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Exploration du Parc National Albert

MISSION J. de HEINZELIN de BRAUCOURT (1950)

FASCICULE 4

Exploratie van het Nationaal Albert Park

ZENDING J. de HEINZELIN de BRAUCOURT (1950)

AFLEVERING 4

1. **QUATERNARY FISH-FOSSILS,** by P. H. GREENWOOD (Jinja, Uganda).

2. **OISEAUX FOSSILES,** par RENÉ VERHEYEN (Bruxelles).

3. **MAMMIFÈRES FOSSILES,** par A. TINDELL HOPWOOD (Londres) et XAVIER MISONNE (Bruxelles).

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PARC NATIONAL ALBERT
MISSION
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Fascicule 4 (1)

NATIONAAL ALBERT PARK
ZENDING
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Aflevering 4 (1)

QUATERNARY FISH-FOSSILS

BY

P. H. GREENWOOD

INTRODUCTION

Fish-remains collected from deposits at Ishango (Lake Edward) and the Semliki valley by Dr. J. DE HEINZELIN's 1950 expedition, have increased considerably our historical knowledge of East African fishes. The collections are of especial value since their temporal range extends over the entire Pleistocene period, a time when the great lakes of Africa were undergoing extensive topographical changes and their faunae were subject to the vicissitudes of changing climate and hydrography. Indeed, the Pleistocene may be looked upon as a critical phase in the evolution of the present-day East African fish-fauna from an earlier and possibly pan-African type.

Many taxonomists and evolutionists have been attracted by the biogeographical problems which these lakes present. But, attempts to explain the often curious distribution of families and genera within the area have been hampered by the lack of an adequate palaeontological background.

The previous, often scanty, fossil records for the major lakes, Edward, Victoria and Albert, have provided tantalizing glimpses of the Tertiary and early Quaternary fishes living in the different basins. It was known, for instance, that during early Pleistocene times certain species now locally extinct, inhabited the Edward basin (WORTHINGTON, 1932; FUCHS, 1934). Likewise, in Lake Victoria there are records of the local extinction of *Tilapia nigra* during the lower Pleistocene and, going further back in time to the Miocene, the presence of two Nilotic genera, *Lates* and *Polypterus* for which there are no further records in the Victoria basin (TREWAVAS, 1937; GREENWOOD, 1951). In Lake Albert, on the other hand, there appears to have been little change in the major elements of the fish fauna since the lower Pleistocene (WHITE, *et al.* 1926).

Despite their importance, the significance of these discoveries was weakened by their isolation. The more complete record provided by the DE HEINZELIN collection enables these earlier discoveries to be seen in truer perspective and provides, for the first time, an account of one lake basin throughout a major period of its existence.

The brief description of the site, which preceeds the account of the fishes therefrom, is taken from notes supplied by the I.P.N.C.B. I have also given, in parenthesis, the number of the page in DE HEINZELIN's paper, « Le Fossé Tectonique sous le Parallèle d'Ishango » (1955), on which the site is described in detail.

ACKNOWLEDGEMENTS.

It is with great pleasure that I acknowledge my gratitude to the « Comité de Direction » of the « Institut des Parcs Nationaux du Congo Belge » for inviting me to study this unique collection. I am also indebted to Dr. DE HEINZELIN for the interest he has shown in this study and for the information he has so readily supplied. The thorough and meticulous way in which the fossils were developed and cleaned before their dispatch to me has greatly facilitated the study; to those who were responsible for this work, I tender my sincere thanks.

SITE I

Kanyatsi, northern shore of Lake Edward, to the east of Ishango. Beds of Kaiso age (p. 84); the fossils dislodged and washed amongst the pebbles of the beach.

DIPNOI

Fam. LEPIDOSIRENIDAE.

Protopterus sp.

One palatopterygoid and one splenial tooth-plate, probably derived from the same individual, are the only specimens of *Protopterus* from this site. Both tooth-plates are somewhat weathered, the upper being better preserved and more complete than the lower.

Neither specimen departs significantly from comparable tooth-plates of *P. aethiopicus*. It must be stressed, however, that only slight inter-specific differences exist in the tooth-plates of the four extant *Protopterus* species and that these differences are easily obscured by intra-specific variability and by wear. Thus, it would be unwise to attempt the specific diagnosis of these fossils on the basis of tooth morphology alone.

OSTARIOPHYSI

Fam. CHARACIDAE.

Hydrocyon sp.

This genus is represented by ten well-preserved teeth, all from large fishes. The enamel is discoloured a soft blue-grey.

Height of individual teeth (measured directly from base to tip) in millimetres : *ca.* 13; *ca.* 14; *ca.* 15(f3); 16; 17(f2); 18; 19 mm.

SILUROIDEA

Fam. BAGRIDAE.

Bagrus sp.

Bagrus is fairly well represented by the following material :

Neurocranium. — (i) An almost complete occiput derived from a skull about 23 cm long. This specimen comprises that part of the neurocranium slightly posterior to the frontal-supraoccipital suture; the lateral horn of the pterotic is wanting on both sides. As far as can be determined, the position of the sutures and of the exoccipital foramina are identical with those of *Bagrus docmac* (FORSKAL).

(ii) A large fragment of flat bone is thought to be part of a frontal. If this identification is correct, then the bone is from a skull greater than 25 cm neurocranial length.

(iii) An almost entire dermethmoid from a neurocranium about 14 cm long.

Dentary. — Two fragments.

Operculum. — A very small fragment comprising the facet and bone immediately surrounding it; from a skull of *ca.* 12 cm neurocranial length.

Vertebrae. — The anterior fused vertebral mass is represented by two incomplete specimens, in which only the centra are preserved; estimated to be from fishes of *ca.* 24 and *ca.* 12 cm neurocranial length.

Clarotes sp.

The articular heads of twelve pectoral spines (1 left and 2 right) are assigned to this genus. Three other spine heads and three distal fragments are tentatively assigned to *Clarotes*.

Auchenoglanis sp.

Four fragments of neurocranium are referred to *Auchenoglanis* on the basis of their ornamentation, curvature and relative thickness.

The proximal part of a right pectoral spine can definitely be assigned to *Auchenoglanis*, as can an almost entire dorsal spine and the proximal part of another. Two incomplete pectoral spines (left and right) and two distal fragments of dorsal spines are tentatively referred to this genus. All specimens are from large fishes.

BAGRIDAE, GENERA INDETERMINABLE.

Vertebrae. — One, somewhat damaged specimen of a 1st. vertebra (from a fish *ca.* 160 cm standard length); the centra of five precaudal and two caudal vertebrae (from fishes of *ca.* 145 and 160 cm standard length).

Cleithrum. — A fragment from the slightly bullate region which overlies the articular fossa for the pectoral spine; perhaps nearest that of *Clarotes*.

Spines. — The damaged articular heads of eleven pectoral spines.

Fam. MOCHOCIDAE.

? Synodontis.

This genus is probably represented by the following specimens: the proximal part of a pectoral spine whose articular head is damaged (from a fish *ca.* 30 cm S.L.); a fragment from the distal third of a dorsal spine and a fragment from the middle third of a pectoral spine (both from fishes about 35 cm S.L.).

More doubtfully referred to *Synodontis* are eight fragments of dorsal and pectoral spines.

Fam. CLARIIDAE.

? Clarias.

Two precaudal vertebrae (centra only) are tentatively consigned to this family and to the genus *Clarias*. It is estimated that the vertebrae are from fishes of *ca.* 60 and 75 cm. S.L.

FAMILY INDETERMINABLE.

Nine pectoral spines, all incomplete, and forty-two fragments from the distal ends of dorsal and pectoral spines are clearly derived from Siluroid fishes, but cannot be further identified.

Skull fragments (possibly *Clariidae*). — These pieces of roofing bones are too small for accurate identification; all are ornamented with low, blunt tubercles. No specimen shows any curvature, thus reducing the possibility of their being from *Auchenoglanis*, whilst the lack of ridges on the ornamented surface reduces the likelihood of their being from any known Bagrid.

PERCOMORPHI

Fam. CENTROPOMIDAE.

Lates cf. **L. niloticus.**

Specimens of *Lates* predominate, both numerically and in the diversity of elements preserved, over all other fish-fossils from this site.

Few interspecific differences can be detected in the skeletons of the extant species (or sub-species) *Lates niloticus* (LINNÉ), *L. albertianus* WORTHINGTON and *L. macrophthalmus* WORTHINGTON. Furthermore, where the fossils have been compared with these species no obvious differences could be determined. It is therefore impossible to assign the Kanyatsi material to any one of these species. Since WORTHINGTON (1940) is of the opinion that *L. albertianus* and *L. macrophthalmus* may be only sub-specifically distinct from *L. niloticus*, it would seem reasonable to consider this material as representing a lower Pleistocene population of *L. niloticus* which inhabited the Lake Edward basin.

Neurocranium. — (i) An almost entire neurocranium, the left side of which is more damaged and distorted than the right. Sinistrally the roofing bones are almost entirely absent, whilst dextrally these bones are virtually complete, although the supra-occipital and parietal ridges are broken. Likewise, the otic region of the left side is fractured and many of its elements displaced. Posteriorly, the median supra-occipital projection and the mesial exoccipital roof to the foramen magnum are both missing; the basioccipital facet is only slightly damaged.

Anteriorly, the skull lacks its ethmoid, pre-frontals and vomer. Since the parasphenoid terminates somewhat posteriorly to its junction with the vomer, it is impossible to measure the complete basilar length of this skull; the length taken from the anterior fracture to the most posterior point of the basioccipital facet is 25.7 cm; the estimated total basilar length is *ca.* 34 cm.

(ii) A fragment of neurocranium (from a large fish) comprises the dorsal roofing bones of the left otic region together with a small part of the sphenotic-pterotic lateral wall. The section of skull preserved is that between the posterior epiotic tip and the anterior extremity of the supra-occipital, which is sub-bisected, and with only the most anterior part of its spine present. The fragment measures 13 cm along this line.

Ethmoid-vomer region. — Seven specimens. With one exception most of the dermethmoid, parethmoid and the prefontals are preserved in each specimen. In the exceptional specimen, the parethmoid and prefrontal are present on one side only.

The smallest specimen is from a fish having an estimated neurocranial length (anterior vomerine tip to the basioccipital facet) of *ca.* 27 cm; the largest is from a skull at least twice that length.

The fossils differ only slightly from the ethmoid-vomer region of extant *Lates* species in that the vomerine tooth patch has the outline of a slightly rounded diamond, except in the largest specimen where it is approximately cardiform. This latter shape is that most frequently observed in extant species, irrespective of size.

Length of the vomerine tooth-patch is given as an indication of size. Due to its cardiform toothed area, the *largest* specimen appears somewhat smaller than the next largest specimen. Length of vomerine patch in cm : 2.5; 2.8; *ca.* 3.0; 3.3; 3.5; 4.4; 3.7.

The vomer alone is represented by nine specimens; their sizes (as measured above) are; 2.0; 2.2; 2.4; 2.5; *ca.* 2.7; 3.5; 3.6; *ca.* 3.3 and 3.2 cm.

There is also a single specimen comprising the dermethmoid, prefrontals and a small fragment of the frontals. It is estimated to be derived from a fish with a neurocranial length of *ca.* 27 cm.

Basioccipital. — Represented by twelve specimens all showing remarkably similar lines of fracture : *ie.* the specimens comprise that area immediately posterior to the facet and the ventral portion of the bone. With three exceptions, all specimens exhibit a similar degree of mineralization and weathering. Exceptional specimens are more heavily mineralized and badly weathered; in addition, the first vertebra is preserved *in situ*.

The size-range is indicated by the greatest width of the basioccipital facet. In those specimens with an associated first vertebra, width of the vertebral face is given; such specimens are indicated thus * : 2.8; 3.3; 3.1; 3.5; *ca.* 3.6; 4.0; 4.1; 4.1; 5.0; *ca.* 4.3*; 4.9*; and 5.1* cm.

Epiotic and parietal — A fragmentary specimen includes part of the epiotic-parietal suture and part of the lateral epiotic wall with its post-temporal suture.

Jaws.

Dentary. — Eighteen specimens (eleven right, seven left) none of which is entire. Since it is both difficult and misleading to estimate the total length of fishes from which such fragmentary specimens were derived, two measurements of the bone itself are given : its depth at the symphysis, and, the width of the dentigerous surface at its broadest point (where this point is preserved).

Symphysial depth (cm).	Greatest width (cm).
2.0	1.2
2.5	*ca.* 2.0
2.7	1.5
2.8	—
ca. 2.8	2.2
3.0	—
3.0	2.0
3.1	—
3.1	1.9
3.1	2.9
3.1	1.8
3.3	1.9
3.3	*ca.* 1.8
3.4	2.3
3.4	—
3.5	2.3
3.8	2.6
3.8	2.3

P r e m a x i l l a. — Eight specimens (4 left, 4 right), none entire. All are from the anterior half to third of the bone. Size range is indicated by breadth of toothed surface immediately adjacent to the symphysial surface : 3.1; 2.7(f2); 2.6; 2.5(f3); 2.3; and 1.4 cm.

In addition, there is a fragment from the middle portion of the premaxilla.

M a x i l l a. — Represented by only one large specimen (left) from the anterior half of this bone, but lacking the articular head.

Q u a d r a t e. — Twenty-six specimens (10 left, 16 right) all incomplete. In each, however, the facet is preserved, as are varying amounts of the posteriorly directed basal limb, the anterior ascending margin and the body of the bone. Excepting two small specimens, all were derived from large fishes. As an indication of size, breadth of the facet is given : 1.2; 1.5; 2.3; *ca.* 2.4; 2.5; 2.6; 2.8; 2.9 (f2); 3.0 (f3); 3.2; 3.3 (f3); 3.4; *ca.* 3.5 (f2); 3.5 (f2); *ca.* 3.6; 3.6 (f2); 3.7; and 3.9 cm.

Without exception, these specimens are heavily mineralized and somewhat weathered

A r t i c u l a r. — Seventeen fragmentary and variously fractured specimens (9 left, 8 right). In each, the entire or greater part of the articular head is preserved, and in some, part of the anterior limb as well.

No really satisfactory measurement can be used to indicate the size of fishes from which the specimens were derived; all are large, the largest probably from a skull *ca.* 55 cm basilar length, the smallest from a skull of *ca.* 27 cm. The modal size is only somewhat less than that of the largest bone.

Preoperculum. — A single specimen (left), almost entire and well preserved; thought to be from a skull of *ca.* 40 cm basilar length.

Operculum. — Represented by a small fragment from the antero-dorsal angle of the bone.

Ectopterygoid. — Four specimens (1 left, 3 right) of which two are almost entire. The two largest specimens are estimated to be from skulls of *ca.* 50 cm basilar length, the smaller bones are from skulls of *ca.* 35 and *ca.* 20 cm basilar length.

Urohyal. — Two specimens both fragments, from the anterior part of the bone. One specimen can be unequivocally identified as the urohyal of *Lates* but the other differs somewhat from both its fossil cogener and the urohyal of extant species. Its form is, however, nearer that of *Lates* than any other known genus.

Vertebrae.

1st Vertebra. — Eleven specimens. With one exception all show slight signs of weathering, particularly of the anterior articular surface; the exceptional vertebra is remarkably well-preserved. Greatest measurements of the centrum are given for : breadth across the anterior face, depth of the anterior face and length : 5.0, 4.1 and 2.5 (f3); 4.0, 3.2, 2.0 (f4); 3.2, 2.6 and 1.8 (f3); 1.8, 2.8, 1.2 (f1) cm.

2nd Vertebra. — Thirteen specimens. With one exception all lack the neural spine and prezygapophyses, and in some specimens the postzygapophyses are also missing. The exceptional vertebra retains the proximal third of its neural spine as well as both pairs of zygapophyses. The material exhibits a wide range of weathering.

Centrum measurements, taken as for the 1st vertebra, are : 5.6, 4.7 and 2.2 (f1); 4.7, 4.0 and 2.0 (f4); 3.5, 3.5 and 2.2 (f1); 3.0, 3.0 and 2.3 (f1); 2.7, 2.6 and 1.4 (f3); 2.1, 1.8 and 0.8 (f1); 1.8, 1.6 and 0.8 (f1). One specimen is too badly damaged for accurate measurement.

3rd Vertebra. — Twenty-four specimens, showing various degrees of weathering and preservation; none is entire. Centrum measurements taken as above : 5.5, 4.6 and 2.5 (f5); 5.0, 4.5 and 2.4 (f6); 4.5, 3.7 and 2.0 (f8); 4.0, 3.0 and 1.5 (f4); 3.7, 2.5 and 1.5 (f1) cm.

In addition, there is a specimen of vertebrae 3 and 4 preserved in articulation; centrum measurements (as above), taken from the 3rd vertebra, are 5.5, 4.5 and 2.8 cm.

4th Vertebra. — One well-preserved and almost entire bone lacks only the distal half of its neural spine. Centrum measurements (as above) :

1.8, 1.6 and 1.3 cm. Two other fourth vertebrae are less well preserved and measure 3.7, 2.7 and 2.2 cm, and 3.5, 2.7 and 2.3 cm respectively.

Two specimens each comprise the 2nd-4th vertebrae still in articulation. Since the fourth vertebra in one group is damaged, measurements for this specimen are taken from the posterior face of the third vertebra : breadth 4.5, height *ca.*3.5, length 2.3 cm. In the other specimens, measurements taken from the posterior face of the fourth vertebra are : 5.5, 4.5 and 2.8 cm.

Other precaudal vertebrae.

Because characters serving to identify individually the fifth to eleventh vertebrae are not always trenchant, even when preserved, it is necessary to consider these elements grouped as 5th-7th; 8th-9th and 10th-11th vertebrae.

In most specimens the neutral spine is wanting, although the basal portion of the neural arch is sometimes present. Otherwise these bones are well preserved and have undergone only slight weathering.

Vertebrae 5-7. — Twenty-four specimens. Measurements are given for the breadth of the anterior face, depth of this face and the length of the centrum : 6.4, 4.7 and 6.5; 6.0, 4.5 and 4.5; 5.7, 4.4 and 4.0(f2), 5.5, 4.5 and 4.1 (f2); 5.4, 4.0 and 3.5; 5.3, 4.0 and 3.2; 5.2, 4.1 and 3.8; 4.8, 4.2 and 3.8; 4.8, 3.7 and 3.0; 4.7, *ca.* 3.6 and 3.2; 4.4, 3.5 and 3.0 (f2); 4.3, 3.5 and 3.0; 4.2, 3.8 and 3.0; 4.2, 3.3 and 3.3; 3.4, 3.0 and 2.8; 2.9, 2.2 and 2.0; 2.3, 2.0 and 1.9. One specimen is too badly damaged for even approximate measurement.

Vertebrae 8 and 9. — Sixteen specimens; measurements taken as above : — 6.0, 4.5 and 4.5 (f3); 5.2, 4.5 and 4.0 (f3); 4.5, 4.4 and 3.6 (f3); 4.3, 4.0 and 3.4(f1); 4.0, 3.7 and 3.2(f2); 3.6, 3.2 and 3.1(f1); 2.8, 2.8 and 2.6(f1); 1.8, 1.8 and 1.8 (f2) cm.

Vertebrae 10 and 11. — Twelve specimens; the centrum is damaged in five specimens and none has well preserved neural arches or lateral parapophyses. Measurements as above : — 6.4, 5.2 and 4.0; 6.0, 5.2 and 4.6 (f2); 4.8, 4.6 and 4.0 (f4); 4.0, 4.0 and 4.3; 3.5, 3.2 and 3.0 (f1, plus one damaged vertebra estimated to have these dimensions); 3.0, 3.0 and 2.5 (f1); 2.4, 2.4 and 2.4 (f1) cm.

Caudal vertebrae.

Forty-one specimens whose serial identity cannot be determined. The state of preservation and degree of weathering shown by these bones is comparable with that of the precaudal vertebrae, although a larger number of caudal elements has damaged centra. In only two specimens are the neural arches and spines preserved, and in none is the haemal arch present. Measurements (as above) are : — 5.0, 4.8 and 3.8 to 4.6, 4.2 and 4.0 (f7); 3.8,

4.2 and 3.4(f8); 3.6, 3.6 and 3.3(f1); 3.2, 3.5 and 2.5 to 3.0, 3.0 and 2.5(f14); 2.8, 2.8 and 2.6(f5); 2.6, 2.6 and 2.5 to 2.5, 2.5 and 2.0(f3); 2.0, 2.0 and 2.0(f2); 1.5, 1.5 and 1.9(f1) cm.

Penultimate and last vertebrae. — One specimen comprising both these elements in association. Another specimen is of the last vertebra only.

Other vertebrae. — The serial identity of twenty-seven vertebrae (and one fragment) cannot be determined; the majority are probably precaudal elements.

Pectoral girdle. — Represented by three fragmentary specimens of the *cleithrum*, which are, however, sufficiently characteristic to allow their immediate identification.

Fins.

Spines. — Thirty-eight specimens of various lengths, but including the proximal articular portion, are most probably dorsal fin-spines; the possibility that some may be anal spines cannot entirely be discounted. Two distal fragments are tentatively assigned to *Lates*.

Ten additional fragments should probably be referred to this genus.

Interneural and interhaemal pterygiophores: The distal ends of five interneurals, together with the proximal two-thirds of a sixth specimen are placed in this genus, as are four incomplete interhaemals.

Pectoral fin-rays. — Four articulated rays from the anterior part of the fin are assigned to *Lates*.

Pectoral spine. — A small fragment from the distal end of a spine should probably be referred to this genus.

Fam. CICHLIDAE.

Tilapia sp.

This species is very poorly represented by a caudal vertebra, lacking both neural and haemal arches (from a fish *ca.* 40 cm S.L.), and by distal portions of two interhaemal pterygiophores, from fishes of about the same size.

Since there are so few specimens of *Tilapia* from this site, and because the genus is not represented in other deposits of this age, the possibility that these specimens were derived from younger deposits cannot be overruled.

GENERICALLY INDETERMINABLE MATERIAL.

Fin-spines. — 6 fragments, one probably from a *Siluroid* fish and five from percomorphs.

Pterygiophore. — A fragment.

? Basioccipital. — A fragment probably from the basioccipital facet.

Dentigerous bones. — Two; one possibly a fragment of *Lates* pharyngeal bone, the other probably from the dentary of this species.

Of particular interest are two, small, sub-circular objects which cannot even definitely be considered as fish remains. Their smooth, almost polished exterior is suggestive of enamel and compares closely in texture and colour with the enamel surface of *Hydrocyon* teeth from this horizon. The presumed upper surface has the form of a low dome; the lower aspect is less regular in outline, with a narrow circular periphery enclosing a shallow, reddish-brown concavity. A distinct neck separates the curved upper surface from the narrow periphery of the lower surface. The greatest diameter of the two specimens is 0.65 and 0.5 cm, and the least diameter is 0.6 and 0.4 cm.

Since these objects are at present unidentifiable it is only possible to suggest that they may be pharyngeal teeth of some large fish, perhaps an extinct Cyprinid, or, as seems more probable, they may be parasphenoidal teeth from a large *Hyperopisus*-like fish.

SITE II

Kanyatsi. Beds of Kaiso age (p. 85). Fossils detatched by erosion and the trampling of animals.

OSTARIOPHYSI

SILUROIDEA

Fam. BAGRIDAE.

Siluroid fishes from this deposit are very poorly represented by fragments tentatively assigned to the Bagrid genera *Auchenoglanis* and *Clarotes*.

Auchenoglanis sp.

The proximal part of a pectoral spine, including the articular head, is referred to this genus on the basis of the detailed structure of its various articular surfaces.

Clarotes sp.

The damaged proximal ends of two pectoral spines are assigned to this genus. As in the spines refered to *Auchenoglanis*, few characters are preserved which will permit precise diagnosis. In neither of the *Clarotes* spines is the articular part entire, but the major head is fairly complete in both specimens.

A fragment of dentary is tentatively identified as that of *Clarotes*.

Fam. CLARIIDAE.

Two fragments of dentigerous bones are probably derived from Clariid fishes.

GENERICALLY INDETERMINABLE SILUROIDEA.

(i) A small and badly damaged pectoral spine fragment.

(ii) Part of a pectoral spine still associated with its matrix.

(iii) Three fragments of fin-spines.

PERCOMORPHI

Fam. CENTROPOMIDAE.

Lates cf. **L. niloticus.**

Neurocranium. — (i) Part of a skull comprising the entire right side of the basioccipital, the lower part of the exoccipital (including the greater part of its condyle), that portion of the opisthotic enclosed between the exoccipital, basioccipital and the parasphenoid, and the posterior part of the parasphenoid. An almost undamaged first vertebra is preserved *in situ*. Neurocranial length of the entire skull is estimated to be *ca.* 23 cm.

(ii) Basioccipital : two specimens, neither entire. Estimated to be from neurocrania *ca.* 25 and *ca.* 35 cm long.

(iii) Vomer : one incomplete specimen but including the dentigerous area, which is cardiform in outline; from a skull *ca.* 25 cm long.

(iv) Parasphenoid : six fragments of various sizes, representing portions from the preorbital region of this bone. All are derived from large fishes.

Jaws.

Dentary. — Six fragments (4 left, 2 right) from the anterior (symphysial) portion; all are from large fishes. As an indication of size, the vertical height at the symphysis is given : Left : 4.2; 3.9; 2.9; and 2.7 cm. Right : 3.5 and 3.1 cm.

Premaxilla. — A small fragment from the anterior half of the bone; derived from a large fish. Another, and even more fragmentary specimen is also derived from a large fish.

Articular. — Two badly damaged specimens (both right) each comprising the facet and region immediately surrounding it; both are derived from large fishes. The greatest length of the facet is 2.1 and 2.7 cm for the specimens respectively.

Quadrate. — A single fragmentary specimen. The greatest breadth of the articular surface is 1.8 cm.

Preoperculum. — (i) A large fragment which comprises the greater part of the vertical limb and a small portion of the horizontal limb. The characteristic spines at the lower angle are damaged, but the origin of the first two, ventrally directed spines is preserved. The estimated height of the vertical limb — taking its sensory canal openings as base — is 17 cm.

(ii) A small fragment from the lower part of a vertical limb, immediately above its point of curvature into the horizontal limb.

(iii) A somewhat smaller specimen, still associated with its matrix. This bone is no more complete than either specimen described above, but represents an entire horizontal limb with the three ventrally directed spines well preserved.

Pectoral girdle.

Cleithrum. — Represented by three specimens. (i) A fragment from the angle between vertical and horizontal limbs of the bone; derived from a very large fish.

(ii) A smaller fragment also from the same region.

(iii) A small fragment from the horizontal limb immediately anterior to the angle between horizontal and vertical limbs; from a very large fish.

? Supracleitrum — A single specimen, derived from a very large fish, is considered to be the proximal end of this bone.

Vertebrae.

Unless specified otherwise, all measurements of breadth and height were taken from the anterior face of the centrum.

First vertebra. — A well preserved and almost entire specimen, breadth 3.9; height 3.2 and length 2.3 cm; a fragment (the right half of the centrum), estimated breadth and length 6.5 and 3.5 cm respectively; a fragment comprising the right anterior facet and a small part of the centrum immediately below it, thought to be derived from a vertebra about 4 cm broad and 2.5 cm long.

Second vertebra. — Two specimens, one almost complete, the other lacking its neural arch and prezygapophyses; b.3.1, h.3.4 and l.1.6; 1.7, 1.7 and 0.8 cm respectively.

Third vertebra. — Four specimens, one of which is badly damaged. (i) b.6.4, h.4.9, l.3.0 cm; (ii) 2.4, 1.8, 1.3 cm; (iii) 1.8, 1.5, 1.1 cm: no measurements were made on the fourth specimen.

Precaudal vertebra. — Five fragments of centra, three from large fishes and two from smaller individuals.

Caudal vertebrae. — Two almost complete specimens (b.3.3, h.2.9 and l.3.0 and 2.8, 2.8, 2.5 cm) and two fragments.

Fin-spines.

Four large fragments from the proximal ends of Percomorph fin-spines should probably be assigned to *Lates*. Two other fragments, from the distal end, are also referred to this genus but with less certainty.

INDETERMINABLE MATERIAL.

Fourteen fragments and three large specimens are undoubtedly of fish origin, but cannot be identified further.

SITE III

Katanda aval, Upper Semliki. Deposits of Kaiso age, extending some metres above the water and forming a small hill below the ford (pp. 43 and 46).

OSTARIOPHYSI

SILUROIDEA

Fam. BAGRIDAE.

Clarotes sp.

Tentative identifications. — (i) The poorly preserved anterior region of a large skull is tentatively assigned to *Clarotes*. The specimen comprises the dermethmoid and part of the prefrontal of each side. Few diagnostic characters are preserved but the shape of the dermethmoid is nearest that of *Clarotes* and there are traces of *Clarotes*-like tubercles present on the posterior part of the prefrontal.

(ii) The anterior fused vertebral mass; a single specimen derived from a large fish. Almost the entire length of the fused centra is complete and a large part of the right lateral wing is present. The base of the median dorsal plate is preserved, as are the basal and lower portions of the paired and posterioly directed spines. As far as can be determined from this fragmentary and fragile specimen the morphology of the elements preserved is nearer that of the vertebral mass in *Clarotes* than in *Bagrus*.

A large and extensively damaged skull can be definitely assigned to *Clarotes*. Besides the neurocranium some elements of the branchiocranium and an almost entire pectoral girdle are preserved *in situ*. The whole structure has undergone dorso-ventral compression so that the hyomandibulae, pterygoids and operculae are displaced laterally. The hyoid arch is less affected, whilst the pectoral girdle is apparently undistorted. Many bones are damaged, especially on their superficial surfaces.

Neurocranium. — The exposed dorsal surface is rather fragmentary and none of the roofing bones is preserved in their entirety.

Ethmoid. — Only the left side of the ethmoid, and an almost complete left prefrontal are present. The tuberculate ornamentation on the ethmoid

is confined to its antero-medial aspects and is replaced postero-medially, and to a lesser degree laterally, by fairly well defined divergently radiating ridges.

Vomer. — Part of the left vomerine tooth-band is visible on the under-surface of the skull.

Frontals. — Both frontals are incomplete. Although sutures cannot be determined with certainty, it seems probable that the anterior part of the left frontal and its union with the ethmoid of that side are preserved. The right frontal is present only in its posterior extension, including part of the junction with the sphenotic. The frontals bear numerous discrete tubercles which are not uniformly distributed but aggregated into posterior and lateral fields, separated by a zone of fine striations. Both the striae and the tubercles are arranged radiately.

Part of a deep fontanelle separating left and right frontals is preserved.

Neither sphenotic is present although there is a clearly defined outline impression of the right sphenotic.

None of the dorsal or dorso-lateral bones posterior to the frontals is preserved on the left side of the neurocranium.

The right pterotic is almost complete although much of its dorsal surface is damaged. Where present, the ornamentation is tuberculate, with the tubercles smaller and more densely aggregated than those of the frontals and ethmoid. Laterally, the right hyomandibula lies in intimate contact with the pterotic.

The entire occipital region is wanting.

Branchiocranium.

Hyomandibulae. — The greater part of both hyomandibulae is well preserved; the right hyomandibula is apparently in articulation with its pterotic facet.

The posterior part of the pterygoid is present on each side. Anteriorly, a small part of the forward end of the arch is visible below the left prefrontal. It is overlain by part of the somewhat laterally displaced palatine. Consequent upon this displacement, the dentigerous patch of the palatine is so orientated that it overlies and is continuous with the left vomerine tooth-band.

Hyoid arch. — The slightly damaged epi-, cerato- and hypohyals of both sides, together with their median basihyal are preserved *in situ*. These bones are displaced laterally to a degree comparable with the hyomandibulae and pterygoids.

Operculae. — The entire right operculum is preserved and the left is represented by an almost complete outline impression. Ornamentation

of the right operculum takes the form of numerous distinct and narrow ridges radiating centrifugally from a focus near the facet.

Jaws.

Premaxillae and Dentaries. — Nearly the entire left premaxilla is preserved in approximately its natural position; only a median fragment of the right premaxilla remains. The left dentary is represented by its antero-median portion, and the right merely by its symphysial head.

Pectoral girdle. — This massive structure is only slightly damaged. The lateral surfaces of the cleithra are strongly ornamented with large, well-spaced tubercles; the slight swellings which overlie the articular fossae for the pectoral spines are ornamented with several vertical and sub-parallel ridges. On each side, the heads and proximal ends of the pectoral spines are preserved in articulation; because the exposed surfaces are badly weathered, it is impossible to determine the nature of any ornamentation which might have been present on the spines.

Fragments of both post-temporals are still associated with their respective cleithra.

Within the limits imposed by its fragmentary nature, this specimen is comparable in size and general appearance with a skull described by ARAMBOURG (1947) from the Omo Beds of Lake Rudolf. ARAMBOURG refered his specimen to *Clarotes laticeps*, but I do not consider the Ishango specimen to be sufficiently well-preserved to warrant specific identification.

Only four measurements can be estimated with any accuracy.

Length (measured from the anterior ethmoidal mid-point to the posterior margin of the pterotic) : *ca.* 30 cm.

Greatest breadth (taken across the hyomandibulae heads after « restoring » them to their natural position) : *ca.* 18 cm.

Length of right sphenotic (taken along its lateral margin) : *ca.* 8 cm.

Greatest length of right pterotic : *ca.* 10 cm.

GENERICALLY INDETERMINABLE MATERIAL.

Vertebrae. — A number of anterior abdominal vertebrae, apparently derived from one individual, is preserved within a lump of matrix. Several vertebrae are still arranged serially, whilst others, more anterior in the series, are displaced. These bones are very similar to comparable elements in the vertebral column of *Bagrus*, to which genus they are tentatively assigned.

UNIDENTIFIABLE MATERIAL.

Twenty fragments and impressions of bones, some of which are only doubtfully considered to be of fish origin.

SITE IV

Kasaka, face à Senga, Upper Semliki. Kaiso beds, outcropping about 15-20 metres above the water, and situated on the left bank of the Semliki, slightly before the junction of Semliki and Kasaka rivers (pp. 40-41). Fossils freed by erosion and by the trampling of animals.

OSTARIOPHYSI

SILUROIDEA

Fam. BAGRIDAE.

GENUS INDETERMINABLE.

Vertebrae. — One anterior precaudal vertebra (from a large fish) which compares closely with serially equivalent vertebrae in *Bagrus*. Centrum measurements, taken from the anterior face, are : breadth *ca.* 3.4, height 3.7 and length 1.6 cm.

Pectoral spines. — Two damaged specimens; in each the articular head and proximal third of the spine are preserved. Because of their poor preservation, these specimens are assigned only tentatively to the *Bagridae*.

Fam. MOCHOCIDAE.

Synodontis sp.

Four fragments of dorsal spines are referred to this genus, as are two fragments thought to be derived from pectoral spines.

FAMILY INDETERMINABLE.

Two very fragmentary pectoral spines probably should be assigned to the *Bagridae*.

One fragment from the proximal end of a dorsal spine closely resembles this spine in extant *Auchenoglanis occidentalis*, especially with regard to its coarse sculpturing.

PERCOMORPHI

Fam. CENTROPOMIDAE.

Lates sp.

One, well-preserved gill-raker from the epibranchial of arch I can definitely be referred to this genus. Length : *ca.* 4.7 cm. (Measured from the basal mid-point to the distal tip).

Ten fragments of fin-rays should probably be assigned to *Lates*.

INDETERMINABLE MATERIAL.

Three large fragments (probably parts of the parasphenoid) representing at least two genera, together with five smaller fragments also of neurocranial origin, cannot be identified further.

SITE IV *a*

Between Ishango and Kanyatsi (point fossilifère L. 273 et L. 352) about 40 metres above the lake.

OSTARIOPHYSI

Fam. CHARACIDAE.

Hydrocyon sp.

This genus is represented by three, well-preserved teeth. Height of teeth (measured directly from base to tip) in millimetres *ca.* 15.0, 15.3 and 19.0.

PERCOMORPHI

Fam. CENTROPOMIDAE.

Lates sp.

Two large (length of each centrum *ca.* 5 cm) and almost complete centra of abdominal vertebrae, with a fragment from a third, preserved *in situ*; five other vertebrae (4 abdominal and 1 caudal) and one vertebral fragment. A fragment of fin spine should probably be referred to this genus.

SITE V

Senga, Upper Semliki. Kaiso beds outcropping about 10-15 metres above the water. Situated on the right bank, somewhat below the rapids and the junction of the Semliki and Kasaka rivers (p. 37). Fossils freed by erosion and by the trampling of animals.

OSTARIOPHYSI

SILUROIDEA

Fam. BAGRIDAE.

? Auchenoglanis sp.

The material listed below is tentatively referred to *Auchenoglanis* since trenchant diagnostic characters are not present in any specimen. Identification is on the basis of greater correspondence with comparable structures in *Auchenoglanis* than in any other extant Siluroid genus. The specimens comprise :

(i) The posterior part of the basioccipital, including its facet; derived from a fish with a neurocranial length greater than 16 cm (the largest *A. occidentalis* available to me). The facet measures 3.1 cm in breadth and is 3.1 cm high.

(ii) A neurocranial fragment whose curvature and ornamentation agree closely with certain bones in the skull of *A. occidentalis*; also derived from a large fish.

(iii) A left humeral process and postero-lateral part of the cleithrum; from a fish as large as that, or those, from which specimens (i) and (ii) originated.

(iv) Part of the proximal two-thirds of a large pectoral spine.

PERCOMORPHI

Fam. CENTROPOMIDAE.

Lates sp.

The genus is poorly represented by the following specimens :

1st Vertebra. — Rather weathered and possibly somewhat compressed; from a large fish. Depth (posterior face of the centrum) 5.2, breadth (anterior face) 5.7 and length 3.2 cm.

Posterior precaudal vertebra. — A well-preserved but incomplete specimen : Breadth (anterior face) 2.8, height (anterior face) 2.7 and length 2.6 cm.

Preoperculum. — A fragment from the lower part of the vertical limb; estimated to be derived from a fish about 100 cm standard length.

Quadrate. — A small fragment from the antero-ventral angle; derived from a large fish.

GENERICALLY INDETERMINABLE MATERIAL.

(i) A small bone, possibly part of the proximal end of a Siluroid pectoral spine.

(ii) Four fragments, of uncertain origin.

SITE VI

Katanda amont, Upper Semliki. Beds of the Semliki Series (Middle Pleistocene), situated on the right bank, about 23 metres above the water (p. 47).

Fish remains from this site are few in number and very fragmentary. In most cases, generic identification is problematical.

OSTARIOPHYSI

SILUROIDEA

CLARIIDAE. — A fragment of neurocranium has ornamentation closely approximating that of present-day *Clarias*. An anterior precaudal vertebra is also referred to this genus (breadth 2.9 cm, height 2.8 cm [both from the anterior face of the centrum] and length 0.9 cm).

BAGRIDAE. — Three fragments of flat bone with coarse, tuberculate ornamentation are tentatively referred to this family. They may represent species of *Clarotes* or *Chrysichthys*.

? MOCHOCIDAE (*? Synodontis*). — Represented by the proximal part of a fin-spine estimated to be derived from a fish about 20 cm standard length.

Unidentifiable material. — Four fragments of bone.

In addition to this material Dr. DE HEINZELIN has kindly sent me a few further specimens collected by him in 1954.

These specimens are identified as follows :

CLARIIDAE (*Clarias* sp.). — A fragment of neurocranium.

? BAGRIDAE. — Four fragments of neurocranium should probably be referred to this family, although their ornamentation is coarser than that seen in extant *Clarotes* and *Chrysichthys*.

Additional material collected from this site in 1954 (27-30 m above the river) :

Synodontis : fragment of pectoral spine.

Lates : a fragment of vertebra (and possibly one other fragment).

SITE VII

As for site VI, except that the fossils were collected from a dispersed outcrop (p. 47).

Only three fish-fossils can be identified with certainty.

OSTARIOPHYSI

CYPRINOIDEA

CYPRINIDAE (*Barbus* sp.). — Represented by the crown of the largest tooth in the pharyngeal series; derived from a fish *ca.* 75 cm standard length.

SILUROIDEA

CLARIIDAE. — The posterior half of a left dentary (from a fish *ca.* 60 cm standard length) is referred to the genus *Clarias*.

Generically Indeterminable material. — A small fragment of thin, curved bone, probably from the rim of a centrum.

SITE VIII*a*

Ishango G. INF., at the source of the Semliki. Excavations.
Debris derived from ancient formations (the majority from Kaiso beds). The bones black, heavy and rolled.

DIPNOI

Fam. LEPIDOSIRENIDAE.

Protopterus sp.

The only specimen of *Protopterus* from this deposit is an incomplete, and heavily rolled, left dentary and splenial tooth-plate.

This splenial tooth-plate differs slightly from those of extant *Protopterus* species which I have examined, or, for which figures are available. The principal difference lies in the fossil possessing a deep, medially directed depression which separates the low, continuous inner ridge from the third (posterior) outer ridge. In *P. aethiopicus* these two ridges run imperceptibly into oneanother. Nothing indicates that the depression in the fossil is due to wear or *post-mortem* damage.

A less obvious difference is that the third ridge is short in relation to the total length of the tooth-plate. The validity of this ratio is perhaps doubtful, since in *P. aethiopicus* it shows some size correlated variation, with the third ridge longer in large fishes.

The entire tooth-ridge, measured over its long axis from the posterior edge to the symphysial surface, is 5.3 cm long.

OSTARIOPHYSI

SILUROIDEA

Fam. CLARIIDAE.

Eight fragments of sculptured neurocranial bones are placed in this family on the basis of their ornamentation. They should probably be referred to the genus *Clarias*.

Fam. MOCHOCIDAE.

Synodontis sp.

One specimen only, (the articular head and proximal quarter of a pectoral spine) is referred to this genus. The relatively slight degree of weathering shown by the spine is in marked contrast to the other, heavily weathered specimens from this deposit.

Fam. BAGRIDAE.

Clarotes sp.

Two incomplete pectoral fin spines (left and right) are assigned to this species. Two damaged pectoral spines (both right), together with the proximal end of a third specimen, and two distal fragments are tentatively referred to *Clarotes*.

SILUROIDEA, FAMILY INDETERMINABLE.

Four fragments of dentigerous bones.

PERCOMORPHI

Fam. CENTROPOMIDAE.

Lates sp.

Vertebrae provide the only evidence for the presence of *Lates* in this deposit. All specimens are somewhat rolled.

First vertebra. — One specimen, from a large fish. Measurements taken from the posterior face are : breadth 4.4, height 4.5, length 3.3 cm.

Third vertebra. — One, damaged specimen : breadth 3.4 and length 1.7 cm.

Fourth vertebra. — Four specimens whose measurements (taken from the anterior face) are : (i) b. 3.9, h. 2.0, l. 3.1 cm; (ii) estimated to be about the same size as (i) but split obliquely across its long axis; (iii) b. 3.9, h. 2.0, l. 3.1 cm; (iv) b. 2.7, h. 1.1, l. 2.0 cm.

A badly damaged vertebra is identified as a posterior precaudal element.

There are also two anterior caudal vertebrae (measurements as above) : (i) b. 2.8, h. 3.0, l. 2.5 cm; (ii) b. 1.7, h. 1.7, l. 1.6 cm, and one face of a large vertebra whose greatest and least diameters are 6.6 and 6.0 cm respectively.

SITE VIII*b*

As for VIII *a*, but the debris probably autochthonous; trench N 143[6] E, G. INF.; lower level of the Ishango terrace (Epi-Pleistocene). Bones light-brown to dark brown in colour, relatively light, porous and little rolled.

OSTARIOPHYSI

SILUROIDEA

Fam. BAGRIDAE.

Clarotes sp.

The articular heads of two pectoral spines (1 left, 1 right) are referred to this genus.

Fam. MOCHOCIDAE.

Synodontis sp.

The genus is represented only by a number of incomplete fin-spines identified as follows :

Dorsal spine. — Three specimens all from fishes of about 25 cm standard length.

Pectoral spine. — Six specimens (three from the proximal end [1 left, 2 right] and three from the distal end of the spine); derived from fishes between 18 and 30 cm standard length.

SILUROIDEA, FAMILY INDETERMINABLE.

Part of a dorsal fin-spine.

CYPRINOIDEA

Fam. CYPRINIDAE.

Barbus sp.

Material referred to this genus comprises one vertebra (from a fish about 40 cm standard length) and, less certainly, part of the third (ossified) dorsal ray.

PERCOMORPHI

Fam. CENTROPOMIDAE.

Lates sp.

Three caudal vertebrae, from fishes of *ca.* 65-70 cm standard length.

Fam. CICHLIDAE.

Tilapia sp.

Precaudal vertebrae. — Five specimens, one from a fish of *ca.* 40 cm. standard length and four from individuals of *ca.* 35 cm.

First interneural pterygiophore. — One, the articular surface only; from a fish of 45-50 cm standard length.

Fin spines.

Anal spine. — One; this stout and short spine is probably the second anal spine from a fish of *ca.* 45-50 cm standard length.

Dorsal spines. — One anterior spine, almost entire, and one other, more posterior in the series (from a fish or fishes of about 40 cm standard length). There is also a somewhat rotted fragment, probably from a dorsal spine.

Pectoral spine. — One almost entire and well preserved spine, from a fish *ca.* 45 cm standard length.

GENERICALLY UNIDENTIFIABLE MATERIAL.

(i) a fin-spine; (ii) one vertebra; (iii) a fragment of bone, possibly not of fish origin.

SITE VIII *c*

As above, but trench N 43^{G} E.

Material from this site is well preserved, shows few signs of weathering and is lightly mineralized. Consequently, it contrasts strongly with the heavily mineralized and weathered specimens of site VIII *a*, particularly with regard to the preservation of fine detail. In many respects, including the adherent micaceous matrix, the appearance of fossils from site VIII *c* closely resembles that of specimens from VIII *b* and from the Makalian deposits of site IX.

DIPNOI

Fam. LEPIDOSIRENIDAE.

Protopterus cf. **P. aethiopicus.**

Dentary and splenial tooth-plate. — Seven specimens (5 left and 2 right); the entire dentary is present in one specimen, the tooth-plate is complete or very nearly complete in three, and is represented by its anterior part in four other specimens. Two indications of size are given : first, for complete teeth, the length of the tooth-plate, and secondly, for incomplete plates, the height of the first tooth fold.

(i) 4.7, 4.0 and 4.2 cm; (ii) 1.4, 1.3, 1,2 (f2) cm.

Palatopterygoid tooth-plate. — One rather fragmentary specimen, in which the first and second tooth-ridges are preserved.

All these specimens are well-preserved; none shows any marked morphological differences from comparable tooth-plates in *Protopterus aethiopicus*.