia* (p. 116)
Outer teeth not as above — (i)

(i) Teeth in the upper jaw in two or more series anteriorly but in a single series posteriorly — (a)
Teeth in the upper jaw in two to five series both anteriorly and posteriorly — (b)

(a) Anterior outer teeth disproportionately longer than the adjacent lateral teeth, slender, pointed and procumbent — *Paralabidochromis* (p. 116)
Anterior outer teeth forming a graded size-series with the lateral teeth, not forwardly directed; crown form variable — *Haplochromis* (p. 117)

(b) Outer teeth enlarged and stout, the crowns obliquely truncated and pointing inwards — *Macropleurodus* (p. 116)
Outer teeth in both jaws small, their crowns bi-cuspid or uni-cuspid; inner teeth in broad bands anteriorly and posteriorly — (c)

(c) Lower jaw broad and flat; the tooth bands in both jaws of uniform breadth anteriorly and posteriorly — *Hoplotilapia* (p. 116)
Lower jaw stout, rounded anteriorly; teeth grouped anteriorly into two pear-shaped patches — *Platytaeniodus* (p. 116)

Tilapia Smith 1840

The majority of generic characters cannot easily be checked without dissection; the cycloid scales of this genus should, however, prove diagnostic. Small fishes are characterized by the '*Tilapia*-mark', a well-defined black blotch or marbling on the anterior part of the soft dorsal fin.

[1] Small *Tilapia* may be distinguished from other cichlid genera by the presence of a large dark spot or circumscribed marbling on the soft part of the dorsal fin.

Since the most readily-determined specific characters are included in the key and figures, the description of each species will usually be confined to an account of the coloration of live fishes.

There is a considerable body of literature dealing with various aspects of the biology of *Tilapia* species in Africa. An additional bibliography dealing specifically with *Tilapia* is therefore given at the end of this chapter.

In preparing this account of *Tilapia*, I have drawn heavily on the experience and unpublished data of my colleague Dr. R. H. McConnell, to whom I tender my sincere thanks.

Key to the Species

Note: Only those species occurring naturally in Uganda are included here. A few other species from various parts of Africa have been introduced into Uganda, but they are neither widespread nor common (see Lowe, 1955). Welcomme (1964) has prepared a key to the juveniles of *Tilapia* species occurring in Lake Victoria.

8-12 gill rakers on the lower part of the first gill-arch — *T. zillii* (p. 108)
18-28 gill rakers on the lower part of the first gill-arch — 1

1 Caudal fin with numerous vertical and wavy bars (i)
Caudal fin intensely spotted (ii)
Caudal fin weakly if at all spotted; body not markedly deep (cf. Figs. 57 and 58 with Fig. 59) (iii)
Caudal fin without spots or bars; body deep (Fig. 59) (iv)

(i) Lateral line series with 31-33 (usually 31) scales; 22-28 (usually 24-26) gill rakers on the lower part of the first arch — *T. nilotica* (p. 110)

(ii) Lateral line series with 28-30 (usually 29) scales; 19-24 (usually 22) gill rakers. Length/depth ratio of the caudal peduncle 0·5–0·8. Body dark with numerous lighter spots. — *T. leucosticta* (p. 111)

(iii) (a) Lateral line series with 30-33 (usually 31) scales; 19-23 (usually 20 or 21) gill rakers. Length/depth ratio of the caudal peduncle 0·8–0·9. Dorsal fin tipped with orange. A well-developed bump in front of, and partly above, the eye — *T. variabilis* (p. 112)

(b) Lateral line series with 32-35 (usually 32 or 33) scales; 18-21 (usually 19) gill rakers. Length/depth ratio of the caudal peduncle 0·9–1·1. No marked bump anterior to, and above, the eye. Dorsal fin sometimes with red tips, *but never orange* — *T. esculenta* (p. 114)

(iv) Body deep (see Fig. 59). Lateral line series with 28-31 scales; 21-26 gill rakers. Length/depth ratio of the caudal peduncle 0·5–0·7 — *T. galilaea* (p. 115)

Tilapia zillii (Gervais) 1848. (Fig. 54)

Native name: Uncertain.

Description: This deep-bodied species (depth contained 2-2¾ times in the standard length) is easily recognized by its low gill raker count (8-12) and the distinctive '*Tilapia*-mark' which persists in adult fishes.

Coloration: Body olivaceous, shot with an iridescent blue sheen; lips bright green; chest pinkish (black surmounted by an intensely crimson flush in breeding fishes). Six or seven dark vertical bars, of variable intensity, may be visible on the body and caudal peduncle. Dorsal, caudal and anal fins olivaceous with yellow spots, the dorsal and anal fins often outlined by a narrow orange band. The '*Tilapia*-mark' is a large, black, nearly circular spot almost completely outlined in yellow. The coloration of breeding fishes is more intense than that of non-breeders.

Habitat: Lake Albert: Shallow inshore waters, especially in sheltered bays. *Lake Victoria:* Welcomme (1964) records that *T. zillii* are usually found associated with *T. variabilis* on moderately exposed sandy and rocky beaches. The species is also common on muddy shores where there is abundant vegetation.

Food: Unlike the majority of *Tilapia*, which feed principally on certain algae in the plankton, *T. zillii* feeds largely on the leaves and stems of rooted aquatic plants and their associated epiphytic algae (see Fish, 1955). Since suitable phytoplankton is often lacking in dams but water-weeds are usually present, the feeding habits of *T. zillii* have made this species an important fish for pond culture in Africa.

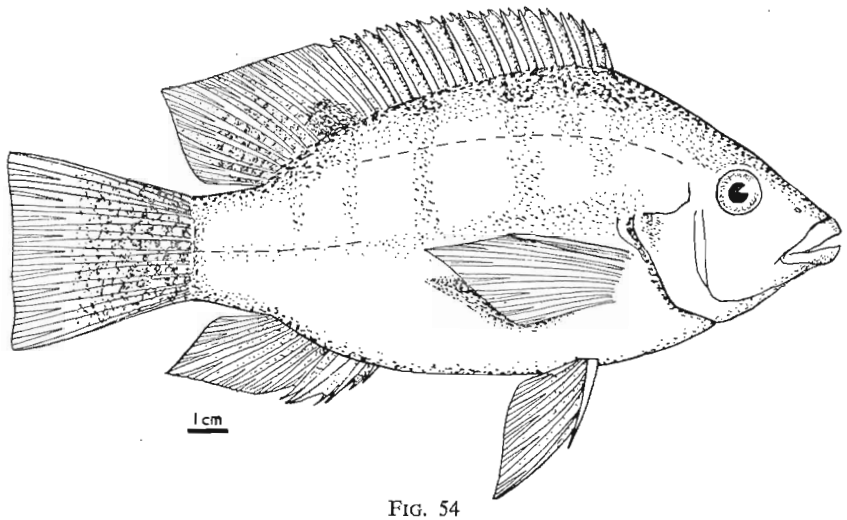

Fig. 54
Tilapia zillii. (Drawn by Barbara Williams.)

Breeding: Tilapia zillii belongs to the group of *Tilapia* which are not mouth-brooders. Spawning takes place in a prepared nest—a depression in the bottom; thereafter one of the parents remains on guard, constantly cleaning the eggs of any detritus which may settle on them and also maintaining a current of water over the nest.

Newly hatched *T. zillii* are smaller than the larvae of mouth-brooding species and are provided with an adhesive organ on the head. By means of an excretion from this organ the young attach themselves to plants and stones.

Distribution: Uganda: Before the value of *T. zillii* as a pond and dam fish was realized, the species was restricted to Lake Albert. Nowadays it is widely distributed throughout Uganda. Considerable numbers have been introduced

into Lake Victoria at Entebbe and Kisumu (Kenya) and the species is now a regular part of the commercial fishery in the lake.

Elsewhere: The Nile basin; Lake Rudolf; Lake Chad; Sierra Leone to the Niger; Israel; Lake Galilee.

Tilapia nilotica (Linné) 1757. (Fig. 55)

Native names: Mahere (Lunyankole); Ngege (Lunyoro and in general use); Nsogora (Lugungu); Zogoro (Alur); Oro (Jonam).

Coloration: Greyish-brown ground-coloration, darker above; faint traces of six or seven dark vertical bars on the flanks and caudal peduncle. Dorsal and anal fins greyish, somewhat irregularly spotted. Caudal fin grey, with numerous dark-red, wavy vertical bars. In breeding males the ventral surface of the body, the anal, dorsal and pelvic fins are black, and the head and flanks are flushed with red.

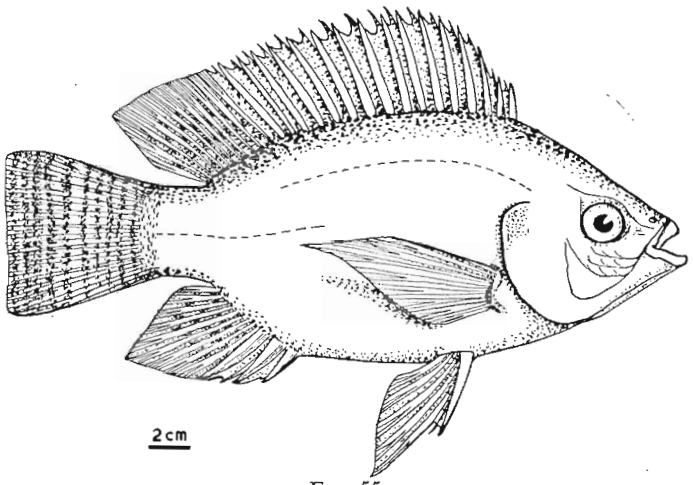

FIG. 55
Tilapia nilotica. (Drawn by Barbara Williams.)

Size: Tilapia nilotica reaches a large size in certain lakes; for example, in Lake Rudolf specimens weighing 14 lb. have been recorded. In Uganda, *T. nilotica* does not reach such a large size; specimens weighing 1¼-1½ lb. may be considered as being of an average size.

Habitat: Lake Albert: restricted to inshore waters, particularly in sheltered bays and in lagoons cut off from the main lake by sand-spits (Worthington, 1929a; E.A.F.R.O., 1951).

Lake Edward: the comparatively shallow inshore waters; it is less common in the more open waters and is absent from deep water except that occasional shoals are seen swimming at the surface (Worthington, 1929a; Poll and Damas, 1939).

Lake George: Ubiquitous, but less common near papyrus-fringed shore-lines (Lowe, 1957).

Tilapia nilotica has been introduced into Lakes Victoria and Kyoga.

In Lake Victoria, *T. nilotica* is not yet a common species; it is usually found associated with *T. esculenta* and *T. variabilis* on mud-bottomed slightly exposed

beaches (Welcomme, 1964). This author also reports that hybridization between *T. nilotica* and *T. variabilis* may be occurring in the northern waters of Lake Victoria; the evidence for such hybrids is based on the presence of fishes with characteristics intermediate between the two supposed parental species.

Food: Principally phytoplankton (either in suspension or from the bottom deposits) of which the diatoms provide the main nourishment (Worthington, 1929a; Poll and Damas, *op. cit.*, Fish, 1955). Insects and crustaceans are also eaten and digested (Worthington, *op. cit.*). In Lake Rudolf, *T. nilotica* feeds on blue-green algae; in other lakes these algae are not digested by this or other fishes. Certain bacteria form a substantial part of the diet of *T. nilotica* living in Lake Kivu (Fish, *op. cit.*).

Economic importance: In Lakes Edward and George, *T. nilotica* is the most important element in the catches of African fishermen.

Breeding: T. nilotica is a mouth-brooder in which the female carries the young.

Distribution: Uganda: Probably the most widely distributed species in Uganda. *T. nilotica* occurs naturally in Lakes Edward, George and Albert, and in many crater lakes in Western Uganda. In addition, the species has been introduced into Lakes Victoria, Kyoga, Nakivali, Kachira, Kijanebalola, Mutanda and Bunyoni (where the experiment was apparently unsuccessful) as well as into many smaller lakes and dams.

Elsewhere: The Nile; Lakes Rudolf, Tanganyika and Kivu; the Niger, Volta and Senegal; Lake Chad; Syria and Israel.

Historical: Like *Mormyrus* and *Lates*, *Tilapia nilotica* attracted the attention of ancient Egyptian artists. The fish appears on murals and rock-engravings, and was apparently kept in ornamental ponds (see plate 9 in the King Penguin *Egyptian Painters*, in which book there is also a delightful picture (plate 3) of a cat eating *T. nilotica*. Both these paintings date from about 1400 B.C.).

Tilapia leucosticta Trewavas 1933. (Fig. 56)

Native names: Kinyamuroro (Lunyankole); Nzizi (Lake Albert).

Coloration: Body dark olive-green to slatey-black, clearly marked with whitish spots; lower lip often bluish-white; eight to eleven dark vertical stripes sometimes visible on the flanks. Dorsal, anal and caudal fins dark; the soft dorsal fin, the entire caudal fin and the anal fin with well-defined bluish-white spots. In breeding males the ground-colour changes to a dark blue-black, whilst the whitish spots on the body and fins are intensified; the eye is outstanding with its bright amber iris crossed by a black bar. Indeed, the pugnacious breeding male invites comparison with some mediaeval 'Black Knight' arrayed for battle.

The colour of breeding females does not differ greatly from that of sexually inactive fishes.

The '*Tilapia*-mark' in young individuals is a relatively indistinct marbling on a yellow background.

Size: The maximum recorded size of *T. leucosticta* in natural waters is 30 cm. total length and weighing 565 gm., but specimens measuring 32 cm. and weighing 610 gm. have been caught in one of the Teso dams (Lowe, 1957).

Ecology: A detailed account of the ecology of *Tilapia leucosticta* has been published (Lowe, 1957). It will suffice here to give only a brief account of the habitats occupied by this species in various lakes.

Lake Edward: In bays, on exposed shorelines (Poll, 1939) and at the mouths of rivers (Lowe, *op. cit.*).

Lake George: Ubiquitous, but more common near the papyrus fringed shores than is *T. nilotica,* the other common *Tilapia* in this lake (Lowe, *op. cit.*).

Lake Albert: Inshore and in lagoons (Lowe, 1957). Lowe (*op. cit.*) notes that in these lakes the distribution of *T. leucosticta* in relation to *T. nilotica* is 'remarkably similar to that of *T. variabilis* in relation to *T. esculenta* in Lake Victoria'.

Tilapia leucosticta has been introduced into Lakes Victoria and Kyoga.

In the northern waters of Lake Victoria, *T. leucosticta* is apparently confined to lagoon areas formed behind the fringing swamps; it was not found in similar areas in the southern parts of the lake (Welcomme, 1964). It seems that the species is tolerant of low oxygen concentrations.

Food: Phytoplankton (Poll, 1939) and bottom deposits largely formed by the 'rain' of phytoplankton from the surface layers (Fish, 1955; Lowe, 1957).

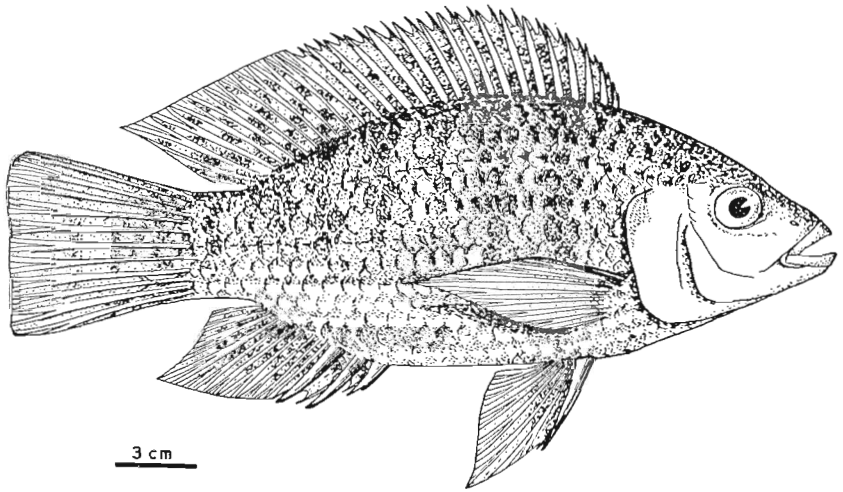

FIG. 56

Tilapia leucosticta. (Drawn by Barbara Williams.)

Breeding: T. leucosticta is a female mouth-brooder, without well-defined breeding seasons; sexually active fishes are found throughout the year (Lowe, *op. cit.*).

Distribution: Lakes Albert, Edward and George; introduced into Lakes Victoria, Kyoga and Wamala, and into numerous dams.

Tilapia variabilis Boulenger 1906. (Fig. 57)

Native names: Mpongo and Mbiru (Lake Victoria); Wasamaru (Lunyoro); Nsalia (Lukenyi).

Description: A characteristic feature of breeding male *T. variabilis* is the conspicuous genital tassel. This is a much branched structure, bright orange in

colour and often several centimetres long, developed from the genital papilla, which lies immediately posterior to the anus.

Coloration: Adult but non-breeding fishes are uniformly grey or greyish-green, the flank scales somewhat darker at the centre than the edge. Fins grey, the caudal only weakly, if at all, spotted. Dorsal fin tipped with orange throughout life.

Breeding males are bluish-grey to bluish-green; the caudal fin is outlined in bright orange. The coloration of breeding females is similar to that of non-breeding individuals.

An atypical colour variety also occurs; the ground coloration is basically a piebald black and silver, variably blotched with bright orange. Such aberrantly coloured fishes are usually females, although a small percentage is males.

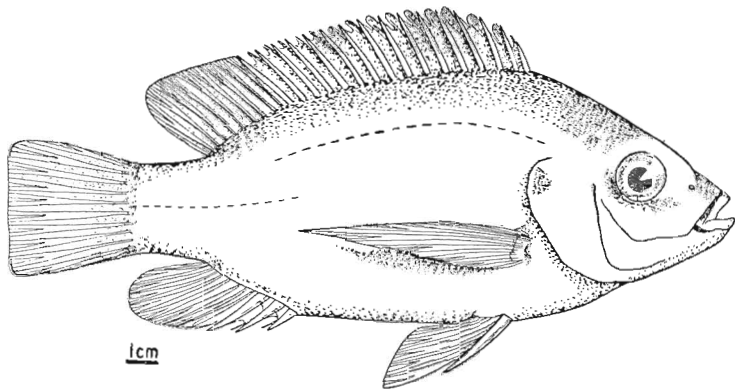

FIG. 57

Tilapia variabilis. (Drawn by Barbara Williams.)

Immature *Tilapia variabilis* are greyish-silver, with eight to ten dark, vertical stripes on the flanks and caudal peduncle. The dorsal fin is outlined in orange; the '*Tilapia*-mark' is a relatively indistinct black marbling.

Ecology: Lake Victoria: Lowe (1956b) describes the ecology of this species in some detail and her observations have been extended by Fryer's (1961) more recent studies. *Tilapia variabilis* occurs mainly in water less than sixty feet deep and particularly on exposed shores; however, the only *Tilapia* caught in nets set on the bottom in one hundred feet of water was a *T. variabilis.*

Some confusion between *T. variabilis* and *T. esculenta* is apparent in the account of these species given by Copley in *The Game Fishes of Africa* (1952). Statements supposedly referring to the ecology of *T. variabilis* actually refer to *T. esculenta* and vice versa; a similar error has been made with many of the morphological data given in the same section.

Lake Kyoga: Confined to areas close inshore, especially where there is a surface covering of water-lily leaves (Worthington, 1929a).

Food: Mainly phytoplankton derived from bottom deposits (Worthington, *op. cit.,* Fish, 1955; Lowe, 1956b), although algae are also scraped from rocks and aquatic plants.

Breeding: A female mouth-brooder, without well-defined breeding seasons (Lowe, 1956a and b).

Size: Most fishes in natural waters are sexually mature at a length of 22 cm.; the maximum size attained is about 30 cm. (Lowe, 1956b).

Economic importance: In Lake Victoria, *T. variabilis* can, at present, be considered of only moderate economic importance (see Lowe, 1956b). On the other hand, in Lake Kyoga and the Victoria Nile, the species is of considerable importance in the catches of gill-nets and traps.

Sport: Although not ranking as a game-fish, *T. variabilis* can be caught by angling, using filamentous green-algae as bait.

Distribution: Tilapia variabilis is indigenous only in Lakes Victoria, Kyoga and Nabugabo, and in the Victoria Nile; but, the species has been widely distributed in dams and ponds throughout Uganda and in neighbouring countries.

Tilapia esculenta Graham 1928. (Fig. 58)

Native names: Ngege (in general use); Nsalia (Lukenyi); Anagu (Lango). The Lunyara and Ludope names (Binage and Mnege) apply to both *T. esculenta* and *T. variabilis*.

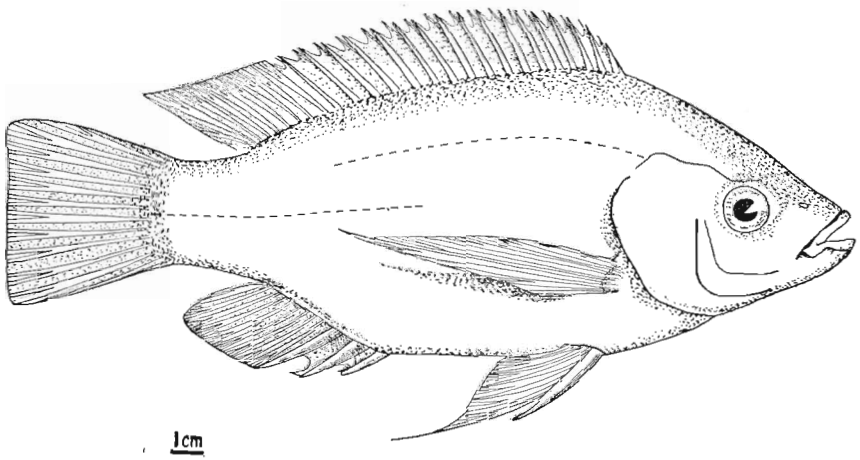

FIG. 58

Tilapia esculenta. (Drawn by Barbara Williams.)

Coloration: Reddish-brown; fins greyish, weakly if at all spotted; dorsal fin without coloured outline, or, if coloured, a deep red (*never orange*). Breeding males have the ventral surface of the body sooty, and the flanks suffused with red.

Young fishes are silvery-grey; the '*Tilapia*-mark' is a well-defined black spot outlined in pale yellow.

Ecology: The most recent and comprehensive account of the ecology of *T. esculenta* is that by Lowe (1956b). Preliminary studies are contained in Graham (1929) and Worthington (1929a).

In Lake Victoria, *T. esculenta* is confined to water less than sixty feet deep and is most abundant in sheltered gulfs and bays where the lake bottom is composed of soft algaceous mud (cf. *T. variabilis* which is predominantly a species of open and exposed coast lines).

In Lake Kyoga, *T. esculenta* is apparently confined to open water (Worthington, 1929a).

Food: The food of this species consists almost entirely of phytoplankton, from which only the diatoms are digested (Graham, 1929; Worthington, 1929a; Fish, 1955; Lowe, 1956b). Insect larvae and planktonic crustaceans occur less frequently although they may contribute to the diet of young fishes (E.A.F.R.O., 1955/56).

Breeding: T. esculenta is a female mouth-brooder, without well-marked spawning seasons; greatest breeding activity occurs between September and May. A detailed account of the breeding biology of this species is given by Lowe (1956b).

Size: In Lake Victoria, most *T. esculenta* are sexually mature at a length of 25 to 26 cm.; the modal adult size is from 30-32 cm. total length. Fishes longer than 36 cm. total length are uncommon, although specimens 40-50 cm. long have been caught in the southern waters of Lake Victoria.

Economic importance: There can be little doubt that *T. esculenta* must still be considered of importance in the fisheries of Lake Victoria. In most parts of the lake, including many areas in Uganda, *T. esculenta* was once the principal catch of the commercial fishermen. Its flesh is readily accepted by Africans and Europeans alike.

Distribution: Tilapia esculenta is indigenous in Lakes Victoria, Kyoga and Nabugabo, and in the Victoria Nile. It has now been introduced into Lakes Kijanebalola and Bunyoni and into many dams in Uganda, Kenya and Tanzania.

Tilapia galilaea (Artédi) 1757. (Fig. 59)

Native name: Kaishata (Lunyoro).

Description: The deep body (depth contained $1\frac{3}{4}$-$2\frac{1}{2}$ times in the standard length) and unspotted caudal fin provide the most obvious diagnostic characters for this species.

Coloration: Body and fins uniformly silver-grey; three to five vertical stripes, of variable intensity, may be present on the flanks.

Ecology: Tilapia galilaea occurs in the shallow, inshore waters of Lake Albert, where it is by no means common. Daget (1954) gives a fairly detailed account of this species in the Upper Niger.

Food: Predominantly phytoplankton; planktonic crustaceans are also eaten (Worthington, 1929a).

Breeding: Tilapia galilaea is a female mouth-brooder (Daget, *op. cit.*; Lowe, 1955b); the small eggs are olive-green in colour, that is, similar to the eggs of *T. zillii*, but unlike the bright yellow eggs of the other *Tilapia* species occurring in Uganda.

Size: Fishes larger than 37 cm. total length are uncommon.

Economic importance: Slight.

Distribution: Uganda Lake Albert. *Elsewhere:* Nile; Niger; Volta; Senegal; Gambia; Lake Chad; Lake Rudolf; Israel and Jordan.

GENERA: *Astatoreochromis, Schubotzia, Paralabidochromis, Macropleurodus, Hoplotilapia* and *Platytaeniodus*.

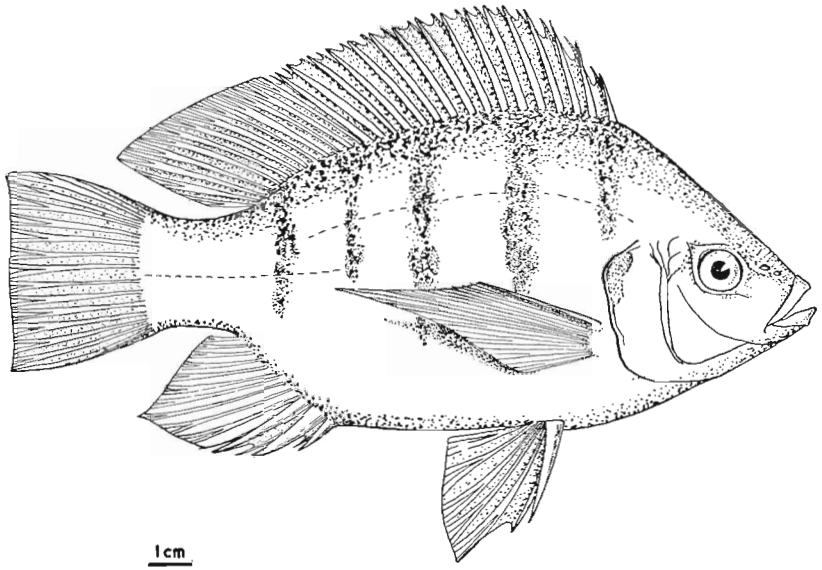

FIG. 59

Tilapia galilaea. (Drawn by Barbara Williams.)

These genera, each represented by a single species, may be considered as part of the *Haplochromis* generic complex. All are small fishes, rarely exceeding 15 cm. standard length.

Astatoreochromis alluaudi Pellegrin 1904

Distribution: Indigenous to Lakes Victoria, Edward, Nabugabo, Kachira, Nakivali and Kijanebalolo; the Victoria Nile and the Semliki River.

Since the diet of *A. alluaudi* consists almost entirely of molluscs, this species may prove of value in controlling the vector snails of such diseases as Bilharzia and Liver-fluke. If experiments with *A. alluaudi* are carried out, it can be expected that the distribution of the species will be extended; it has already been introduced into Tanzania (E.A.F.R.O.).

References: Trewavas, 1933; Poll and Damas, 1939; Greenwood, 1954 and 1959, 1965b; E.A.F.R.O., 1951 and 1953.

Schubotzia eduardiana Boulenger 1914

Distribution: Known only from Lake Edward (see Trewavas, 1933).

The following monotypic genera are known only from Lake Victoria and are discussed at length by Greenwood (1956a): *Paralabidochromis victoriae* Greenwood 1956 (a very rare species); *Macropleurodus bicolor* (Boulenger) 1906; *Hoplotilapia retrodens* Hilgendorf 1888; *Platytaeniodus degeni* Boulenger 1906.

Haplochromis Hilgendorf 1888

Native names: Nkeje (Lake Victoria); Nyamororo (Lunyankole); Butoba (Lugungu); Mpere (Lunyoro, Luruli and Lunyara); Waloko (Lukenyi); Anang (Ludope).

Some difficulty may at first be experienced in separating young *Tilapia* from young and adult *Haplochromis*. The following characters should prove useful in this respect.

	Haplochromis	*Tilapia*
Scales:	Rough posterior border.	Smooth posterior border.
Gill rakers:	Rarely more than 12.	Rarely less than 18 (except in *T. zillii*).
Coloration:	No large spot on the anterior part of the soft dorsal fin.	A well-defined spot on the soft dorsal fin.

No attempt will be made here to produce a key to the numerous species of *Haplochromis* occurring in Uganda. Keys to the *Haplochromis* species in the three major lakes have been published (Regan, 1922, for Lake Victoria; Trewavas, 1933, and Poll and Damas, 1939, for Lake Edward) but personal experience has shown that these keys are difficult to use unless one has an extensive knowledge of the fishes, and a named collection for comparison with the new material. Furthermore, a thorough taxonomic revision of the genus, coupled with ecological studies, is an urgent necessity. A study of the Lake Victoria *Haplochromis* has recently been completed, but all the results are not yet published (Greenwood, 1956–1962). This work has again shown the difficulty of producing a simple yet effective key which can be used by anyone who has not made a special study of the group.

In no Uganda lake can the *Haplochromis* be considered of direct economic importance. On the other hand, these small fishes, which occur in countless thousands, do play an important role in the bionomics of the lakes. *Haplochromis* provide the principal food for many economically important species, such as *Bagrus* and *Clarias*, and are probably an important element in the diet of *Lates*. By the mere fact of their living and dying, the *Haplochromis* help to maintain the fertility of the lakes by constantly returning essential chemicals to the water, either in their excreta or as the decomposition products of their dead bodies.

Around Lake Victoria, some use is made of *Haplochromis* as food. The fishes are caught in beach-operated seine nets and in traps, and are usually sun-dried before being eaten. *Haplochromis* (Nkeje) played an important part in the village life and customs of Buganda, where these fishes were an essential dish at all feasts (Nsimbi, 1956).

The number of species in each lake is of interest and is probably correlated with various ecological changes which took place during the evolution of the lakes. There are over ninety *Haplochromis* species in Lake Victoria, about twenty-three in Lake Edward, five in Lake Albert, seven in Lake Nabugabo and two in the Koki lakes.

The two major lake systems, Victoria and Edward, together with Lake Nabugabo, are outstanding for their high percentages of endemic *Haplochromis* species (see Chapter I). Species occurring in Lakes Edward, Victoria and Nabugabo, although mostly endemic to each lake, are very closely related to one another and at least one species is common to the three lakes. The *Haplochromis* of the Koki lakes are species which also occur in both Lake Edward and in Lake Victoria. Geological and zoological evidence (see Green-

wood 1958 and 1965 for references) indicates that during the past million years all these lakes were probably interconnected at some period, and that the species flocks of Lakes Edward, Victoria and Nabugabo were derived from the same ancestral stock.

In each lake, species of *Haplochromis* have occupied almost every available habitat. This adaptive radiation is seen most clearly in Lake Victoria (Greenwood, 1965a). although the species flock of Lake Edward also shows considerable ecological diversity, but on a reduced scale (Poll and Damas, 1939). Even the small *Haplochromis* flock in Lake Albert contains representatives of several feeding habits (Trewavas, 1938).

In a comparable marine biotope the different habitats and ecological niches would be occupied by different species belonging to several genera and even families, and not, as in these lakes, by different species of one genus.

The Lake Victoria *Haplochromis* species, may, on the basis of their usual source of food, be divided into the following categories: mollusc eaters, plant detritus eaters, grazers on epiphytic and epilithic algae, insectivorous species, predators on the eggs and larvae of other *Haplochromis*, and finally, predators on small fishes—especially other *Haplochromis*, and *Engraulicypris*. By far the greatest number of species in Lake Victoria are predators on other fishes (Greenwood, 1965a).

The categories listed above represent the chief food of the different species, but most are facultative feeders and include in their diet a number of different foods besides the main items. Even the vegetarian species are known to feed on insects if, for example, there has been a heavy hatch of lake-flies.

Like the majority of *Tilapia* species, the *Haplochromis* are female mouth-brooders; there are, however, numerous species whose breeding habits are still unknown.

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TABLE IX

Distribution of *Tilapia* spp. (Cichlidae) in Uganda. I=introduced i.e., not occurring naturally.

LAKES	Victoria and Kyoga	Edward and George	Albert	Introduced	Elsewhere
Tilapia zillii ..	I (Victoria)		P	Dams and ponds	
Tilapia nilotica	I	P	P	Koki lakes; Lake Bunyoni; dams, ponds and some crater lakes	Many crater lakes; Albert and Murchison Niles
Tilapia leucosticta	I	P	P	Lake Wamala; various dams and ponds, especially those in the Teso district	
Tilapia variabilis	P			Dams and ponds	Victoria Nile
Tilapia esculenta	P			Lakes Kijanebalola and Bunyoni. Many dams and ponds	Victoria Nile
Tilapia galilaea ..			P	Dams in the Teso district	Albert Nile

CHAPTER IX

SUB-ORDER: ANABANTOIDEA

Family: Anabantidae

Body short, moderately compressed. Scales large and ctenoid, the entire head covered with scales. Two nostrils on each side. An accessory breathing-organ is situated above the gills.

The Anabantidae are widespread in Africa and Asia; one genus occurs in Uganda (see Table VIII, p. 101).

Ctenopoma Peters 1844

Lateral line interrupted, forming an upper (anterior) and lower (posterior) series of lateral line scales. Anterior nostril in the form of a short tube.

The accessory breathing-organ is developed from the first gill-arch of each side; it lies in a large chamber above the gills. Each organ consists of a thin plate thrown into numerous folds and is covered by vascular epithelium through which respiration takes place. Because of its ability to utilize atmospheric oxygen in addition to carrying out aquatic respiration, *Ctenopoma* can tolerate foul and stagnant waters.

Two species occur in Uganda.

(i) Dorsal fin with 15 or 16 (rarely 14) spines; sub-operculum with numerous, fine serrations. Two groups of well-defined spines, separated by a deep notch, at the upper angle of the posterior margin of the operculum *C. muriei*

(ii) Dorsal fin with 17 or 18 spines. Sub-operculum smooth or with feebly-developed serrations. Opercular spines weak, separated by a shallow notch *C. damasi*

Ctenopoma muriei (Boulenger) 1906. (Fig. 60)

Native name: Kizinzi (Lukenyi).

Description: The generic description, together with the characters given in the key, should enable this species to be identified easily. *C. muriei* is a small species, rarely exceeding 90 mm. standard length.

Coloration: Silver-grey, the body with numerous dark spots and a well defined black spot, outlined in yellow, at the base of the caudal fin and partly extending onto the fin itself.

Habitat: Streams and swamps, both temporary and permanent; also in the marginal grass and water-lily swamps of Lakes Victoria and Kyoga.

Food: The scanty information available indicates that *C. muriei* feeds on insect larvae and Crustacea (E.A.F.R.O.).

Breeding: Larval *C. muriei* have been found in a temporary stream connected with Lake Victoria. The presence of these larvae, together with numerous sexually active adults, suggests that spawning takes place when such streams are flooded during the rainy seasons (E.A.F.R.O.).

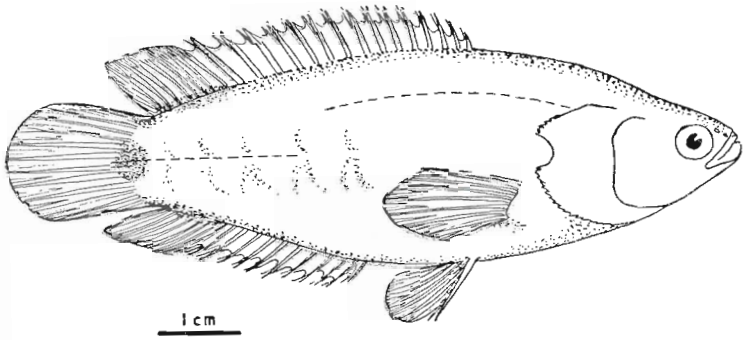

FIG 60

Ctenopoma muriei. (Drawn by Barbara Williams.)

Distribution: Uganda. Lakes Victoria, Kyoga and Edward, and their affluent streams; streams in Uganda. *Elsewhere:* The Nile; Lake Tanganyika.

Ctenopoma damasi Poll 1939

Native name: Unknown.

Description: In general appearance *C. damasi* resembles *C. muriei,* but it is distinguished by the greater number of dorsal fin spines (17 or 18 as compared with 14-16), the weakly serrated, or even smooth, sub-operculum and by the poorly-developed opercular spines, which are separated by a shallow notch.

Coloration: Dark brown to blackish; a small black spot without a surrounding lighter area, at the base of the caudal fin (Poll and Damas, 1939).

Ecology: There is no published information on the ecology of this species. From the locality list given by Poll and Damas (*op. cit.*) *C. damasi* would appear to be more common in rivers and in the vicinity of river-mouths than in the lake.

Distribution: Lake Edward and its affluent rivers.

CHAPTER X

ORDER: OPISTHOMI

Family: Mastacembelidae

Body elongate and eel-like, covered with minute, cycloid scales. Anterior nostril in the form of a short tentacle. Snout produced as a fleshy appendage. Mouth not protractile. Dorsal and anal fins long, confluent with the caudal fin (at least in the African species). Pelvic fins absent.

The Mastacembelidae are widespread in southern Asia and in tropical Africa, (where the family is represented by a single genus). Despite their eel-like appearance, the Mastacembelidae are not related to the true eels.

Mastacembelus Scopoli 1777

Little need be added to the description given above. One species occurs in Uganda (see Table VIII, p. 101).

Mastacembelus frenatus Boulenger 1901. (Fig. 61)

Native name: Unknown. *English:* Spiny eel.

Until recently it was thought that a distinct species of *Mastacembelus* (*M. victoriae* Blgr. 1903) occurred in Lake Victoria and other Uganda waters. However, Matthes (1962) has demonstrated that *M. victoriae* cannot be distinguished from *M. frenatus* Blgr. 1901.

Description: Characters given in the description of the family should enable this species to be identified readily. The dorsal fin consists of 32-34 (rarely

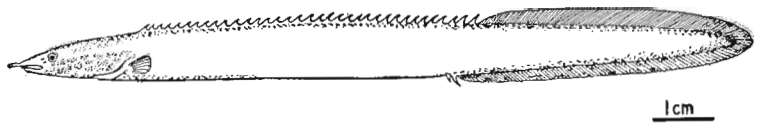

FIG. 61

Mastacembelus frenatus. (Drawn by Barbara Williams.)

29-31, or 35) separate spines, and a soft fin (64-73 rays) confluent with the caudal and soft anal fins. The latter consists of 67-80 branched rays and two separate spines (the anterior spine is often deeply embedded in a fold of skin).

Coloration: The colour patterns shown by *M. frenatus* are extremely variable. Observations on fishes kept in aquaria indicate, however, that the pattern is fixed and does not change with the environment. The ground coloration, on the other hand, does show some correlation with the tone of the background on which the fish is living.

Five common colour-patterns of fishes from Lake Victoria and the Victoria Nile are:

(i) Ground-colour brown; numerous white spots on the body, becoming reticulations ventrally. Dorsal and anal fins marbled or reticulate. Head with numerous white, wavy lines.

(ii) Similar to (i) but body spots replaced by marbling.

(iii) Ground-colour of body and fins almost uniform brown, with darker blotches at the base of the dorsal fin. Anal fin with large white reticulations.

(iv) Almost uniform brown, but head with white reticulations.

(v) A combination of (iii) and (iv), marbled above, reticulate and spotted below.

The brown ground-colour varies from a dark chocolate (almost black in some cases) to a bright, orange-brown.

Size: Boulenger (1916) gives 33 cm. as the longest recorded length; the modal adult size is about 17 cm.

Ecology: As *M. frenatus* is not often caught, there is very little information about its ecology. In Lake Victoria, the species is found in marginal swamps and has been caught in temporary streams. It is particularly common in the Victoria Nile below the Owen Falls dam. In this habitat, *M. frenatus* lives amongst the stones forming the river-bed.

Food: Principally insect-larvae and, to a lesser degree, other bottom-living invertebrates (E.A.F.R.O.).

Breeding: Unknown.

Distribution: Uganda: Lakes Victoria, Kyoga and Nabugabo; the Victoria Nile and the Aswa River. *Elsewhere:* Lake Tanganyika; Zambezi system; Rwanda; Katanga.

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CHAPTER XI

THE FOSSIL RECORD

The distribution of fishes among the lake and river systems of Uganda is far from uniform. In many areas the reasons for a poor fish fauna are obvious: the waters are stagnant, or subject to periodic desiccation, or are torrential and suitable only for highly specialised inhabitants. Far more mystifying is the chequered pattern of distribution shown by particular families and genera. Good examples are provided by the Bichir (*Polypterus*), the Nile Perch (*Lates*), certain cat-fishes (*Synodontis*) and some characins (the Tiger-fish *Hydrocynus*). All these fishes occur in Lake Albert and in the Nile, but none is present in Lake Edward, and only *Synodontis* occurs in Lake Victoria. Naturally, one asks the question: 'Did these fishes, which have a wide distribution in Africa, ever occur in the areas from which they are now absent?' If the answer is 'Yes', the next question is: 'What factors were responsible for their local extinction?'

A good fossil record can often give a satisfactory answer to the first question, and may also suggest answers to the second. Even a good fossil record, however, has certain drawbacks. If a fish is not found as a fossil there is no proof that it did not occur in the area; its habits or size may have been such that it escaped fossilization. Thus, when looking at the list of fossils recovered from the different lakes (Table X) it must not be thought that they represent a complete record of the fishes at any particular time or place.

The student of Uganda fishes is fairly fortunate because there is a very good fossil record covering the last million years in the history of Lake Edward. There is also an as yet unstudied record which carries the time scale back another twenty million years. Such a well-documented historical record is rare for any African lake. Two other lakes, Albert and Victoria, have tantalizingly poor fossil records which cover only short periods of their histories.

In terms of political boundaries the number of Ugandan sites yielding fishes is small (the major fossiliferous sites of the Edward basin are in the Congo at Ishango). However, there are some sites on the Kazinga Channel which are contemporaneous with certain deposits at Ishango, and the only fish fossils from Lake Albert are in Uganda (Kaiso). The principal fossil sites for the lake Victoria basin are in Kenya (Rusinga Island) but some fish fossils have been found in the Kagera river valley.

The present-day fish fauna of Lake Edward (see pp. 3 and 125) can be described as an impoverished Nilotic one; in other words, it is basically that of the Nile but with numerous Nilotic genera and some families absent. Notable absentees are the Tiger-fish (*Hydrocynus*), the Nile Perch (*Lates*), certain cat-fishes (*Synodontis, Clarotes* and *Auchenoglanis*) and the Bichir (*Polypterus*). Fossils collected at Ishango show that the present impoverished fauna of Lake Edward is a comparatively recent development. As recently as 12,000 years ago, *Lates, Synodontis* and *Polypterus* lived in the lake, and in certain other genera there were then two species whereas only one has

survived until the present. Parenthetically, it may be noted that all these fishes were apparently caught and eaten by the people then living on the lake shore; the fossils came from a kitchen refuse dump (Greenwood, 1959).

At a somewhat earlier period, *Hydrocynus, Clarotes* and *Auchenoglanis* were also inhabitants of Lake Edward; these genera disappeared, however, at about the end of the middle Pleistocene, say 500,000 years ago. Looked at over the past million years, the fish fauna of Lake Edward was, for a greater part of the time, very similar to that still populating the Nile and Lake Albert.

Unfortunately, it is impossible to tell exactly what factors were responsible for the differential extinction of certain genera in Lake Edward. However, the fossil faunas themselves, certain palaeoclimatological evidence and knowledge of the ecology of the different genera (albeit derived from studies of their living relatives) all point towards some factors being more involved than others. For example, it seems possible that a period of aridity at the close of the lower Pleistocene resulted in the lake becoming relatively saline; this may have been an important factor in the extinction of *Hydrocynus*. Later, during the Makalian phase of the epi-Pleistocene, and at about the time that *Lates, Synodontis* and *Polypterus* disappeared from the record, there was a period of intense volcanic activity around the shores of Lake Edward. Material and gases ejected from these volcanoes could, directly or indirectly, have produced conditions to which certain species were unable to become adapted. The whole question is an extremely complex one, and to date we have only some pointers towards its solution. (See Greenwood, 1959, for a more detailed discussion).

The present fish fauna of Lake Albert is virtually identical with that of the Nile, and is perhaps very little different from the one which inhabited the lake in Pleistocene times. Lower Pleistocene fossils from Kaiso are, with one exception, of genera still occurring in the Lake (White, 1926). The exceptional genus, the cat-fish *Clarotes*, has not been recorded from Lake Albert but it is found in the Nile.

The great similarity in the Pleistocene faunas of Lakes Edward and Albert does suggest that the two lakes were once in direct contact. Geological evidence adds support to this supposition but also indicates that the connection was broken in middle Pleistocene times. Thereafter the lakes remained isolated from each other (Greenwood, *op. cit.*).

If, as seems likely from their contemporary fishes, Lakes Edward and Victoria, were also once in contact it is reasonable to suppose that their fishes at that time would also have been similar. Like that of Lake Edward, the fauna of present-day Lake Victoria is characterized by the absence of *Hydrocynus*, *Lates* and *Polypterus*. The genera *Clarotes* and *Auchenoglanis* are also absent, but *Synodontis* is represented by two endemic species. Regrettably, we cannot check on the former fishes of Lake Victoria because the fossil record for the lake is so poor. A few lower Pleistocene fishes were found at Rawe (Kenya) but only

TABLE X

Fossil fishes from lakes in Uganda. Genera and species marked * are no longer present in that lake basin.

Geological period	Lakes: Edward	Lakes: Victoria	Lakes: Albert
Holocene (Mesolithic)	*Protopterus* sp. *Barbus* sp. *Clarias* spp. **Synodontis* sp. *Bagrus* sp. **Lates* sp. *Tilapia* sp.		
Epi-Pleistocene (Makalian)	*Polypterus* sp. *Protopterus* sp. *Barbus* spp. ?*Heterobranchus* sp. **Clarias lazera* *Clarias mossambicus* **Synodontis* cf. *schall* **Synodontis* cf. *frontosus* **Lates* sp. *Tilapia* sp.		
Middle Pleistocene	*Barbus* sp. *Clarias* sp. **Synodontis* sp. ?**Clarotes* sp.		
Lower Pleistocene	*Protopterus* sp. **Hydrocynus* sp. *Clarias* sp. **Synodontis* sp. **Auchenoglanis* sp. *Bagrus* sp. **Clarotes* sp. **Lates* sp. ?*Tilapia* sp.	*Tilapia* sp. (probably **T. nigra*)	*Heterobranchus* sp. *Bagrus* sp. **Clarotes* sp. *Lates* sp.
Miocene	A rich fish fauna, including **Lates* and several cat-fishes	**Polypterus* sp. *Protopterus* sp. *Synodontis* sp. **Lates* sp. ?*Tilapia* sp.	

one genus, the widespread *Tilapia*, is represented (Trewavas, 1937). Going much further back in time, to the Miocene (about 25 million years ago), we know that *Lates* and *Polypterus* were present in a part of the area now occupied by Lake Victoria (Greenwood, 1951); but the intervening period is completely blank except for the Rawe *Tilapia*. It would be unwise to suppose that the Miocene lake was a proto-Victoria. Indeed there is good evidence suggesting that the Miocene lake was completely destroyed at about the time that the fossils were preserved. The present lake probably did not appear until late Pliocene or early Pleistocene times, and the first fishes to inhabit it were almost certainly drawn from the rivers that existed at that time. We have still to discover what these fishes were like.

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ADDENDUM

Another genus, *Varicorhinus*, should be added to the family Cyprinidae (see page 50).

Varicorhinus Rüppell, 1836

Very similar to *Barbus* but distinguished by the broad, inferior mouth, the lower jaw having an almost straight anterior margin and the lip covered by a horny, sharp-edged sheath; the upper lip is thin but fleshy.

Since a *Varicorhinus*-like mouth and lower lip is developed in some individuals of certain *Barbus* species (possibly in response to particular environmental conditions), the taxonomic status of this genus must remain uncertain pending further field—and laboratory studies.

Pellegrin published the first record of *Varicorhinus* from Uganda (Wimi river, southern drainage of the Ruwenzori Mountains) in 1909. This paper has been overlooked generally, probably because there have been no further records of the species from Uganda. My attention was drawn to it by the recent discovery, in the British Museum (Natural History) of several unstudied specimens of *Varicorhinus* collected from the Mbuku river (Toro), in the foothills of the Ruwenzori by Captain C. R. S. Pitman in 1936. These fishes differ somewhat from Pellegrin's specimens (see below).

Varicorhinus ruwenzorii (Pellegrin) 1909

Description: General appearance like that of *Barbus*, but with straight-edged lower jaw, and horny, sharp-edged lower lip. Depth of body contained 4-4$\frac{1}{3}$ times in standard length, length of head 3$\frac{3}{4}$-4 times. Snout rounded, dorsal surface of head rather flat. Single, small barbel on each side, or barbel absent. Dorsal fin with III 10 rays, the last unbranched ray slender and flexible. Anal with III, 5 rays. Lateral line with 39-40 scales.

No data are available on the live coloration, nor is there any ecological information.

Distribution: Known only from the Wimi river, a southerly drainage stream of the Ruwenzori Mountains.

The nine specimens of *Varicorhinus* collected by Captain Pitman from the Mubuku river closely resemble *V. ruwenzori* in most characters. They differ, however, in having a shorter head (head length 4$\frac{1}{2}$-5 times in standard length) and smaller scales (40-43 in the lateral line). Whether these fishes represent a distinct population of *V. ruwenzori*, or are of an undescribed species has yet to be determined.

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INDEX

SCIENTIFIC NAMES

Alestes 38
„ baremose 39
„ dentex 39
„ jacksonii 42
„ macrolepidotus 40
„ macrophthalmus 43
„ nurse 41
„ sadleri 43
Amphiliidae 93
Amphilius 93
„ jacksonii 93
Anabantidae 120
Aplocheilichthys 97
„ eduardensis 99
„ kassenjiensis 98
„ mahagiensis 99
„ pelagicus 98
„ pumilus 98
Astatoreochromis
„ alluaudi 116
Auchenoglanis
„ occidentalis 77

Bagridae 75
Bagrus 75
„ bayad 76
„ degeni 76
„ docmac 75
Barbus 58
„ altianalis 60
„ amphigramma 64
„ apleurogramma 72
„ bynni 63
„ cercops 69
„ doggetti 58
„ hollyi 61
„ jacksonii 68
„ kerstenii 67
„ kiogae 63
„ longirostris 63
„ magdalenae 71
„ minchini 58
„ neglectus 70
„ neumayeri 65
„ nummifer 58
„ nyanzae 67
„ obesus 63
„ paludinosus 64
„ perince 69
„ pietschmanni 61
„ radiatus 70
„ sexradiatus 65
„ somereni 69
„ tetraspilus 73
„ trispilopleura 73
„ viktorianus 67
„ yongei 70
Barilius 54
„ loati 55
„ niloticus 55
Centropomidae 102
Characidae 35
Cichlidae 106
Citharinidae 44
Citharinus 46
„ citharus 46
„ latus 47
Clariallabes
„ petricola 80
Clarias 81
„ alluaudi 86
„ anguillaris 84
„ gariepinius 82
„ carsonii 85
„ lazera 85
„ moorii 85
„ mossambicus 82
„ phillipsi 86
„ werneri 86
Clariidae 80
Ctenopoma 120
„ damasi 121
„ muriei 120
Cynopanchax 100
„ bukobanus 100
Cyprinidae 50
Cyprinodontidae 96

Distichodus 44
„ niloticus 44
„ rostratus 45

Engraulicypris 56
„ argenteus 56
„ bredoi 56
Eutropius 79
„ niloticus 79

Garra 53
„ johnstonii 54
Gnathonemus 32
„ cyprinoides 33
„ longibarbis 33
„ rehni 35
„ victoriae 34

Haplochromis 106, 117
Hoplotilapia
„ retrodens 116
Heterobranchus 87
„ longifilis 87
Hydrocynus 35
„ forskahlii 36
„ goliath 38
„ vittatus 37
Hyperopisus 22
„ bebe 22

Hypsopanchax
„ deprimozi 100
Labeo 50
„ coubie 52
„ forskalii 51
„ horie 51
„ victorianus 52
Lates 102, 124
„ albertianus 103
„ macrophthalmus 104
Macropleurodus
„ bicolor 116
Malapteruridae 93
Malapterurus
„ electricus 94
Marcusenius 30
„ grahami 32
„ nigricans 30
„ petherici 31
Mastacembelidae 122
Mastacembelus 122
„ frenatus 122
Mochokidae 88
Mormyridae 21
Mormyrops 28
„ anguilloides 28
Mormyrus 23
„ caschive 27
„ kannume 25
„ macrocephalus 24
„ niloticus 27
Nothobranchius 96
„ taeniopygus 96
Paralabidocromis
„ victoriae 116
Petrocephalus 28
„ catostoma 29
Platytaeniodus
„ degeni 116
Polypterus
„ senegalus 11
Protopterus
„ aethiopicus 12
Schilbe 78
„ mystus 79
Schilbeidae 78
Schubotzia
„ eduardiana 116
Synodontis 88
„ afrofischeri 92
„ frontosus 91
„ macrops 89
„ nigrita 88
„ schall 90
„ victoriae 89
Tilapia 106, 107
„ esculenta 114
„ galilaea 115
„ leucosticta 111
„ nilotica 110
„ variabilis 112
„ zillii 108
Varicorhinus 128
Xenoclarias 81
„ eupogon 81
„ holobranchus 81

VERNACULAR NAMES

Adinga 94
Adol 32
Anagu 114
Anang 117
Apok 52
Aporo 46
Binage 114
Bubu 77
Butoba 117
Changa 60
Dono 32
Ekumbi 33
Gologolo 89
Gowa 40
Gurr 103
Kaishata 115
Kaitampio 89
Kamtontoru 32
Kamuduli 90
Karakogere 79
Karuka 51
Kasamene 25
Kasonzi 82
Kasulubana 25
Kigogole 89
Kimenge 24
Kinyamuroro 111
Kisinja 60, 64, 65, 66, 71, 72
Kiswala 24
Kizinzi 120
Kobia 25
Kwangurameli 52
Kwoke 91
Lanya 76
Lungu 90
Lut 12
Mahere 110
Mali 82, 85, 86
Mamba 12
Mbiru 112
Mboli 75
Mpere 117
Mpoi 46
Mpongo 112
Mpumbi 33
Mputa 103, 104
Mtona 11
Mukene 56
Ngassa 36
Ndonge 32
Nduka 51
Ngai 22
Ngala 36
Ngambwa 60
Ngara 39
Ngasia 36
Ngege 110, 114
Ngolobo 24
Ningu 52
Nkeje 117

Nkoiro 33
Nkolongo 89
Nkuyu 60
Nsalia 112, 114
Nsoga 41, 42, 43
Nsogora 110
Nsonzi 85, 86
Nsulusu 24
Nsuku 52
Ntanant 25
Ntera 94
Nyai 85
Nyaki 82
Nyamororo 117
Nzere 79
Nzizi 111
Obanga 75
Ombala 75
Omuruma 51
Omukora 75
Okok 52
Okoke 89
Oreko 75, 76
Oro 110
Orukwe 77
Oshoi 63
Otell 11
Owaro 40
Posso 51
Sanga 60
Semutundu 75
Sirri 63
Taitai 79
Takutaku 89
Twang 82
Wachone 44, 45
Wahrindi 90
Waloko 117
Waraga 40
Wasamaru 112
Zogoro 110

ENGLISH

Albert Perch 103
Barbel 60, 63, 82
Butterfish 79
Cat-fish 82
Electric cat-fish 94
Elephant-snout fish 25
Lung-fish 12
Mosquito-fishes 96
Mud-fish 82
Perch 103
Ripon Falls Barbel 60
Spiny eel 122
Tiger-fish 36, 37