



The Journal

OF THE

EAST AFRICA AND UGANDA NATURAL HISTORY SOCIETY

OFFICIAL PUBLICATION OF THE CORYNDON
MEMORIAL MUSEUM.

(MUSEUMS TRUSTEES OF KENYA).

September, 1941.

Vol. XVI.

No. 1 (70).

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Date of Publication: September, 1941.

Additional copies to members: 7/6; non-members, 15/-.

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A SHORT ACCOUNT OF THE FRESH WATER FISHES OF KENYA.

BY HUGH COPLEY.

The lack of a list of the fresh water fishes of Kenya has been felt for years by the person who takes an interest in the fauna and also by those who wish to see some economic use made of the fishery resources of the Colony.

Before discussing the various sheets of water and the fishes which inhabit them a little may be said of their prehistory.

The waters of Kenya can be divided into three parts: Lake Victoria as one part; Lakes Rudolf, Hannington, Baringo, Nakuru, Elmenteita, Naivasha, and Magadi in the Rift Valley as the second part and the river systems of the Athi and the Tana as the third. All the other rivers group into their respective lake systems. Not enough is known of the prehistory of the third group to make any definite statements, but enough is known of the first two to get a general idea of their early history. The prehistory of Lake Rudolf is simple and differs entirely from that of Lake Victoria and so do the fish which inhabit its waters. To begin the story we will go back a brief period of 15,000 years.

Fifteen thousand years ago the waters of Lake Rudolf stood 475 feet higher than they do to-day with the consequence that a greater part of West Suk and parts of Turkana were submerged. Being at the end of one of the pluvial periods there were heavy rains; snow on the summits of the Aberdares; and snow on Mount Kenya 1,000 feet below its present level. The amount of water flowing into the lake was far greater than the evaporation and this surplus overflowed northwards down the present dried-up bed of the Sobat River and so into the Nile. In other words the Great Lake Rudolf fed the Nile and consequently Nilotic fish inhabited this great sheet of water.

The Pluvial period finished and a period of desiccation set in. The waters shrank and gradually stopped supplying the Nile until Lake Rudolf became isolated; its waters lost their freshness until they became hardly fit for drinking. The Nilotic fish have survived, even multiplied, and although only 15,000 years have passed away, yet there are definite small differences between the Lake Rudolf fish and those of the Nile showing the effects of isolation and environment.

The prehistory of Lake Victoria is much more complicated. We will not consider the history of the formation of the lake,

but we may mention that its waters were connected with the great rivers of the Congo and then to the Nile. Then owing to the complete drying up of the lake the whole stock of fish died off with the exception of the lung-fish, a catfish or two and a tilapia; these surviving owing to accessory breathing appliances or sheer cussedness. The lake filled up again during the last pluvial period (15,000 years ago) and no Nilotic fish (predatory or otherwise) were able to get into the lake owing to the formation of the Murchison Falls.

The lung-fish being very ancient in its lineage, only multiplied itself, but the very modern *Tilapia*, being most unstable and, owing to a lack of predators, was able to break up into dozens and dozens of species and all this has occurred in the short space of 15,000 years.

There is no doubt that the ancient lakes Baringo, Hannington, Elmenteita, Nakuru, Naivasha, and Magadi had a Nilotic fauna. Naivasha, Nakuru, and Elmenteita have dried out several times and their fish have died out. Baringo and Hannington have also dried out at various times, but seem to have received two or three species of fish from the Athi-Tana River systems in very recent times.

In Lake Magadi, there is a little *Tilapia* which is a relic from some ancestral form, maybe Nilotic, and this fish has survived and adapted itself to a progressive increase in the soda content of the lake. It shows how hardy their constitution is and how a few could have survived distressing conditions experienced during the drying-up of Lake Victoria.

The freshwater fishes are interesting as they contain one Sub-Order *Dipneusti*, Family *Lepidosirenidae*, Genus *Protopterus* (Lung fish) with a very ancient history going back to Devonian times. This fish is also interesting as it has many primitive features developmentally in common with the Amphibia.

The other fish are all, what one might call, straight forward bony fishes with a more recent line of ancestry only going back to the Cretaceous times.

The fossil remains of fish so far found are few and only of fish which are still found in our lakes and rivers.

The fish fauna of Lake Rudolf is characterised by a large number of genera each representing a very few species. On the other hand Lake Victoria, and the rivers flowing in to it, have comparatively a small number of genera representing a great number of individual species. This is due to the latter body of water having no predatory fish to control the breaking up of the genera into numerous related species. This question of the influence of large predators has been discussed by

CONVERSAZIONE

This will be held in the **Coryndon Museum on October** the 15th and 16th inst. 1941. For further notices and details consult newspapers and wireless.

There will be an exhibition of photographs of **Nature and Natural History Subjects** in its widest sense. Will all who have such pictures please submit same to the Honorary Secretary, P.O. Box 241, Nairobi, not later than **October the 7th**.

The most desirable size of picture would be half plate or larger. The greatest care will be taken of all prints and for the return of all prints submitted but no financial responsibility for loss or damage in any form can be accepted.

Will All Members Please Help.

Dr. Worthington and the interested can refer to his writings. The following are brief notes on the lakes and rivers of Kenya and their fishes.

Lake Victoria.—This lake has an area of about 26,000 square miles, nearly the size of Scotland. Its greatest length is 250 miles with a breadth of 200 miles and a coastline of 2,100 statute miles. There are 60 islands with an individual coastline of 4 miles and others, smaller, which makes the total coastline of about 3,000 statute miles.

The greatest depth is about 250 feet whilst the bottom is composed of fine greenish-black ooze composed entirely of diatoms, (*Melosira*, *Cyclotella*, and *Surirella*). There are two areas of sand on the Uganda side. The water of the lake is fresh and potable whilst the pH ranges from 7.4 to 8.5 and the temperature is, on an average, 76° F.

The lake supports a large fishing industry. The figures for 1938, which are only for Kenya, are interesting and show the size of the industry. The number of *Tilapia* caught was 3,578,428 of a value of £38,648. The value of other fish used for the dried fish industry and fresh native consumption is roughly worth another £60,000. This is for Kenya alone and the total value for the lake fisheries would be about £300,000.

Lake Rudolf.—This lake lies in the trough of the Rift Valley; its northern shores being on the Kenya-Sudan-Abyssinia border. It is 180 miles long with a width of from 15 to 35 miles. The eastern shoreline is steep and rocky whilst the western shore is bordered by a strip of desert country. There are three small volcanic islands. The lake has an altitude of 1,250 ft. above sea level. The greatest depth is about 300 ft. whilst the average water temperature is about 86° F. with a high soda content (sodium carbonate).

There are no commercial fisheries but a small communal fishery exists at a few scattered places. pH 9.4—9.6.

Lake Baringo.—This lake also lies in a trough of the Rift Valley. The lake is situated at an altitude of 3,150 ft. above sea level. It is 12 miles long by 5 miles wide and has a fairly uniform depth of 22 feet. The water is comparatively fresh with an average temperature of about 84° F. There is no economic fishery in the lake but a few primitive Njemps catch fish for their own consumption. pH 8.4—8.8.

Lake Hannington.—Another lake in the Rift Valley about 4 miles long with an average width of half a mile. What is the average depth, temperature or pH, I do not know, but the water is excessively alkaline.

Lake Naivasha.—Another lake in the Rift Valley at an altitude of 6,200 ft. It has one island which is at the present, owing to a series of low water seasons, joined to the mainland. This island is the remnant of the partially submerged rim of a volcanic crater. The greatest depth of water inside the crater is about 60 feet whilst the average depth over the main lake is not more than 12 feet. The temperature of the water, which is fresh and potable, is, on an average, 72° F. and the pH 8.5.

There is no economic fishery. *Tilapia nigra* was introduced from the Athi River system and the Large Mouth Black bass from England to supply sporting amenities. Rainbow trout have migrated into the lake from the Morandat River.

Kerio River.—This river rises in the highlands round Molo and then continues its course down the Rift Valley until it reaches the southern extremity of Lake Rudolf. The waters only reach this lake for a short period during the heaviest of rains and in the dry periods no water gets beyond a point quite 40 miles south of the lake. The water is palatable with a temperature of 84° F. and an air temperature of 94° F. at noon. The fish fauna is typically Lake Rudolf. pH 8.0.

Namanga River.—A short stream rising on Ol Joro Orok which loses itself in the swamp Amboseli. Its total length is not more than 10 miles.

Lumi River.—The headwaters of this river are on the eastern slope of Mount Kilimanjaro. The total length of the river is not more than 20 miles when it loses itself in Lake Jipe. In its lower course the volume of water is considerably augmented by strong springs of cold water. The fish fauna is the same as Lake Jipe. Temperature, 72° F. pH 8.0.

Athi River.—This river drains the south-eastern slope of the Aberdare range and the country bordering the Ngong Hills whilst the Tsavo, a tributary, draws its water from the south-eastern slopes of Mount Kilimanjaro. Some of the tributaries are stocked with trout above the 6,000 feet contour. The total course of the river is about 320 miles before it debouches into the Indian Ocean near Malindi. The water is potable, but contains large quantities of mica particles in suspension. The average temperature of the water after the upper tributaries have joined is 76° F.; pH 7.8—8.1. A considerable native fishing industry is carried on along the banks, the fish being dried and sold to native employees on the many large sisal shambas in the vicinity.

Uaso Nyiro River.—This river drains a considerable portion of the eastern slopes of the Aberdares whilst other tributaries,

the Naro Maro, Burguret, the Liki, Nanyuki, and the Sirimon, drain a part of the slopes of Mount Kenya. A number of these streams contain trout in their upper reaches. The evaporation in the low country coupled with the extraction of water in regions bordered by European settlement have considerably reduced the water flowing through the Northern Frontier. In seasons of high rainfall water reaches the Lorian Swamp; but at other times the river is dry 40 miles below the bridge at Archer's Post. There is no commercial fishing done on the river. The water temperature in the low country is high, 84° F., whilst the pH is 8.0 to 8.4.

The Tana River.—This is the largest and the longest river in the Colony. It drains a section of the eastern slopes of the Aberdares and a considerable portion of Mount Kenya. Nearly all its tributaries rise on the Aberdare Range and Mount Kenya and have been stocked with trout. During its lowland course to the sea the river is subjected to large seasonal fluctuations in the amount of water carried to the Indian Ocean. No temperature or pH readings have been taken. Less is known of the fish fauna than any other river in the Colony. There are a number of resident tribes who trap and sun-dry fish, but the trade is not large.

The following are a few descriptive notes on the different fishes their characters, food, and habits which should help the layman to identify them should any come to hand.

PROTOPTERUS.—The English name for this fish is "Lung-fish" whilst the common native name all over Lake Victoria is "MAMBA," but the DHOLUO have another name "KAMONGO." The young pass through a larval stage. At the beginning of the dry weather the fish disappears into a cylindrical cavity fitted with a lid perforated with small air holes. The fish, when in this cavity, is surrounded by a secretion of mucus. When the rains begin the fish comes forth. At the beginning of the rains a nest is made in the grass at the water edge. Thousands of eggs are laid on the mud at the bottom of the nest and these hatch out in from 7 to 9 days depending on the weather conditions. Whilst the young are in the nest the male keeps guard.

The food of the adult fish consists largely of snails and bivalves, but they will attack fish caught in the seine nets or hooked on a long line. The fish is rather eel-like in its movements and progression forward is made by ripple movements along its body. Another character of the fish is that the air bladder is a functional lung at all times acting in connection with the gills. The fish, at intervals, comes to the surface of

the water, puts its snout out, empties the lungs, and takes in a fresh supply. Whilst doing this it makes a decided noise which can be heard for some distance. The fish as will be seen from Fig. 1, Plate 1, cannot be mistaken for any other. The average length caught is from 24 to 32 inches, but there is in the Coryndon Museum one of nearly 72 inches which is a monster. The flesh is red, like beef, and very good eating when fresh.

POLYPTERUS.—A typical fish of the Nile and found in Lake Rudolf. Its rounded tail and the row of finlets in place of the dorsal fin will enable one to recognise this fish from all others. Shallow warm water plentifully supplied with weeds is the home of this fish. By day it is sluggish and hardly moves from one favoured spot. At night it is far more active, feeding on small fish, worms, frogs, snails, etc. From the egg stage it undergoes a larval stage. In this stage its most striking feature is the cutaneous gills.

The general colour of the matured fish is a dark green, blotched with black whilst the belly is yellow.

The flesh is oily and mushy; often with an odour which is not pleasant. Fig. 2, Plate 1.

MORMYRIDAE.—The "Elephant Snout Fish" generally known on Lake Victoria as "SUMA."

All the species in this family can be immediately recognised by the snout. In some species it is small, hardly more than a bump, whilst in others it is long with a small flexible, feeling tip. These fish have a brain far larger than any other fish and also feeble electric organs. Again they are always covered with slime which gives a pale olive-green colour to the fish. Rub this off and the fish becomes drab. Fossil Mormyridae are unknown, but there are some beautiful pictures of this fish in the mural paintings and bronze medals of the ancient Egyptians. The eyes are minute and it is presumed that the long snout, with the soft fleshy feeling tip, pokes about in the mud at the bottom of the water, for its food consisting principally of the underwater larvae of flies, blood worms, etc. The flesh of the fish is a sickly yellow in colour and full of oil, which goes bad very quickly. The Kavirondo will not eat it as they say it gives them diarrhoea. This fish goes up to 5 lbs. in weight and will take a small worm at bait. Figs. 3 and 4, Plate 1.

GYMNARCHUS.—This is another fish of the lower Nile and is found in Lake Rudolf. It is eel-like, very powerful and generally covered in a layer of slime. It is principally active

at night when it feeds on small fish, frogs, snails and other trifles. In the hours of daylight it generally tucks itself away in deep holes or in banks of weeds. Its general colour is a dark brownish olive shading to white on the belly. In size it goes big, even to a weight of 12 pounds. Fig. 5, Plate 2.

HETEROTIS.—Another unusual looking fish of the lower Nile and Lake Rudolf is *Heterotis niloticus*. It has a funny little tail. The scales are very large and rugose. It is a dirty blackish green in colour fading to greenish yellow on the belly. The fish builds an enormous nest in the papyrus or suitable reeds in which it lays its eggs. The young pass through a larval stage when they have long blood-red gill filaments. It goes to 7 pounds in weight and the flesh is wholesome eating. Fig. 6, Plate 2.

CHARACINIDAE.—One member of this family is well-known as the "Tiger Fish." The two members found in the Colony are *Hydrocyon forskalii* (the small Tiger Fish) and *Hydrocyon lineatus* (the large Tiger Fish). The native name for the small tiger fish in Lake Rudolf is "LOKEL." Here again is a fish which cannot be mistaken for anything else because of its terrible teeth. Its colour is a gleaming silver with steel-blue on the back. Along the sides are a number of black dots in stripes whilst the fins are an orange-flame colour. Both are predatory and live on nothing but live fish. The little one goes to a pound and a half whilst the large one to 35 pounds and both give grand sport on suitable tackle. They are rotten eating owing to the numerous, small, needle-sharp bones embedded in the flesh. Fig. 7, Plate 2.

The cousins of the tiger fish are the *ALESTES* which are small, silvery, roach-like fish with a beautiful blue or a golden sheen. An *Alestes* in an aquarium is a very beautiful sight. *Alestes nurse* has a black blotch on the sides of the body just near the gills. *Alestes dentex* is long and slim with no black spot and so is *Alestes baremose*, but *Alestes sadleri* has a black blotch on the base of the tail. All have an adipose fin like the tiger fish. All these fish are plankton eaters and the writer has seen none over 9 inches in length. The native name on Lake Rudolf is "DOROBELA." Fig. 8, Plate 3.

DISTICHODUS again can never be mistaken, see Fig. 9, Plate 3. It goes large, up to 10 lbs. will not take a bait, is rotten eating and the native name is "GWOLO." It feeds on weeds, snails, chironomid larvae, gastropods, and all sorts of funny things from the bottom of the lake.

CITHARINUS.—Might be called the Lake Rudolf Bream as it has the shape of a dinner plate and is incredibly thin across the back. It is, however, a very handsome fish with a beautiful silver colour, green-black back and pinkish fins. It goes up to 7 or 8 pounds in weight and feeds off weeds, plankton and things off the bottom. It is better eating than the previous fish, but only just. The Lake Rudolf name is "AGURT." Fig. 10, Plate 3.

CYPRINIDAE.—This is a large family having about 1,300 species of which just over a 100 are found in Africa. A great number cannot be distinguished from each other except by an expert, so a typical small barbus Fig. 12 and a large type Fig. 11 will be described and illustrated.

This fish is of a silvery colour with an olive or blue-black shading on the back; fins dusky or tinged with yellow or pink. The scales are large and the lateral line well-defined. There is no adipose fin. The Rhino Fish of the Athi, Fig. 11, Plate 4, gives great sport to anglers as it grows to a weight of 45 lbs. It can be recognised by the horn on the snout which rises when the mouth is protracted. The main food of the barbus is weed, plankton, underwater insects, mollusca, etc., but the rhino fish when large feeds on small fish. They have all good eating flesh, but suffer from numerous small bones.

The *LABEO* are carp-like, but narrower in the body whilst the mouth is underneath the face. The flesh is firm and rich, but suffers from small bones. Mollusca, weed and insect larvae are their principal food. Fig. 13, Plate 4.

Labeo victorianus is called "NINGU" on Lake Victoria and is caught in large quantities and sun-dried for native consumption.

The *BARILIUS* are small dace-like fish, some having a number of dark finger marks along their sides. They are a brilliant silver with olive-green backs. Fig. 14, Plate 5.

ENGRAULICYPRIS are other little sardine-like fish which generally go in shoals at the surface of the water and feed upon plankton. They are fed upon by the tiger fish, tern and gulls. The scales come off very easily when handled and the fish is very delicate, dying as soon as it is out of the water. Fig. 15, Plate 5.

SILURIDAE, the catfishes.—These are well known as they have flat hard heads, adipose fins and seem scaleless whilst they are generally covered in slime. Some croak when out of the water. There are also, round the mouth, feelers which often have attached taste buds. These fish eat anything good, bad

or indifferent; but are very good eating themselves. Two typical species are shown Fig. 16 and Fig. 17, Plate 5.

CYPRINODONTIDAE, the top minnows.—Tiny fish found in Lake Rudolf and Lake Naivasha. Never more than 2½ inches in length feeding on plankton and algae. Like *Engraulicypris* they are very delicate. See Fig. 18, Plate 6.

CICHLIDAE, the tilapias.—These are the most important economic fish in Lake Victoria and the Colony. There are four important ones; the two tilapias of Lake Victoria (*Tilapia variabilis*, *Tilapia esculenta*); the Lake Rudolf Tilapia (*Tilapia nilotica*) and *Tilapia nigra* of the Athi River.

Tilapia variabilis, Fig. 19, native name "MBIRU" differs from *Tilapia esculenta*, Fig. 20, the "NGEGE" by having less scales on the body and on the cheeks; the shape of the head is a little different; whilst the "ngege" is olive-brownish in colour. The "mbiru" has scarlet tips to the rays of the dorsal fin and to the edge of the tail whilst its general colour is bluish. The males of both species put on an added colouration of reds, golds and green during the breeding season whilst the males of the "mbiru," during the breeding season, have a highly decorated tassellated genital papila. The food of these two tilapia is diatoms, green algae, floating vegetable life (phytoplankton). The "mbiru" will not keep so is sun-dried or smoked for local native consumption. The "ngege" is shipped all over the Colony in a fresh state as it will keep. The average size of the "ngege" in the trade, cleaned and gutted, would be 14 ounces.

The Lake Rudolf Tilapia (*Tilapia nilotica*) is similar to an overgrown "ngege" as it grows to a weight of 12 pounds. Owing to the great distance of the lake from selling centres no economic use has been made of this fish. The food of this fish is phytoplankton, weeds and algae.

The Athi River Tilapia (*Tilapia nigra*). This fish has been used extensively for stocking artificial dams. It is on a par with the "ngege" as a good fish and being much more omnivorous in its habits gives sport to the angler. In appearance it resembles the "ngege." Very much more could be done with this fish from the economic point of view, for it is an ideal subject with which to carry out continental methods of fish culture.

All these species of tilapia have similar nesting habits. The male hollows out a nest in sand in shallow warm water, sometimes utilising the foot-print of a hippo as a foundation. In this depression the female lays about 250 eggs and these are fertilised by the male. After this process these eggs are carried

in the mouth of the female until their development is complete. Even after that the female will take the young fry into her mouth in time of danger. The fry frequent hot, shallow water where they swim about in shoals.

HAPLOCHROMIS.—The stronghold of these fish is Lake Victoria and it seems that when the lake filled up after one of its dry periods a few tilapia survived. As there was no predatory fish the tilapia bred and split up into a great number of species of *Haplochromis*. All are small and can be recognised by the comparatively large head which is far more drawn out to the lips than in the tilapia. Some have beautiful colouration, but it requires one who has specialised on the cichlids to tell one from the other. Their food and general habits are the same as those of the tilapia. They are caught by the natives, dried and then sold all over the Colony. Fig. 21, Plate 7.

CENTROPOMIDAE, the Nile perch.—The only body of water in which this large fish is found in Kenya is Lake Rudolf. In this lake there is a small type and a large type. The small type lives in the deep open water whilst the large type lives in the bays and inshore water. The food of the Nile perch is fish and yet more fish. The male hardly ever goes over 30 pounds in weight whilst the females go up to 300 pounds. The flesh is wholesome and good eating; but no economic use has been made of this fish up to the present. Fig. 22, Plate 7.

ANABANTIDAE.—A very pretty little fish which can be immediately recognised from the tilapia's and the *Haplochromis* by its rounded tail and spinuous anal fin. The colouration is olive with numerous black spots and there is a dark blotch edged with yellow at the base of the tail. Fig. 23, Plate 7.

MASTACEMBELIDAE.—A long eel-like creature, olive-green with black bands and wavy black lines on the body and a pointed head. This fish can be recognised from any of the eels by passing the hand along the back from the tail to the head when a number of needle-like spines will be encountered. The largest specimen seen was about 14 inches in length. Fig. 24, Plate 8.

MALOPTERURIDAE, the electric fish.—A filthy, flabby, nasty fish of a dirty bluish grey colour, blotched with black. All the fins are edged with orange-red. It is sluggish in habit and gives a good electric shock when handled. It has a long fleshy adipose fin. In every respect a revolting fish. Fig. 25, Plate 8.

TETRODONTIDAE, the puffer fish.—Another funny little fish with an olive-grey back and a yellow-coloured belly. There are numerous black stripes along the body. The head and body are covered with minute spines making the skin feel like sand-paper. The teeth are coalescent forming a beak like the marine parrot fish. This fish can blow itself out into a miniature balloon; but in this position the fish is helpless. It exhales the air with a long sigh. Very pathetic. Fig. 26, Plate 8.

Having given a very brief description of the fishes and their habitat I will conclude with a provisional list in the hopes that it will be useful to the layman as well as form a basis for future work by those who will have to work on our fresh water fishes in the future.

A PROVISIONAL LIST OF THE FRESH WATER FISHES OF KENYA.

FAMILY.	SCIENTIFIC NAME.	COMMON AND NATIVE NAME.
LAKE VICTORIA.		
<i>LEPIDOSIRENIDAE.</i>	<i>Protopterus aethiopicus.</i>	Lungfish; Mamba, Kamongo.
<i>MORMYRIDAE.</i>	<i>Marcusenius nigricans.</i>	Elephant snout-fish; Suma.
	<i>Mormyrus kannume.</i>	
	<i>Petrocephalus degeni.</i>	
	<i>Gnathonemus longibarbis.</i>	
<i>CHARACINIDAE.</i>	<i>Gnathonemus victoriae.</i>	Bobo.
	<i>Marcusenius grahami.</i>	Kuumpi.
	<i>Alestes sadleri.</i>	Osoga.
<i>CYPRINIDAE.</i>	<i>Alestes nurse.</i>	General name barbel, scaley, yellow belly, Kasinga.
	<i>Barbus nummifer.</i>	
	<i>Barbus paludinosus.</i>	
	<i>Barbus thikensis.</i>	
	<i>Barbus radcliffii.</i>	
	<i>Barbus bayoni.</i>	
	<i>Barbus minchini.</i>	
	<i>Barbus tetraspilus.</i>	
	<i>Barbus sexradiatus.</i>	
	<i>Barbus apleurogramma.</i>	
	<i>Barbus doggetti.</i>	
	<i>Barbus magdalenae.</i>	
	<i>Labeo victorianus.</i>	Ningu.
	<i>Engraulicypris argenteus.</i>	Omena.
<i>SILURIDAE.</i>	<i>Discognathus johnstonii.</i>	The catfishes.
	<i>Clarias alluaudi.</i>	
	<i>Clarias eupogon.</i>	
	<i>Clarias anguillaris.</i>	
	<i>Clarias mossambicus.</i>	
	<i>Clarias carsonii.</i>	
	<i>Clarias weneri.</i>	Mumi.

FAMILY.	SCIENTIFIC NAME.	COMMON AND NATIVE NAME.
	<i>Bagrus degeni.</i>	Seu.
	<i>Bagrus docmac.</i>	
	<i>Schilbe mystus.</i>	Butterfish; Sire.
	<i>Synadontis victoriae.</i>	
CYPRINODONTIDAE.	<i>Synadontis afro-fischerei.</i>	
	<i>Fundulus taeniopygus.</i>	
	<i>Haplochilus pumilus.</i>	
CICHLIDAE.	<i>Cynopanchax bukobanus.</i>	
	<i>Tilapia variabilis.</i>	Mbiru.
	<i>Tilapia esculenta.</i>	Ngege.
	<i>Haplochromis multicolor.</i>	General name for
	<i>Haplochromis nigricans.</i>	all these fish Fulu.
	<i>Haplochromis nuchisquamulatus.</i>	
	<i>Haplochromis gestri.</i>	
	<i>Haplochromis nubilus.</i>	
	<i>Haplochromis melanopus.</i>	
	<i>Haplochromis macrops.</i>	
	<i>Haplochromis cinereus.</i>	Bihuru.
	<i>Haplochromis sauvagei.</i>	
	<i>Haplochromis crassilabris.</i>	
	<i>Haplochromis annectens.</i>	
	<i>Haplochromis humilior.</i>	
	<i>Haplochromis ishmaeli.</i>	
	<i>Haplochromis obesus.</i>	
	<i>Haplochromis chilotes.</i>	
	<i>Haplochromis flavipinnis.</i>	
	<i>Haplochromis taeniatus.</i>	
	<i>Haplochromis martini.</i>	
	<i>Haplochromis nigrescens.</i>	
	<i>Haplochromis microdon.</i>	
	<i>Haplochromis guiarti.</i>	
	<i>Haplochromis serranus.</i>	
	<i>Haplochromis altigenis.</i>	
	<i>Haplochromis squamulatus.</i>	
	<i>Haplochromis bayoni.</i>	
	<i>Haplochromis macrodon.</i>	
	<i>Haplochromis prognathus.</i>	
	<i>Haplochromis maculipinna.</i>	
	<i>Haplochromis dichrourus.</i>	
	<i>Haplochromis spekii.</i>	
	<i>Haplochromis serranoides.</i>	Somo.
	<i>Haplochromis acutirostris.</i>	
	<i>Haplochromis plagiostoma.</i>	
	<i>Haplochromis macrognathus.</i>	
	<i>Haplochromis dentex.</i>	
	<i>Haplochromis mento.</i>	
	<i>Haplochromis cavifrons.</i>	
	<i>Haplochromis orthostoma.</i>	
	<i>Haplochromis xenostoma.</i>	
	<i>Haplochromis pellegrini.</i>	
	<i>Haplochromis argenteus.</i>	
	<i>Haplochromis longirostris.</i>	

FAMILY.	SCIENTIFIC NAME.	COMMON AND NATIVE NAME.
	<i>Haplochromis gracilicauda.</i>	
	<i>Haplochromis xenodon.</i>	
	<i>Haplochromis obliquidens.</i>	
	<i>Haplochromis michaeli.</i>	
	<i>Haplochromis maxillaris.</i>	
	<i>Haplochromis gowersii.</i>	
	<i>Haplochromis melanopterus.</i>	
	<i>Haplochromis obtusidens.</i>	
	<i>Haplochromis plagiodon.</i>	
	<i>Haplochromis diplotaenia.</i>	
	<i>Haplochromis eutaenia.</i>	
	<i>Haplochromis tridens.</i>	
	<i>Haplochromis latifasciatus.</i>	
	<i>Haplochromis pharyngomylus.</i>	
	<i>Haplochromis worthingtoni.</i>	
	<i>Haplochromis estor.</i>	
	<i>Astatoreochromis alluaudi.</i>	
	<i>Macropleurodus bicolor.</i>	
	<i>Hoplotilapia retrodens.</i>	
	<i>Platytaeniodus degeni.</i>	
ANABANTIDAE.	<i>Anabas muriei.</i>	
MASTACEMBELIDAE.	<i>Mastacembelus victoriae.</i>	Okunga.

LAKE RUDOLF.

POLYPTERIDAE.	<i>Polypterus bichir.</i>	
	<i>Polypterus senegalus.</i>	
MORMYRIDAE.	<i>Gymnarchus niloticus.</i>	
OSTEOGLOSSIDAE.	<i>Heterotis niloticus.</i>	
CHARACINIDAE.	<i>Hydrocyon forskalii.</i>	Lokel.
	<i>Hydrocyon lineatus.</i>	
	<i>Alestes dentex.</i>	
	<i>Alestes baremose.</i>	Dorobela.
	<i>Alestes nurse.</i>	
	<i>Distichodus niloticus.</i>	Gwolo.
	<i>Citharinus citharus</i>	
	<i>intermedius.</i>	Agurt.
CYPRINIDAE.	<i>Barbus bynni rudolfianus.</i>	Toto Chibule.
	<i>Barbus meneliki.</i>	
	<i>Barbus plagiostomus.</i>	
	<i>Barbus weneri.</i>	
	<i>Labeo horie.</i>	Chibule.
	<i>Barilius niloticus.</i>	
	<i>Engraulicypris stellae.</i>	
	<i>Engraulicypris bottegi.</i>	
SILURIDAE.	<i>Clarias lazera.</i>	Cat-fishes; Obito.
	<i>Schilbe uranoscopus.</i>	Naili.
	<i>Bagrus bayad.</i>	Lorogo; Lorok.
	<i>Auchenoglanis occidentalis.</i>	
	<i>Synodontis schall.</i>	Tirr.
	<i>Synadontis frontosus.</i>	

FAMILY.	SCIENTIFIC NAME.	COMMON AND NATIVE NAME.
	<i>Mochochus niloticus.</i>	
	<i>Andersonia leptura.</i>	
CYPRINODONTIDAE.	<i>Haplochilichthys rudolfianus.</i>	
	<i>Haplochilichthys jeanneli.</i>	
CENTROPOMODAE.	<i>Lates niloticus rudolfianus.</i>	Large Nile Perch; Idgi.
	<i>Lates niloticus longispinis.</i>	Small Nile Perch.
CICHLIDAE.	<i>Tilapia nilotica.</i>	Rogene.
	<i>Tilapia vulcani.</i>	
	<i>Tilapia galilaea.</i>	
	<i>Tilapia zillii.</i>	
	<i>Haplochromis rudolfianus.</i>	
MALOPTERURIDAE.	<i>Pelmatochromis exsul.</i>	
	<i>Malopterus electricus.</i>	Electric Cat-fish.
TETRODONTIDAE.	<i>Tetrodon fahaka.</i>	The Puffer-fish.

LAKE BARINGO.

CYPRINIDAE.	<i>Barbus gregorii.</i>	Libile.
	<i>Labeo cylindricus.</i>	Livuli.
SILURIDAE.	<i>Clarias mossambicus.</i>	Singre; Mumi.
CICHLIDAE.	<i>Tilapia nilotica.</i>	Sibore.

LAKE HANNINGTON.

CYPRINIDAE.	<i>Labeo cylindricus.</i>	
SILURIDAE.	<i>Clarias mossambicus.</i>	Cat-fish.

LAKE NAIVASHA.

CYPRINODONTIDAE.	<i>Haplochilichthys antinorii.</i> (Indigenous to the Lake.)	
CICHLIDAE.	<i>Tilapia nigra.</i> (Introduced 1926.)	Ngege.
CENTRARCHIDAE.	<i>Micropterus salmoides.</i> (Introduced 1928.)	Large mouth black bass.
SALMONIDAE.	<i>Salmo irideus.</i> (Downstream migration from the Morandat River.)	Rainbow trout.

KERIO RIVER.

CYPRINIDAE.	<i>Barbus bynni rudolfianus.</i>	
SILURIDAE.	<i>Clarias lazera.</i>	Cat-fish.
CICHLIDAE.	<i>Tilapia nilotica.</i>	
MALOPTERURIDAE.	<i>Malopterus electricus.</i>	Electric Cat-fish.

FAMILY.	SCIENTIFIC NAME.	COMMON AND NATIVE NAME.
SEYA RIVER.		
CYPRINIDAE.	<i>Barbus erlangeri.</i> <i>Barbus percivali.</i> <i>Labeo cylindricus.</i>	
NAMANGER RIVER		
CYPRINIDAE.	<i>Barbus paludinosus.</i>	
SILURIDAE.	<i>Clarias mossambicus.</i>	Cat-fish.
CICHLIDAE.	<i>Tilapia nigra.</i> (Introduced.)	Ngege.
LUMI RIVER, TAVETA.		
CYPRINIDAE.	<i>Barbus lineomaculatus.</i> <i>Barbus lumiensis.</i> <i>Labeo cylindricus.</i>	
SILURIDAE.	<i>Clarias mossambicus.</i>	Cat-fish.
ATHI RIVER.		
CHARACINIDAE.	<i>Alestes nurse.</i>	
CYPRINIDAE.	<i>Barbus mariae.</i>	Domo.
	<i>Barbus tanensis.</i>	} Large barbus Mtonzi, Kambale, Kuyu.
	<i>Barbus athi.</i>	
	<i>Barbus copleyae.</i>	
	<i>Barbus matris.</i>	
	<i>Barbus amphigramma.</i>	} Small barbus.
	<i>Barbus percivali.</i>	
	<i>Barbus alkeleyi.</i>	
	<i>Labeo cylindricus.</i>	
SILURIDAE.	<i>Schilbe mystus.</i>	Butter fish.
	<i>Clarotes laticeps.</i>	Pongwe.
	<i>Bagrus docmac.</i>	Shula.
	<i>Clarias mossambicus.</i>	Kambali.
	<i>Amphilius grandis.</i>	
	<i>Chiloglanis athiensis.</i>	
	<i>Chiloglanis brevibarbus.</i>	
CYPRINIDAE.	<i>Discognathus hindii.</i>	
	<i>Discognathus dembeensis.</i>	
MORMYRIDAE.	<i>Mormyrus kannume.</i>	Tangu; Elephant snout-fish.
	<i>Mormyrus tenuirostris.</i>	
CICHLIDAE.	<i>Tilapia nigra.</i>	Kina.
GOBIIDAE.	<i>Gobius (Awaous) aenofuscus.</i>	
ANGUILLIDAE.	<i>Anguilla mosambica.</i>	Eels; Mkunga.
	<i>Anguilla labiata.</i>	
	<i>Anguilla unicolor.</i>	
MASTACEMBELIDAE.	<i>Mastacembelus victoriae.</i>	

The tributaries are as follows:—

The Stoney Athi, Embakasi, Nairobi, Thita, Thiririki (trout) Ndarugu (trout), Ruraka, Kibwesi, Tsavo, and Kiboko Rivers.

FAMILY.	SCIENTIFIC NAME.	COMMON AND NATIVE NAME.
UASO NYIRO RIVER.		
MORMYRIDAE.	<i>Mormyrops deliciosus.</i>	Elephant snout-fish.
	<i>Mormyrus kannume.</i>	Elephant snout-fish.
CYPRINIDAE.	<i>Barbus erlangeri.</i>	
	<i>Barbus percivali.</i>	
	<i>Barbus argyrotaenia.</i>	
	<i>Barbus minus.</i>	
	<i>Barbus mariae.</i>	
	<i>Barbus perplexicans.</i>	
	<i>Labeo percivali.</i>	
SILURIDAE.	<i>Labeo cylindricus.</i>	
	<i>Discognathus hindi.</i>	
	<i>Eutropsis depressirostris.</i>	Cat-fishes.
	<i>Bagrus urostigma.</i>	
	<i>Clarias lazera.</i>	
	<i>Synodontis schall.</i>	
	<i>Synodontis geledensis.</i>	
	<i>Synodontis zambesensis.</i>	
	<i>Amphilius grandis.</i>	
	<i>Amphilius oxyrhinus.</i>	
CICHLIDAE.	<i>Clarotes laticeps.</i>	
	<i>Tilapia nilotica.</i>	
	<i>Tilapia percivali.</i>	
(Hot springs at Chandler's Falls.)		

The tributaries are as follows:—

Uaso Narok (trout), Sugaroi, Mutara, Naro Maro (trout), Burguret (trout), Liki (trout), and Nanyuki (trout).

TANA RIVER.

MORMYRIDAE.	<i>Mormyrus kannume.</i>	Elephant snout-fish.
CHARACINIDAE.	<i>Alestes nurse.</i>	
CYPRINIDAE.	<i>Barbus gregori.</i>	
	<i>Barbus tanensis.</i>	
	<i>Barbus mariae.</i>	
	<i>Barbus aphigramma.</i>	
	<i>Labeo cylindricus.</i>	
SILURIDAE.	<i>Labeo gregori.</i>	
	<i>Clarias mossambicus.</i>	Cat-fishes.
	<i>Schilbe mystus.</i>	
	<i>Eutropius depressirostris.</i>	
	<i>Synadontis victoriae.</i>	
	<i>Chiloglanis brevibarbus.</i>	
ANGUILLIDAE.	<i>Amphilius grandis.</i>	
	<i>Anguilla mosambica.</i>	Eels.
	<i>Anguilla labiata.</i>	
	<i>Anguilla unicolor.</i>	

The tributaries are as follows:—

Thika (trout), Thika Chania (trout), Maragua (trout), Gura (trout), Mathioya (trout), Nyeri Chania (trout), Ragati (trout), Amboni (trout), Thiba (trout), Mara, Thuchi, Ena, Nithi, Mutonga, Itaru (trout), Thingishu (trout), Karita (trout), and Mariani (trout).

PLATE 1.

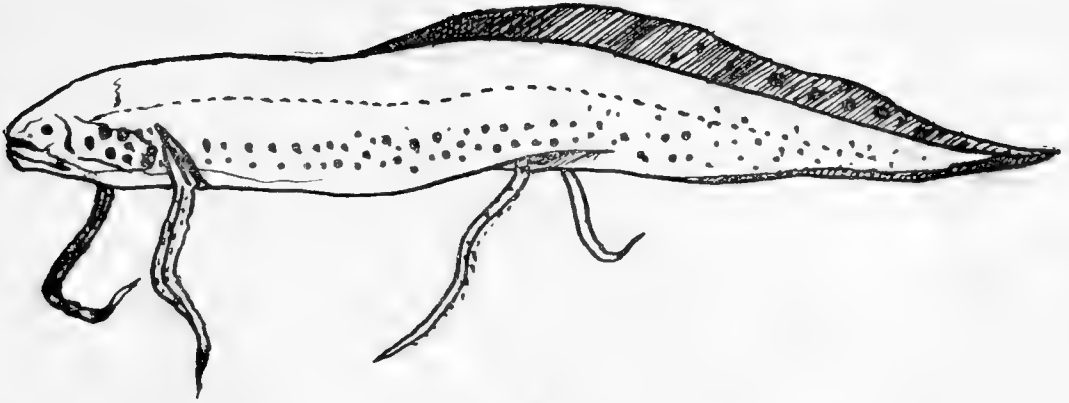


FIG. 1. *Protopterus aethiopicus*. 1/3

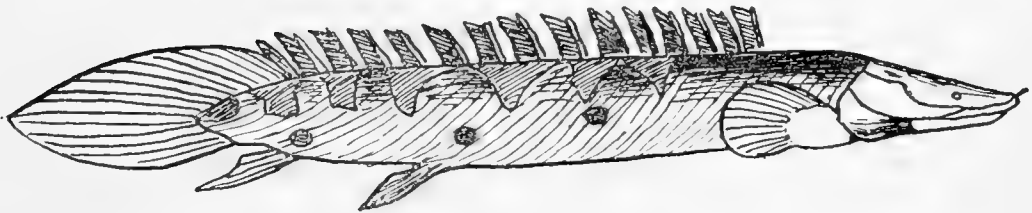


FIG. 2. *Polypterus bichir*. 1/4

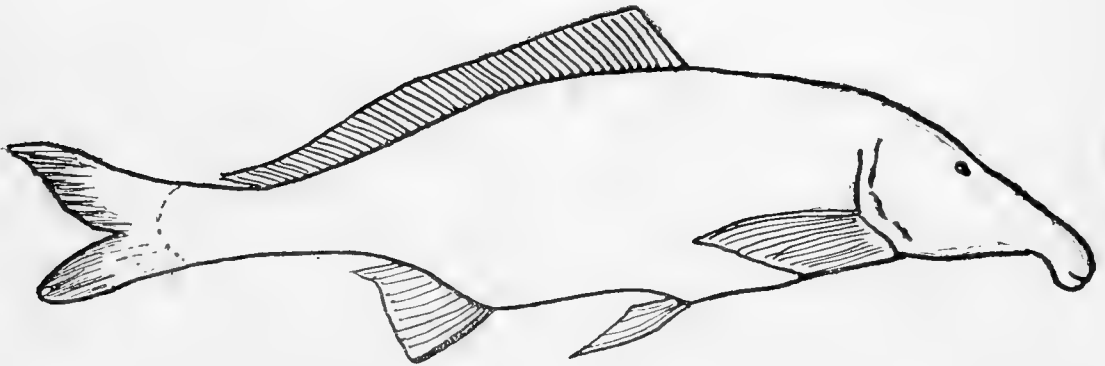


FIG. 3. *Mormyrus kannume*. 1/3

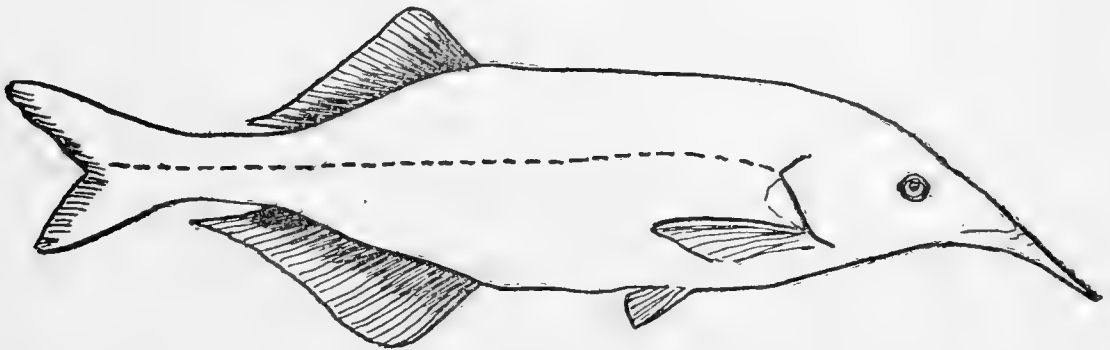


FIG. 4. *Gnathonemus longibarbis*. 1/3

PLATE 2.

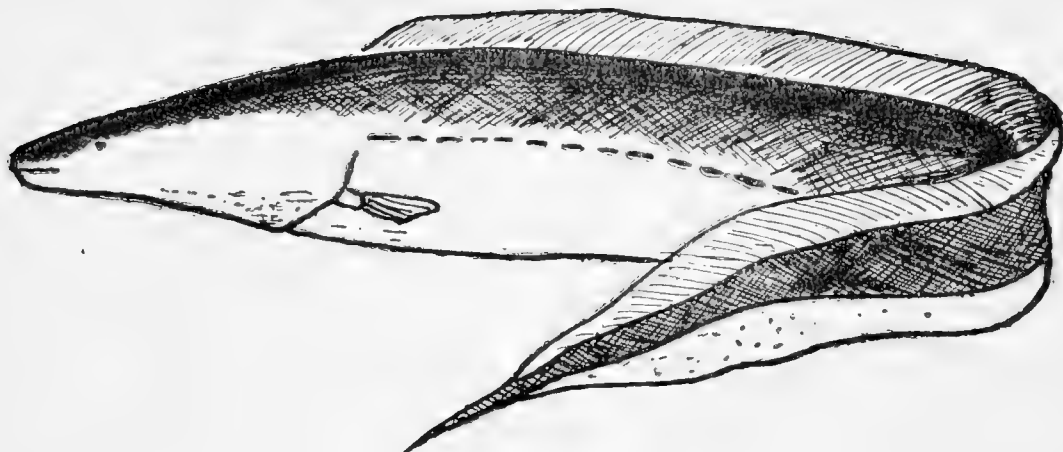


FIG. 5. *Gymnarchus niloticus*. 1/5



FIG. 6. *Heterotis niloticus*. 1/4

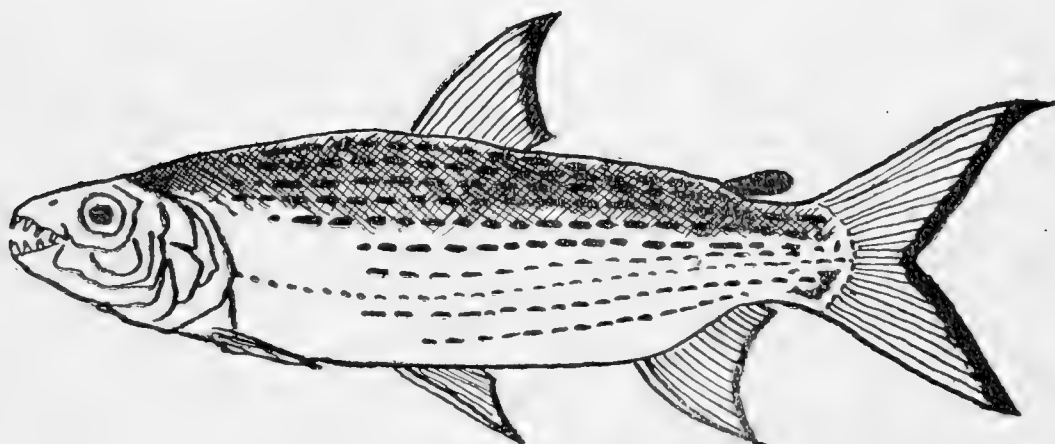


FIG. 7. *Hydrocyon lineatus*. 1/4

PLATE 3.

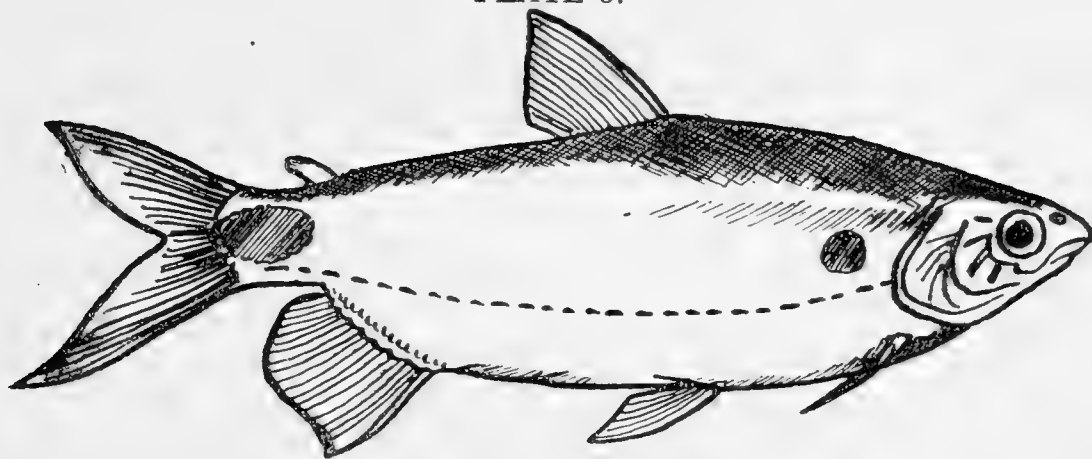


FIG. 8. *Alestes nurse*. 1/2

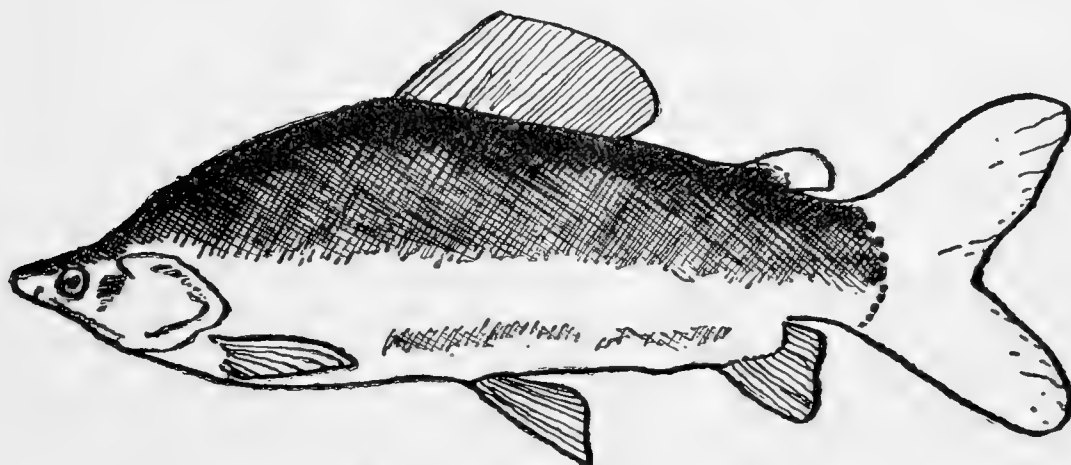


FIG. 9. *Distichodus niloticus*. 1/4

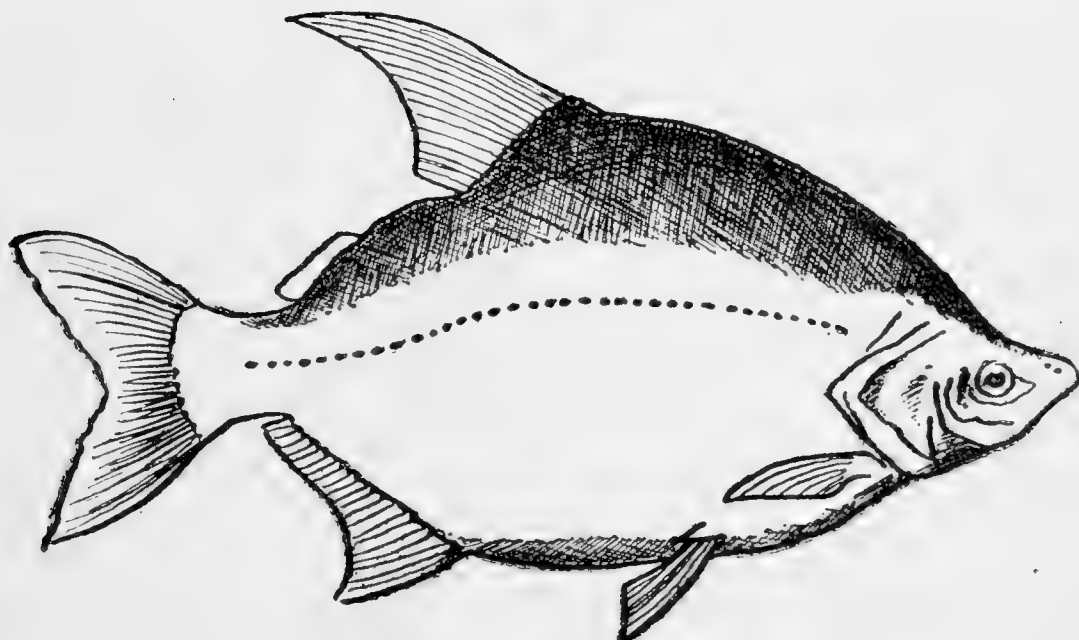


FIG. 10. *Citharinus citharus*. 1/4

PLATE 4.

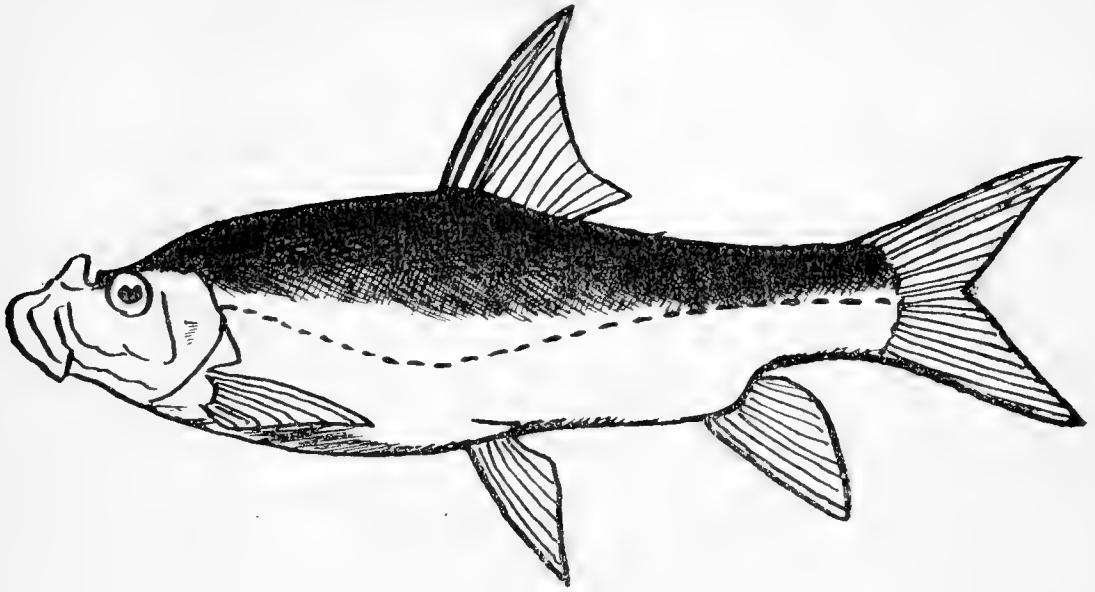


FIG. 11. *Barbus mariae*. 1/4

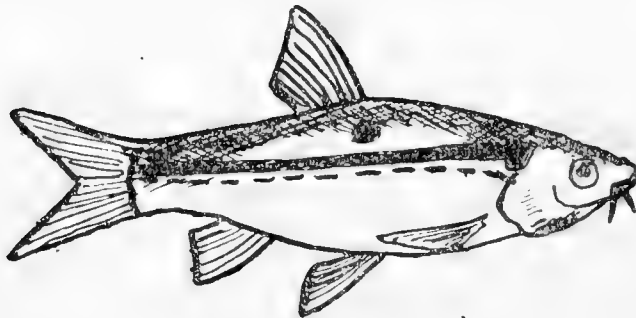


FIG. 12. *Barbus percivali*. Nat. size.

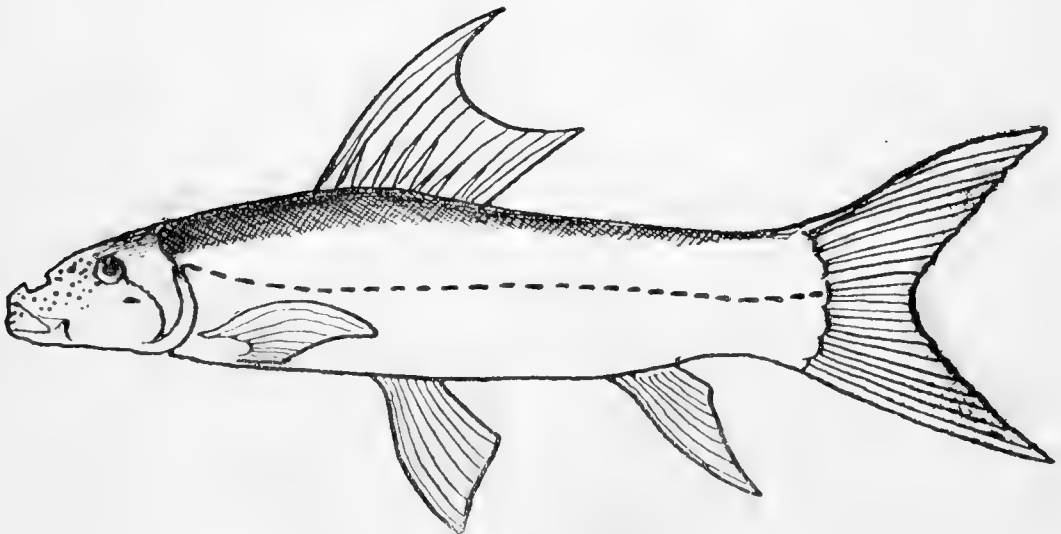


FIG. 13. *Labeo cylindricus*. 1/3

PLATE 5.

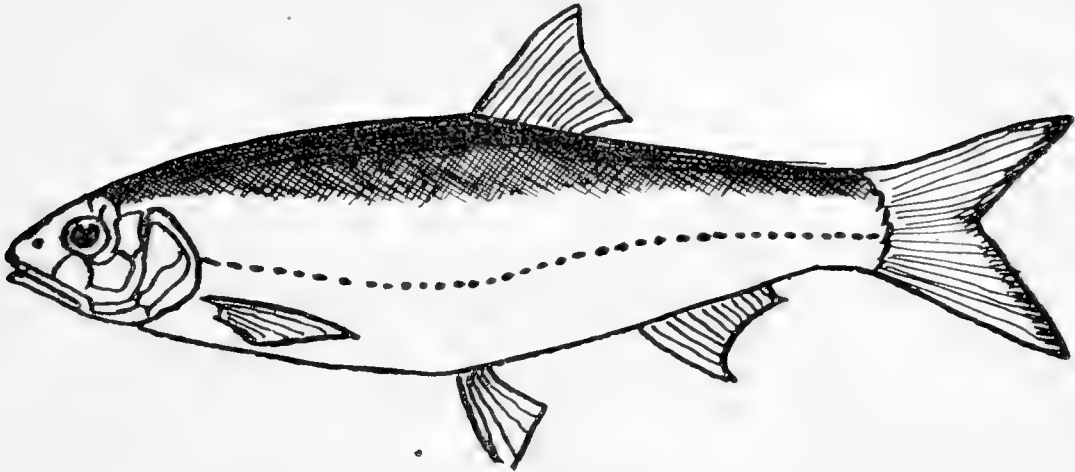


FIG. 14. *Barilius niloticus*. 1/2

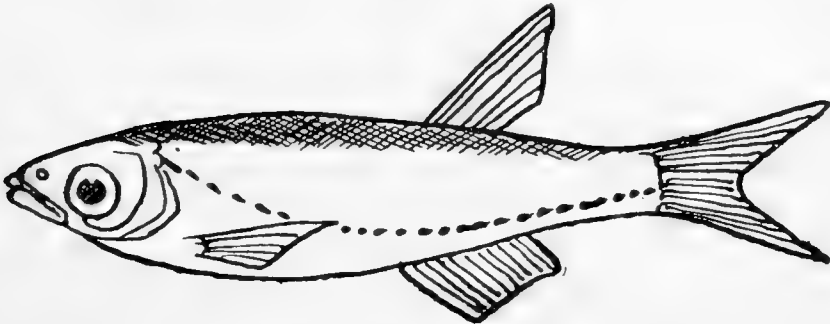


FIG. 15. *Engraulicypris stellae*. Nat. size.

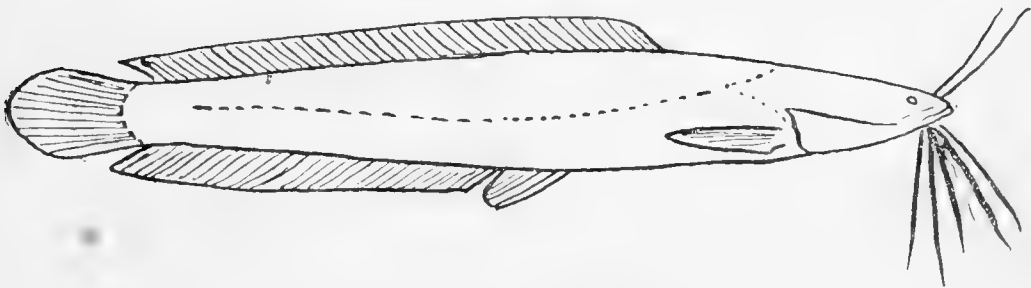


FIG. 16. *Clarias lazera*. 1/3

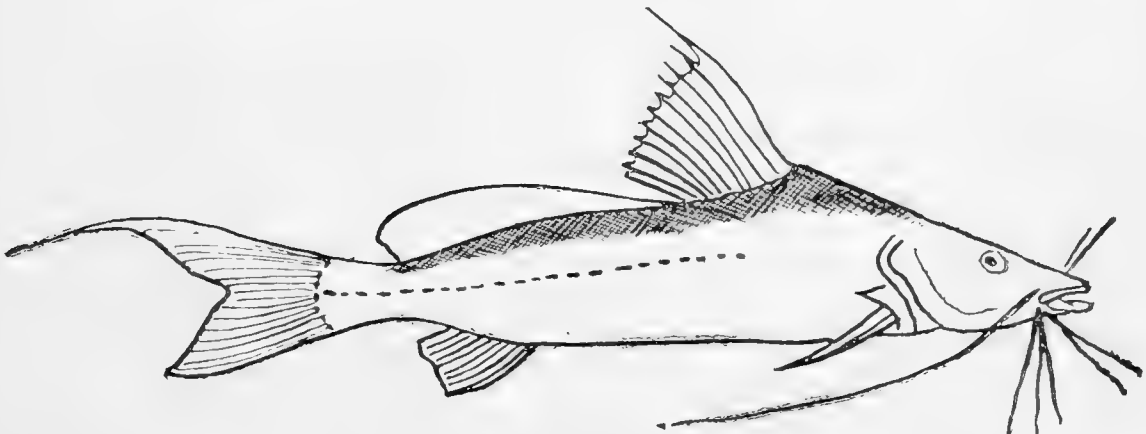


FIG. 17. *Bagrus docmac*. 1/4

PLATE 6.

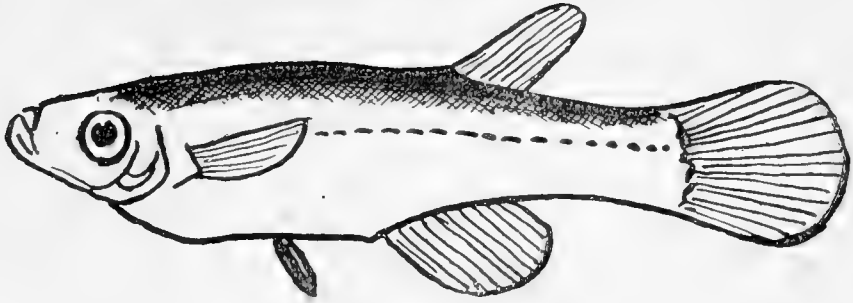


FIG. 18. *Haplochilichthys rudolfianus*. Nat. size.

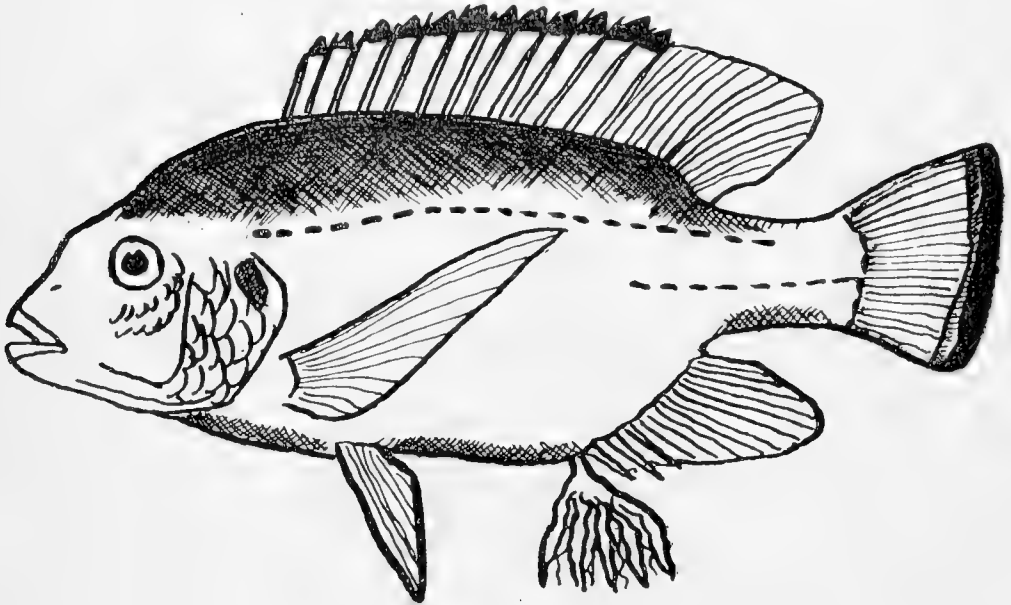


FIG. 19. *Tilapia variabilis*. 1/2

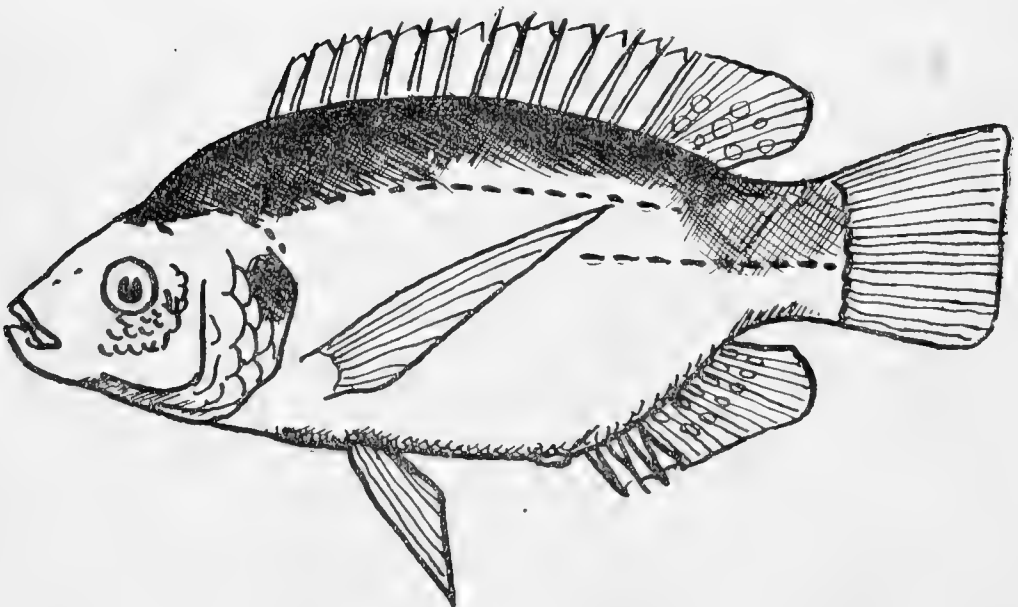


FIG. 20. *Tilapia esculenta*. 1/2

PLATE 7.

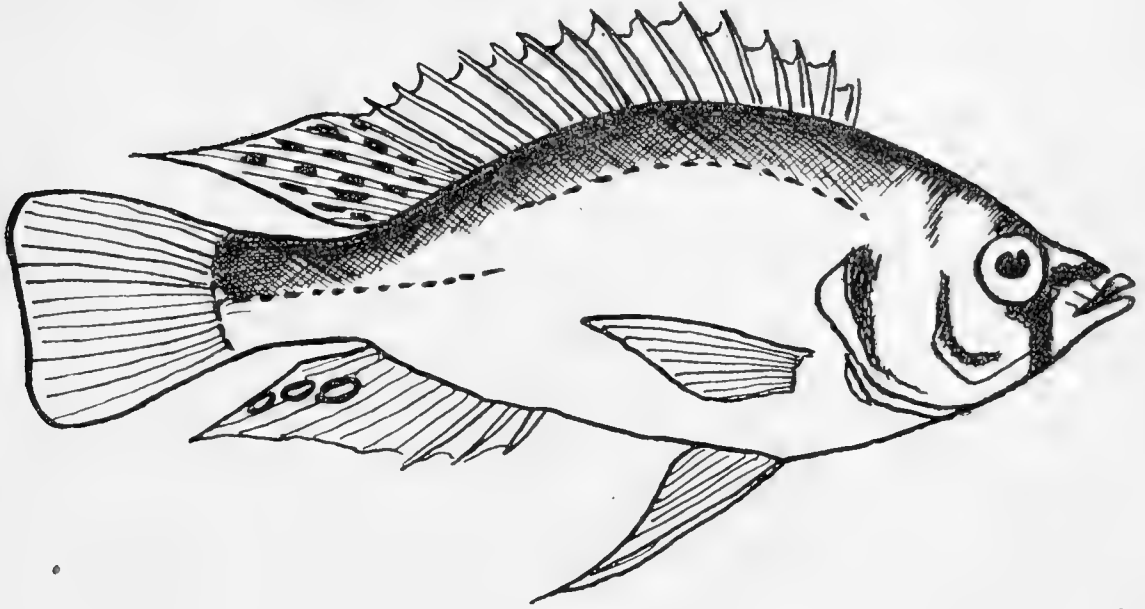


FIG. 21. *Haplochromis nuchisquamulatus*. 1/1.25

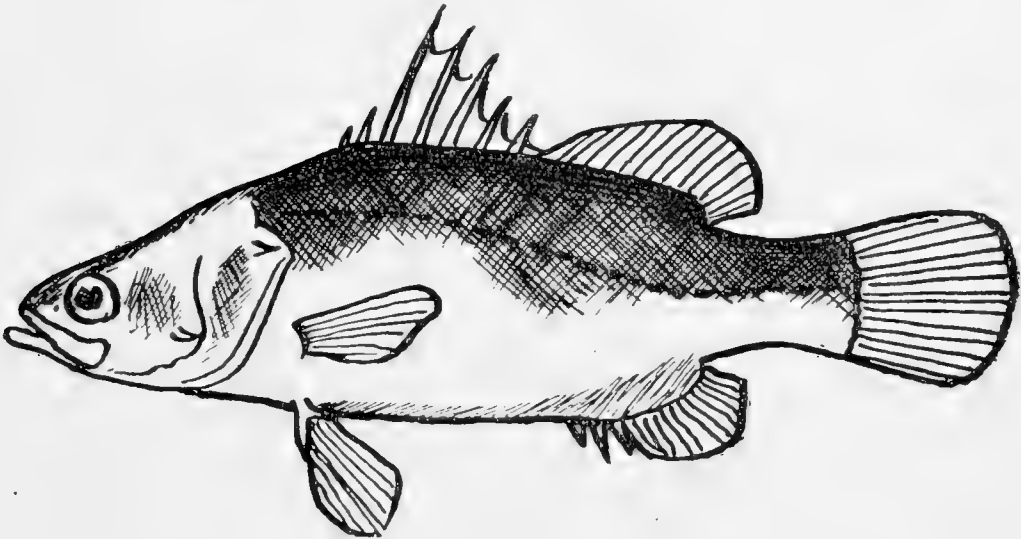


FIG. 22. *Lates niloticus rudolfianus*. 1/10

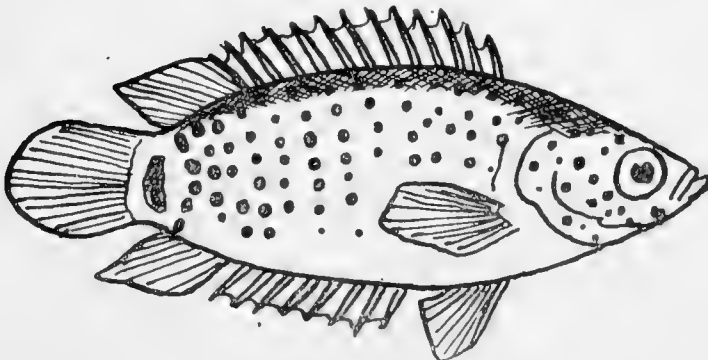


FIG. 23. *Anabas muriei*. Nat. size.

PLATE 8.

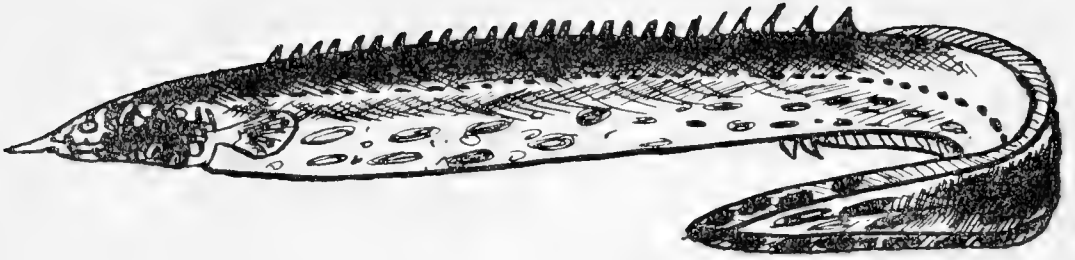


FIG. 24. *Mastacembelus victoriae*. 1/3

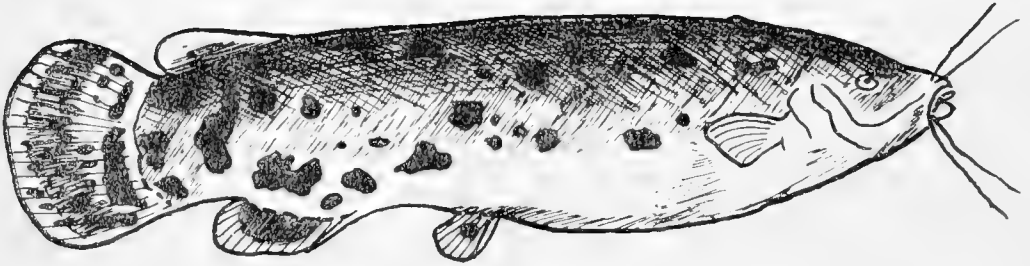


FIG. 25. *Malopterus electricus*. 1/2

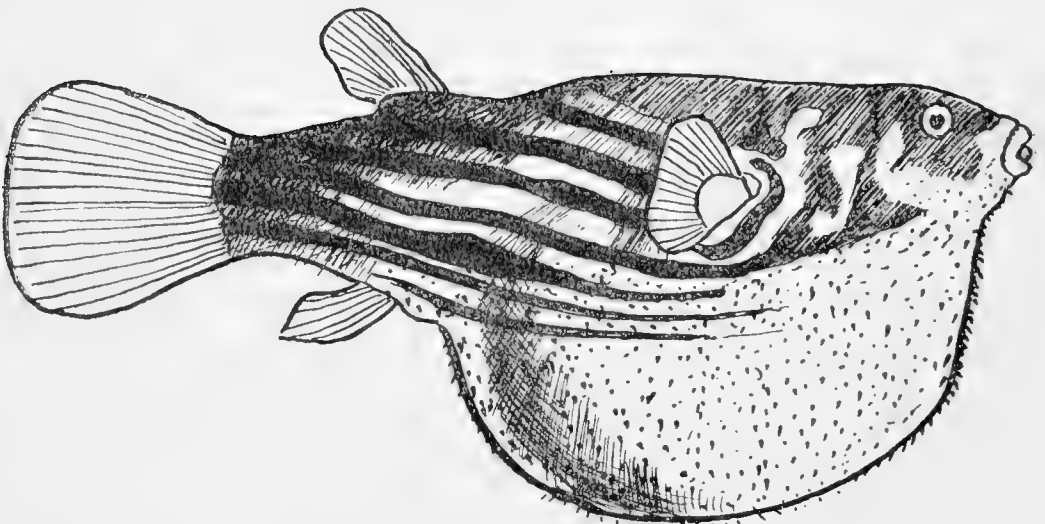


FIG. 26. *Tetrodon fahaka*. Nat. size.

NEW GRASSHOPPERS (ORTHOPTERA, ACRIDIDAE)
FROM KENYA.

BY B. P. UVAROV, D.Sc.,

Imperial Institute of Entomology.

The following species of *Acrididae* are described from the material communicated by Dr. V. G. L. van Someren, of the Coryndon Memorial Museum, Nairobi. The types of all new species have been kindly presented to the British Museum (Natural History), while paratypes, when available, are deposited in the Coryndon Museum.

***Aulacobothrus emalicus* sp.n.**

♂ (*type*). Antennae slender, somewhat longer than head and pronotum together.

Head relatively thick. Face strongly oblique. Frontal ridge distinctly convex in profile, very broad, scarcely narrowed at the fastigium; its surface very weakly concave below the ocellum and weakly convex above it, with small punctures which are sparse in the upper part and more dense in the lower. Fastigium of vertex broadly parabolic, wider than long, with well-defined margins which are roundly convergent behind; median carinula reaching the apex, but not very regular, and extending backwards on to the occiput; submedian lateral carinulae not very regular, but developed throughout the length of the head; the spaces between the carinulae rugulose; sides of the occiput weakly rugulose. Foveolae of vertex shallow, small, elongate, with rounded ends.

Pronotum not constricted in the middle, weakly narrowed forwards. Disc smooth, but with velvety surface, except at the posterior angles of metazona where it is somewhat rugulose. Median carina well-developed, intersected by the typical sulcus in its middle. Lateral carinae low and thick, somewhat irregular owing to punctures, weakly incurved in the prozona, distinctly divergent in the metazona; they are intersected by the first sulcus at the middle of the prozona. Posterior angle of the disc obtuse, not rounded apically, with straight sides. Lateral lobe rugulose and coarsely punctured; lower margin distinctly sinuate; posterior lower angle a little over 90°, rounded. Mesopleura and metapleura strongly rugose.

Elytra not quite reaching the apex of the hind knee; discoidal area narrower than the interulnar, with the cells forming

two very irregular rows, but without a false vein; interulnar area expanded, with regular cross-veins.

Hind femur relatively long and slender. Lower inner spur of hind tibia long, hairy, straight, with curved apex.

General colouration rusty-brown; sides of head and pronotum of darker shade; lower sides of fastigium blackish, with the lateral ocellus ivory-white and standing out sharply. Lateral pronotal lobe with an ivory-white callous linear spot below the middle, and the lower margin of the same colour. Elytra brownish hyaline, with faintly brown spots along the middle; wings infumate apically. Hind femur with narrow brown streaks on the two upper areas; knee blackish on both sides, but the apices of knee-lobes are pale. Hind tibia light-red.

♀. Robust, with thick head and distinctly convex frontal ridge. Discoidal area of elytra with an irregular false vein; an incomplete false vein is present also in the interulnar area which is moderately expanded. Colouration characterised by the presence of a sharply defined black lateral stripe occupying the upper half of pronotal lobe and extending on to the side of the head and elytra (this is merely a colour form occurring in both sexes).

Length of body ♂ 16, ♀ 24; pronotum ♂ 3.5, ♀ 4.2; elytra ♂ 14, ♀ 17; hind femur ♂ 12, ♀ 14 mm.

Emali Range, Sultan Hamud, 4,900-5,900 ft., 3-40, 13 ♂♂, 14 ♀♀.

A very distinct species, somewhat similar in general appearance to the Indian *A. luteipes* (Walker).

Rhaphotittha reducta sp.n. Fig. 1, R.

A small species with abbreviated but strongly expanded elytra and with rudimentary wings, differing in that latter character from the known species.

♂. Antennae stout, a little longer than head and pronotum together.

Frontal ridge in profile very weakly convex, deeply sulcate throughout, with sharply raised margins; the surface of the ridge and of the face scarcely rugulose. Fastigium of vertex rhomboidal, with briefly rounded apical angle which is about 90°; surface weakly concave; median carinula present in the posterior half. Foveolae of vertex less than twice as long as broad, distinctly concave, with well-defined margins. Occiput with a weak median carinula.

Pronotum without a constriction. Disc obtusely punctured, the punctures in the metazona being smaller and denser than in the prozona. Typical sulcus placed well behind the middle, the ratio of prozona to metazona being 5:3. Median carina low

but thick in prozona and weak in metazona. Posterior margin of the disc very weakly rounded, almost truncate. Lateral lobe with an interrupted, callous ridge along the middle.

Elytra strongly abbreviated, not reaching the apex of abdomen, inflated, with the scapular area very broad; venation See Fig. 1, R. Wings rudimentary, not longer than one-third of elytra.

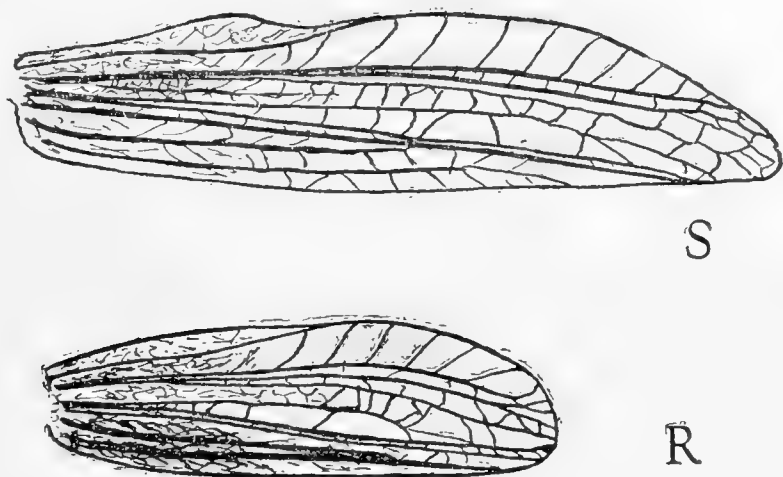


FIG. 1.

FIG. 1. S. *Rhapsotittha subtilis* Karsch, male elytron; R, *R. reducta* sp.n., ditto.

General colouration mainly buff; sides of head and pronotum with a broad chocolate-brown stripe, enclosing a light median line, which on the pronotal lobe coincides with the callous line; lower edge of pronotal lobe broadly pale. Elytra hyaline. Hind femur and abdomen rufous. Hind tibia dirty yellowish.

Length of body 10; pronotum 2.2; elytra 5.2; hind femur 6 mm.

Stony Athi, 5-40, 2 ♂♂ (East Africa and Uganda Natural History Society Biological Survey).

Pyrgomorphella albini (Chopard, 1921).

1921. *Parasphena albini* Chopard, Voyage Afr. orient., angl. Guy Babault, Orthoptères, p. 54, Fig. 31.

There can be no doubt that the species described by Chopard from the Sotik District of Kenya is not a *Parasphena*, but a *Pyrgomorphella*. A series of specimens from Naivasha, 7-37 (H. J. A. Turner) agrees in all details with the description of *P. albini* and the species appears to be very close to *Pyrgomorphella variegata* Kay 1937, (Ann. S. Afr. Mus., 32: 161), known

from the Masai Reserve, but differs from it in smaller size, narrower fastigium of vertex and shorter elytra. These differences may be of sub-specific value only, but the material at hand is not sufficient for a definite conclusion.

***Ixalidium bicoloripes* sp.n. Fig 2.**

Apart from the morphological characters as described below, this new species differs from the known ones by the hind tibia being brownish-black in the basal half and red in the apical. In this respect, as well as in the male genitalia, *I. bicoloripes* approaches *I. haematoscelis* Gerstaecker, in which the tibia is almost wholly red but becomes brownish in the basal third.

♂. Antennae a little longer than head and pronotum together, slightly incrassate in the apical half.

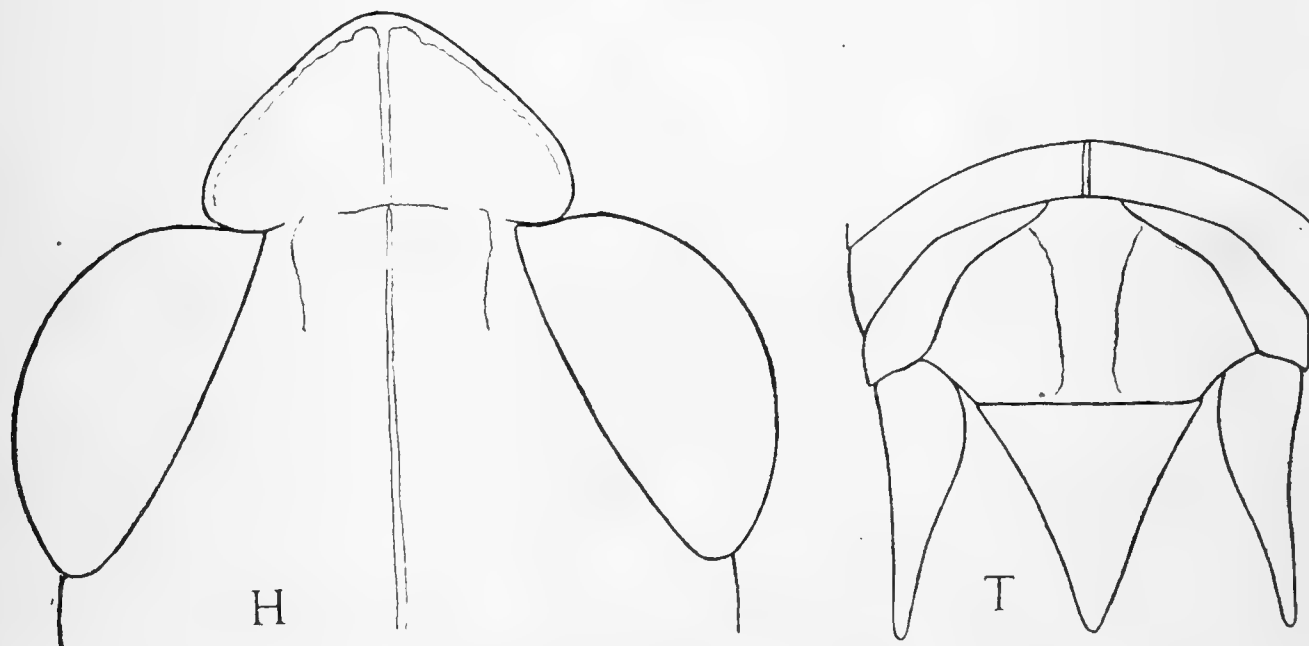


FIG. 2.

FIG. 2. *Ixalidium bicoloripes* sp.n., ♂, head and apex of abdomen.

Face in profile very weakly convex, scarcely projecting forward between antennae. Frontal ridge fairly wide and concave between fastigium and a point above the ocellus where it is constricted and becomes linear, expanding again round the ocellus and downwards from it where it is again concave. Face rugose. Fastigium of vertex (Fig. 2, H) mushroom-shaped, with broadly parabolic outline, nearly twice as broad as its length. Surface of the whole head very coarsely punctured and rugose; median carina distinct throughout, but interrupted by an irregular transverse depression at the base of fastigium.

Pronotum compressed laterally, but not constricted; its surface very coarsely punctured and rugose. Median carina well-raised, distinctly convex in profile, deeply cut by the typical sulcus which is placed at three-quarters distance from the anterior margin. Abdomen sculptured as pronotum, both punctures and rugosities becoming less pronounced posteriorly; median carina acute throughout, distinctly convex in profile on each segment.

Prosternal tubercle wedge-shaped, its apex is straight and broader than its base.

Last tergite (Fig. 2, T) with a broad and deep excision. Supra-anal plate very long and acute, clearly divided in two parts by a transverse sulcus; the basal part wider than long, with a pair of very irregular rugose ridges parallel to the middle line; the apical part acutely triangular, distinctly longer than its basal width. Cercus weakly excurved, about as long as the supra-anal plate. Subgenital plate elongate-conical, compressed laterally.

General colouration rusty-brown, with indefinite blackish markings. Posterior section of metapleura shiny-black. Hind femur on the inside black with a brown spot near the base of the upper margin; outer lower area dull brownish-black; inner lower area shiny-black, becoming dull-red towards the base. Hind tibia dark-red in the apical half, gradually becoming black in the basal half; spines dirty yellowish with black tips.

♀. Fastigium of vertex more than twice as broad as its length. Supra-anal plate similar to that in the male, with the apical portion long and acute.

Length of body ♂ 19, ♀ 30; pronotum ♂ 4.2, ♀ 5.5; hind femur ♂ 11, ♀ 14.5 mm.

Emali Range, Sultan Hamud, 4,900-5,900 ft., 3-40, 4 ♂♂, 4 ♀♀, 2 ♂ nymphs.

The new species differs from the closely allied *I. haematoscelis* Grst., by the colouration of hind legs, by wider fastigium of vertex, by the abdominal tergites gibbose in profile and by the shape of the male supra-anal plate. The latter in *I. haematoscelis* has the basal portion less broad, with straight sides, while the apical portion is less acutely pointed. Two other known species of *Ixalidium*, namely *I. usambaricum* Ramme 1929, and *I. obscuripes* Miller 1929, differ from *I. bicoloripes* by the colouration of hind legs, and particularly by the male genitalia, the supra-anal plate in both those species being much shorter and less pointed, while the subgenital plate is inflated, with attenuate apex. *I. transiens* Ramme 1929, has the male genitalia of an aberrant structure. The tendency to a specialisation in that respect is most pronounced in *Tangana asymmetrica*

Ramme 1929, which has been made the type of a distinct genus by that author. The female of *T. asymmetrica*, however, cannot be distinguished from *Ixalidium*, in spite of Ramme's assertion that there is a difference in the structure of the head; this is true only for some species of *Ixalidium*, e.g., *I. usambaricum* which has the fastigium more prominent than others, but the head of *T. asymmetrica* is certainly not different from that in *I. haematoscelis* which is the genotype of *Ixalidium*. The following generic synonymy should therefore be recorded:—

Ixalidium Gerstaecker 1869 = (*Tangana* Ramme 1929).

The number of the known species of *Ixalidium* is now six (not counting the doubtful *I. gabonense* Brisout 1851), but many more new species can be confidently expected, as most species appear to be highly localised. I have before me at least two undescribed species from Kenya, but abstain from describing them as they are represented by females only, and the best specific characters in the genus are found in the male external genitalia.

Mecostibus sellatus sp.n. Fig. 3.

Amongst the known species, only *M. sublaevis* Karsch 1896, may be considered as somewhat similar to the new one, as its female has slight projections on the pronotum and abdominal tergites of the same type as in *M. sellatus*, where they are very large, forming a "saddle" on the back of the insect.

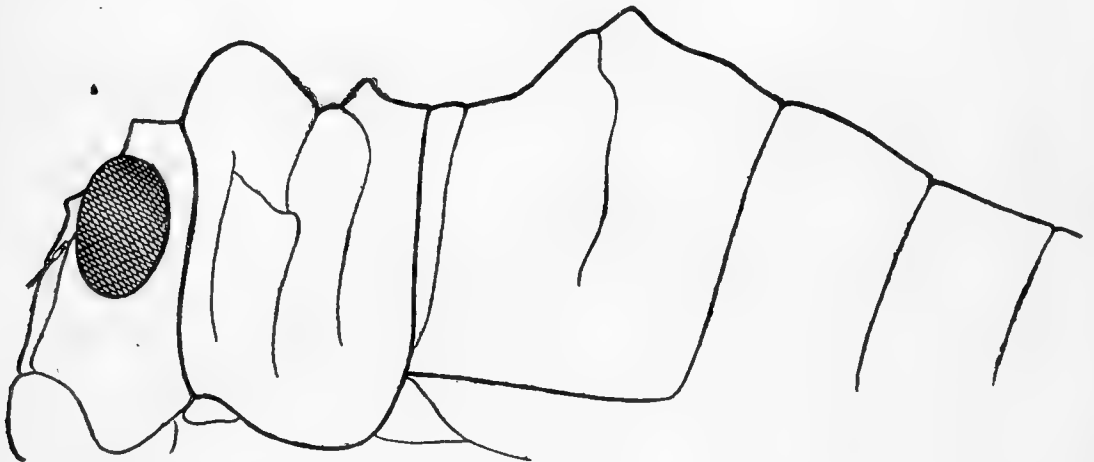


FIG. 3.

FIG. 3. *Mecostibus sellatus* sp.n., ♀, profile.

♀. Antennae fine, filiform a little longer than head and pronotum together.

Face moderately sloping forward, very broad. Frontal ridge weak, concave, with irregular margins. Lateral facial carinae

very thick, irregular; face between them concave. Fastigium of vertex strongly sloping, concave; its anterior portion half the width of the posterior; lower lateral angles of the posterior portion raised each into a strong rounded tubercle bearing rudimentary ocellus. Interocular distance about twice the anterior width of fastigium.

Pronotum weakly compressed laterally, surface shiny, but very uneven, with obtuse ridges and shallow pits. Front margin in the middle with a broadly trapezoidal projection. Submarginal furrow deep and broad; second and third furrows approaching each other near the middle, but still clearly separated. Median carina in front of the first furrow raised into a large hump which is as high as its basal length; between the second and the third furrow the carina is replaced by a shallow sulcus; in the metazona it is raised again in an obtusely conical tubercle. Lateral lobe much deeper than long; anterior margin oblique, sinuate; anterior lower angle obtuse, rounded; lower margin strongly sinuate; posterior angle broadly rounded. Mesonotum very short. Metanotum and first tergite divided only in the dorsal portion, raised in a high hump, broadly triangular in profile. Abdomen with a low, finely sulcate median carinula, and with very weak and interrupted irregularly wavy, sublateral carinae. Prosternal tubercle very large, low, transverse, weakly convex. Mesosternal interspace distinctly narrower than one of the lobes. Metasternal lobes contiguous along a line.

Front femur laterally compressed; outer surface strongly uneven; margins weakly wavy; outer knee-lobe large, longer than broad. Front tibia thick, with a shallow sulcus along the upper side. Middle coxa with a bean-shaped oblique lobiform appendage; middle femur strongly compressed and uneven; middle tibia compressed. Hind femur broad, weakly narrowed apically; upper margin acutely denticulate in the distal half; outer knee-lobe somewhat bent down, with the lower posterior angle about 90°; hind tibia sinuate, its basal portion expanded in vertical direction; hind tarsus as long as three-fourths of the tibia.

General colouration rusty-brown, with blackish-grey dots; the dorsal humps blackish. Hind femur and tibia on the inside brownish-black, with faint reddish tinge.

All legs and lower edges of body fringed with long soft pale-yellow hairs.

Length of body 36; pronotum 6.8; hind femur 16 mm.

Emali Range, Sultan Hamud, 4,900-5,900 ft., 3-40, 1 ♀.

BRACHYPTEROUS SPECIES OF *Catantops* FROM EAST AFRICAN MOUNTAINS.

Two brachypterous species of *Catantops* have so far been described from East African mountains, *C. lobipennis* Sjöstedt 1933, from Mt. Elgon and *C. impotens* Johnston 1937, from Mt. Kenya. It appears, however, that endemic species occur on other isolated mountains as well, since I have before me two new ones, one from the Mt. Kinangop in the Aberdare Range and another from the Ngong Hills. All four are quite closely allied, but clearly distinct in a number of characters. General appearance and most of the usual morphological characters are very similar in all four species and it appears best to offer for their differentiation the following key:—

1 (2). Elytra reaching nearly to the apex of the second tergite and almost contiguous on the dorsum, broadly oval (Fig. 4, L, below). Male cercus (Fig. 4, L, above) simple, very slightly curved. Hind femur with uninterrupted brownish-black stripe on the outside; lower outer sulcus brownish-red. Hind tibia red.—Mt. Elgon.

lobipennis Sjöstedt.

2 (1). Elytra extending only just beyond the hind margin of the first tergite, widely separated on the dorsum. Male cercus distinctly curved.

3 (4). Hind tibia reddish-brown, paler at the base. Hind femur with the lower outer sulcus brownish-black; outer side with the brownish-black stripe usually interrupted obliquely. Elytra broadly oval (Fig. 4, I, below). Male cercus strongly curved, its apex weakly expanded and obliquely truncate (Fig. 4, I, above).—Mt. Kenya.

impotens Johnston.

4 (3). Hind tibia bright-red. Hind femur with the outer lower sulcus reddish-brown. Elytra narrowly oval (Figs. 4, K and 4, N, below).

5 (6). Larger and of darker general colour. Elytra broader, the greatest width being at the middle (Fig. 4, N, below). Male cercus longer and more curved; its apex somewhat expanded and truncate, with the lower angle briefly attenuate (Fig. 4, N, above). Length of body ♂ 17, ♀ 23; pronotum ♂ 4.5, ♀ 6; elytra ♂ 3, ♀ 4.5; hind femur, length ♂ 10, ♀ 13; hind femur, maximum width ♂ 3, ♀ 3.8 mm.—Ngong Hills, 8,000 ft. 8 ♂♂ (including the type), 13 ♀♀.

ngongi sp.n.

6 (5). Smaller and of paler general colour. Elytra narrower, the greatest width being beyond the middle (Fig. 4, K, below). Male cercus shorter and less curved; its apex roundly truncate, with the lower angle not attenuate (Fig. 4, K, above). Length of body ♂ 14, ♀ 20; pronotum ♂ 4, ♀ 5.2; elytra ♂ 3, ♀ 3.5; hind femur, length ♂ 9, ♀ 11; hind femur, maximum width ♂ 3, ♀ 3.5 mm.—Aberdare Range, Mt. Kinangop, on *Lobelia aberdarica*, 31/10/1935, (J. Ford, British Museum East African Expedition), 1 ♂ (type), 1 ♀; Mt. Kinangop, 12,000 ft., 1 ♀ (F. M. Edwards, same Expedition); West Aberdare, above 9,000 ft., March-April, 1934, 1 ♂, 1 ♀, *in copula* (H. J. A. Turner).

kinangopi sp.n.

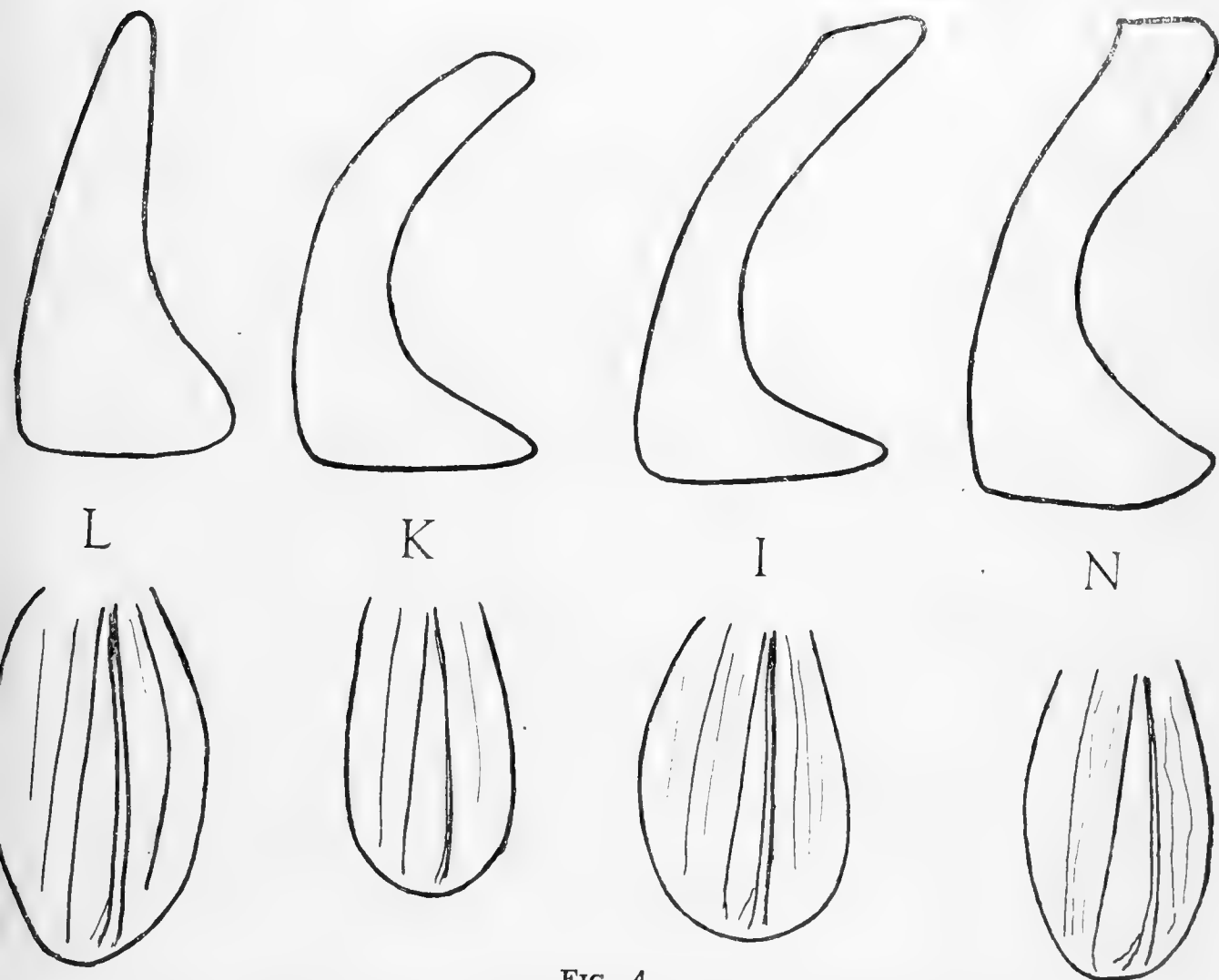


FIG. 4.

FIG. 4. Male right cerci (above) and male right elytra (below) of: L, *Catantops lobipennis* Sjöstedt; K, *C. kinangopi* sp.n. I, *C. impotens* Johnston; N, *C. ngongi* sp.n.

There is little doubt that further collecting on other East African mountains will bring to light more new species of brachypterous *Catantops*, which seem to represent an excellent example of species formation through isolation. The four species so far known all belong to the group regarded by Sjöstedt (1931, Ark. Zool., Bd. **22A**, No. 15, p. 42) as a subgenus *Vitticatantops*, except that all species included in the latter have normally developed elytra and wings. Judging from the distributional data, the brachypterous species dealt with above, represent the results of isolation of the normal stock on mountain tops owing to fluctuations in climate. Their case is clearly parallel to that of the brachypterous species of *Paracomacris*, *Euprepocnemis* and *Gastrimargus*, and of *Parasphena* and lends further support to the theory of their recent development from lowland forms advanced by me elsewhere (Uvarov, 1934, Linn. Soc. Journ., Zool., **38**, p. 592; 1938, Miss. Scient. de l'Omo, Zool., **4**, p. 146). A thorough exploration of the mountain fauna of East Africa would undoubtedly supply most instructive evidence with regard to the evolution of species through spacial isolation.

EAST AFRICAN SUCCULENTS.

PART II.

BY PETER R. O. BALLY.

The first part of EAST AFRICAN SUCCULENTS contained—besides a general introduction—descriptions and illustrations of East African Crassulaceae, represented in the collections of the Herbarium at the Coryndon Memorial Museum.

Since its publication Mr. P. J. Greenway, Systematic Botanist, E.A.A.R. Station, Amani, and Mr. S. A. Thomas, Botanist, Agricultural Department, Uganda, have very kindly contributed all available information on indigenous succulents from the records of their respective herbaria.

I am thus in a position to give a far more comprehensive survey of the known East African succulents, and I begin Part II with an additional list of East African Crassulaceae.

N.O. CRASSULACEAE (continued).

BRYOPHYLLUM.

With few exceptions the genus *Bryophyllum* is restricted to Madagascar. *Bryophyllum* has four-petalled, tubular, flowers which brings it close to the genus *Kalanchoe*, but they are pendent like those of the five-petalled *Cotyledon*. A characteristic which has given the genus its name (*Bryophyllum* means "sprouting leaf") is that many of them produce plantlets along the leaf margins.

Bryophyllum pinnatum S. Kurz, (syn: *B. calycinum* Salisb.).

Is found at present in most tropical countries, and it can be considered as naturalized in East Africa, where it has been observed in and around native villages along the coast. The plant grows two to four feet in height and has fleshy, sometimes irregularly-pinnate leaves with crenate margins from which numerous plantlets are developed. The pendent flowers are $1\frac{1}{2}$ to 2 inches long and they are conspicuous for their large bell-shaped calyx and orange petals.

CRASSULA (continued).

Crassula alba Forsk.

A succulent herb, grows to one foot high and has small white flowers. It is locally common on Mt. Elgon, Debasien, and Imatong Mountains, in Uganda.

Crassula alba Forsk., var. *puberula* A. Rich.

Occurs in Kigezi, Uganda.

Crassula muscosa (L.) Roth.

A dwarf plant, hardly more than $\frac{1}{4}$ inch in height, of moss-like appearance, but definitely succulent, has an almost cosmopolitan distribution. It is found on the Canary Islands, on the Mediterranean Coast, in Western Europe up to Belgium and in the Netherlands, in British India, Sokotra, from Abyssinia to Natal, in the Cameroons, in Angola and South-West Africa. In East Africa it is found commonly in sandy areas which are regularly flooded. The white flowers are mostly five-petalled, the fruits contain one to two seeds.

Crassula phyturus Mildbr.

Is a small, fleshy herb not unlike clubmoss in appearance; the few flowers grow from the leaf axils; they are small five-petalled stars. It is found on the Eastern Slopes of Mt. Elgon, in forest, at 10,000 ft.

Crassula Vaillantii (Wild.) Schoenl.

Is closely allied to *C. aquatica* (see Part I, pag. 12). The flowers are four-petalled, and the fruits hold more than two seeds. It is a small succulent herb which prefers damp places. The distribution of this plant ranges from Europe through Abyssinia to East Africa.

Crassula Zimmermannii Engl.

The plant is 3 to 5 inches high, branched more or less symmetrically above the root, with stem segments about $\frac{3}{4}$ inch long. The fleshy, lanceolate leaves are up to 1 inch long near the base, and $\frac{1}{4}$ inch wide. The flowers grow on slender stems from the leaf axils as well as from the end of the branches. The flowers are white and measure about three-eighths of an inch in diameter. The plant differs from *C. Volkensii* (see Part I, pag. 12) only through its slightly hairy, very thin flower stalks. (Fig. 1, *Crassula Volkensii* Engl.) Western Usambara, below Mbalu, 4,500 ft. on rocks.

Crassula Zimmermannii Engl., var. *Uhligii* Engl.

From Teita Hills, near Bura, in Kenya Colony, has thinner and longer flower stalks which are up to $1\frac{1}{2}$ inch long, and narrower and slightly longer leaves.

KALANCHOE (continued).

Kalanchoe Goetzei Engl.

The plant is 10 to 20 inches high. The fleshy leaves are to $2\frac{1}{2}$ inches long and 1 inch wide. The flower cymes are double, about $2\frac{1}{2}$ inch long, developed from the leaf-axils. The tube of

the flower is three-eighths of an inch long. It occurs in the Kinga Mountains in Tanganyika, near Ussangu, on the Msimasi Swamp.

Kalanchoe obtusa Engl.

Of shorter growth than other species, this plant attains a height of 4 inches only; the fleshy leaves are nearly circular and about 1 inch in diameter.

The inflorescence is a many flowered cyme. The plant occurs in Tanganyika Territory.

Kalanchoe sp.

Is another small *Kalanchoe*, which rarely exceeds 7 inches in height. The growth is somewhat decumbent, with the flowering stems erect. The dark-green, fleshy leaves are obovate, up to $1\frac{1}{2}$ inch long and $\frac{3}{4}$ inch wide. The flowers are a bright-orange tipped with red. It occurs in Tanaland, near Kolbio, in the half shade of shrubs.

Kalanchoe sp.

A very fleshy plant with thick large leaves, with a velvety, glandular surface. The leaves, which attain a length of 7 inches and a width of $3\frac{1}{2}$ inches, are developed close to the ground, while the ascendant flowering stem bears few and much smaller leaves. The flowering cyme, which bears purple glandular hairs, grows to $1\frac{1}{2}$ ft. high. The multiflowered cyme is a dense cluster at first and unfolds into several double cymes, densely set with orange, red-tipped flowers. The plant is locally common on the Escarpment, South of the Ngong Hills, Kenya Colony, on rocky soil. Fig. 2.

Kalanchoe sp.

Similar in appearance to the above, it is more upright in growth, the leaves are a darker green and the leaf stalks thinner and longer. The flowering cymes are denser, and are developed not only terminally, but also from leaf axils.

It occurs in the Mara River area, Kenya Colony.

Kalanchoe sp., (Museum No. 4832).

See Part I, pag. 14, has now been identified as *Kalanchoe lanciniata* D.C. Fig. 3.

Kalanchoe spp.

Several other unnamed species from East Africa await description.

SEDUM (continued).

Sedum epidendrum Hochst.

First found in Abyssinia, the plant occurs also on Mt. Elgon in Kenya Colony. The much branched plant bears few, very thick, smooth, elongated leaves which are 1 to 2 inches long. The small flowers grow in few-flowered, rounded heads; it is an epiphyte on trees.

Sedum sp.

A new species from Kigezi in Uganda, has not yet been described.

N.O. FICOIDACEAE (AIZOACEAE).

In the widely accepted system of classification of Hutchinson's Families of Flowering Plants the family name *Aizoaceae* has been replaced by *Ficoidaceae*, and the succulent genera *Sesuvium* and *Trianthema* have been included.

MESEMBRYANTHEMUM.

More than two thousand species of "Mesembs" are known from Southern Africa and with modern research the genus is split up into new genera. In outward appearance they vary greatly; they range from shrubby perennials with fleshy leaves, to small very succulent annuals, some of which exemplify the most amazing mimicry which is encountered in plant life: they imitate the outward shape and colouring of the pebbles among which they grow to such perfection that it is nearly impossible to detect them on the ground; it is only during their short flowering season that their brilliantly coloured flowers give them away.

A characteristic of many mesembryanthema are the crystal-clear papillae which cover their green parts; they are most conspicuous in *Mesembryanthemum crystallinum* L., which originates from the Cape, but which has established itself in many other parts of the world and is now quite common on the Mediterranean coasts. The whole plant looks as if it had been dipped into crystalline sugar or as if it were covered with icicles, hence the popular name of "ice plant." Fig. 4 shows a specimen which was found growing as an escape in a Nairobi garden.

Another extreme form is shown in the genus *Fenestraria* from the deserts of South-West Africa, whose erect, club-like leaves are buried in sand up to their blunt ends which are modified into one large "window," or lens, which acts as a protective filter against the fierce radiation of the sun.

EAST AFRICAN SUCCULENTS

PART II

BY PETER R. O. BALLY

Plates 9 to 14

PLATE 9.



FIG. 1.
Crassula Volkensii Engl.



FIG. 2.
Kalanchoe sp.



FIG. 3.
Kalanchoe lanciniata D.C.

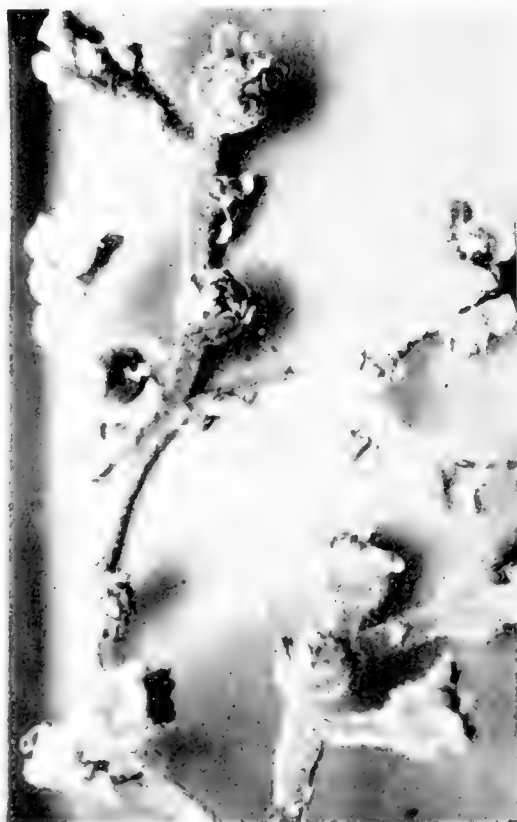


FIG. 4.
Mesembryanthemum cristallinum L.

PLATE 10.



FIG. 5.
Mesembryanthemum nakuruense Engl.



FIG. 6.
Talinum cuneifolium (Vahl) Willd.



FIG. 7.
Portulaca foliosa Ker.

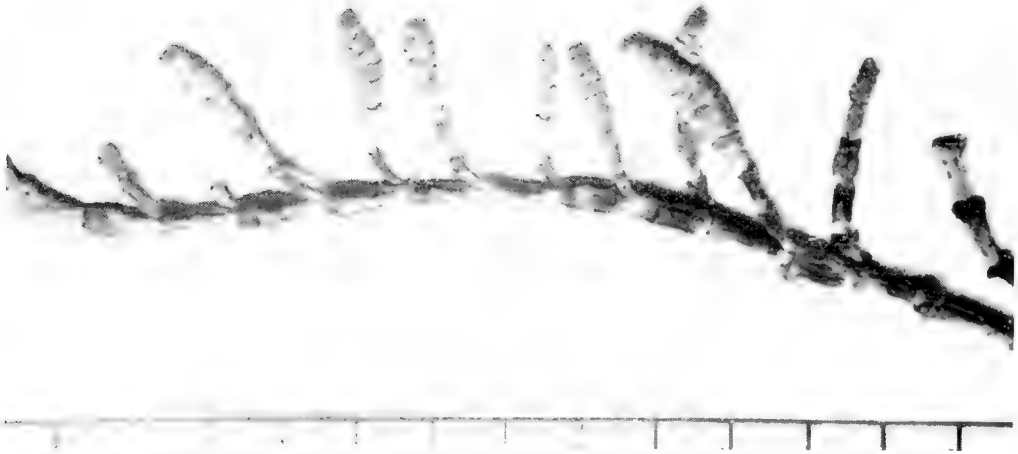


FIG. 8.
Arthrocnemum indicum Moq.



FIG. 9.
Adenia keramanthus Harms.

PLATE 12.



FIG. 10.
Adenia globosa Engl.



FIG. 11.
Adenia globosa Engl.

PLATE 13.



FIG. 12.
Momordica rostrata A. Zimm.

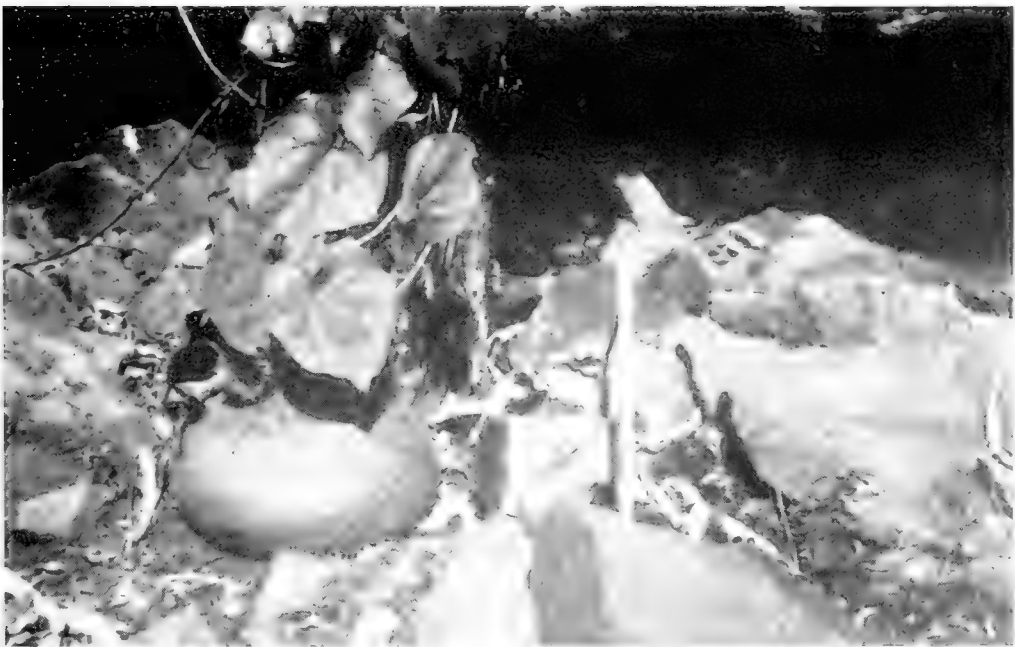


FIG. 13.
Gerarardanthus macrorhizus Harv.

PLATE 14.



FIG. 14.
Rhipsalis cassytha Gaert.

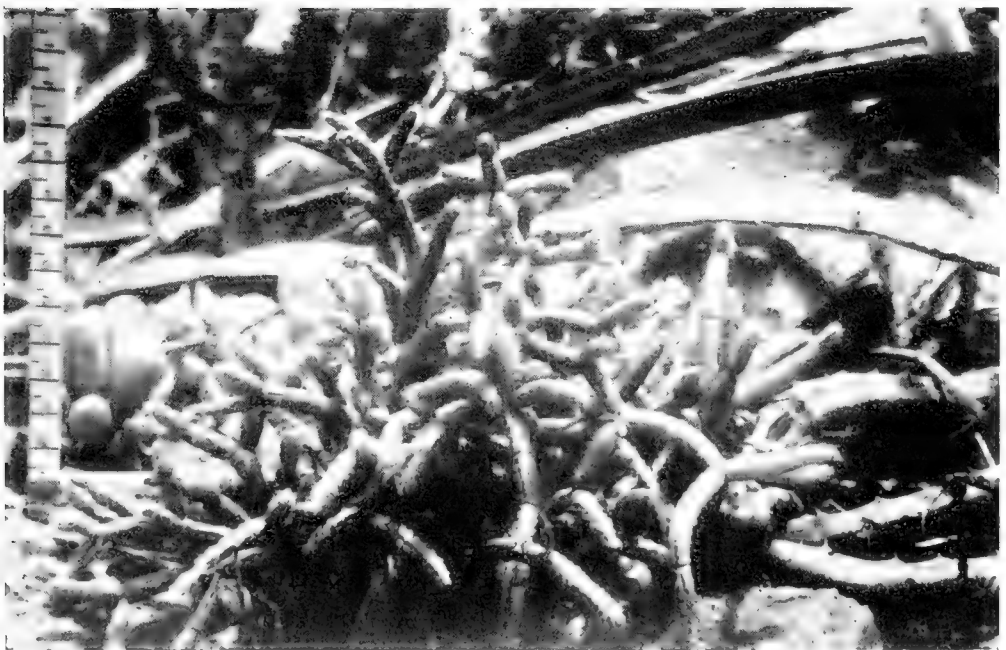


FIG. 15.
Rhipsalis sp.

The mesembryanthema found in East Africa resemble one another closely; they belong to a sub-shrubby type with elongated fleshy leaves.

Mesembryanthemum nakurense Engl.

Has a fairly wide distribution in Kenya Colony and it is also found in Tanganyika. It is a decumbent, shrubby herb, which grows rarely more than 1½ feet in height; it seems to prefer crevices in rocks and one often sees its tortuous branches spread over the surface of rock faces. The leaves are elongated, rather like small sausages, slightly triangular in cross-section, about 2 inches long.

They are covered—as are all other green parts—with small, regularly set, clear papillae, which look, when seen through a magnifying glass, very much like the scales on a lizard's body.

The flowers appear as many-petalled stars, up to 1 inch in diameter, usually white, with a yellow centre formed by the anthers; magenta—and red-petalled flowers have also been recorded from the Masai Reserve, in the vicinity of Narok. The flowers are set in a curious, fleshy calyx; they open in the morning and are closed by noon. Fig. 5.

Mesembryanthemum Oehlerii Engl.

Is recorded from the hills of Niasekera and from Lasa mountain in Tanganyika. It is closely allied to *M. nakurense*, but seems to have shorter and more clustered leaves and branches.

Mesembryanthemum Schimperii Engl.

Although known from Urarut District in Abyssinia only, it is possible that this allied species might be found in Northern Kenya Colony. The flowers are set on a much longer and more slender stem, the tips of the leaves bear a small tuft of bristles.

Mesembryanthemum abyssinicum Regel.

Is recorded from Kohaito plateau in Eritrea might also appear in Northern Kenya Colony.

SESUVIUM.

Sesuvium portulacastrum L.

A succulent herb of the seashores, especially near river mouths, with procumbent slender stems and elongated fleshy leaves. The plant is halophytic (preferring brackish soil). It grows in large interwoven mats. The flowers are purplish or rose, on short peduncles growing from the leaf axils; sometimes

the whole plant is of a purplish-red colour. In view of its peculiar mode of life in the brackish water zone, *Sesuvium* is of no interest to the gardening amateur, though it is of importance as a vegetable to the coastal peoples.

TRIANTHEMA.

Trianthema sedifolium Vis.

A prostrate, much branched herb with fleshy, needle-like leaves; it is common in the dry areas of Northern Kenya Colony on waste land in sandy soil.

Trianthema salsoloides Fenzl.

Is not unlike the former species and is found in similar surroundings. Both species of *Trianthema* are of no interest to the gardener.

N.O. PORTULACACEAE.

Contrary to *Ficoidaceae* which have evolved mainly in South Africa, the family of *Portulacaceae* seems to have originated in America, from where eight genera are known. Only a small number of species of *Talinum* and of *Portulaca* are indigenous to East Africa.

With few exceptions they are of modest appearance, though during their short flowering period they may enliven a barren corner in a rockery.

TALINUM.

Succulent herbs or rarely shrubs with fleshy leaves and with comparatively large flowers either in racemes or solitary. The roots are tuberous and often large.

Talinum cuneifolium (Vahl) Willd.

A semi-succulent perennial which grows up to 3 feet in height, sparsely branched from a tuberous root. It produces long, loose racemes bearing five-petalled flowers, about $\frac{3}{4}$ inch in diameter, mostly of a bright magenta, but sometimes pale-pink or greenish-white.

The plant is very common in East Africa in areas of low rainfall. Fig. 6.

Talinum taitense Pax et Vatke.

A scandent, yellow flowered succulent shrub which climbs into trees up to 20 feet high; the fleshy leaves are 2 inches long and about 1 inch wide. The distribution of this rare plant is restricted to Ndi Mountain in Kenya Colony, and to the south-western part of the Uмба steppe.

Talinum caffrum (Thunb.) Eckl. et Zeyh.

A low, succulent perennial, decumbent, or erect, up to 3 feet tall, with a tuberous rootstock. The flowers are solitary in the leaf axils; they are pale lemon-yellow and the petals taper into a finely pointed tip. In Kenya, the plant occurs in dry areas between Stony Athi and Sultan Hamud, and it extends down to South Africa.

Talinum carinatum A. Peter.

A bulbous-rooted perennial herb with slender decumbent stems and solitary yellow, rarely white flowers in the axils of the leaves. Found in Tanganyika Territory.

PORTULACA.

The East African species are fleshy, decumbent, or erect herbs with hairy, sometimes woolly, stipules at the joints. The flowers are terminal, either solitary, or in few-flowered heads, some of them quite showy.

Portulaca oleracea L. Purslane.

A much branched, prostrate, succulent herb with spatulate leaves and very small, yellow flowers. The plant is locally common on sandy soils, especially in abandoned cultivations. In cultivation it soon attains a more robust appearance (var. *sativa*) and is known as such as the potherb purslane. Though of Old World origin, it is now distributed in all warm climates.

Portulaca foliosa Ker.

This species is a perennial herb with fleshy, sausage shaped leaves. It is found in a procumbent form as well as an erect plant; the growth is robust, and the flowers quite large and showy, about $\frac{1}{2}$ inch in diameter, and bright-yellow. Fig. 7.

Portulaca pilosa L.

Although originating from tropical America, this delicate *Portulaca* is found naturalized in many parts of the African continent. It is known from Durban, and from various parts of East Africa, far away from cultivated districts. It is a procumbent herb with very slender fleshy leaves and with small, bright-red flowers. The stipules at the nodes are long, woolly filaments.

Portulaca quadrifida L.

Very widely distributed in East Africa, common on bare soil and on rocky ground. It is a spreading, prostrate procumbent herb with narrow fleshy leaves with conspicuously woolly stipules at the joints. The yellow flowers are five-petalled, small, but larger than those of *P. oleracea*.

N.O. CHENOPODIACEAE.

All succulent species in this family are halophytes (loving saline or brackish soil) and they are found in the more open flats and on the margins of mangrove swamps along the coast and also on salt pans and in the neighbourhood of salt lakes in the interior. Most of them are small, insignificant herbs with inconspicuous flowers, and their dependence on saline soils makes them unsuited for the succulent garden.

ARTHROCNEMUM.

Arthrocnemum indicum Moq.

A procumbent leafless succulent herb which throws up many fleshy fruiting spikes in which the flowers are wholly hidden; it is locally dominant in the sandy soil of salt creeks and in very open mangrove swamps. It is found on most tropical African coasts, and also in India. Fig 8 (from dried specimen).

SALICORNIA.

Salicornia herbacea L.

In general appearance and with its flowers sunk into the fleshy stems, this halophytic succulent herb is similar to *Arthrocnemum* in many ways, though it is of erect growth. Its distribution is very wide: it is known from the coasts of Europe, Africa, and America. It prefers the same localities as does *Arthrocnemum*, but it is rare on the East African coast.

SUAEDA.

Suaeda monoica Forsk.

A much branched, succulent evergreen shrub up to 20 feet tall. The flowers are inconspicuous, small and green, the fruits are round berries, which turn red when ripe. The sausage shaped, fleshy leaves are up to 1 inch in length. It is found very locally along the coast, and up-country in patches on saline soils; thus it is locally dominant in some places near Mkomazi and near Himo in Tanganyika Territory.

N.O. PASSIFLORACEAE.

ADENIA.

In this family it is the genus *Adenia* only which has evolved forms which store water in their stems such as the rambling climber *Adenia venenata* Forsk., a fairly common climber in East Africa. Its stem has developed into a thick, fleshy trunk which ascends high into trees. Other semi-succulent forms found in East Africa are *Adenia Volkensii* Harms., and *Adenia*

keramanthus Harms., Fig. 9, with erect non-climbing, fleshy and inflated stems. It shows well the bulging fleshy stems and the bell-shaped flowers which bear no outward resemblance to the highly ornamental flowers of *Passiflora*.

In East Africa there is one species only of *Adenia* which has all the characteristics of a true succulent, i.e., reduction of leaves to a minimum, inflation of trunk out of all normal proportions, and a coating of chlorophyll-bearing cells on the whole surface.

Adenia globosa Engl.

Is one of the most striking forms of East African plant life and of adaptation to conditions of drought. The trunk, while of a fairly symmetrical globular shape in immature specimens (Fig. 10), develops into an immense, shapeless lump, attaining a diameter of 6 feet and over. The root system is weakly developed, but from the upper part of the trunk it sends long climbing branches high up into trees. They support themselves by means of 1 to 2 inches long, green, horny tipped thorns, which are modified tendrils. The minute three-lobed leaflets appear only on the young shoots during the season of growth. The tubular, pale yellow-green flowers are in clusters in the axils of the thorns.

In waterless regions the natives make use of the plant for the storage of water. The trunk is of a soft, fleshy texture throughout, built up of moisture storing cells. Rainwater stored in the hollowed-out trunk will remain fresh for long periods, and it is quite protected against evaporation by the walls of living tissue.

The opening is often closed with a stopper of wood to prevent animals from getting at the water-supply. (Fig. 11).

The plant occurs in the dry areas of Southern Kenya Colony and Northern Tanganyika from coast level to 3,000 feet and it is locally common.

N.O. CUCURBITACEAE.

Some members of this family have evolved an erect, soft, comparatively short but voluminous trunk above ground, and on account of this feature they deserve mention in an enumeration of indigenous succulents.

In *Dendrosicyos socotrana* of Socotra Island, the trunk attains a height of 7 to 8 feet, and a diameter of 3 feet. The branches are pendent and they have no tendrils.

None of the East African *Cucurbitaceae* compare with such dimensions; their trunks rarely exceed 1 foot in height.

There are several species of this type, all of them creeping or climbing plants with well-developed tendrils. Most common and widely distributed in the dry areas in East Africa is:

MOMORDICA.

Momordica rostrata A. Zimm.

The fleshy, irregularly-grooved trunk of this plant is found frequently at the base of shrubs, half hidden in the undergrowth; the long, slender, scandent branches climb over the surrounding vegetation, to which they cling with the aid of their tendrils, often smothering them with their dense foliage, and with a profusion of deep yellow, maroon-centred flowers. (Fig. 12.)

It is common in dry areas throughout East Africa.

GERARDANTHUS.

Gerardanthus macrorhizus Harv.

Is interesting from the succulent grower's point of view on account of the perfectly symmetrical vase-shaped trunk, but also for its attractive leaves, which are slightly fleshy, ivy-like in outline, and marked in two shades of green. The branches are thin, climbing and tendrilled. The flowers are small and insignificant, the fruits are characteristic, elongated, three-sided, and when dry they are often discovered by the rattling noise which the seeds produce inside the hull. (Fig. 13.)

Its distribution in East Africa is wide; it is found in the dry areas of South Kenya Colony and Northern Tanganyika.

N.O. CACTACEAE.

The *Cactaceae* with over 1,500 species are almost exclusively indigenous to America. A few species of the genus *Opuntia* have, however, established themselves very well in other tropical and sub-tropical countries, and *Opuntia ficusindica*, an excellent hedge plant with edible fruits, is found in many parts of East Africa.

This paper is concerned with indigenous succulents only, and the one genus represented in East Africa is:

RHIPSALIS.

Rhipsalis cassytha Gaertn.

At first glance the slender, drooping, cylindrical branches, with fruits the size and colour of those of our mistletoe, bear no similarity to our general conception of a number of the cactus family. Seedlings and young plants show, however, the usual

characteristics: they have erect, angular branches, armed with minute spines. The plant grows as an epiphyte on trees and on rocks, and it is locally common. The distribution is wide. It is known from the rain forests of the West Indies and of Brazil, in tropical West Africa from Liberia through the Cameroons and the Congo Basin to Angola, also on Lake Kivu and in Uganda, in the Chyulu Hills in Kenya Colony, in the Usambara and Uluguru Hills in Tanganyika, in South Rhodesia, and in Natal. It is possible that its wide distribution is due to the sticky juice of its fruit, which facilitates propagation by birds. (Fig. 14.)

Rhipsalis erythrocarpa K. Schum.

Very similar to *R. cassytha*, but with red berries and slenderer growth, this plant has been collected in Kibosho on the slopes of Kilimanjaro in Tanganyika, and near Thomson's Falls in Kenya Colony.

Rhipsalis spp.

Judging from habit character alone, there seem to be more species indigenous in Kenya. Fig. 15 shows a little erect plant with sturdier branches, and with small spines which are retained to maturity.

(To be continued)

A NEW EAST AFRICAN *TRICHOLOIPEURUS*.*

By G. H. E. HOPKINS, M.A.

The Mallophaga or biting-lice are obligatory external parasites of mammals and birds, and the family Trichodectidae, to which *Tricholipeurus* belongs, is found exclusively on certain groups of the mammals, including (in East Africa) the Carnivora or flesh-eaters, the Ungulata or hoofed animals, the Hyracoidea or hyraxes (known to South Africans as dassies), and certain Primates (lemurs and monkeys).

Among the Ungulata the pig-family are apparently never infested with Trichodectidae, but with this exception almost every member of the Carnivora, Ungulata and Hyracoidea may be expected to be infested with a species peculiar to itself, and a hyrax may have a number of such species. Only when the host-species are very closely related, as in the case of the two species of water-buck, is it to be expected that their Trichodectidae will be indistinguishable from each other, and among the hyraxes even barely distinguishable sub-species of the host may have mallophagan parasites which are specifically distinct.

Although these parasites are of great interest (particularly because they often throw new light on the relationships and ancestry of their hosts), and are very easy to collect, our knowledge of them is very incomplete, and it is perhaps worth indicating how great our ignorance is by giving a few examples of very common animals of which the parasites are unknown. We do not know the parasites of any of the East African cats, from lion down to jungle-cat, nor of either species of hyaena, nor of any of the dog-group; those of the mongooses and genets are better known, but there are many gaps even here. Among the hoofed animals the parasite of the common zebra is very imperfectly known and (as the specimens were collected from a zebra in a zoo) we may not even have the right parasite at all; the Trichodectidae of buffalo, bush-buck, Grant's gazelle, Coke's hartebeest (kongoni), oribi, oryx and topi are all unknown. From East African hyraxes we know less than half of the species which must occur; from lemurs we have no records whatever,

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and the sole record from a monkey (a colobus) is doubtful. Even among the domestic mammals much remains to be learnt: we do not know if the parasite of the donkey is the same as that of the horse, and the camel ought to have a species of exceptional interest, but it has never been collected. This list is merely given to indicate how easy it would be to add to our knowledge, and the omission of any animal in no way implies that we know its Trichodectidae. If any reader would like to assist in increasing our knowledge I would be delighted to supply all necessary information.

In view of the extent of our ignorance it is a great pleasure to be able to fill one of the gaps by describing the mallophagan parasite of the familiar "Tommy" (one of the commonest species of buck in Kenya), and I am much indebted to Mr. J. L. Hewlett-Parker for giving me the opportunity to examine the dried skins from which the new species was obtained. I am also greatly indebted to Mrs. G. J. Edney for the beautiful drawings from which the figures were prepared.

Tricholipeurus parkeri sp.nov.

Probably most closely related to *Tricholipeurus cornutus* (Gervais) and *T. longiceps* (Rudow), the former described from *Gazella dorcas* and the latter from *G. arabica*. *T. cornutus* has not been satisfactorily described, though Taschenberg (1882, p. 220, Pl. 7, Figs. 9, 9a, 9b) redescribed under Gervais' name a pair of Rudow's type-series of *longiceps*. His description and figures, though inadequate by modern standards, are sufficient to show that *parkeri* is distinct. Taschenberg considered *longiceps* to be a synonym of *cornutus* and as the two hosts are very closely related his opinion may be accepted provisionally, though it requires confirmation because he had apparently seen no material from *Gazella dorcas*. His figures show the following main differences from *parkeri*—head with a much deeper frontal notch, less elongated and with much less convergent lateral margins in the pre-antennal region (especially in the female); male genitalia with basal plate longer and narrower and with parameres apparently much straighter; apex of female abdomen differently shaped. The new species also resembles *Tricholipeurus balanicus* (Werneck), but in the latter the sides of the pre-antennal region are strongly convex.

Male (Fig. 1). Length: 2.00 mm.

Head much longer than broad (cervical index 1.57); frontal notch rather shallow, its median portion forming a smooth concave curve (a very unusual character); pre-antennal region with

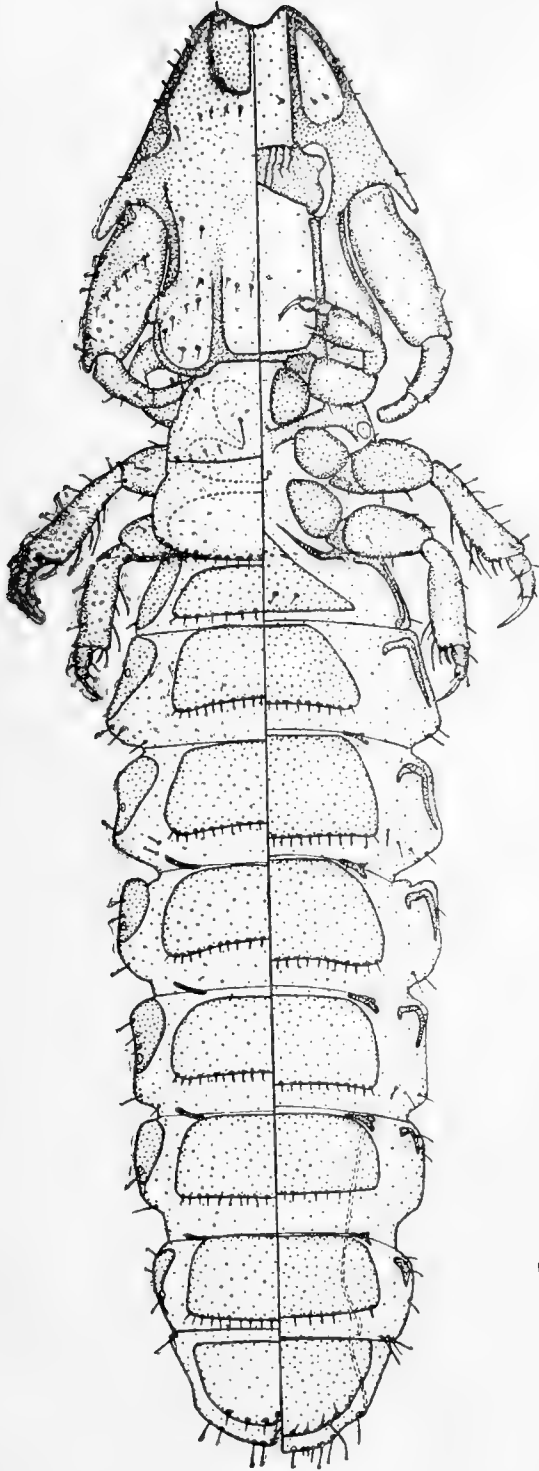


FIG. 1. Dorsal (left hand) and ventral (right hand) views of male of *Tricholipeurus parkeri* sp. nov.

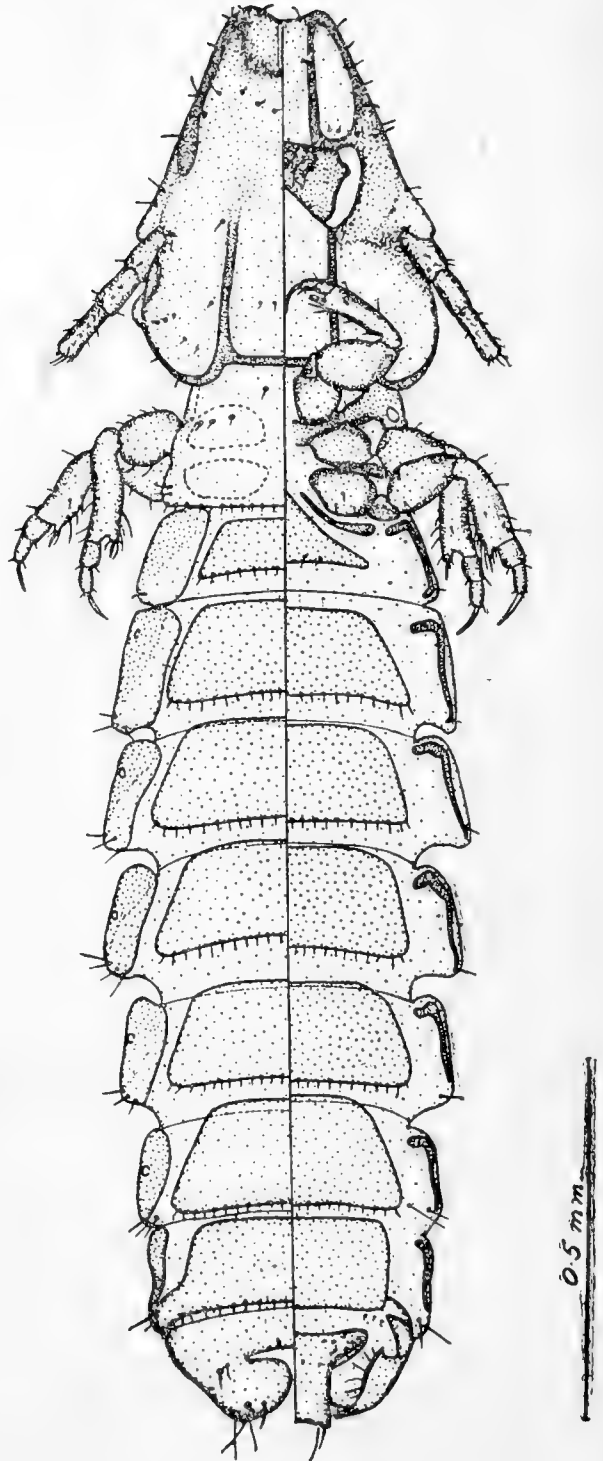


FIG. 2. Similar views of female *T. parkeri*.

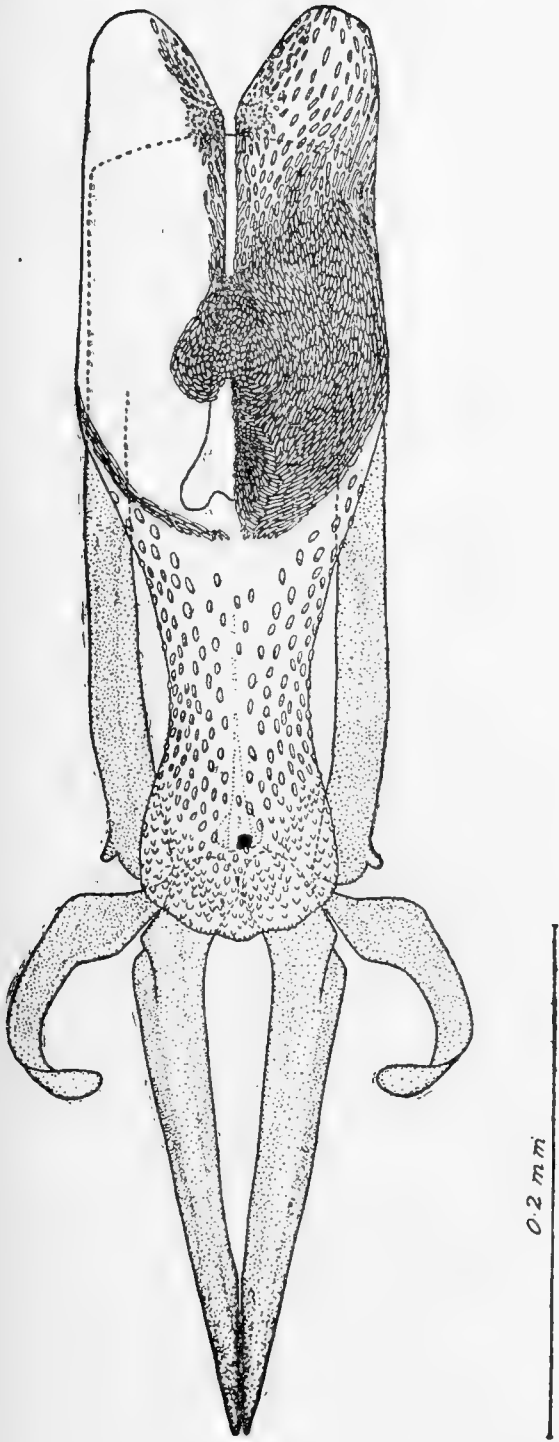


FIG. 3. Dorsal view of genitalia of male *T. parkeri* in the resting position. The ornamentation of the preputial sac is partly omitted on the left side so as to show underlying structures.

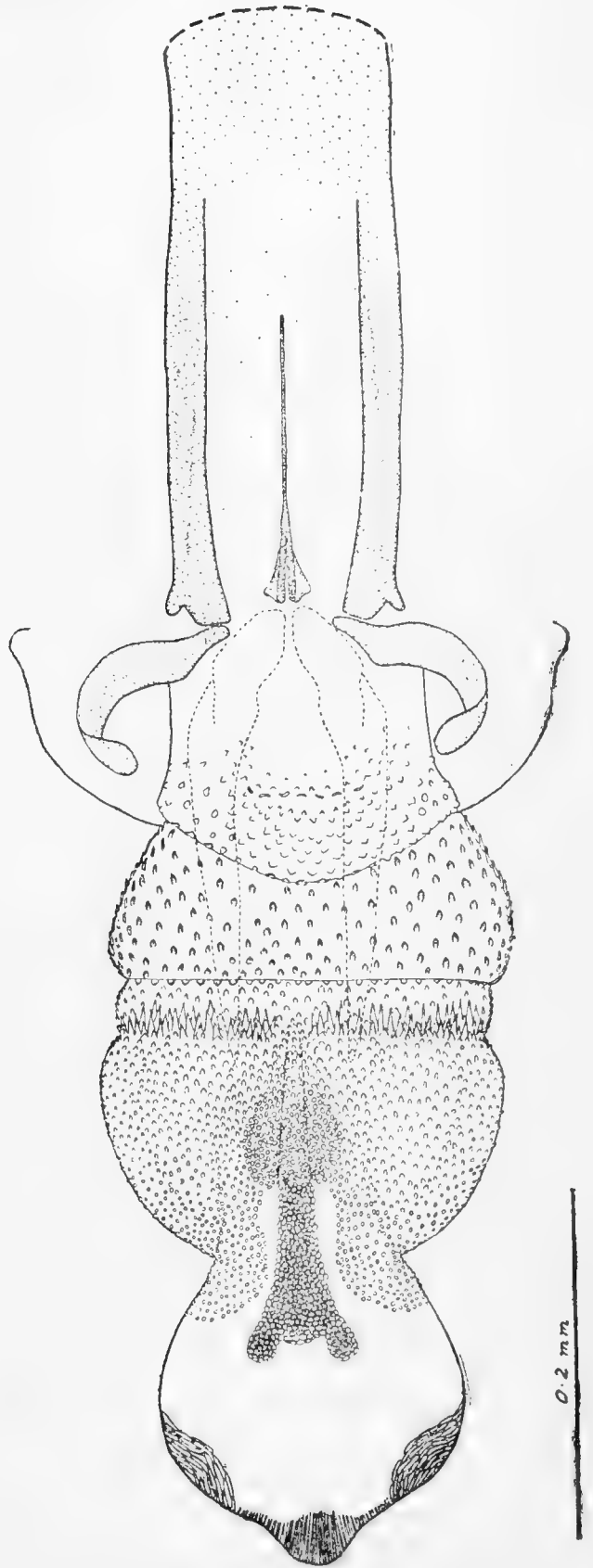


FIG. 4. Dorsal view of exerted male genitalia of *T. parkeri*.

almost straight sides which are strongly convergent anteriorly; temples projecting considerably behind median part of posterior margin of head, but not to so marked a degree as in *T. elongatus* Bedford; trabeculoid processes weakly sclerotised and rather narrow. Antenna with first segment enormous, making up about two-thirds of the total length of the antenna and more than twice as stout as the second segment; second and third segments subequal in length (the third segment shown foreshortened in the figure). Apart from marginal and submarginal setae the dorsum of the head bears a transverse row of eight or nine very small post-epistomal setae, two very small setae on each side internal to the antennal fossa, and a group of five or six small setae on each temple, more or less merging into the outer ends of a transverse row of about eight setae placed on the vertex a little anterior to the temporal groups.

Prothorax little broader than long, almost straight-sided, with on each side a minute seta placed within the margin of the antero-lateral angle, a much larger single tergo-central seta, and an oblique row of four small setae near the posterior margin; prothoracic spiracle moderately large. Pterothorax slightly shorter and broader than prothorax, with convex sides (particularly in its posterior or metathoracic portion) and a row of about twenty setae, of which the outermost and the fourth from the outer end are more than twice as long as the rest, on its posterior margin.

Legs short and rather slender, first pair shorter and stouter than the others, tibiae of second pair slenderer than those of the third.

Abdomen moderately elongate (abdominal index 2.8); its margins very strongly crenulated and very slightly convex; the third and fourth apparent segments the broadest, but only very slightly broader than the second and fourth. Tergal plates single, weakly sclerotised; sternal plates rather more strongly sclerotised. Small Y-shaped sclerites strengthening the ends of the intersegmental grooves are present between each pair of segments from the second and third to the eighth and ninth apparent segments, inclusive. Longitudinal sclerotic bars present on each side of the genitalia, as in most species of the genus. A row of about twenty very small setae on the hind margin of each tergal and sternal plate, these setae less numerous on the tergal plate of the first apparent segment and only about four in number on the sternal plate of the same segment, on the eighth and ninth tergites and sternites the setae are also less numerous and are much larger. Spiracles very small, subequal, present on apparent segments two to seven.

Genitalia (Figs. 3 and 4) with basal plate moderately long and broad (about two and a half times as long as broad) extending to posterior margin of fifth segment, its lateral bars well-sclerotised and slightly forked apically; a well-marked median sclerite, situated at the apex of the basal plate and just anterior to the bases of the endomeres, is of somewhat complicated shape (see Fig. 4). Parameres short (a little more than half length of endomeres), strongly curved, their tips folded inwards and dorsad in such a way as to suggest the beginning of the process by which, in many Trichodectidae, fusion of the tips of the parameres has produced a ring-shaped band. Endomeres long (about three-quarters of length of basal plate), almost straight but with the basal third bent inwards at an obtuse angle so that the extreme bases are in very close proximity with each other. The copulatory sac is of unusual interest because in its exerted state (Fig. 4) it shows very clearly its origin from at least two abdominal segments; the proximal segment has its surface rather densely covered with small triangular teeth; the intersegmental membrane between this and the next segment with larger teeth; the median portion is stiffened internally by a highly-sclerotised dagger-shaped rod which apparently prevents this portion of the sac from being turned inside out when retracted, and its surface is very densely covered (especially immediately over the dagger-shaped rod) with small roundish plaques which are somewhat larger and less dense proximally; the terminal portion has dorsally a latero-basal and central area which is devoid of spicules or plaques of any kind, and ventrally is very densely covered with sclerotised striae which are more or less continuous on the periphery and broken up into small elongate plaques medially (Fig. 3), its apex is heavily sclerotised and striate and of constant and characteristic shape (Fig. 4).

Female (Fig. 2). Length: 1.97 mm.

Preantennal region of head narrower and more regularly convergent anteriorly than that of the male; cervical index 1.4; trabeculoid process much broader than in male. Antenna slender, first segment stouter and slightly shorter than the second, third segment longer than the second but of the same width. Thorax and legs as in male.

Abdomen slightly stouter than that of the male (index 2.5), but not markedly different in shape except distally. The small Y-shaped sclerites in the intersegmental grooves of the male are absent in the female. Tergal plate of terminal segment with a slot which is crescent-shaped in its anterior portion and has a posterior extension with nearly straight and parallel sides (the whole slot resembling in shape the head of a pickaxe with a

portion of the shaft, or a section through the cap and stalk of a mushroom). The posterior part of this plate appears to be continuous laterally with the sternal plate of the same segment (Fig. 5), which is very broad anteriorly, much narrower and almost straight-sided in its posterior portion, and shallowly concave distally. In several other members of the genus this

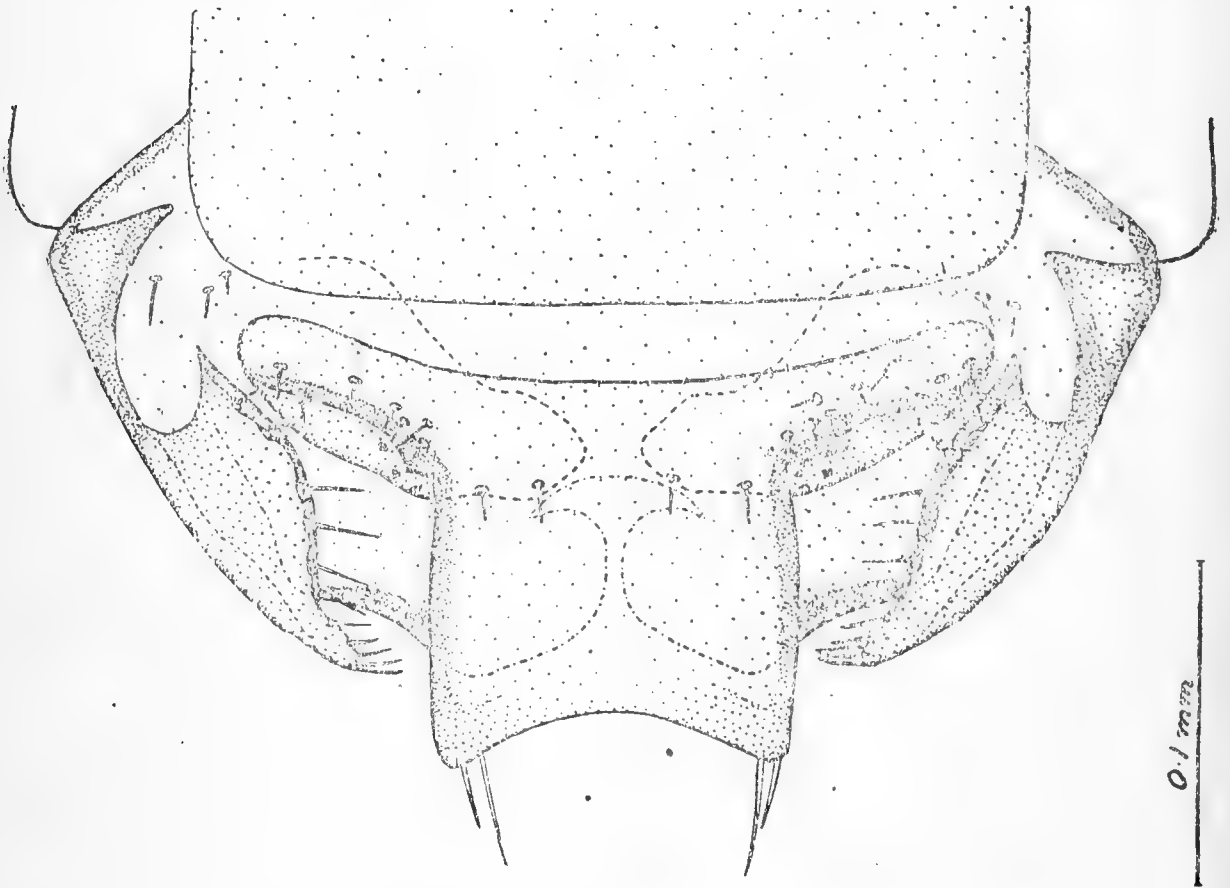


FIG. 5.

FIG. 5. Ventral view of apex of abdomen of *T. parkeri*.

In all the figures broken lines indicate that the structures drawn thus lie below those shown in solid lines.

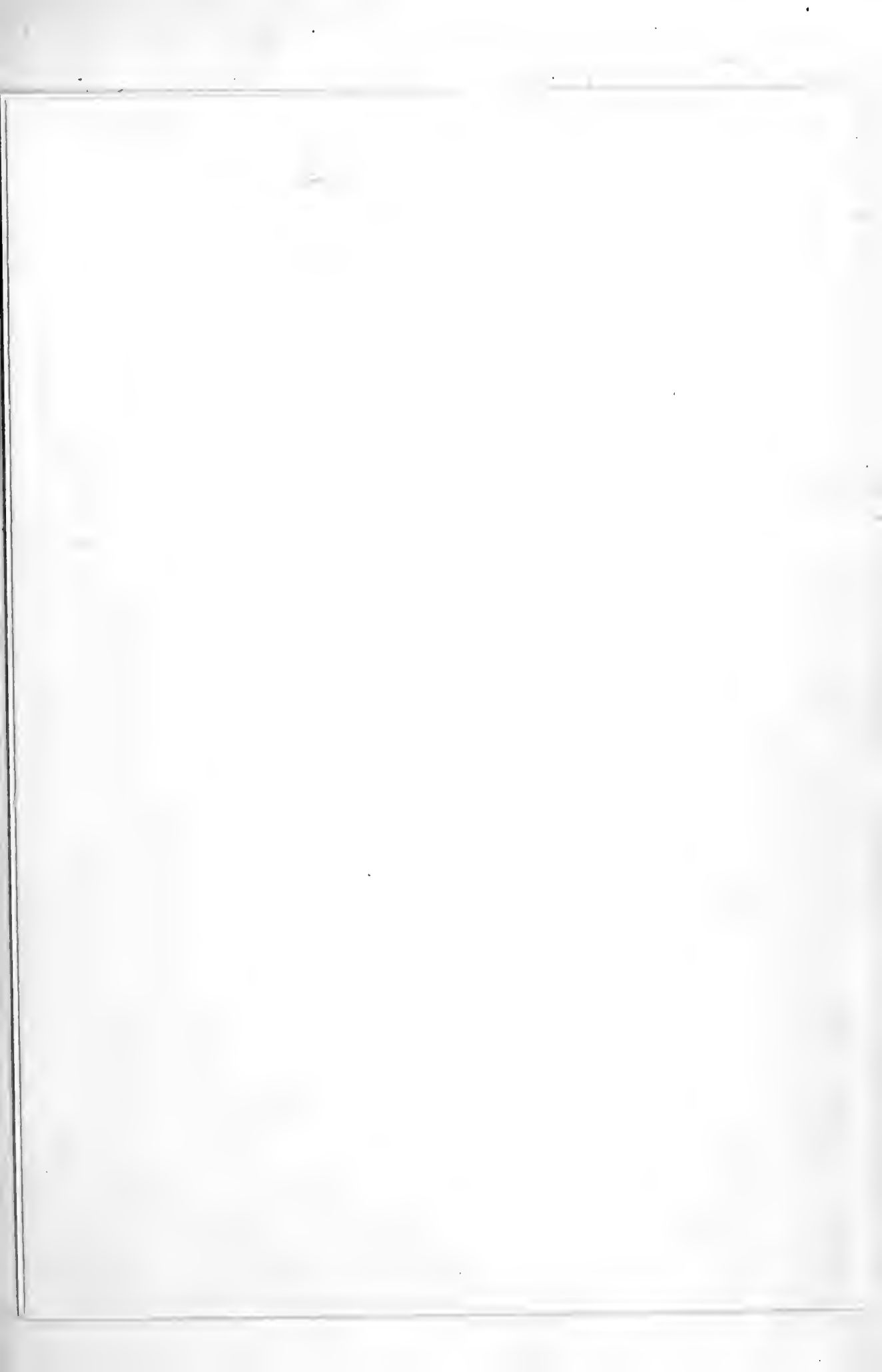
plate is of somewhat similar shape, but it is much more projecting in *parkeri* than in any other known species with the possible exception of *longiceps*; Taschenberg's figure of the apex of the abdomen of the latter is on too small a scale to be of much value, but appears to show a plate rather like that of *parkeri* but much more deeply emarginate distally.

Copulatory lobes, or gonapophyses. (Fig. 5) apparently of rather distinctive shape, with a very deep bay at the base of the expanded terminal portion, but in all the specimens they are seen in almost end-on view so that their exact shape cannot be made out.

Type-material: Male holotype, female allotype, eleven male and fourteen female paratypes, and a considerable number of teneral and immature specimens collected from the dry skins of two individuals of *Gazella (Eudorcas) thomsoni nasalis* Lönnberg, (Thomson's Gazelle), obtained near Naivasha, Kenya Colony, on 22/1/1941.

The types will be presented to the British Museum when conditions allow, paratypes are in the Coryndon Memorial Museum, Nairobi, and in the Bedford, Hopkins, Peters, Thompson and Werneck collections.





THE NAMES OF SOME BIRDS IN SEVERAL NYANZA LANGUAGES.
COLLECTED BY R. L. HULL, Maseno School, Central Kavirondo.

ENGLISH NAME.	SCIENTIFIC NAME.	LUO.	KISII.	KITOSH.	KAKAMEGA.	MARAGOLI.	SAMIA.	BUNYORE.	HANGA.	TERIKI.	SUK.	NANDI.	KIPSIGIS.
Red Crane	<i>Balearca regulorum gibbericeps</i>	Owang'	Ek'ung'a	Ng'oli	Ik'onye	Ekonye	Ewang'	Ik'onye	Liwange	Ik'onye	Kung'onyon	Kung'onoyot	Kung'onoyot.
Heron	<i>Ardea cinerea</i>	Nyamnahā	—	Namulovi	Inamak'onolera	Ling'ong'oi	Enak'a	Linak'a	Linak'a	Ing'ong'oi	—	—	—
Red-bellied Darter	<i>Anhinga rufa</i>	Osopi	Endubi	Liyoyo	Lilobi	Keyoyo	Esofo	Ak'ayoyo(?)	Namulobi	Shuyoyo	—	—	—
Great Egret	<i>Bubulcus ibis</i>	Okok	Awayaye	Enyange	Inyange	Inyange	Enyange	Inyange	Inyange	Inyanje	Abong'	—	—
Red-winged Fowl	<i>Numida mitrata</i>	Awendo	Enkanga	Lik'anga	Lik'anga	Lakanga	Ehanga	Lik'anga	Lik'anga	Lik'anga	Mangarach	Terekikyat	Terekekyat.
Red-bellied Coucal	<i>Centropus burchelli</i>	Tutu	Retutu	Namwitwitwi	Lidudu	Lidudu	Edwidwi	Litutwi	Litutu	Lidudu	Kurlulu	Chepkukutyet	Chepkurbeit.
Red-nosed Hooded Kingfisher	<i>Halcyon albiventris</i>	Opir	Etibibri	—	Indiang'ung'u	Isimindwa	Mulumba	—	Otore	Indiamumu	—	Kiptituet	Kiptituet.
Great Owl	<i>Tyto alba</i>	Tula	Enyakweumia	Lik'ulik'iki	Lik'ule	Lak'uli	EK'irik'iki	Lichichi	Lik'ule	Lik'ulu	Pyukuk	Sugurut	Sugurut.
White-crowned Crow	<i>Corvus albus</i>	Agak	Ekigonkoru	Ng'ofulo	Lik'ok'o	Lijikoro	EK'ok'o	Lik'ok'o	Lak'ok'o	Lik'ok'o	Kukai	Chepkukit	Chepkunguruet.
Black-winged Wagtail	<i>Motacilla aguimp tidua</i>	Ochinjo	Ekibarata	Nak'oto	Sh.chunjonjo	Iktsientsie	Ak'ajwinjwini	Esitsisie	Ek'ichinjichwi	Shijonjono	Chepkiliiny	Chepkesiokut	Chepkolinyet.
Black-bellied Shrike	<i>Lanius collaris humeralis</i>	Odiero	Ritambombo	Masak'aha	Inamande	Likungulugu	Enyibara	Likungulubu	Likongoloni	Lik'ulungu	—	Kipkeke	—
White-bellied Vented Bulbul	<i>Pycnonotus tricolor</i>	Ochongoriyo	Rikorobo	Likolobe	Lik'olobe	Lakolove	Echokole	Lik'olobe	Lak'olobe	Lik'olove	Kanyirpt	Chepkorobitiet	Chepkoropitiet.
Red-bellied Chested Sunbird	<i>Chalcomitra senegalensis equatorialis</i>	Onyodhi	Egisibi	Ak'anamususuni	Muzuni	Omutsune	Ak'anyojonyojo	Omutsune	Omutsune	Muzuni	Chesectuk	Chepkemisiet	Chesibit.
Red-bellied Weaver	<i>Ploceus reichenowi</i>	Osogo	Richore	Esogo	Lisogo	Lisasi	Esogo	Lisoko	Lisoko	Lisogo	Sowokin	Kibachat	Chepisakyat.
Red-bellied Redbird Coly	<i>Colius striatus ugandensis</i>	Oluru	Ensetwa	Esefu	Iseru	Esetwe	Esefu	Esefu	Itsefu	Iserwe	Sition	Chepositiet	Kipkositwet.
Red-bellied Tanager	<i>Streptopelia sp? capicola</i>	Akuru	Riruma	Lihusi	Shidudi	Lakuulu	Egugu	Lik'ulwi	Lik'usi	Shidudi	Cheptuko	Cheptuget	Cheptuget.
Red-bellied Tanager	<i>Buphaga erythrohyncha</i>	Odharis	Ensaria	Lichuria	Lizaria	Litsaria	Echalia	Litsalia	Litsalia	Lizalia	Chirriarian	Ririat	Ririat.
Red-bellied Noddy	<i>Scopus umbretta</i>	Onyinjo	—	Namuningie	Shisindovoli	Kikuni	Namuningye	Esik'ome(?)	—	Shik'une	Wuttpogho(?)	—	—
Red-bellied Fantailed Nightjar	<i>Cosmetornis neriarius</i>	Mbugembuge	Esirria	Lubugabuga	Imbugavuga	Imbugabuga	Embukambuka	Imbukambuka	Imbukambuka	Imbugavuga	—	—	—

(To be continued)



OCCASIONAL NOTES.

SLUG vs. SAFARI ANTS. The large white slug which is common in the wet forests of Kenya would seem to be quite unprotected against the attacks of the wandering ants. An observation which I made recently shows, however, that it has nothing to fear from their voracious hordes: A branch carrying a white slug about 6 inches long had fallen across a trail of *siafu*, which swarmed immediately all over it. On finding the slug they attacked it at once in such numbers that the slug was nearly hidden from view; it pulled in its horns, contracted a little and remained motionless, and apparently inactive. The *siafus* seemed to sink their jaws right into the slug, and then hung onto it without motion. After the first excitement of finding this prey in its way, the main trail resumed its marching order and passed on, leaving the victim covered with its aggressors.

For a few minutes nothing happened, when suddenly the covering of ants opened in one place, and the slug moved out from underneath unscathed, leaving them behind, their prongs well buried in the slime which it had exuded, and which it shed as if it had been a cloak.

Not one of the *siafu* seemed to realize that their prey was making an escape, for they continued to hold on to the slime left behind.—P. R. O. BALLY, Coryndon Museum, Nairobi.

NANDI BEAR? A Military Officer stationed at Nanyuki reports that he was returning to Nanyuki along the Loldaikas road at night about the 12th June. Near Mr. Payne's farm he saw an animal, a short distance away on the road, very clearly in the headlights of his car.

His description is as follows:—

“At the first glance my impression was definitely a bear-like animal, with a large and powerful head. It was the size of a calf, heavily built and with large feet, the latter feature being especially noticeable. The general colour was brown, and the coat was smooth over the front part of the body. The hinder parts were more shaggy. I particularly noticed that the body did not fall away towards the hind quarters—rather the reverse—if anything. I did not notice any tail. When the creature moved off the road, it appeared to shamble rather than trot or canter.”—HUGH COPLEY, Game Department, Nairobi.

REPORT ON THE CORYNDON MUSEUM.

FOR THE PERIOD JANUARY 1ST TO JUNE 30TH, 1941.

(It is hoped in future to publish regular half-yearly reports on the activities in the Museum for the benefit of Members of the Society.)

On January 1st, 1941, Dr. V. G. L. van Someren resigned from his post as Director of the Museum and thus severed his long connection with the institution, which for many years now has been built up as a result of his activities. From the date of Dr. van Someren's resignation, the Museum has been in charge of Dr. L. S. B. Leakey in the capacity of Honorary Curator. The staff this year consists of Dr. D. G. MacInnes (who is on military duty and can only devote spare time to the work), Mr. P. R. O. Bally who is in charge of the botanical section and Mr. H. J. Allen Turner as assistant to the Honorary Curator.

During the six months under review considerable changes have been made in an attempt to achieve a better arrangement of the exhibits in the Main Hall. The whole of the bird collection has been completely rearranged and now the birds, instead of being in cases scattered about in different parts of the Hall, are all together. On either side of the door are the cases containing the game birds, while all the rest of the birds are in a line of cases in front of the habitat groups.

The mammals too have been rearranged and, with the exception of the lion and the group of antelope, are to be found along the West Wall of the Main Hall. The butterfly and insect exhibits, which were formerly in the West Gallery, are now arranged on the floor of the Main Hall in front of the mammals.

Previously the Archaeological Exhibits were placed in two cases on either side of the Staircase. These cases have now been moved to the West Gallery, the whole of which is devoted to Prehistoric Man. By this arrangement it has become possible to make a big increase in the amount of archaeological material exhibited and a really representative series is now shown.

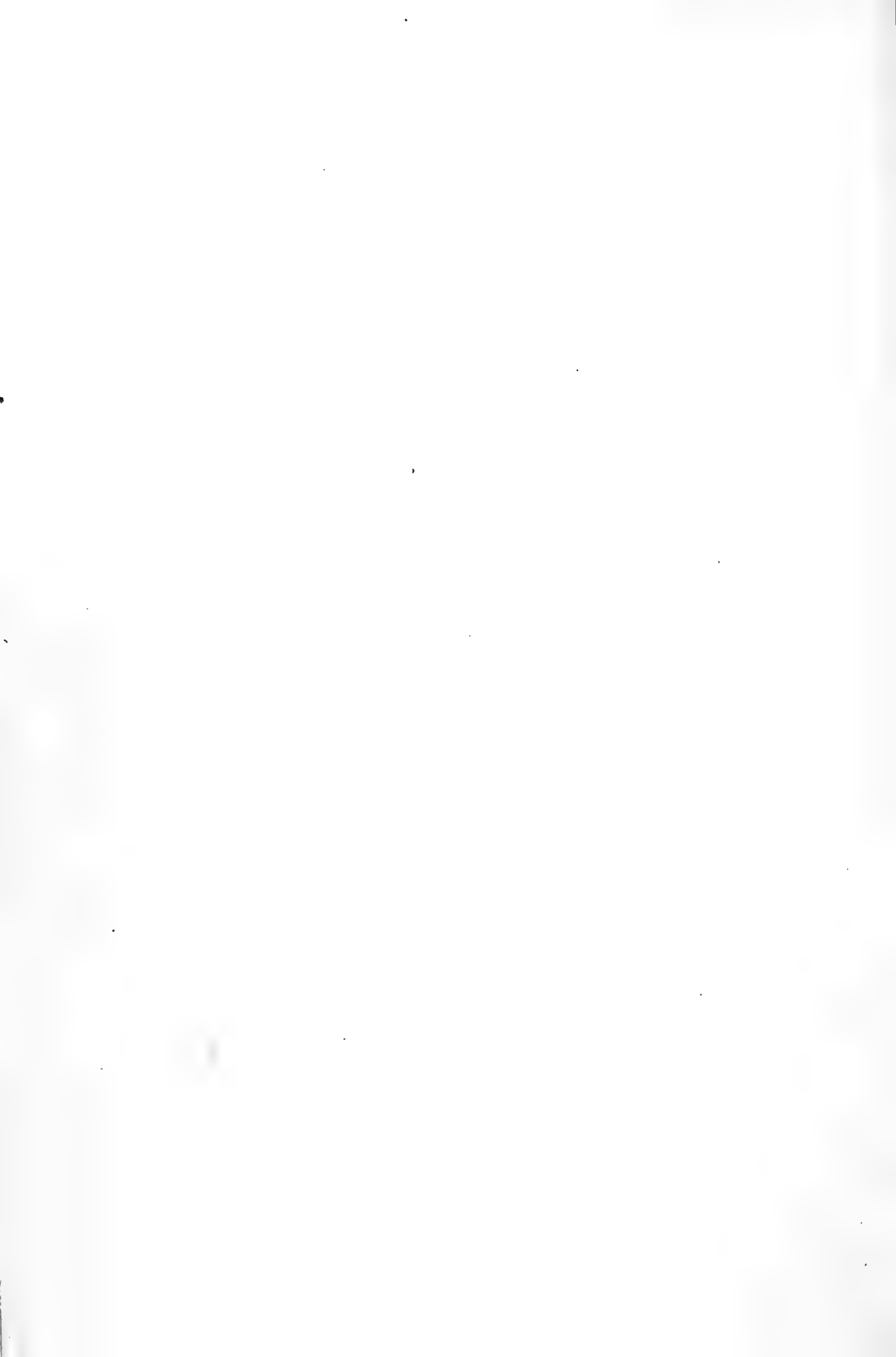
The spaces on each side of the Staircase, where the Prehistoric Exhibits used to be, have now been devoted to collections of Fish, freshwater fish on the West side and sea fish on the East. The Fish Exhibits have been very considerably

increased in the last six months and an interesting and representative collection of both freshwater and marine forms is now on view.

The Botanical Room upstairs has been greatly improved by the hanging of some 70 very fine paintings of flowers by Mrs. Bally, wife of the Botanist.

The Museum has been very well-attended during the first six months of the year, the total number of visitors, apart from children and Members of the Society who enter free of charge, being 6,140. This is highly satisfactory and promises well for the future.

L. S. B. LEAKEY,
Honorary Curator.



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NOTICE

THE article entitled "A Short Account of the Freshwater Fishes of Kenya" will be available in an attractive cover. It is intended to follow this publication with others of interest to the public. The next to follow will be a "Guide to the Raptorial Birds" and to follow with a guide to the "Succulent Plants of Kenya" and so on.

All these will be sold for the sum of Shs. 3/- each copy and will be available to the public at the Coryndon Museum or through the Honorary Secretary of the Natural History Society, P.O. Box 241, Nairobi.

The Journal

OF THE

EAST AFRICA AND UGANDA NATURAL HISTORY SOCIETY

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EDITOR:

J. RICHARD HUDSON, B.Sc., M.R.C.V.S.

Date of Publication: February, 1942.

Additional copies to members: 7/6; non-members, 15/-.

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AFR 2



Lammergeyer.

A FIELD GUIDE TO THE SCAVENGING BIRDS OF KENYA.

BY M. E. W. NORTH, M.B.O.U.

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INTRODUCTION.

I. FEEDING HABITS.

In Kenya, there are sixteen species that regularly resort to scavenging. Scavengers may roughly be grouped into two classes—corpse-eaters and garbage-eaters. By *corpse-eaters* I mean birds that locate and feed upon carcasses. Carrion of this nature is likely to become available at irregular intervals and in scattered localities, and must be searched for: this entails a wide foraging range, keen eyesight, and power to remain in the air for hours at a stretch. A corpse-eater is likely to obtain large meals alternating with prolonged fasting periods. *Garbage-eaters* are birds that feed, not on entire carcasses, but upon scraps (e.g., of meat or refuse) that are to be found near the haunts of man (particularly slaughter-houses, camps and native villages). Here the food-locality is known, so there is less need for “ranging,” and the food-supply is likely to be constant, though often it may be inadequate. Most of the scavengers show a preference for one or other of these two feeding methods, though some birds are equally partial to both. Many species, in addition, possess means of food-supply which may have nothing to do with scavenging. “Side-lines” such as these may help to explain the problem that has puzzled more than one observer: how can so large a scavenger population subsist upon what appears to be so limited a supply of carrion and garbage?

The feeding-methods of the scavenging species vary considerably. Only three of the largest and most powerful vultures—Nubian, Ruppell’s and White-backed—seem to concentrate upon corpse-eating. There is evidence that the White-headed prefers to kill live game, such as guinea-fowl or dik-dik. Of the smaller vultures, the Hooded is an inveterate garbage-eater, whilst the Egyptian specialises upon dung. The Brown Kite has a distinctive pounce-and-grab method of scavenging; it also catches live prey, and attacks weaker scavengers to make them drop their food. The Tawny Eagle scavenges, takes live prey, and is predatory upon other scavengers (especially the Kite). The Marabou eats corpses and garbage—which are curious habits for a member of the stork family—but it can also be seen searching for insects in the orthodox stork manner. The crow family is omnivorous: scavenging with these is only one of numerous ways of feeding. Of the foraging habits of the Lammergeyer, nothing seems to be known in Kenya, but elsewhere this bird lives on bones, which it sometimes carries to a height and then drops, hoping thus to secure manageable

pieces. The Sooty Gull is confined to the sea-coast. Here it picks up scraps like a typical garbage-eater, but, in addition, it has at least one side-line: to chase terns until they disgorge their catch, which the gull then appropriates.

It seems to be generally agreed that it is sight, not scent, that guides scavengers to a kill; as soon as this has been located, the actions of one bird are observed by others, and many appear, swooping down out of the sky, and the carcass is soon finished. Scavengers perform an invaluable service in getting rid of refuse, hence certain species (vultures, Lammergeyer, and Marabou) are protected.

II. FLIGHT.

All the scavengers possess one common characteristic—exceptional skill in soaring flight—which clearly is of the greatest value to a bird that is obliged to cover large distances searching for food. (The alternative of flapping flight would use up far more energy.) Soaring is, however, only possible in the day-time, while the sun is well up. This can be proved by watching vultures depart from their roosts in the early morning. At dawn, they are disinclined to move at all; if they do, the method of flight is a heavy, laborious type of flapping, with periods of gliding during which elevation is lost rapidly. As the sun rises and warms the air, one begins to see birds circling with wings stiffly extended and tail open, gradually gaining elevation. Once the sun is well up, “soarability” improves, and birds can dispense with the stiff, circling attitude, and glide at high speed in any desired direction, with wings flexed and tail folded, gaining or losing altitude as desired. Such “flex-gliding” is possible only during the heat of the day. As evening approaches, conditions deteriorate, and birds descend to their roosts, and are again reduced to flapping. On cold, cloudy days, soaring may never be possible at all, except where hill-sides provide upward currents.*

When sailing high in the air, the movements of these carrion birds are so graceful, and their silhouettes so striking, that surely it would be wrong to let the thought of their feeding habits spoil one’s appreciation of their beauty.

III. SIGHT IDENTIFICATION.

The object of this paper is to assist people to identify the birds *by sight only*. The following points may be found useful:

- (1) Where possible, try to make sure of the family to which a bird belongs before looking for the features of the individual species.

*For this short description I am indebted to Hankin (“Animal Flight,” 1910). His observations on bird-flight in India are highly applicable to East African species.

- (2) Each species has its own special marks. If one knows these beforehand, they can be looked for; if not, one may note all sorts of features but still miss the essential ones.
- (3) Where a species possesses several identificatory features, do not be satisfied with observing one only; look for all of them. This reduces the chances of error.
- (4) One should gradually master the features of all the members of a related group, since otherwise one can never be really certain of identifying any one of them.
- (5) Once the members of a group are all known, negative observations—such as that the bird shows no white wing-streak—may be of value.
- (6) Keep on the look-out for features that do *not* agree with those of the species provisionally identified. This is a check on “wishful thinking”—a fault to which everybody is prone.
- (7) When trying to identify a bird, consider which members of its family are likely or unlikely to be encountered in the place concerned (thus reducing the number of “probabilities”).
- (8) Use field-glasses and carry a pencil and paper. Features should be noted down, or sketched, *on the spot*.

IV. OBJECT AND FORM OF PAPER.

This paper is intended for the “layman,” and I have tried to make it as practical as possible. English names are normally used, rather than Latin. The list of contents is for quick reference. Descriptions are given under standard headings; in writing these, I have attempted to follow the principle that, so long as distinctive features are emphasised, the simpler the description, the clearer the mental picture formed in the reader’s mind. Field-keys are provided for the vulture and crow families, as well as notes on the individual species.

The detailed descriptions are arranged under the following headings:

- (1) **SIZE.** The approximate wing-span is given, as being a better guide to size than the exclusive use of vague terms such as “large” and “small.” Size is of the greatest value for identification when individuals of more than one species are seen together, as comparisons can then be made.
- (2) **ASPECT AT REST.** Here it is assumed that the bird is moderately close, so that features such as the colour of the head or the shape of the bill can be seen.

- (3) **UPPER-SIDE IN FLIGHT.** This aspect shows (a) with a bird *below* eye-level, or (b) with a bird *above* eye-level, when diving, or circling with the body canted. Such views are often no more than brief glimpses, but usually give one time to see the features required for recognition.
- (4) **UNDER-SIDE IN FLIGHT.** Unquestionably the most important aspect to recognise, since scavenging birds spend so much of their time circling high in the air. Both shape and colour should be noted. *Shape* will nearly always be sufficient to identify the family to which a bird belongs (e.g., vulture or crow) and in some instances it will even give the species (e.g., Brown Kite). *Shape*, however, varies considerably according to the way in which the bird is flying at the moment of observation—with wings stiff, as when soaring, or flexed, as when gliding; with neck stretched, as when taking off, or withdrawn between the shoulders, as when soaring; with tail closed (appearing long and square) or open (appearing short and rounded). The shape of the bill is a feature of importance in all scavenging species. *Colour*—both of the wings and body—should always be noted. A bird seen flying high may often be a mere silhouette, impossible to recognise, with the under-side in shadow. Sooner or later, however, the canting of the body may allow the sun to strike it and reveal the true colour-scheme, hence such glimpses should be watched for.
- (5) **CALL.** Important for Kite, Tawny Eagle, Crows and Gull only; omitted for the other species, except for brief mention in the “General” paragraph.
- (6) **COMPARISONS.** The paragraph gives a brief reference to those species with which confusion is most likely, distinctive features being noted and compared. This involves constant repetition, but will, I think, be found useful.
- (7) **GENERAL.** Brief observations on distribution, habits, or other features directly or indirectly useful for indentifying the birds. A few examples will show how valuable such notes can be. The Hooded Vulture often frequents populated areas to which the other vultures do not penetrate; the Ruppell’s Griffon nests in crags and the White-backed Griffon in trees; the Fan-tailed Raven is not found south of the equator, and the Pied Crow is the only crow of the coastal regions.

- (8) ILLUSTRATIONS. These are from photographs taken by me, with a Leica camera, in 1938-41. Most of them were made at Wajir in the Northern Frontier. The paragraph gives the place and date of each photograph, an account of the circumstances under which it was taken, how the bird behaved, what features are brought out, and so forth. Most pictures show the "under-side in flight," because this aspect is so frequently seen in the field, so infrequently illustrated in books, so beautiful, and (in many species), so distinctive. Care was taken to photograph the birds at a moment when the colour-pattern showed naturally, without distorting shadows, and the results should give a fair idea of the essential features.

V. SOURCES OF INFORMATION.

I have accumulated the material for this paper in the course of seven years' residence in East Africa: from 1934-39, in the Kenya Administration; in 1940, in the King's African Rifles; in 1941, in the Military Administration of Italian Somaliland. The information given is based on:

- (1) My own unpublished notes.
- (2) An article of mine in the "Ibis" for July, 1939, giving certain field-characters which the present article amplifies and supersedes.
- (3) Much valuable information communicated to me verbally by Dr. V. G. L. van Someren.
- (4) Books mentioned in Section VI, below, particularly "Jackson" (for classification and distribution) and "Bannerman" and "Gill" (for field-characters).

VI. BOOKS RECOMMENDED.

The following books are recommended for use in Kenya. The prices given are those at which the books were sold in England. Numbers 1, 2, 3 and 9 can usually be purchased in Nairobi. Most, if not all, can be seen at the MacMillan Memorial Library or the Coryndon Museum.

- (1) "The Birds of Kenya Colony and the Uganda Protectorate" by Sir Frederick Jackson and W. L. Sclater (1938). Three volumes. £4-10-0. This is the only complete book on the birds of Kenya. It classifies and describes all the species, and possesses useful keys for identification. The field notes are of great value. There are not enough coloured illustrations, but this defect can be remedied by the use of:
- (2) "The Birds of South Africa" by Austin Roberts (1940). £1-10-0. This contains over a thousand coloured figures, drawn with a really remarkable accuracy of detail.

Many tropical species are included, so if a bird is described but not illustrated in Jackson, there is a good chance of finding either the actual bird, or a near relation, illustrated in Roberts. The latter also possesses much data on South African birds which is useful for comparative purposes. For somebody who wishes to become acquainted with Kenya species, it is enough, at first, to use Roberts exclusively, but sooner or later the problem will arise: "Have I really identified the actual Kenya bird, or am I mistaking it for a South African relation?"—and this can only be solved by reference to Jackson. Before these two books were published, the study of Kenya birds was possible only for an ornithologist with access to a museum; now, the amateur bird-watcher is in a position to contribute.

- (3) "A First Guide to South African Birds" by Leonard Gill (1936). Shs. 12/-. This is a smaller book than Roberts, and does not possess so many coloured illustrations. Nevertheless, these are numerous and good, and the letterpress is extremely helpful regarding field-characters and habits. For anybody wanting a "first guide" for the birds of Kenya, this book is strongly recommended.
- (4) "The Birds of Kenya and Uganda" by Dr. V. G. L. van Someren. Published serially in this Journal, beginning in 1925; deals with game-birds, sandgrouse, pigeons, ducks, bustards and waders. Separate copies of most of these papers can be obtained from the Coryndon Museum and might cost about Shs. 60/-. This possesses a great deal of information that is not found in Jackson, so it will be required by anybody who is interested in the families mentioned. It is fully illustrated.
- (5) "The Birds of British Somaliland and the Gulf of Aden" by Sir Geoffrey Archer and E. M. Godman (1937). Two volumes; in continuation. Deals only with the larger, or non-passerine, birds. £3-3-0.
- (6) "The Birds of Tropical West Africa" by D. A. Bannerman (1930 onwards). Five volumes; in continuation. Shs. 21/- per volume.
- (7) "The Handbook of British Birds" by H. F. Witherby and others (finished in 1941). Five volumes. Shs. 21/- per volume.

These three books—Archer, Bannerman and Witherby—are outstanding authorities in ornithological literature: for use in Kenya, they are recommended for comparative purposes. Both Archer and Bannerman go into greater detail than Jackson, and the illustrations, field-characters and general notes will all be found of con-

siderable value. Witherby summarises the large amount of ornithological research undertaken in Britain during the last twenty years. This includes work on migration (in which ringing has played an essential part); population censuses; the determining of incubation and fledging periods; the study of field-characters, and enquiries concerning status, habitat, courtship, and song. The book thus contains much information unobtainable elsewhere. The species are fully described and admirably illustrated.

- (8) "Birds of the Ocean" by W. B. Alexander (1928). About Shs. 20/-. This describes and illustrates the sea-birds of the world. It is a small book, pocket size, useful on the coast of Kenya, and essential for any sea-voyage.
- (9) "Watching Birds" by James Fisher (1940). Pelican Books, 6d. The best short general introduction that I know. It deals first with the structure and biology of birds themselves, then with the equipment of bird-watching; after this, it gives a most interesting description of the subjects which have received special attention recently, and shows how important the amateur bird-watcher has become in furthering ornithological investigations.

So much for ornithological literature. If one can handle a specimen of the bird that is being studied, the book-descriptions will often be very much easier to understand. For this purpose, the large collection of mounted specimens and skins available for inspection at the Coryndon Museum will be found extremely useful.

MARABOU STORK (*LEPTOPTILOS CRUMENIFERUS*).

PLATE 17.

SIZE: Enormous; stands about four feet high; wing-span $6\frac{1}{2}$ to $8\frac{1}{2}$ feet.

AT REST: Slaty-grey above, white below; head bald and pinkish; bill huge, tapering and pickaxe-like; legs long and white. Many birds have a long, sausage-like pouch hanging from the throat.

UPPER-SIDE IN FLIGHT: Appears slaty. Once a bird is well under way, the head is drawn in, and the bill and feet both point slightly downwards.

UNDER-SIDE IN FLIGHT: Body and part of wings white, the effect being that of a *broad white T* (see middle figure). Wings and tail dark. The flashing white body shows up against the dark wings at great distances, and is an excellent guide to identification. Juveniles have the whole under wing-coverts white (not dark as in the adult).

COMPARISONS.

At rest: This is the only stork that habitually goes scavenging, so there is no likelihood of confusing it.

Under-side in flight: The bird may often be seen soaring with vultures; here the long bill and legs, as well as the colour-pattern, are distinctive.

GENERAL: The Marabou is the acknowledged monarch of the scavenging birds; when at a kill, it towers over the vultures, and pecks, prods or pulls them out of the way if they are consuming something that the Marabou fancies. It has been suggested that the bill of this bird, though excellent as a weapon of attack, is not well adapted for tearing at a carcase; hence the Marabou allows the vultures to perform this function, then relieves them of their spoil. It is an inveterate garbage-hunter, and can be seen in numbers at slaughter-houses, rubbish pits, stock enclosures or other places where pickings can be had. If man appears, it often refuses to take to flight, but walks off in a slinking manner, with its head sunk between its shoulders, just like a stage villain detected in the perpetration of a dastardly act.

The bird ranges from the Rift Valley eastwards to the Northern Frontier and Jubaland. For so common a species, there is surprisingly little on record concerning its breeding haunts. It nests colonially in trees, often in the tall forest-types bordering rivers (as on the Tana near Garissa), but also in small acacias in bare, open plains (as at Habbas Wein). Though normally a silent bird, it makes the weirdest variety of squeals and groans when breeding.

ILLUSTRATIONS. PLATE 17.

Upper figure: Arusha Chini near Moshi, September, 1940. The bird is sailing past in horizontal flight, near a nesting tree.

Middle figure: Same place and date. The bird is just about to alight at a nest; the feet are lowered ready.

Lower figure: Wajir, October, 1939. A bird walking off in the typical "detected villain" manner.

VULTURES (GENERAL).

I. HOW DISTINGUISHED FROM OTHER BIRDS OF PREY.

At rest. Look at the heads. Those of vultures are bare or covered with down; those of other birds of prey are feathered.

In flight. When the type of head cannot be seen, the distinction is not so simple; it is wiser to depend upon the colour-pattern and shape of each species. One can, however, safely say that raptorial birds with wide wings and short tails seen *in numbers* are pretty certain to be vultures.

II. HOW DISTINGUISHED FROM EACH OTHER.

There are six species—Ruppell's, White-backed, Nubian, White-headed, Egyptian and Hooded. For details, the illustrated descriptions should be consulted, but a few of the most useful distinctions are tabulated below.

1. SIZE.

Large (span seven feet or more): Ruppell's, White-backed, Nubian, White-headed.

Small (span five feet): Egyptian, Hooded.

2. SHAPE OF BILL.

Thick and heavy: Ruppell's, White-backed, Nubian, White-headed.

Slender: Egyptian, Hooded.

3. COLOUR OF BILL.

Pale horn: Ruppell's adult.

Dark: Ruppell's immature, White-backed.

Red: White-headed.

Yellow: Egyptian.

Brownish: Nubian, Hooded.

4. GENERAL ASPECT IN FLIGHT.

Wings wide, tail short, rounded when open: Ruppell's, White-backed, Nubian, White-headed, Hooded.

Wings narrow, tail long and pointed when closed, diamond-shaped when open: Egyptian.

5. COLOUR OF UNDER-WINGS IN FLIGHT.

A. FLIGHT FEATHERS.

Dark: Ruppell's, White-backed, Nubian, White-headed immature, Egyptian.

Dark with white secondaries: White-headed adult.

Sheeny grey with brown tips: Hooded.

B. WING-COVERTS.

Brown, with a white streak (or streaks) near fore-edge of wing: Ruppell's, White-backed immature, Nubian.

Dark, with a white line bordering coverts: White-headed.

Dark brown: Hooded.

Light brown or "pepper and salt": Egyptian immature.

White: White-backed adult, Egyptian adult.

RUPPELL'S GRIFFON VULTURE (*GYPS RUPPELLII*).

PLATE 18.

SIZE: Span eight feet, i.e., larger than White-backed or White-headed, but smaller than Nubian.

A. ADULT.

AT REST: Two features suffice for identification: *spotted brown-and-white plumage* (both above and below), and *pale bill*.

UPPER-SIDE IN FLIGHT: Spotted; looks very pale; flight-feathers and tail black.

UNDER-SIDE IN FLIGHT: Spotted; wings and tail black; wing coverts show *several narrow white streaks*, the most conspicuous being near the fore-edge of the wing. (See plate.)

COMPARISONS: When a bird is flying high, the under-side might be mistaken for that of an immature White-backed, but the latter has a streaky body, while that of the Ruppell's is spotty.

B. IMMATURE.

AT REST: Plumage variable, usually *streaky-brown with a rufous tinge*. No spots. The bill is *dark* (not pale as in the adult).

UPPER-SIDE IN FLIGHT: Streaky-brown; flight-feathers and tail black.

UNDER-SIDE IN FLIGHT: As upper-side; streaks on body more pronounced; conspicuous narrow white streak near fore-edge of wing.

COMPARISONS.

1. *With the immature White-backed.*

This, in certain plumages, appears almost identical with the immature Ruppell's, both birds being streaky-brown, with dark bills, brown backs and white streaks on the under wing-coverts. The only field distinction seems to be in size, Ruppell's being noticeably the larger. But this is of value only when the two species are seen side by side. (The systematic distinction is that Ruppell's has fourteen tail feathers and White-backed twelve, but even this test is not always infallible, and in any case is no use unless one can shoot or capture the bird). In fact, I have failed to discover a reliable field distinction between the two species at this stage of plumage, though if one shot a number of specimens and made comparisons, it is probable that some feature might be found.

As soon as the birds begin to adopt adult plumages, however, distinctions become available, and should always be looked for. These are as follows:

The back. If white, or predominantly white with a few brown patches, bird is White-backed. If brown, may be either species. (N.B.—When a bird is at rest, the back is often covered by the wings, but it becomes visible as soon as the bird takes to flight.)

The under wing-coverts (seen in flight only). If white, or predominantly white with a brown streak or so (as in Plate 19, middle figure) bird is White-backed. If brown, with narrow white streaks, may be either species.

The upper wing-coverts. If with white spots (even a few) bird is Ruppell's. If brown, may be either species.

The bill. If pale (even partly) bird is Ruppell's. If dark, may be either species.

In conclusion, I might add that this is the only distinction of difficulty among all the scavenging birds, which is why I have dealt with it in detail.

2. Comparisons with other brown vultures.

These should not cause any difficulty. The Nubian has a bare red head and a distinctive breast. The immature White-headed has a red bill and long pink legs, and distinctive underwings. The Hooded has a slender bill and greyish underwings. The immature Egyptian has a slender bill and a distinctive shape.

GENERAL: This species utters a loud, harsh call at its breeding places or when scuffling at a kill. It breeds in colonies in large precipices at medium or low altitudes in the wilder parts of the country. Birds can be seen on the cliffs of the Njorowa Gorge, Naivasha, at any time of year, breeding, roosting or merely resting. The Ruppell's Griffon is widely distributed over "game" or "stock-rearing" country when not breeding.

ILLUSTRATIONS. PLATE 18.

Upper figure: Naivasha, April, 1940. Picture taken from the top of a big cliff at the Njorowa Gorge, where these vultures nest. The bird (a typical adult) has just swerved after seeing me.

Middle figure: Wajir, February, 1940. A magnificent adult bird standing with raised wings, preparatory to bouncing with ferocious mien and hoarse cries towards a feeding neighbour, hoping to scare it off its meal (a dead sheep).

Lower figure: Same place and date. This shows the meal, with two adult Ruppell's on the right. The bird on the left is (judging by the smaller size) an immature White-backed, but an immature Ruppell's is very similar.

WHITE-BACKED GRIFFON VULTURE (*PSEUDOGYPS AFRICANUS*).

PLATE 19.

SIZE: Span seven feet; i.e., smaller than Nubian or Ruppell's, but much larger than Hooded or Egyptian.

A. ADULT.

AT REST: Uniform light buff, with *dark bill and face*, and *white back* (the latter present in old birds only, and often concealed by the wings).

UPPER-SIDE IN FLIGHT: Buff, with darker wings and tail. If present, the *white back* is distinctive.

UNDER-SIDE IN FLIGHT: Body buff with a dark crop; tail dark; flight-feathers dark but *coverts conspicuously white*. When the bird approaches, the dark bill and face show as a black spot against the lighter body (see upper figure).

COMPARISONS: A White-headed (old adult) has a white back but differs in all other respects. An adult Egyptian has white under wing-coverts, but the body is also white, and the tail long, white and pointed.

B. IMMATURE.

AT REST: Variable, brown or streaky-brown, *bill and face dark*.

UPPER-SIDE IN FLIGHT: As at rest; back brown in immature birds, but *white with brown patches* in semi-adults.

UNDER-SIDE IN FLIGHT: Body streaky-brown, tail dark; flight-feathers dark; coverts brown with narrow white streaks in immatures, but *white with a few brown streaks* in semi-adults (see middle figure).

COMPARISONS: The difficulty of distinguishing this bird from the immature Ruppell's has already been dealt with. Comparisons with other brown vultures, given for Ruppell's, apply equally to this species.

GENERAL: A common vulture, found in most places where game or stock are encountered, but not usually in forested or highly cultivated areas. Nests are in trees. It arrives in numbers at a kill, descending steeply and lowering the legs while still some distance from the ground. When feeding, it appears (to my mind) quite the most ruffianly of the vultures.

ILLUSTRATIONS. PLATE 19.

Upper figure: Buna, Wajir District, November, 1939. An old adult gliding over my camp, showing the characteristic features—white wing-coverts and dark head.

Middle figure: Wajir, February, 1940. An immature, believed to be White-backed and not Ruppell's because of the large amount of white on the coverts. The bill was black. The bird is flapping hard, just before taking off.

Lower figure: Near Wajir, February, 1940. An adult White-headed (right) with an immature White-backed (left), photographed near the road-side from my car. The White-headed is stretching its neck to capacity, wondering why the car has stopped, and what the suspicious-looking person is doing inside; the bird flew off an instant later. The picture shows what a strikingly beautiful species this is; the White-backed looks a mere cut-throat beside it.

NUBIAN VULTURE (*TORGOS TRACHELIOTUS*).

PLATE 20.

SIZE: Span nine feet; easily the largest and most powerful of the vultures.

AT REST: Back and wings dark brown; head and neck *bare and fleshy red*, often with folds and whitish streaks; bill brownish, exceptionally heavy and powerful.

UPPER-SIDE IN FLIGHT: Dark brown.

UNDER-SIDE IN FLIGHT: The breast shows as a *dark brown spear-head* against the white, downy flanks. Wings are dark, with a *short but pronounced white streak* near the fore-edge. These two features distinguish an adult at almost any distance, though the long red head and heavy bill should also be looked for. Immature birds may have brown (not white) flanks, and thus do not show the "spear-head" so distinctly.

COMPARISONS: The Hooded Vulture is a small bird and its bill is *slender*; nevertheless the brown plumage is very similar to that of the Nubian, particularly when the bill cannot be seen and there is no scale to show its size. In flight, too, the Hooded shows white marks on the underparts that often look like a Nubian's "spear-head." The under-wings of the Hooded are, however, different; the coverts are dark and the flight-feathers sheeny-grey with brown tips.

The under-sides in flight of the immature Ruppell's and White-backed are uniformly streaky-brown (no spear-head); the White-headed, in a semi-mature plumage, may show a very misleading spear-head, (see Plate 21, upper figure), but the wings have a long white streak bordering the coverts.

GENERAL: Distributed sparingly over most areas where vultures are numerous; equally partial to the open plains of the highlands or the low-lying scrub-bush of the Northern Frontier; breeds in trees (usually thorn acacias, I think). Normally seen singly or in small parties; is apt to be shy of man. Has unquestioned precedence over all other vultures at a kill; even the Marabou Stork, which makes short work of the lesser vultures, treats this bird with respect.

ILLUSTRATIONS. PLATE 20.

Upper figure: Wajir, August, 1939. Bird flying over at some height. The white wing-streak, brown "spear-head" on breast, and white flanks all show.

Middle figure: Wajir, October, 1939. The bird has just taken off; the attitude gives some impression of the size and power of this species.

Lower figure: Wajir, August, 1939. Two Nubians are prominent, with their immensely heavy bills; on the left is a White-headed, while a Hooded or two are just visible behind. I found the Nubians by far the shyest of all the vultures at Wajir; it was difficult to get near enough for photography.

WHITE-HEADED VULTURE (*TRIGONOCEPS OCCIPITALIS*).

PLATE 21 (ALSO PLATE 19, LOWER FIGURE).

SIZE: Span seven feet, i.e., medium size, about the same as the White-backed.

• A. ADULT.

AT REST: A striking bird; head white, with an angular downy tuft on the crown; wings dark with white secondaries; breast dark, thighs and stomach white; bill red, legs pink. (See Plate 19, lower figure.)

UPPER-SIDE IN FLIGHT: Dark, with *white secondaries*. Old birds sometimes show a white rump.

UNDER-SIDE IN FLIGHT: *Breast dark, thighs and stomach white; wings dark with white secondaries* through which the sun can shine, giving an effect of translucency.

B. IMMATURE.

AT REST: A young bird is brown almost all over, then various intermediate plumages are adopted until the full black-and-white dress is attained. Semi-adult birds often have yellow (not white) heads, dark (not white) secondaries, and varying amounts of white on the thighs and stomach. In any plumage, however, the bird may be recognised when at rest by the *angular head, red bill and pink legs* (none of these features being possessed by other vultures).

UPPER-SIDE IN FLIGHT: Sombre coloured, brown or blackish.

UNDER-SIDE IN FLIGHT: Wings dark, with a *conspicuous white line bordering the dark coverts* (a distinctive mark, present also in the adult; see upper and middle figures). Breast dark; thighs and stomach with varying amounts of white.

COMPARISONS.

Under-side in flight. The Hooded sometimes shows a lightish line bordering its brown coverts, but this line is not usually pronounced, and the flight-feathers are silvery-grey (not dark), and the bill slender (not heavy). A Nubian's "spear-head" breast marking may be well simulated in an immature White-headed (see upper figure) but note the difference in wing streaks (short and well forward in the Nubian; long and more central in the White-headed). Ruppell's and immature White-backed have white wing streaks *on* the coverts, i.e., it is the coverts themselves that are streaky (not dark with a light margin as in the White-headed).

GENERAL: This bird, like the Nubian, is widely but sparingly distributed over the vulture-suiting portions of the country; is rarely seen in numbers; is shy of man, and is a tree-nester. An adult, at rest or in flight, is strikingly beautiful; undoubtedly this is the aristocrat of the vulture family. It is the only member of this family that is believed to make a practice of capturing and killing live creatures (e.g., dik-dik, guinea-fowl and kids) as well as eating carrion.

ILLUSTRATIONS. PLATE 21.

Upper figure: Wajir, August, 1939. A semi-adult flying overhead. The white line bordering the coverts shows clearly. The secondaries are greyish, and will soon be white; the thighs are white, but there is still a good deal of dark on the stomach. (It is this combination that causes a "false spear-head" like a Nubian's.)

Middle figure: Same place and date. A young immature in brown plumage; white line along coverts prominent.

Lower figure: Same place and date. An adult in all its glory, rising swiftly from one of the wells. These were much frequented by White-headed Vultures during the heat of the day; I have seen a congregation of twenty or more here, in all stages of plumage. And for birds that are usually so shy, they were confiding in the extreme—if approached by car, and with discretion. I have sat within ten yards of a party which were splashing and drinking at a puddle near the wells, and they did not pay the slightest attention to myself, my car or my camera.

EGYPTIAN VULTURE (*NEOPHRON PERCNOPTERUS*).

PLATE 22.

SIZE: Span five feet; one of the two small vultures, the other being the Hooded.

A. ADULT.

AT REST: Small, slim, *pure white* except for some black on the wings; bill, face and feet yellow. Bill slender.

UPPER-SIDE IN FLIGHT: White, with dark flight-feathers.

UNDER-SIDE IN FLIGHT: White, with dark flight-feathers; wings narrow; tail long, tapering to a blunt point if closed, *diamond-shaped* if open.

COMPARISONS: Colour and shape are so distinctive that one should not confuse this species with any other.

B. IMMATURE.

AT REST: Young birds begin dark brown, and pass through stages of being dirty grey, then speckled-white, until they finally attain the white adult plumage. Bill, face and feet *yellowish*; back of neck covered with *long feathers* which show as a crest if the head is bent forwards. The *slender bill* should always be looked for.

UPPER-SIDE IN FLIGHT: Brown, grey or speckled.

UNDER-SIDE IN FLIGHT: Body as upper-side; wing pattern varies, but coverts usually are light-coloured, contrasting with the dark flight-feathers. The *silhouette* is, however, the best guide: wings narrow, tail diamond-shaped (as in adult).

COMPARISONS: All the large brown vultures have heavy (not slender) bills. The Hooded (which possesses a slender bill) has the back of the neck covered with down (not feathers), and the feet are grey (not yellow).

Under-side in flight. All other vultures, including the Hooded, have wide wings and short tails. The only bird that has long wings and a diamond-shaped tail like the Egyptian is the Lammergeyer, but this, besides being much larger, has light rufous underparts and dark wings and tail.

GENERAL: The distribution of this species does not yet seem to have been worked out satisfactorily, but it is a resident in parts of the Rift Valley, where it is believed (though not yet conclusively proved) to breed in certain crags. As regards the rest of Kenya, all I know is that in the Northern Frontier (Wajir and Garissa) it is a migrant, arriving in October and leaving before the long rains. Parties of a hundred or more were to be seen in October at Habbas Wein; subsequently the birds scattered round the Somali encampments, at which one or two individuals could usually be found. Here I was told they ate excreta, preferably human.

ILLUSTRATIONS. PLATE 22.

Upper figure: Habbas Wein (Wajir District), October, 1939. An adult, in superb black-and-white livery, flying low over my head after being disturbed at its afternoon nap beside the river Waso. On seeing me, it braked hard, hence the tail is usually extended.

Middle figure: Same place and date. A bird flies past, with tail closed.

Lower figure: Wajir, October, 1939. A typical young bird taking off. Note its yellow face and feet, and the light streak on the under wing-coverts; also the diamond-shaped tail, which here shows plainly.

HOODED VULTURE (*NECROSYRTE MONACHUS*).

PLATE 23.

SIZE: Span five feet; one of the two small vultures, the other being the Egyptian.

AT REST: Dark brown; bill long and slender. Face and throat bare, pink or white in colour. Back of neck down covered up to the crown (which gives the "hooded" effect from which the bird derives its name). This down is lightish in the adult, dark-brown in the immature.

UPPER-SIDE IN FLIGHT: Brown, with dark wings and tail.

UNDER-SIDE IN FLIGHT: Wings very wide and "square"; tail short. Slender bill. *Wing coverts dark-brown; flight-feathers sheeny-grey with brown tips.* Underparts usually brown, but may have some white, particularly on the thighs and crop-patch.

COMPARISONS.

At rest: Small size and slender bill distinguish this bird from the large vultures. The immature Egyptian has the back of the neck covered with feathers (not down).

Under-side in flight: Here the wide wings and short tail contrive to make the bird look very much bigger than it is, and if a scale is lacking, it can be mistaken for one of the large vultures. The latter, however, have heavy (not slender) bills, and none possess the wing-pattern of the Hooded (coverts dark, quills with grey sheen). The immature Egyptian usually has light coverts and dark quills, and its shape is different (narrow wings and pointed tail).

GENERAL: This is the common vulture of East Africa. Not only is it numerous in places like the Northern Frontier where all the species are to be found, but it can be encountered in localities which one would say were not "likely vulture country" at all. For example, quite a number could be seen at Kakamega in a part-cultivated, part-forested area; here, the birds were garbage-eaters, relying upon the local slaughter-house and butcher's shop for their feeding. This species is small and weak compared with most vultures, but it is particularly bold and adaptable, and these qualities enable it to utilize places to which the other vultures are too shy to penetrate. At a kill, it is usually the first to begin feeding (perhaps realizing that as soon as the larger birds appear, it will be ejected). Even in breeding, it shows unusual adaptability, being the only vulture that is prepared to nest in either trees or crags. Trees, however, are usually chosen.

ILLUSTRATIONS. PLATE 23.

Upper figure: Habbas Wein, October, 1939. A bird soaring overhead. This is an adult, judging by the whiteness of the head and neck.

Middle figure: Wajir, October, 1939. An immature (note brown hind-neck). The bird has just taken to flight, but without hurry or alarm; the attitude is, therefore, particularly graceful. The sheeny-grey under-wings show plainly.

Lower figure: Same place and date. Another immature. I was only five yards away from this bird, but it is interested, not frightened. Young Hooded Vultures often have this highly ingenuous aspect; their boldness is remarkable, and their curiosity unbounded.

BROWN KITE (*MILVUS MIGRANS*).

PLATE 24.

SIZE: Span four and a half feet.

AT REST: A slender, brown bird with long wings and a *long, forked tail*. The tarsus is unfeathered.

UPPER-SIDE IN FLIGHT: Brown, with light shoulder-patches and dark flight-feathers. The forked tail is again the best guide; it is often rotated obliquely to the plane of the body and wings.

UNDER-SIDE IN FLIGHT: *Long, forked tail* distinctive. If the tail is open, it appears triangular, the fork being almost or quite lost. (See lower figure.) Body slender and brown; *wings long, narrow and usually sharply bent at the carpal joint.*

CALL: *A shrill, vibrating whistle, constantly uttered.*

COMPARISONS: The Kite is not easy to confuse with other species, on account of its forked tail. Even when this is wide open, and, therefore, triangular, it is still distinctive, because the tails of the other birds, when similarly open, are *rounded.*

GENERAL: No description of the immature bird has been given, because this is, in essentials, (forked tail and whistling call), similar to the adult, but the plumage is streaky-brown, giving the bird a mottled appearance (not plain brown as in the adult).

The bill in the adult may be yellow or dark, depending upon the geographical race to which the bird belongs. Bills of young birds of all races are dark. There are several yellow-billed and black-billed races, which cannot, however, be distinguished in the field, so I compromise by giving the representative of each of the two types that is most likely to be encountered.

Yellow bill, plain brown plumage. Adult *Milvus m. parasitus*, the common African Kite, resident and breeding.

Dark bill, plain brown plumage. Adult *Milvus m. migrans*, the so-called Black Kite, a migrant coming to Kenya during the European winter. The head is often almost white, much paler than that of *parasitus*.

In addition to these, there are the immatures, with *dark bill and mottled or streaky-brown plumage*, which may belong to either race. (Bills of *parasitus* begin dark and then become yellow; bills of *migrans* begin dark and stay dark.)

The Brown Kite is found all over Kenya; it is most numerous during the European winter months, when both *migrans* and *parasitus* are present. In certain localities, even the resident *parasitus* departs for a few months (usually April to September), but in other areas this race is present all the year round. The bird is one of the most graceful and athletic fliers of all African raptorial: it is exceedingly bold, swooping down for food and bearing it triumphantly away often from under the very nose of mankind. No vulture or crow would dare to attempt such tactics; hence the kite possesses a source of food-supply denied to the other scavengers. It has a peculiar habit of feeding on the wing, passing a morsel from claws to bill. It frequents villages, townships, camps and harbours, and is prepared to take live prey (e.g., locusts, termites and domestic chickens) as well as garbage. Nests are in trees, frequently high up; the

introduced eucalyptus plantations so frequently found near townships are a favourite breeding site.

ILLUSTRATIONS. PLATE 24.

Upper figure: Moshi, September, 1940. A pure silhouette, but quite typical of the bird—long, narrow wings, bent slightly forward, and unmistakable forked tail.

Middle figure: Same place and date. A closer view, semi-silhouetted.

Lower figure: Same place and date. Still closer, showing the light patches under the wings, and the tail partly extended, so that the fork is lost. The birds were circling over Moshi slaughter-house, pouncing down at intervals for scraps of meat.

TAWNY EAGLE (*AQUILA RAPAX*).

PLATE 25.

SIZE: Span six feet.

AT REST: A typical eagle, uniform-coloured, varying from *dark brown to pale putty-brown* according to age; legs feathered down to the toes.

UPPER-SIDE IN FLIGHT: Brown, with darker wing and tail feathers.

UNDER-SIDE IN FLIGHT: Brown, with conspicuous light patches near the wing tips (the actual tips being dark). Tail longish when closed, rounded when open.

CALL: A distinctive *harsh, barking* "Kah."

COMPARISONS.

At rest. The Kite has a forked tail (not rounded), a bare tarsus (not feathered), and a whistling call (not a bark). Vultures all have heads bare or downy (not feathered).

Under-side in flight. For the Kite, the forked tail and whistling call are again good distinctions. The Tawny Eagle can be distinguished from vultures in the following ways:

- (1) When soaring, the silhouetted head looks rounded, with the bill protruding. (The head and bill of a soaring vulture taper regularly to a point.)
- (2) Neck and throat are feathered (not bare and downy) and there is no crop patch.
- (3) The light patches near the ends of the wings are unlike the colour-pattern of any vulture.
- (4) Barking call is also distinctive.

GENERAL: This is the only eagle that regularly takes carrion, so it should not be hard to recognise. It is a bold, pugnacious bird, which enjoys bullying such of the lesser scavengers that cannot retaliate (kites, crows and small vultures). Live prey, as well as carrion, is often taken. The bird is usually to be

seen perched on the top of a thorn-acacia near a water-hole; it uses the same situation for nesting. It is distributed over the type of "game country" where one would expect to see vultures, and is a fairly common bird.

ILLUSTRATIONS. PLATE 25.

Upper figure: Wajir, November, 1939. The bird, seen from below, is banking. Note its feathered, rounded head, so different from a vulture's.

Middle figure: Wajir, October, 1939. This bird has just risen from a tree; it is not at all alarmed, and there is sufficient wind to allow it to take off with superb effortlessness. The light patches near the tips of the wings show up well.

Lower figure: Wajir, October, 1939. The picture is typical of this species in both stance and attitude. The two lower photographs were taken from my car at Wajir slaughter-house, where these birds were exceptionally confiding.

LAMMERGEYER (*GYPAETUS BARBATUS*).

ILLUSTRATED ON PAGE FACING INDEX.

SIZE: Huge; span nine feet.

A. ADULT.

AT REST: Head white and thickly-feathered; wide black line from eye to base of bill; black tufted "beard" hanging from chin; wings and tail long and dark; neck and underparts rufous-white.

UPPER-SIDE IN FLIGHT: *White head with dark eye-streak* conspicuous; body, wings and tail dark brown; wing-coverts and mantle very dark, forming a dark band across the fore-part of the flying bird, contrasting with the somewhat lighter flight-feathers and tail. (The distinctive shape is described in the next paragraph.)

UNDER-SIDE IN FLIGHT: *Head and body white with a red tinge; wings and tail dark.* Wings very long; tail, when closed, exceptionally long, narrow and bluntly rounded at tip; when open, elongate diamond-shaped. When the bird is gliding, the wings are narrow, curved and pointed, and the closed tail long and narrow—the general impression being that of a *huge falcon*. When soaring, the wings are held stiff, and appear narrow and square-ended, and the open tail takes its distinctive diamond-shaped form. (See illustration.) The wings sometimes show a greyish sheen.

COMPARISONS.

At rest. The white, feathered head, dark eye-streak and unique black beard have no counterpart.

In flight. The Brown Kite, when high in the air with tail closed, is not unlike the Lammergeyer (with tail similarly closed), but the Kite's tail is forked. The Egyptian Vulture

has a long tail, diamond-shaped when open, but the adult is pure white with dark flight-feathers, and the immature rather uniformly brown or speckled. Both Kite and Egyptian Vulture are, in addition, only half the size of the Lammergeyer.

B. IMMATURE.

AT REST: Head black, with beard as in adult; rest of upper-side dark brown, except for light spots on mantle and pale spotted bar along coverts; throat and underparts rufous-brown.

UPPER-SIDE IN FLIGHT: *Head black;* wing-coverts and mantle spotted and light-coloured, forming a conspicuous pale band across the fore-part of the flying bird, contrasting with the flight-feathers and tail, which are darker.

UNDER-SIDE IN FLIGHT: Head black; body rufous-brown; wings dark, with a pale line down the centre; tail dark. Shape (quite the best guide) is as adult.

COMPARISONS.

Upper-side in flight. Note how the plumage is, in certain features, just the opposite of the adult's: head black (not white); band across forepart of bird light (not dark). The immature Egyptian has no such band, and the head is never black (though it may be dark brown).

Under-side in flight. Here the immense length of tail, together with the very prominent head, distinguishes this bird from all the scavengers bar the Egyptian Vulture and Brown Kite (for which, see comparisons under adult). A young Egyptian can be very similar in colour to a young Lammergeyer, but the former, besides being much the smaller, has an inconspicuous head and a very slender bill.

GENERAL: This magnificent species is the rarest and finest of all the scavengers, and the most graceful in flight. A figure drawn by Mr. Hugh Copley after a sketch of Abel Chapman's is given on the page facing the first page of this article. It possesses characteristics of both eagle and vulture (with the emphasis on vulture) as well as other features entirely of its own. It inhabits certain localities in the highlands, and has been seen at great altitudes (17,000 feet or so). I have been lucky enough to obtain numerous views of both adult and immature, and to discover an eyrie (November, 1941). This was on a large crag at a height of about 7,000 feet; I was shown the crag by Mr. Raymond Hook. The nest was being used for roosting, and contained a varied assortment of bones, wool and dung. In other parts of the world the Lammergeyer's diet includes bones, which it has been observed to carry to a height, then drop, so that the bones are splintered into a convenient size for eating. Hitherto I have failed to obtain adequate photographs of this bird which is extremely shy and wary. For coloured pictures of the adult, see the plates in Gill's and Roberts' books, especially Gill's figure of a flying bird with tail extended.

CROWS (GENERAL).

I. HOW DISTINGUISHED FROM OTHER SPECIES.

Usually there is no difficulty about recognizing a crow as such; the black or black-and-white plumage, straight bill and cawing or croaking call are unmistakable. But when a crow is soaring high, and showing merely as a silhouette, it might be confused with a bird of prey, so the following features should be looked for:

- (a) Large, rounded head with straight bill (much more conspicuous than that of a raptorial).
- (b) Wings short and wide, often curving sharply backwards.
- (c) Wings very "centrally placed" along the body line, i.e., the head projects roughly the same distance in front of the wings as the tail projects behind them.
- (d) The call is often uttered on the wing, and carries a surprising distance.

II. HOW DISTINGUISHED FROM EACH OTHER.

There are five species—White-necked Raven, Fan-tailed Raven, Dwarf Raven, Pied Crow and Cape Rook.

I. COLOUR.

Black with white collar and white breast: Pied Crow.

Black with white collar only: White-necked Raven.

Black all over: Fan-tailed Raven, Cape Rook, Dwarf Raven (the latter showing a brownish gloss around the neck at close range).

2. SHAPE OF BILL.

Very heavy, upper mandible arched: White-necked Raven.

Stout: Fan-tailed Raven, Dwarf Raven, Pied Crow.

Slender: Cape Rook.

3. LENGTH OF TAIL.

(Remember that tails look short when expanded, long when folded.)

Noticeably short: Fan-tailed Raven.

Medium: White-necked Raven, Cape Rook.

Long: Dwarf Raven, Pied Crow.

4. CALL.

A falsetto croak: White-necked Raven, Fan-tailed Raven.

A "caw" (not falsetto). Dwarf Raven, Pied Crow, Cape Rook.

5. HABITAT.

Highlands (with crags) northern limit about 1° N.: White-necked Raven.

Less high country (with crags) southern limit about equator: Fan-tailed Raven.

Low-lying northern deserts, southern limit about 1° N.: Dwarf Raven.

Everywhere bar northern deserts (and the only crow on the coast): Pied Crow.

Highlands only: Cape Rook.

WHITE-NECKED RAVEN (*CORVULTUR ALBICOLLIS*).

PLATE 26.

SIZE: Span four feet; easily the largest crow.

AT REST: Black, with a *white half-collar round the back of the neck* and an extremely *heavy, white-tipped bill*, the upper mandible of which is arched.

UPPER-SIDE IN FLIGHT: Black, *white collar* conspicuous.

UNDER-SIDE IN FLIGHT: Black, the only special feature being the heavy, arched bill.

CALL: Usually a *false croak* (like that of the British Raven).

COMPARISONS.

At rest. The white collar is the best field character at all ranges. The Pied Crow possesses a similar collar, but the breast is white (not black); also the bill is slenderer and the tail longer (see Plate 27).

Under-side in flight. This, being black, is like that of the Fan-tailed and Dwarf Ravens, and Cape Rook. The Fan-tailed Raven has a similar call, but the tail is shorter and the bill less prominent. (Compare Plate 26, middle figure, with Plate 28, lower figure.) The Cape Rook has a cawing call and a very slender bill. The Dwarf and White-necked Ravens are unlikely to be encountered together.

GENERAL: This fine species is a bird of the highlands, usually to be seen at anywhere between "5,000 and 14,000 feet" (Jackson). At New Moshi, however, I found it common as low as 2,500 feet, but the birds came down from Kilimanjaro each morning and returned there each night. (Jackson mentions the same habit at even lower elevations in Teita.) It is a crag-breeding and crag-roosting bird, rarely to be seen far from its native rocks. Its range extends northwards to Mount Kenya and Elgon, but not further; beyond this, it is replaced by the Fan-tailed Raven. In certain places (roughly between the equator and 1° N.) the two species overlap. The White-necked Ravens were very much at home around the military cantonment at Moshi, and seemed to have plenty of time for diversions, such as hanging upside down from a branch (sometimes by one leg only) accompanying the feat with a series of stentorian croaks.

ILLUSTRATIONS. PLATE 26.

Upper figure: Moshi, July, 1940. A silhouette, seen from below. Note medium tail and heavy, arched bill. The bird is carrying a twig.

Middle figure: Moshi, July, 1940. A side view, the wings being raised in flapping flight. The bill is again prominent, and the white collar just shows.

Lower figure: Moshi, September, 1940. This bird was enticed near my window with scraps of bread. It has just seen the camera, which it is regarding with suspicion. The collar shows distinctly.

DWARF RAVEN (*CORVUS CORAX EDITHAE*).

PLATE 27 (UPPER FIGURE).

SIZE: Span three feet. A very small raven.

AT REST: Black, with medium bill; tail longish, extending beyond the folded wing-tips; at close range the *crown and neck have a brownish gloss*.

UPPER-SIDE IN FLIGHT: Black; body rather slender, tail long.

UNDER-SIDE IN FLIGHT: As upper-side (see Plate).

CALL: *A typical caw*, resembling that of the British Rook.

COMPARISONS: The Fan-tailed Raven is larger, has a short tail and a croaking call, and is confined to the vicinity of rocky mountains. (See this species for the systematic distinction between the two.) The Cape Rook has a slender bill and a shortish tail.

GENERAL: There is little on record about the Dwarf Raven; it seems to be a bird of the low-lying plains of the Northern Frontier and Turkana. At a rough guess, latitude 1° N. may be its southern limit. East of Lake Rudolf, I found it very plentiful in the arid region north-west of Marsabit, and it was common at Wajir, but no birds were seen south of Laisamis or Habbas Wein, or in Garissa district. West of Rudolf, Dr. van Someren records specimens of a larger sub-species of this bird as far south as Suk and Kavirondo. Though called a raven, the Dwarf appears to a field observer much more like a Rook; indeed, the resemblance between its call and that of the British Rook is most marked. Regarding breeding, I cannot find any published records, but in February, 1941, I saw the ravens paired in the low country round Marsabit, and in two instances I saw a bird standing on a crow-like nest in a small acacia. Unfortunately circumstances did not permit me to stop and investigate.

ILLUSTRATION. PLATE 27.

Upper figure: Wajir, February, 1940. A couple of birds flying over, the long tails showing clearly.

PIED CROW (*CORVUS ALBUS*).

PLATE 27 (MIDDLE AND LOWER FIGURES).

SIZE: Span three feet.

AT REST: Black, bill medium; *white breast and white collar*.

UPPER-SIDE IN FLIGHT: Black, with *white collar*.

UNDER-SIDE IN FLIGHT: Black, with *white breast*.

CALL: *A deep, sepulchral caw*, not like the croak of a raven.

COMPARISONS: No other crow has a white breast. The White-necked Raven has a white collar only.

GENERAL: This bird has the widest range of all the crows. It is common on the coast (where none of the other species appear to penetrate) and well-distributed over most of the highlands. I have not, however, seen it in the low-lying plains of the Northern Frontier; here its place is taken by the Dwarf Raven. In Nyanza, it is particularly common, associating with the Cape Rook, and breeding in the tall eucalyptus trees surrounding townships. In feeding habits, it is a typical garbage-eater of the dust-bin type.

ILLUSTRATIONS. PLATE 27.

Middle figure: Hwesero (Kakamega), November, 1938. A bird flying over, showing the white breast.

Lower figure: Moshi, September, 1940. Showing upper-side, with white collar, medium bill and long tail.

CAPE ROOK (*CORVUS CAPENSIS*).

PLATE 28 (UPPER AND MIDDLE FIGURES).

SIZE: Span three feet.

AT REST: A small, black crow, with a *rounded head, slender bill and thick, bulging neck.*

UPPER-SIDE IN FLIGHT: As at rest.

UNDER-SIDE IN FLIGHT: Rounded head and slender bill again distinctive; tail rather short.

CALL: A rook-like caw.

COMPARISONS: The only crows that I have seen associating with the Cape Rook is the Pied Crow, which has a white collar and breast, and the Fan-tailed Raven, with a heavy bill and a croaking call.

GENERAL: This species is found (according to Jackson) "chiefly in the highlands and Rift Valley . . . unequally and not widely distributed." I found it common around the townships of North Kavirondo; here it breeds in eucalyptus and other introduced trees, often in practically inaccessible situations. Its scavenging habits are normal for the family.

ILLUSTRATIONS. PLATE 28.

Upper figure: Hwesero (Kakamega), November, 1938. A bird flying over, showing slender bill, rounded head and shortish tail.

Middle figure: Same place and date. Flying past, cawing loudly, with the bulging throat particularly noticeable. This bird was highly indignant because I had just climbed to its nest. It dashed up and down within a few feet of my head, then sat on a tree, and literally danced with rage, accompanying the action with a stream of abusive language.

FAN-TAILED RAVEN (*RHINOCORAX RHIPIDURUS*).

PLATE 28 (LOWER FIGURE).

SIZE: Span three and a half feet.

AT REST: Black, bill normal, *tail very short* (the folded wing-tips reach well beyond it).

UPPER-SIDE IN FLIGHT: Black; short tail again distinctive.

UNDER-SIDE IN FLIGHT: As upper-side (see figure).

CALL: *A typical falsetto raven's croak.*

COMPARISONS: The Dwarf Raven (which I have seen associating with the Fan-tailed) has a cawing call (not a croak) and a long tail. Also it is smaller, and shows bronze about the neck at close range. (The systematic distinction is that the Fan-tailed has the nasal bristles sticking upwards, while those of the Dwarf lie flat, but such features are almost impossible to see in the field.) The White-necked Raven has a white collar, a heavy, arched bill and a medium tail. The Cape Rook has a slender bill and a cawing call.

GENERAL: This is a bird of the crags, like the White-necked. Roughly speaking, the Fan-tailed inhabits suitable localities from the Abyssinian border southwards to the equator, while the White-necked is distributed from the Tanganyika border northwards to latitude 1° N.—that is to say, the ranges of the two species are complementary, with about one degree of overlap. The White-necked is, however, usually a bird of greater elevations than the Fan-tailed; whether this applies in the area of overlap is not certain, but I think so, at any rate so far as Mount Elgon is concerned. At Buna, in Wajir District, the bird is common, though it keeps near the rocky hills in the vicinity. At my camp near the drift, it associated with the Dwarf Ravens of the plains. It is a cliff breeder.

ILLUSTRATION. PLATE 28.

Lower figure: Ajao, near Buna, November, 1939. I was on a foot safari with camels, and we were just leaving camp when a couple of ravens came down to forage among the debris. The bird photographed is in flapping flight; the very short tail shows clearly.

SOOTY GULL (*LARUS HEMPRICHII*).

PLATE 29.

SIZE: Span three and a half feet.

AT REST: A typical gull; above, *brown with a white half-collar*; below, throat brown, remainder white. Tail white. Immature birds lack the white collar and may have a bar on the tail.

UPPER-SIDE IN FLIGHT: Brown, with white collar; white tail.

UNDER-SIDE IN FLIGHT: Throat and wings brown; remainder white.

CALL: A mewing note.

GENERAL: The Sooty Gull is confined to the coast, and is the only gull to be found there, so it should be easy to recognize. (Terns are more slender, and have straight bills, not hooked like a gull's; moreover, they do not scavenge.) In harbours this gull circles round ships, and pounces on scraps that are thrown overboard. It breeds on the Kiunga Islands, east of Lamu. The place I know it best is at Brava, on the Italian Somali coast. Here the gull used not only to scavenge, but preyed on the Swift Tern (*Sterna b. velox*)—a bird almost as large as itself—which was pursued on the wing until it dropped the fish that it carried.

ILLUSTRATIONS. PLATE 29.

All of these were taken at Brava in August, 1941, on some rocks off the coast upon which the birds were breeding. They were extremely tame.

Upper figure: A bird flies over.

Middle figure: Lands on a rock near its nest.

Lower figure: And watches anxiously.

PLATE 17. MARABOU STORK.



Adult sailing past.



About to alight.



Walking away.

PLATE 18. RUPPELL'S GRIFFON VULTURE.



Adult gliding.



In menacing attitude.



Two adults on right; White-backed Griffon on left.



Adult approaching.



Immature in flapping flight.



Adult on left; White-headed Vulture on right.

PLATE 20. NUBIAN VULTURE.



Passing over.



Taking off.



Two birds (showing huge size). A White-headed Vulture on left.

PLATE 21. WHITE-HEADED VULTURE.



A semi-adult.



A young bird.



PLATE 22. EGYPTIAN VULTURE.



Adult braking.



Gliding past.



A brown immature.

PLATE 23. HOODED VULTURE.



Adult soaring.



Juvenile taking off.



A juvenile.



Silhouetted.



Overhead.



Showing the tail squared.

PLATE 25. TAWNY EAGLE.



Overhead.



Taking off.



At rest.



Silhouetted.



Passing.



Enticed by bread-crumbs.

PLATE 27. DWARF RAVEN AND PIED CROW.



Dwarf Ravens passing.



Pied Crow overhead.



Pied Crow (side view).



Cape Rook silhouetted.



Cape Rook flying past, angry.

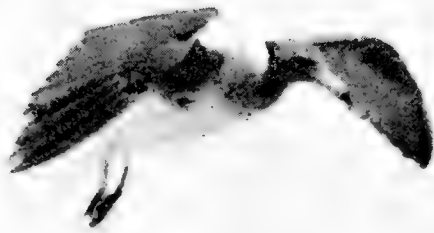


Fan-tailed Raven, passing.

PLATE 29. SOOTY GULL.



Passing over.



Landing.



At rest.

VOLCANOLOGICAL OBSERVATIONS IN EAST AFRICA.

I. OLDONYO LENGAI.

The 1940-41 Eruption.

BY J. J. RICHARD.

Contents.

1. Introduction: Situation, Ascents and History of Oldonyo Lengai.
2. Preliminary Investigations of the Eruption of 1940-41.
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4. The Summit of Oldonyo Lengai.
5. Petrographical Notes on the Pyroclastics of the 1940-41 Eruption.
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1. INTRODUCTION.

Situation, Ascents and History of Oldonyo Lengai.

About 2,900 m. high, Oldonyo Lengai is situated $2^{\circ} 45' S.$ latitude and $35^{\circ} 55' E.$ longitude, just south of Lake Natron (Fig. 1.) It is the only active member of a group of volcanoes in Northern Tanganyika. This group occurs on either side, on the Western Highlands as well as on the eastern low parts, of that section of the North-South Rift-wall which stretches between Lake Natron in the north and Lake Manyara in the south (Fig 2).

The volcano, according to Barns (1923) first mentioned in the Mombasa Mission map of 1850, was ascended and its summit reached in 1904, by Jaeger (see Uhlig, 1905); in 1913, by Reck (see Reck, 1914); in 1915, by Schulze (see Reck and Schulze, 1921); in 1932, by Reck again (verbal communication from Dr. L. S. B. Leakey); and in 1941, by the writer.

Reck (Reck, 1914, Reck and Schulze, 1921; Reck, 1923; and Reck, 1924) was the first to make a serious study of the geology of Oldonyo Lengai and published a series of papers a list of which will be found at the end of this article. These papers give a valuable description of the situation at the summit which remained more or less unchanged from 1904 when Jaeger visited it to 1913, the time of Reck's first ascent, and until the 1917 eruption.

Schulze (Reck and Schulze, 1921) also wrote on the geology of Oldonyo Lengai and the surrounding cones and craters and, together with Reck, he gave an account of the 1914 and 1917 periods of activity.

The fact that Oldonyo Lengai was at times active had not escaped the notice of the travellers who had visited the

neighbourhood in the past. Scholler (1904) reports that according to the natives, steam escapes from the top in the rainy season. Thomsen (1885) describes the mountain as an active volcano. Fisher (1882-83) saw smoke escaping from the summit and the natives who accompanied him spoke of stretches of fire on the flanks and rumbling noises inside the mountain. An eruption with a thunder-like noise and thick smoke seems to have taken place in 1880.

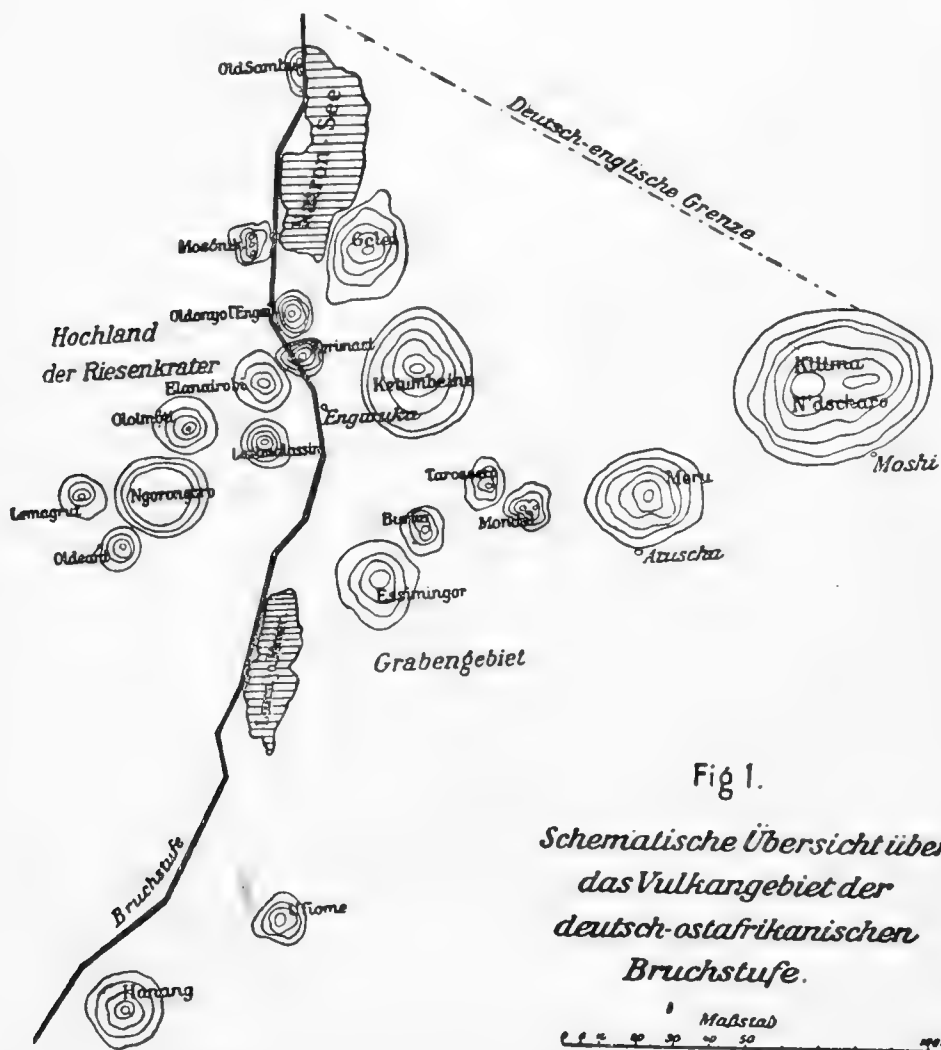


Fig 1.
Schematische Übersicht über
das Vulkangebiet der
deutsch-ostafrikanischen
Bruchstufe.

FIG. 2. The volcanoes in the N.E. of Tanganyika East and West of the Rift wall in its section Natron-Lawa ya Mweri or Manayara lake after H. Reck's Fig. 1 in Oldonyo Lengai, Branca Festchrift, 1914.

Schulze (loc. cit.) mentions that a lava-stream 1-2 m. thick and 100 m. broad had flowed in a southerly direction for about 200 m. from a cone 25 m. high on the top. This must have happened between December, 1913, after Reck visited the summit and April, 1915, when Schulze climbed it. Reck (1923) records further slight activity in 1915, and put the starting of a new eruption at the end of 1916.

Hobley (1918) describes the eruption of Oldonyo Lengai in January-June, 1917, as also does Reck, who mentions the reports of Verch (Reck and Schulze, 1921) who passed near the volcano shortly afterwards. This eruption is also mentioned by Gregory (1921), Barns (1923), Jaeger (1921), and by Krenkel (1922). The main features of the 1917 eruption were the disappearance through explosions of the white needle about 150 feet high, which formerly occupied the northern edge of the crater. The thick vegetation, which in 1913, made an ascent very long and difficult, was completely destroyed. The country around was covered over a radius of about 6 miles with grey and black ashes. Some of the parasitic cones on the eastern side of the mountain showed active fumaroles. Several new streams, containing warm salt-water, appeared on the north-east side, while on the south-east side a salt-water lake 1 by 2 km. extended between Oldonyo Lengai and Kerimasi. The whole mountain was white like snow owing to the sublimations of soda. The lower part of Kerimasi, the Rift-wall and land to the west were also white with soda crusts.

Barns (1921) saw Oldonyo Lengai in eruption in February, 1921.

We possess no details of the alterations which took place in the crater during this eruption or during that of 1926 mentioned in the next section and observed by Mr. Billington of Magadi.

Whilst staying at the top we were able to see roughly the results of the transformations of the last twenty-four years and we shall give a brief account of these as well as a description of the 1940-41 eruption in so far as it is possible to do so. Several months had passed since the beginning of the eruption when our visit took place.

Before going further we wish to express our gratitude to the Civil Authorities of Kenya and Tanganyika and to Dr. L. S. B. Leakey and Dr. V. G. L. van Someren for the facilities given, to Captain A. T. A. Ritchie and Mr. Hugh Copley for their assistance and to Mr. J. P. Teare, Game Warden at Arusha, Mr. Page Jones, District Officer, Masai Reserve at Monduli, and to Mr. R. R. Buckland, Engineer-in-Charge of Irrigation at Arusha for their interest and help to the expedition. A special word of thanks is due to Miss A. F. R. Hitchins for the analysis of several rock-samples, performed in the laboratories of the Geological and Mining Department, Nairobi.

2. PRELIMINARY INVESTIGATIONS OF THE ERUPTION OF 1940-41.

As no one had visited the summit of Lengai since the late Professor Reck climbed the mountain in 1932, the situation at the crater before the eruption is not known. No records are

available about the temperature of the fumaroles or of their behaviour prior to the eruption.

Towards the end of July, 1940, Masai living east of the volcano at Londoi, noticed some rumblings and saw during the daytime, occasional puffs of smoke originating from the northern part of the summit. No big explosions, however, occurred. These phenomena must have been somewhat stronger than the occasional weak manifestations which are a feature of the volcano, for the Masai sacrificed milk and goats near the foot of the mountain, as they are accustomed to do at the time of an eruption.

On a visit which I made to Lake Magadi in December, 1940, some data about the eruption were given to me by Mr. W. H. Billington. In clear weather, the volcano, looking as if covered with snow, is clearly visible sixty miles to the south-west.

Mr. Billington, of course, did not observe the volcano regularly; but, having seen the eruption of 1926, he noticed sooner than others that there was "something going on." At the beginning of August, he saw that the volcano continued active for about two to three weeks. This period was followed by a pause lasting several days, after which it started to erupt again.

The eruption clouds showed great variations both in height and density. Sometimes they were twice the height of the volcano itself and dark in colour. During the earlier period of the eruption there seemed to be a pause of two to two-and-a-half minutes between the explosions; later the interval became longer. Sometimes a glow was seen at night and there were electric discharges in the cauliflower-like overhanging cloud. No sounds of explosions were heard.

Mr. Billington, comparing the eruption of 1940 with that of 1926, said that the latter lasted longer. Sometimes the south-west horizon was hardly distinguishable owing to the curtains of ashes which, for several weeks, were carried by the wind for a distance of a hundred miles.

On my visit to Magadi on December 10th, 1940, I saw Lengai well and it was apparently quiescent.

Interesting facts were given to me by Mr. Page Jones, District Officer, Masai Reserve, and Mr. Howe of Monduli. While on tour, eight miles east of Engaruka, about a week after the first signs of activity of Oldonyo Lengai—which were characterised by odd puffs—shortly after 10 a.m. on July 31st, a column of dark smoke appeared suddenly from the top of the volcano. This grew quickly to a black, vertical pillar which extended for over 9,000 feet above the summit, i.e., to a height of 18,000 feet. The upper part developed later into an enormous, cumulus-like cloud. The whole phenomenon looked like a gigantic

pinetree. No detonations were noticed. An hour later the appearance changed somewhat; smaller eruptions occurred, followed however, by the same pinetree-like eruptions. This type of activity continued for the rest of the day and on the return of the observers in the direction of Monduli at 5 p.m., a black cloud still hung over the white rain-clouds.

Mr. Buckland was at Engaruka camp on August 28th, when the volcano was behaving somewhat differently. Dark, heavy clouds of ashes were belched from the crater and reached several thousand feet above the summit. Kerimasi, north of Engaruka, was sometimes enveloped in smoke. The plains near Engaruka and the village itself were covered with a greyish film of fine ashes. The air was hazy and irritated the throat. The noise from the volcano was like a growl, or the sound of a lorry in the distance. The east wind was transporting most of the ashes in the direction of Elanairobi, Oolmoti and further away.

His Excellency, the Governor of Tanganyika Territory, Sir Mark Young, accompanied by Mr. Page Jones, flew over the mountain on November 20th, 1940. The crater showed on its northern side a funnel-like hole, hundreds of feet deep, with smoke escaping from its deepest part.

The importance of the above observations made by those persons who from close quarters witnessed the activity of the volcano at different dates proved to be of real value afterwards. The writer, accompanied by Mr. G. Babault and his son, examined the surroundings and the volcano itself on a tour which lasted from the 11th to the 18th of January, 1941.

3. OBSERVATIONS IN THE NEIGHBOURHOOD OF OLDONYO LENGAI.

Leaving Engaruka camp on January 12th, we motored through thorny bush, at first going in a north-easterly direction towards Kitumbene, then after ten miles of very rough going, in a northerly direction towards Gelei. Passing a few hills of volcanic origin we turned west and arrived at a Masai *manyata* called Londoi.

The volcano, as it was approached at 12 o'clock, was clear of cloud and there was no sign of activity (Plate 31, Fig. 3). According to some Masai herdsmen, there had been slight activity the day before when a small cloud had escaped from the crater. The dry grass around Londoi had been burnt in patches; but the fires had been caused by herdsmen and not by volcanic action. That fires had occurred recently was also shown by the green-coloured, lower parts of the flanks of the mountain. This green coloration merged into a more yellow and grey tint on the higher parts.

While at Engaruka the ashes had not been thicker than 1 or 2 mm., at Londoi, four miles east of the volcano, the Masai said

that they had reached ankle-depth. Compared with those of Engaruka, which were very fine, the ejecta at Londoi contained more coarse sand.

Travelling west, it was clear that there, also, no grass-burning had been caused by the volcanic outburst. Where the grass looked dead, its appearance could be attributed in part to the seasonal drought and, probably also, in part to the high percentage of alkaline salts in the fallen ashes.

Whilst crossing the numerous, dry river-beds and radial ravines (Plate 33, Fig. 6) which contained sand and ashes thrown out by the volcano and washed down by the rains, a slight smell of chlorine was noticed. The sands were often covered with a thin crust of soda (? carbonate) which gave to the flanks and especially to the higher parts of the volcano, its white appearance.

By comparing the photograph taken after the 1921 eruption and after the 1940-41 eruption (Plate 32, Figs. 4 and 5), it can be seen that no great changes apart from those at the summit have taken place in the outer aspect of the volcano during the last twenty years. Though the season was at its driest and no rain had fallen to dissolve the crusts, the impression is gained that the 1940-41 eruption was not so violent as that of 1921, since the whitish deposits are less well developed.

The small volcanic cones east and south of Oldonyo Lengai were not active, as they were in 1917.

In certain places on the south side at the foot of the volcano, where the ashes had remained undisturbed, samples examined showed some interesting features. On the top of the old, fine, grey-brown, weathered ashes from previous eruptions there was a layer, one-and-a-half inches thick, of fairly coarse sand consisting of particles 0.1 inch in diameter and this was covered by a grey-blue layer, two-and-a-half inches deep, of fine ashes with a particle size of 0.004 inch. These proportions remained the same when the western side was reached; but the first, earliest layer, as one approached nearer to the foot of the volcano became thicker and contained larger material, lapilli and small scoriae mixed with coarse sand and ashes. The ashes emitted later were very fine and showed no difference from those of the same period from other sites, except in that, as the distance from the volcano increased, the ashes naturally became still finer. This constant feature together with the observations referred to in Section 2 give the strong impression that the eruption of Oldonyo Lengai of 1940-41 was composed of three different phases, as have been observed with several eruptions of volcanoes in the Netherlands East Indies and elsewhere.

On Lengai, the first or preliminary phase was characterised by occasional small explosions indicated externally by odd puffs

of smoke belching from the crater. These small eruptions threw up old material from the funnel. Apart from some small showers of ashes little could be seen from a distance. This period apparently lasted from about the 24th to the 30th of July, 1940.

The second or gas-phase, with discharges sometimes assuming the form of a huge column, was characterised by explosions which threw up boulders and bombs together with sand and ashes and released great quantities of gas. The heaviest material was dropped around the actual vent which was widened and swept clear of accumulated material. During this phase of volcanic activity the climax of the eruption was reached and the coarser deposits mentioned accumulated, their aspect depending on the strength of the explosions, the distance covered by the ejecta and the direction of the wind. This period, according to the observations of Messrs. Page Jones and Howe, probably started on July 31st, and although we do not know how long it lasted, it may well have carried on for one or two weeks. It is not improbable that the change from one to another phase of activity, after two weeks of heavy eruption, was taken at Magadi, sixty miles away, for a complete cessation of activity.

The third or ash-phase did not throw up material to so great a height as did the second phase and the ejecta consisted in the main of large quantities of fine ashes. This formed the final stage which persisted, on a reduced scale, until the time of my visit to the volcano in January, 1941.

These three phases, first clearly observed by Perret (1924) during the 1906 eruption of Vesuvius and later described from other volcanoes by Neumann van Padang (1931), Richard (1935), have their origin in the differences in composition of the underlying magma. The first phase, is characterised mainly by the ejection of already crystallised magma with material and debris that has collected in the upper parts of the crater. In its second phase, the eruption liberates a physically-different magma in which great quantities of gas are accumulated, whilst in the third, the lower, normal magma occurs.

The more one proceeded to the west, the more obvious it became that most of the finer material had been blown WNW, W and SW by the wind. For many miles the escarpment nearby and the hills north and east of Elanairobi were still white with deposits covering the ashes. Sixty miles away, at Oldeani, which I passed a few days later, according to the District Officer, a blue film of ashes with a salty taste covered the ground on about 18th of August, 1940. At Ngorongoro camp it had reached about a quarter of an inch in thickness. Several people, where heavy falls of ashes had occurred, spoke of the blighting of their crops or the withering of young maize and

vegetables. The damage, however, was not very severe and disappeared with the first showers of rain.

Nearer to the volcano, especially on the western side, the grazing was completely ruined by the alkaline ashes and the Masai cattle were badly affected. The waterholes were spoiled and large areas of grass having been rendered useless, the district had to be abandoned by its inhabitants. It was also free from game for several months.

I was told by Mr. Page Jones that the situation was very bad at Engamat, south of Elanairobi and that the Masai cattle had to be moved elsewhere. On one of the forced treks an old woman got lost and probably died.

Gelei cattle, east of Lengai, showed patches of discolouration in the coat and on a visit to Ol Balbal and Oldoway, where I could still collect ashes from beneath sheltering rocks, an old Masai showed me some of his cattle which had lost their hair through the action of the alkaline ashes. Falls of ashes were reported from as far away as the Loliondo track on the Serengeti plains, a distance of sixty miles.

4. THE SUMMIT OF OLDONYO LENGAI.

The last camp was established at the foot of a few small craters on the south-west side. In order to minimise the final struggle, a camp higher up on the flanks of the mountain would have been advisable; but we were unable to persuade our Engaruka porters to go any higher with their loads. They believe that evil spirits inhabit the volcano.

On the morning of January 17th, we crossed a large ravine (Fig. 7) cutting through an old adventive crater half-filled with debris. Some interesting incrustations were seen; deposits of nearly pure sodium carbonate in holes, probably brought there by water containing the salt in strong solution and a jelly of yellowish, colloidal sodium silicate, which dried out as brown crusts, from some cracks on the side of the ravine. The few dead tree-trunks which we passed were all that remained of some forest which was destroyed in the great eruption of 1917.

To ascend the volcano, one has to proceed as far as possible to the west in order to avoid the numerous, radial erosion gullies and to leave on one's right the brownish, overhanging rocks at a height of approximately 5,000 feet. The fairly steep western slope was covered by the well-known white incrustations and had it not been for the black foot-prints it would have resembled snow. On the towering slope of the cone near the top, the surface had to be broken with an ice-axe step by step to avoid slipping. The view extended wider and wider as the numerous "barrancos" in the west with their complicated erosion labyrinths (Fig. 12) sank deeper and deeper. Lake Natron, in the north, showed blue, green and red-coloured patches. These colours are also observed at times on Lake

Magadi and are due, I was told, to algae which appear as the result of variations in the soda content of the water.

Whilst taking a short rest on a small ridge, which had to be dug in the hardened ashes, suddenly from what seemed to be a lower level on the north side, a brown puff of smoke appeared, proof that the top was not far off.

After four-and-a-half hours' climbing, at 12-15 p.m., we arrived at a spot west of the old crater and a few minutes later the summit itself was reached. It is situated on a hill of ejecta running roughly ENE to WSW, between the old SSE and the young NNW crater. This ridge, which in 1913 did not exceed a few feet, according to Reck's (1924) photographs taken at the time and Schulze's (Reck and Schulze, 1921) profiles of 1917, became higher after the 1917, 1921, 1926 and 1940-41 eruptions through the accumulation of material ejected by the actual working crater. It forms the highest point on Oldonyo Lengai and has increased the height of 2,878 m. given by the maps, by at least 20 m.*

The old crater to the south (Fig. 14) showed a flat bottom measuring approximately 1,200 feet from ENE to WSW and approximately 600 from north to south. The south rim, approximately 90 feet high, at its highest part shows ripple marks due to aeolian action. This crater, of which no working has been recorded, had nearly the same aspect when Reck visited the volcano in 1913. It is slowly filling with material from the northern crater, as well as with mud from the hill, 300 feet high, separating the two craters. This hill showed on its south side several gulches left behind by small mud-streams. These were covered with white crusts which were found to consist of ashes underneath (Figs. 15 and 16).

The south crater, especially its south and south-west parts, was marked with impact-holes (Fig. 14) caused by boulders and bombs thrown up to a great height by the explosions from the northern crater. Most of the bombs were entirely buried forming small craters some with a diameter of over 7 feet (Fig. 17). Some of the boulders must have weighed about half a ton (Fig. 18). The big ejecta, the majority of which were thrown out during the second or gas-phase, were covered by ashes from the third and formed a large bomb-field. The large amount of decomposed material, destroyed by the action of gas and the weather after it had been thrown out, was characteristic of this field.

In the south-east part of the slope separating the two craters there was another fairly large bomb-field (Fig. 13) with thousands of bombs and fragments of boulders. In contrast to those of the first-mentioned field, the ejecta were not buried,

*The anaeroid barometer taken with me did not function, hence all heights given in the paper are approximate only.

belonged to a later period and contained much fresher material. I shall return later to the origin of these two fields.

After climbing the middle ridge, one had a good view to the north of the working crater which was about 800 feet wide (Fig. 19). In a northerly direction there was first a fairly steep slope of about 65° consisting of tuffs from the new crater. This was followed by a 90° wall, built up partly of ejecta from the old south crater and partly of those from the north crater. The second slope was followed by a third small slope of 25° and this, in turn, by a fourth which had an angle of between 15° and 20° and led to the actual working crater. This fourth terrace was demarcated on the east, south and west by a large crack and its surface was broken by a series of smaller cracks running east to west showing that it consisted of loose material.

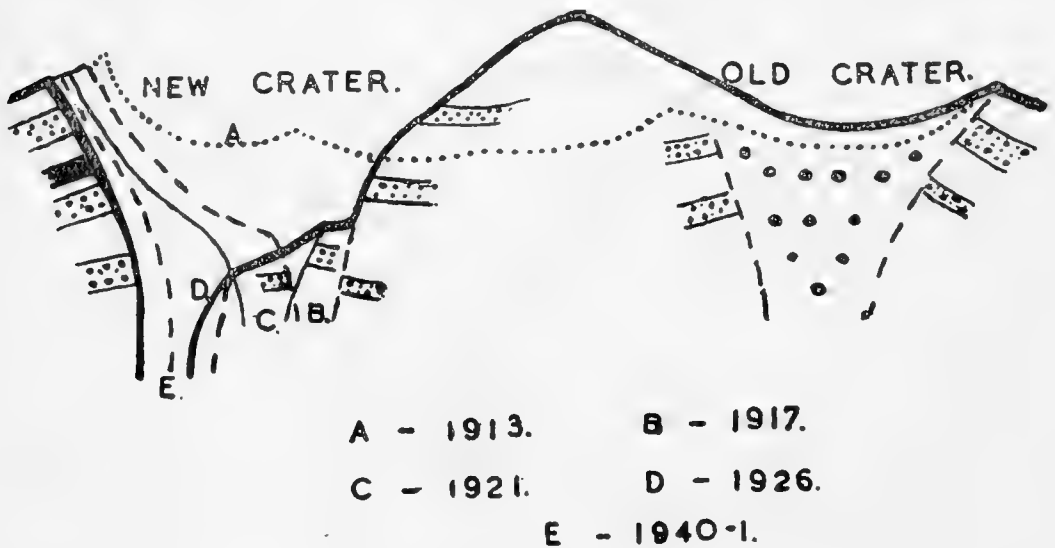


FIG. 20.

The terraces with different angles of slope show clearly how, since 1917, the eruption points or vents have proceeded successively in a north to north-westerly direction (Fig. 20). The fourth and last slope is due to the filling up of the former 1917 and 1921 craters by the accumulation of debris.

The northern edge of the wall of the crater reached approximately 300 feet above the bottom of the last terrace. The large crack, to which reference has been made, was visible on the east and west of the wall. It climbed up in a northerly direction and at two places joined the upper rim. This crack showed that subsidence of the crater after the ejection of huge quantities of material had occurred, the deepening of the eruption vent having undermined the foundations of the crater. Some white vapours were escaping from the crack on the east side.

The northern wall of the crater was formed principally of tuffs; but in one part at about two-thirds of its height the

remains of an old lava-stream were seen. On the west side the rim consisted of rough, grey stalactitic material, probably soda crusts.

No living vegetation was seen although on the inner, north slope of the middle ridge there were patches of dried grass where the slope was so steep that the loose 1940-41 deposits could not stay. The heat from the crater was not, therefore, great enough to burn this grass even during the strongest eruption period. The so-called "fire columns" seen at night were probably due to the reflection in the eruption cloud of lava glowing at the bottom of the vent.

The active crater was a funnel-shaped vent, about 300 feet deep and 100 feet wide, with a pit at the bottom in an eccentric position. Fumes escaped slowly with a noise like that of a strong wind in trees.

Some interesting facts concerning the two bomb-fields were obtained. The west and north slopes of the volcano, in contrast to the south, south-west and south-east showed practically no heavy ejecta. It was also clear that the course followed by the bombs, south, south-west and south-east was independent of the main drift of the ashes which had been pushed in a westerly direction by the prevailing wind.

The position of the pit to the north of the bottom of the vent, instead of at its centre, explained the situation of the bomb-fields as well as the distribution of the larger ejecta. The eccentric explosion pit being close under the northern wall, the explosion products, owing to the resistance offered to the expanding gases, had been directed in a southerly direction. Reference to Figs. 8 and 19 will show that the north wall is nearly vertical for about 600 feet in contrast to the opposite wall which ends approximately 300 feet lower. The ejecta could only pass the south rim at a projection angle of between 70° and 90° . With an angle approaching 90° they would fall back into the crater; but if forming a parabola with an angle of, for example, 70° or 80° and if endowed with sufficient initial velocity, the projectiles could cover a horizontal distance of 2,000 feet from the explosion pit to produce the SSW field. It has already been made clear that this field was probably formed when the volcanic activity was at its climax during the second phase of the eruption.

The SE field probably originated later, when the activity was decreasing and the initial velocity had become smaller. Its centre is only just over 1,000 feet in horizontal distance from the crater. It is not impossible that the explosion pit was shifted during the eruption so that the boulders and bombs took a south-easterly direction. The scattered aspect of both fields is easy to understand since, between 70° and 80° or over, many projection angles are possible and probable.

Even if one knows the projection angle, it is practically impossible in ballistics to construct the parabola of a projectile without knowing its initial velocity. It is equally impossible to determine the highest point of the trajectory. For the bomb-fields of Lengai, however, it is probable that some of the ejecta reached a height of between 2,000 feet and 4,000 feet.

While standing on the middle ridge at 2-50 p.m. on the 17th, a small eruption occurred, followed a few seconds later by the appearance of a grey cloud which went up fairly quickly to 600 feet. At 3-04 p.m., accompanied by a terrific noise as of crashing trees, a second eruption took place (Plate 33, Fig. 8). It came from a deep level, for it was ten seconds before brownish smoke was seen. The explosion level of this second explosion must have been approximately 300 feet deep as the smoke took a further ten seconds to reach the upper edge of the crater on its northern side. The edge soon became invisible. A strong smell of sulphur came over and ashes 0.1 to 0.5 mm. in diameter fell on the paper on which I was writing three minutes after the explosion occurred.

These two explosions, with another following when I was back at the camp, showed that the volcano was still active. No temperatures could be taken and no analyses of gases could be made under the circumstances. They will have to be postponed until a later date when the fumarolic stage has again been reached.

5. PETROGRAPHICAL NOTES ON THE PYROCLASTICS OF THE 1940-41 ERUPTION.

The time spent in the neighbourhood of Oldonyo Lengai was too short to allow of the collection of enough material to enable a detailed classification of the successive rocks which took part in the building up of the volcano to be given here. The supposition that some differentiation has taken place in the composition of the rocks is confirmed, for example, by the tuffs of different colour that occur in the deep eastern valley facing Londoï: the yellowish tuffs and brecciae belong to an older series, while the grey tuffs are characteristic of a later date. Further indications of variability are found in the layers of some of the adventive craters around the volcano. For example, in a small crater south of Lengai, tuffs rich in biotite can be seen under the previously-mentioned grey and yellow tuffs and above an old steppe formation of calcite in concretionary nodules.

Furthermore some metamorphic material found in the layers of ash in the river-beds that one crosses, give evidence that the volcano in its earlier eruptions had to break through formations of older origin.

The specimens brought back are divided into four groups:

- (1) Essential ejecta of the 1940-41 eruption: L6a, L7, L9 and L11.
- (2) Accidental ejecta: L6b, L12 and L15.
- (3) Accessory ejecta: L4, L10, L13 and L14 with two specimens of an older eruption: L16 and L17.
- (4) Other secondary products formed later through outside circumstances: L1, L2, L3 and L8.

(1) *The Essential Ejecta.*

These consist of fresh lava boulders and bomb-fragments thrown up mostly during the second and third phases of the eruption.

Macroscopically the rocks are grey in colour, with a medium-grained structure, porphyritic. Nepheline in grains up to 3 mm. in size is visible to the naked eye together with occasional prisms, of which some reach 4 to 5 mm. in length, of pyroxene. This latter mineral, of black colour in the rock, varies from pale to dark-green in thin splinters. When altered the rock shows a whitish, powdery surface similar to that of L10.

Under the microscope, L9 and L11 are very similar and may be described together. The major constituents are nepheline, pyroxene and some magnetite. Pyroxene, although not the most conspicuous mineral in these lavas, forms large phenocrysts, evidently crystallised before the nepheline. The crystals are mostly idiomorphic, of large rectangular size and frequently show confused, fringed, terminal portions. The pyroxene, grass-green in colour and sometimes darker near the margin or of zonary structure, is a sodiferous augite, approaching to monoclinic aegirine. The angle of extinction is as low as 15° . In sections perpendicular to the axes the optic sign is negative.

Nepheline occurs in numerous, large rectangular and small hexagonal or square idiomorphic or hypidiomorphic sections. The mineral is uniaxial and shows a positive sign in perpendicular sections. The nepheline often contains inclusions of minute needles and crystals of aegirine-augite.

The matrix is composed mostly of idiomorphic nepheline with some augite microlithes. Grains of magnetite are scattered throughout the slide and occur as a fine dust in the matrix. In L9 some microlites of sanidine, arranged like a fan, occur in the matrix, while in L11 some of the smaller hexagonal sections of nepheline show a corona of kataphorite.

L6, a lapilli of the second phase of the eruption is much altered and contains corroded crystals and vesicular holes. The nepheline when showing zonary structure in hexagonal sections, is often dark or even opaque under crossed nicols. Non-pleochroic and colourless augite, occurs in biaxial laths, 2 mm. long, with aegirine.

The ashes of the first and second phases of the eruption are not mentioned here for obvious reasons: (a) they cannot give a true picture of the composition of the magma as they are not of juvenile but of composite origin, belonging as they do to a mixture of pulverised old rocks and debris thrown up by the volcanic explosions. (b) transported in the eruption cloud for variable distances, they were liable to rapid weathering.

L7. was taken from the fine ash-layer of the third period. It was covered with the characteristic, slightly protective white crust to which we shall return later. These ash-deposits show less important alterations as the greater part of them was formed well towards the dry season. L7 has the same constituents as L9 and L11, but seems to contain more isotropic glass.

L6a, L7, L9 and L11 are all nephelinites.

Two analyses from the essential ejecta are quoted here. They were made by Miss A. F. R. Hitchins, B.Sc., A.I.C., Chemist and Assayer of the Mining and Geological Department, Nairobi.

	L7	L11			
	ζ_c	ζ_c			
SiO ₂	39.66	42.44			
TiO ₂	2.01	2.15			
Al ₂ O ₃	11.49	12.20	Norms according to Niggli.		
Fe ₂ O ₃	6.70	6.33			
FeO	3.56	3.14			
MnO	.33	.34	L7	L11	
CaO	17.54	10.73	ζ_c	ζ_c	
MgO	1.90	1.03	si ...	85.5	94.4
K ₂ O	3.52	5.19	al ...	14.4	15.8
Na ₂ O	7.84	14.24	fm ..	23.9	20.4
P ₂ O ₅	1.03	.60	c ...	40.4	25.6
CO ₂	2.54	.50	alk .	21.1	38.—
S	.28	—	k ...	0.22	0.14
F	.43	.28	mg ..	0.46	0.16
Water below 110° C.	1.31	.46	ti ...	3	3
Water above 110° C.	.30	.19	p ...	0.9	0.4
	110.44	99.82	qz ...	-98	-157 /
Less O ₂ equiv. to Fluorine	.18	.12			
	100.26	99.70			
Less O ₂ equiv. to Sulphur	.12	—			
	100.14	99.70			

Nephelinites have been described not only from several places in East Africa, but also from other localities in and outside Africa. Some analyses of similar rocks follow for comparison below:

Analysis No.	1.	2.	3.	4.	5.	6.
SiO ₂	43.59	43.47	38.80	40.45	41.18	43.17
TiO ₂	2.71	2.52	4.30	3.21	4.04	—.
Al ₂ O ₃	15.07	12.60	14.22	17.32	12.40	15.24
Fe ₂ O ₃	6.96	9.85	7.28	7.25	7.47	7.61
FeO	4.54	3.53	6.34	4.—	6.89	2.67
MnO	0.25	1.74	0.14	0.08	0.35	—.
CaO	10.53	11.96	12.35	11.78	11.69	10.63
MgO	3.51	4.11	5.65	4.43	5.15	5.81
K ₂ O	3.87	1.74	2.19	3.78	.48	4.07
Na ₂ O	6.03	3.25	5.—	5.99	6.59	5.68
P ₂ O ₅ ... ..	.62	1.04	.72	.71	.97	—.
CO ₂ ... ..				.15		
Water below ...	2.57	4.14	1.80	1.18	2.75	3.57
Water above 105			1.40			
	100.25	99.62	100.19	100.31	99.96	99.39

(Analysis No 1.—Nephelinite, SW part of the caldera-rim Mount Elgon, from Odman, 1930.)

(Analysis No. 2.—Nephelinite, Fort Ternan, Kenya, from Goldschlag, 1912.)

(Analysis No. 3.—Nephelinite “augitite,” west of Ngong Bazaar, Kenya, from Smith, 1931.)

(Analysis No. 4.—Nephelinite, Etinde Volcano, Cameroons, from Wolff, *a.*)

(Analysis No. 5.—Nephelinite tephrite, Lyngemarkenfjoldes, Godhaven Disco, Greenland, from Wolff, *b.*)

(Analysis No. 6.—Theralite, Martinsdale, Crazy Mountains, Montana, from Rheinisch.)

Generally speaking, when SiO₂ decreases in a magma, Al₂O₃ and Na₂O also decrease, while Fe₂O₃+FeO, MgO and CaO increase. For the Lengai rocks we see with a low SiO₂ content a rather low MgO and an abnormally high Na₂O and K₂O content, while Al₂O₃, Fe₂O₃+FeO and CaO show about the normal percentages for igneous rocks low in silica. The rocks are undoubtedly affiliated to the alkali-rich magmas between nepheline syenite and alkaline gabbros, foyaite or theralite. With regard to some singularities in their composition (high Na₂O, low MgO, etc.), we may suspect that the magma of Oldonyo Lengai has been influenced locally by contact with older formations, which have resulted in assimilation; but, so long as we have no stratigraphic information we cannot draw further conclusions. A study of the nearby Rift-wall and more

petrographic data of the constituent rocks of the surrounding volcanos will perhaps give a key to solve the problem.

The low silica content associates the Lengai lavas with the basic magmas, typical for some of the offshoots belonging to the great Atlantic volcanic chain.

(2) *Accidental Ejecta.*

L6b, which was brought up together with L6a, shows under the microscope an altogether different structure and approaches to phonolite with ophitic structure.

Macroscopically L12 is a grey, medium-grained rock showing crystals of felspar up to 5 mm. in size, together with pyroxene and agglomerates of biotite. Some isolated plates of the latter attain the very large size of over two inches.

L15 is a whitish rock of fine texture with some grey-green parts containing dark grains of indistinct, non-crystalline form.

Seen under the microscope, L12 and L15 are both holocrystalline rocks, L12 being melanocratic in contrast to L15 which is hololeucocratic, or composed almost entirely of white minerals. The structure of L15 is partly granular, partly of intersertal fabric.

Pleochroic, idiomorphic pyroxene forms the major constituent of L12. Many augite crystals show a dark edge of aegirine, biaxial and negative. Some amphibole seems to be present: also nepheline and plagioclase anorthose. A feature of the augite is the inclusion of a dust of magnetite or limonite disposed in zones. Biotite is sometimes massed around some of the pyroxene or forms inter-stratified colonies in small irregular grains with highly bi-refrangent, monoclinic pyroxene.

The mineral content of the rock and the fact that there is no matrix (deep origin) associate L12 with the rock family of nephelinitic gabbros.

L15, as already mentioned, consists mainly of light-coloured minerals. The lamellar felspar shows Carlsbad twinning and is sanidine, a variety of felspar orthose. The sanidine is sometimes idiomorphic or in grains with indistinct crystalline outline, often shows corrosion and contains minute inclusions. Small masses of highly-bi-refrangent zircon, scaly chlorite and some greenish, lamellar serpentine occur in the slide.

L15, with its alkaline felspar, although it has not quite its appearance is a digested gneiss.

(3) *Accessory Ejecta.*

During the first and second phases of the eruption, the quantity of accessory ejecta was overwhelming. The altered rocks L4, L10, L13 and L14 belong to the western field of boulders and bombs.

L4 is a powdery product from boulders which at the time of the eruption were thrown out in a solid condition, but which weathered rapidly afterwards into a brownish powder. Under

the microscope the greater part consists of intricate, light-coloured, crystalline aggregates. The aggregates appear to be partly soluble in water and form, after evaporation of the latter, fan- and feather-shaped needles of, probably, sodium sesquicarbonate. There is about 12% of the oxide of iron Fe_3O_4 as dark-brown granules which are attracted by a magnet.

Mr. J. A. Stevens of Magadi made an exploratory analysis of L4. It contains, among other constituents, the following:—

Fe_2O_3	...	...	...	...	11.99%
CaO}	...	...	...	...	6.82
MgO}	...	...	...	...	0.38
Na_2CO_3	...	...	...	...	40.
Na_2SO_4	...	...	...	...	5.4
K	...	...	...	...	0.37
SiO_2	...	...	...	...	0.16

L10 is a rock which was formerly grey in colour like the ordinary ejecta, L9 and L11; but of which the nepheline has become much altered and converted to a soda-rich white powder showing, under the microscope, the same aggregates as in L4.

L13, taken from a large block, of which several were encountered, especially in the western field of ejecta, is a whitish-grey, soda-containing mud with some altered nepheline. These blocks of mud showed, after drying out, a multitude of cracks in their outer shell and fell to pieces when tapped gently with a hammer.

L14 was taken from another large bomb (Fig. 18) of salty taste and conchoidal fracture. It consists mainly of semi-transparent minerals. Under the microscope there appear to be some large, non-pleochroic, highly bi-refrangent crystals of bi-axial, negative anorthoclase in addition to quartz and magnetite. Around the magnetite small collections of interstitial needles with low bi-refrangency of, possibly, anorthite are constantly found. In sections the quartz reveals uniaxial structure with low bi-refrangency parallel to the optic axis. It shows undulating extinction like crushed quartz sometimes does in gneiss.

The rocks L10, L13 and L14 have been analysed for K_2O and Na_2O by Miss A. F. R. Hitchins with the following results:—

	K_2O			Na_2O			
	Insoluble fraction.	Soluble fraction.	Total.	Insoluble fraction.	Soluble fraction.	Total.	
L10	...	2.20	2.72	4.97	6.53	17.79	24.32
L13	...	4.18	1.15	5.33	12.24	12.45	24.69
L14	...	2.75	0.41	3.16	11.39	4.67	16.06

L10 and L13 are obviously much richer in Na_2O than the normal magma L7 and L11 with 7.84% and 14.24% respectively.

This high content of Na_2O does not indicate necessarily that these are exceptional eruptive rocks or juvenile deposits of soda. The soda may have been derived from the silicate in the ordinary soda-bearing rocks. The rocks had accumulated for a long time in the crater before the last eruption took place, or forming part of the northern wall, which as we have seen was partly blown away when the eruption vent shifted northwards, were slowly decomposed by hydrothermal action. Volcanic gases like CO_2 could combine with the Na ions to form sodium carbonate in the upper parts of the volcano. The highly-soluble salts were washed along cracks or fumarole channels to form accumulations rich in Na (L4 ?). If the ions Cl or SO_4 , which are common in fumarole incrustations and hot springs came into contact with this solution chlorides or sulphates, etc., would be formed. The phenomena are probably complex and more data on temperatures, pressure and analyses of gases will be necessary to solve the problem.

The rock specimens L16 and L17 although they do not belong to the latest eruption, are mentioned here. Both specimens are grey-greenish rocks which show, in addition to phenocrysts of nepheline, numbers of dark laths of pyroxene. Microscopically some of the pyroxene, in transverse and longitudinal sections, has a grass-green to brownish colour. In thin sections the two terminal portions are often perpendicular to each other (87°). The extinctions of the plates fluctuate between 4° and 45° , indicating the presence of augite, aegirine-augite and aegirine. In addition to pyroxene there is also some hypersthene showing extinction of about 0° , and with negative optic sign. Amphibole prisms showing extinction of between 10° and 16° are numerous in L17.

The ground mass of L16 contains many grains of non-pleochroic pyroxene and is dotted with magnetite, whilst L17 shows a more glassy matrix in which are numerous dark-green crystals of aegirine-augite and hypersthene. In contrast to L9, L11, etc., nepheline is much less prominent.

Both L16 and L17 are nephelinite-augitites rich in iron. Augitites from Ngong, containing about 13% ferrous and ferric oxides have been quoted from Campbell Smith (Analysis No. 3, page 103).

(4) *Secondary Products.*

L1 was found between some layers of ashes in the western ravine at the foot of the volcano. The incrustations occurred as round cakes of yellowish and whitish colour or grey where ashes of the eruption adhered to them. They are composed of

accumulations of crystalline soda, obviously deposited by infiltration of water and are entirely soluble.

L8, another grey crust, consists of ashes cemented together by soda carbonate.

L2 is a jelly-like product, already mentioned in Section 4, page ..., which was flowing out from cracks in the side of the same ravine. It was identified by Mr. Stevens as a gel of sodium silicate. Unlike L1 and L3 it has the appearance, when dry under the microscope, of non-crystalline aggregates or concretions of transparent or light-grey matter with dendritic or arborescent form.

L3, the white crust giving to Oldonyo Lengai and its surroundings their well-known white colour, is merely a white film which cannot be collected without the underlying matter to which it adheres. Mr. Stevens kindly made a preliminary analysis of these crusts collected from ashes on the top of the volcano. While SiO_2 with 34.60%, Al_2O_3 , Fe_2O_3 and FeO with a total of 20.70% and CaO with 17.25% have percentages similar to those found in L7 the alkaline constituents were apportioned as follows: Na_2CO_3 , 8.8%; NaF , 0.15%; NaCl , 0.69%; Na_2SO_4 , 0.76%; giving a total of 10.20%.

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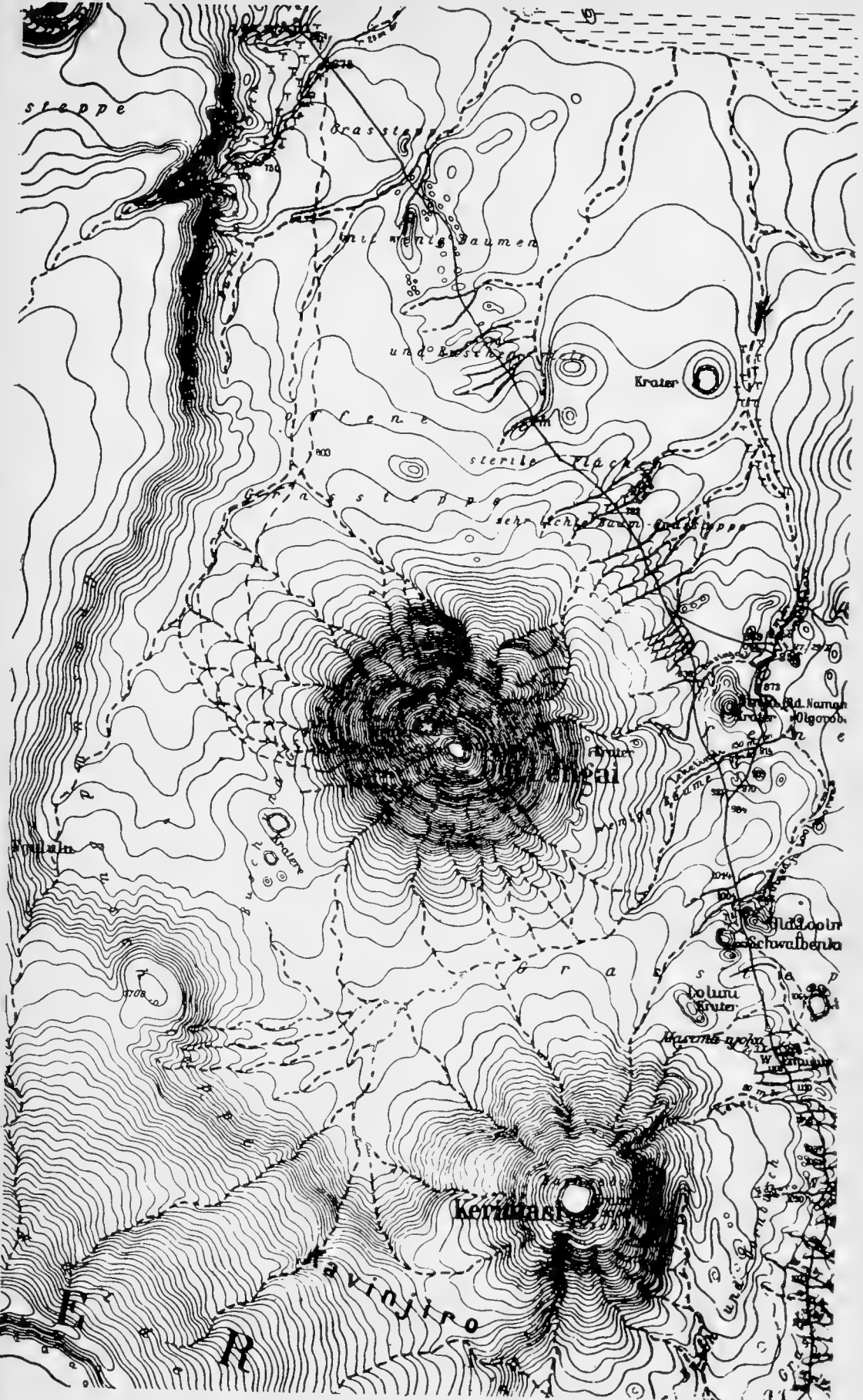


FIG. 1. Map showing Oldonyo Lengai and Kerimasi (after C. Uhlig's map "Die Ostafrikanische Bruchstufe von 1° 40' to 4° S. lat.")

PLATE 31.

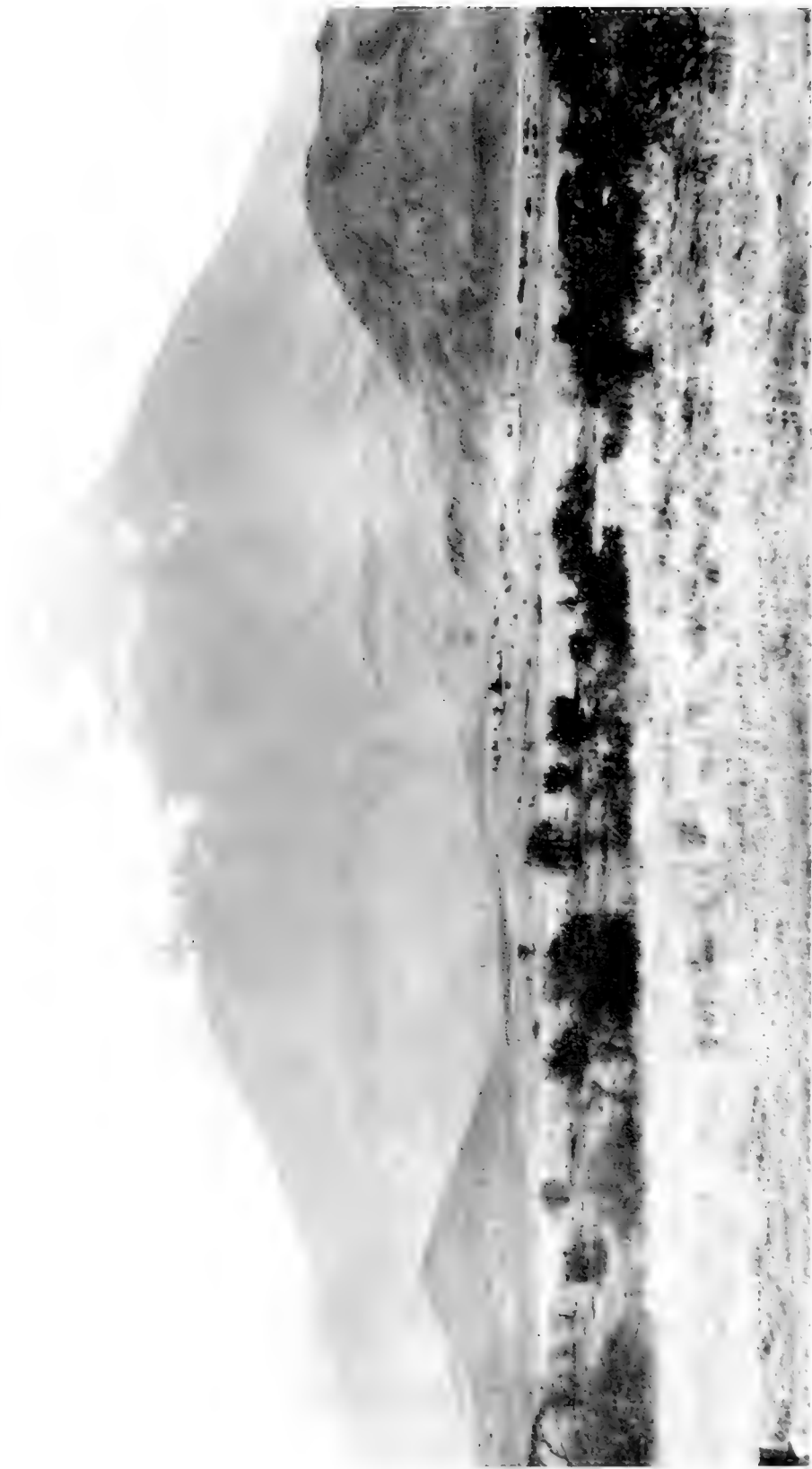


FIG. 3. Oldonyo Lengai seen from the east side at Londoi.

PLATE 32.



FIG. 4. *Oldonyo Lengai as seen from Kerimasi saddle after the eruption of 1921.*

Photo: BARNS.



FIG. 5. *Oldonyo Lengai seen from the valley between Kerimasi and Lengai, January, 1941.*

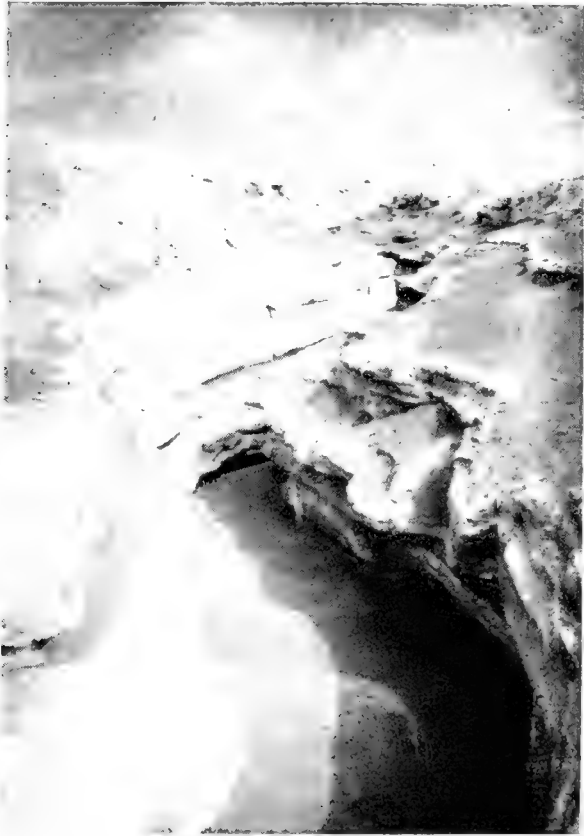


FIG. 6. *Radial ravine on the south side of the volcano.*

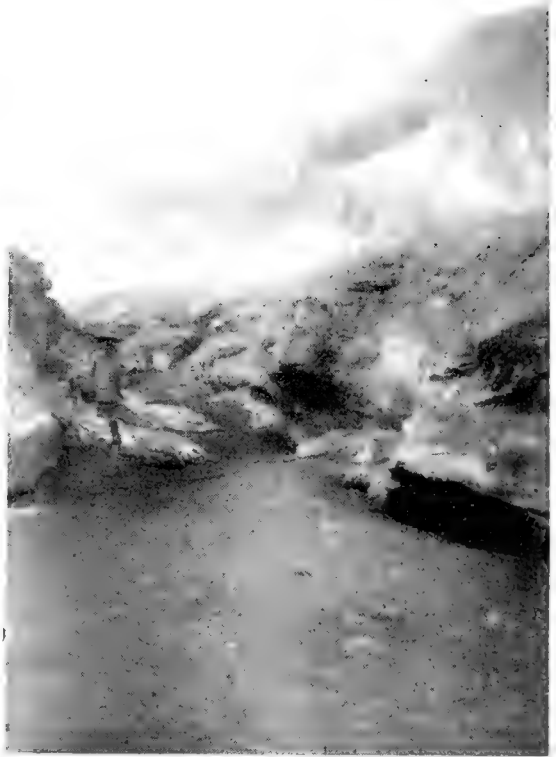


FIG. 7. *The ravine between Lengai and the south-western parasitic crater.*



FIG. 8. *The small eruption of 3-04 p.m., 17th January, 1941.*



FIG. 9. Oldonyo Lengai from the south.



FIG. 10. Camp on the S.W. side



FIG. 11. *Remnants of vegetation about halfway to the top.*

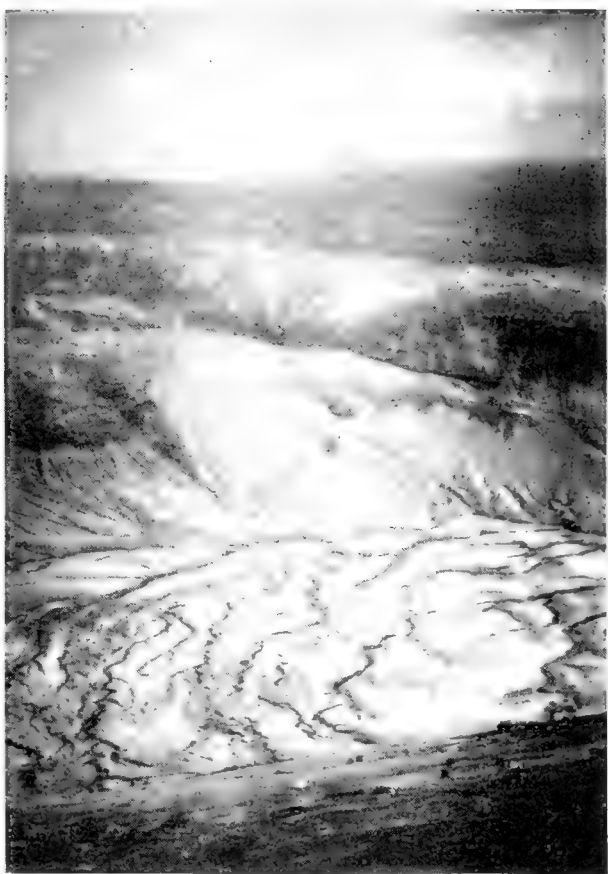


FIG. 12. *Erosion on the west foot of Oldonyo Lengai.*



FIG. 13. *The eastern bomb-field.*

PLATE 37.



FIG. 14. The old SSE crater with numerous impact-holes of bombs on the right.

PLATE 38.



FIG. 15.



FIG. 16.

Marks left by mudstreams along the southern slope of the middle ridge between the two craters.

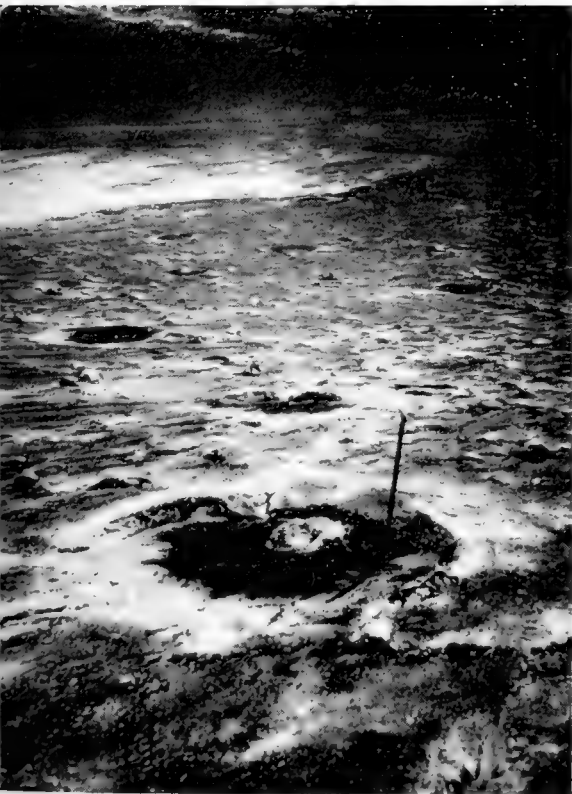


FIG. 17. A 7-foot crater and half-buried boulder from the 1940-41 eruption.



FIG. 18. One of the boulders thrown out during the 1940-41 eruption.

PLATE 39.

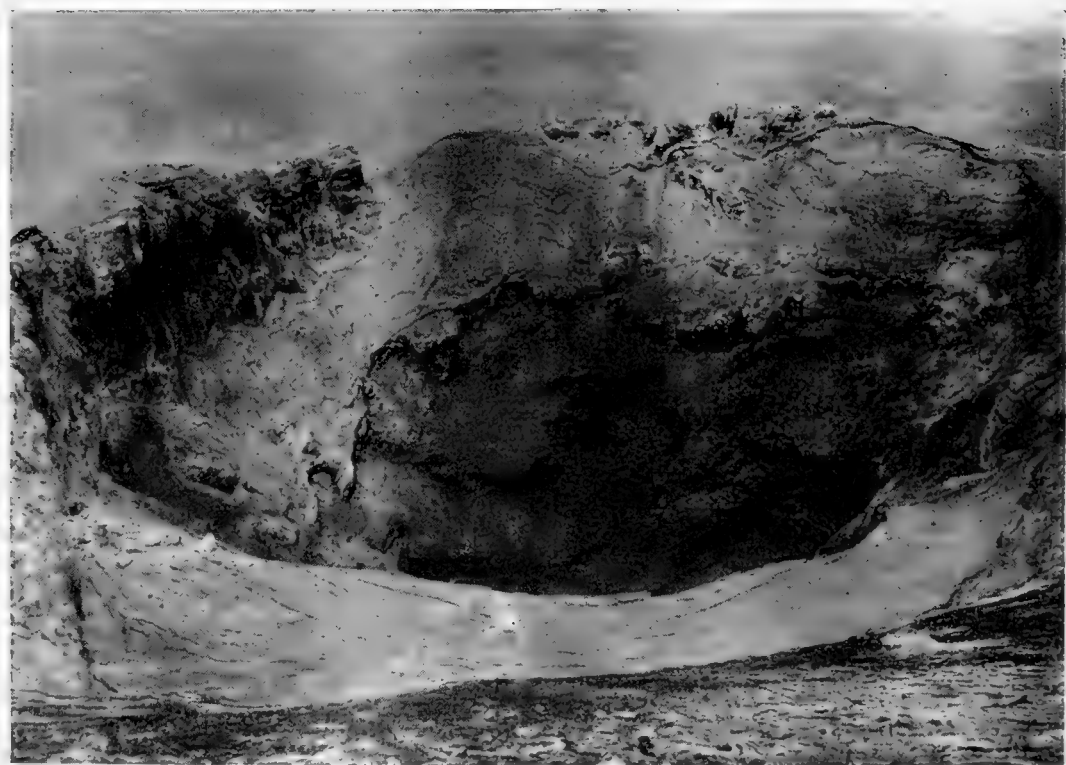


FIG. 19. *The active NNW crater.*

SOME SPECULATIONS ON THE COLORATION OF ANIMALS.

BY J. C. CAROTHERS, M.B.

A short time ago an article appeared in the *Illustrated London News* on the subject of the Camouflage of Aeroplanes. It was stated that "exhaustive experiments have been carried out by experts of all the great air powers to obtain invisibility, and even today, when the camouflage of fixed objects on the ground has reached astonishing perfection, the problem of camouflaging aircraft still leaves much to be desired and causes a wide divergency of views, as may be seen by comparing the British and German schemes."

I submit, with diffidence, that no satisfactory solution of this problem will be found. For the problem is really no new one; life in its flying forms has been faced by it since the carboniferous age and has utterly failed to solve it.

The rest of this essay will be devoted to a consideration of the colouring of wild animals and I hope that, as the subject is a large and obscure one, it will at least serve to provoke further speculation and discussion.

The coloration of animals may be roughly divided into three types: (1) cryptic, (2) conspicuous, and (3) a small group, which includes ourselves and a number of larger animals, in whom the coloration appears to bear no significant relation to the environment. The great majority of wild creatures fall clearly into one of the first two types and are either well disguised or startlingly conspicuous.

Now the principle of cryptic coloration in nature is a well-established fact and the many methods employed and the secrets of their success are relatively well understood. Essays and articles on new aspects of this subject are continually appearing and indeed the phenomenon is so universal that it would probably be true to say that if all the wild life of this world stood perfectly still (and kept silent), one would hardly ever see a single creature.

The subject of conspicuous colouring, however, is much less well understood, so it is this aspect of the matter that we shall chiefly study today. I will confine the study to land animals, partly because this essay arose out of some speculations about flight, and partly because a study of the coloration of sea creatures is complicated by the difficulty of appreciating their appearance to each other. (Indeed even the most brilliant colours in these creatures are probably cryptic in effect, such as the blues and greens of those near the surface, and the reds of those in the depths.)

Brilliant and conspicuous colouring in air-breathing animals is seen in a great many birds and adult insects, and in relatively few other creatures, including the Skunk among mammals, some caterpillars, and some poisonous snakes. The vast majority of the possessors of this characteristic are flying creatures, and most notably the lepidoptera among insects, and certain groups of birds.

We will, therefore, proceed to a short analysis of the coloration of birds, butterflies and moths, which has been mainly based on a study of literature dealing with birds in South Africa and lepidoptera in Great Britain and on personal observations of all these creatures in England and Kenya.

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(a) BIRDS.

(The following notes refer to South African birds.)

Birds that fly by night and hide by day are cryptically coloured with a spotty mixture of browns, russets, fawns, black and white. A complete list of such birds embraces the Owls, Nightjars and Dikkops.

Birds that spend most of their time on the open ground are cryptically or raptively coloured, at least so long as they remain on the ground, and exhibit a spotty or patchy mixture of browns, russets, fawns, black and white. A complete list of such birds embraces the Partridges, Guinea-Fowls, Quails, Sand Grouse, Bustards, Coursers, Larks, Pipits, Rock-Jumpers, Plovers and Dikkops. Certain of these birds, such as the Plovers, while extremely well hidden on the ground, are intensely conspicuous in the air. The only exceptions to this rule of the cryptic coloration of essentially terrestrial birds are a few very large ones, namely, the male Ostrich, the Ground Hornbill, and certain Herons, Storks, Ibises and Cranes.

Brilliant and conspicuous colouring in birds is, therefore, confined to those that spend much of their time by day in the air, to certain smaller ground birds when in flight, and to a very few large ground birds at all times.

(b) BUTTERFLIES AND MOTHS.

The coloration of these insects appears to be governed by two factors: First, how far the flight is diurnal or nocturnal, and second, the position of the wings at rest.

Now all butterflies are day fliers and when at rest the wings are held vertically backwards in such a way that only the undersides are seen, especially the undersides of the hind wings. Brilliant coloration of the wings is usually confined to the upper surface; and the under surface especially of the hind

wings is almost always cryptically coloured with a spotty or confused mixture of colours.

In regard to moths, the great majority fly only by night, a small number (which includes, in England, the Hawk moths, the Burnet moths, many Bombyces, and the Magpie moth) fly by day especially in twilight. The position at rest varies considerably in the different families, but may be divided for our purposes into two groups: (a) those (mainly Geometrae) which spread their wings in such a way that the upper surface of the whole body and of all four wings is visible, and (b) those which fold their wings so that only the upper surface of the fore wings and of the head and thorax is visible.

Moths that fly only by night are cryptically coloured with a dingy mixture of browns and greys. The Geometrae are almost always cryptically coloured all over unless (as in the Magpie moth) they fly by day, when they are apt to be brilliantly coloured all over the upper surface of all four wings. In other moths (which at rest show only the upper surface of the fore wings and thorax) the coloration is usually dingily cryptic all over (as in most Noctuae) unless they fly by day (as in the Hawks, Burnets and many Bombyces) when brilliant colours often occur on the upper surfaces of the hind wings and of the abdomen.

In the brilliant coloration of butterflies the whole spectrum is well represented; in that of moths only the lower end is seen, and blues and purples are rare.

Brilliant and conspicuous colouring in lepidoptera is, therefore, practically confined to day-fliers and to those parts of the wings and body that are seen in flight, but hidden at rest.

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Before proceeding to any speculations, let us examine the existing theories that attempt to explain the phenomenon of brilliant colouring in animals.

There are a large number of these theories and at first sight they appear to fall into two groups according to whether the brilliant colours are shared by both sexes, or are a peculiarity of the male. As, however, it is a well-established fact that where brilliant colouring occurs in both sexes of a species it has almost invariably first appeared (in evolutionary history) in the male and only later in the female, it would seem that the distinction is more apparent than real.

So we will not attempt to divide them into groups but will merely take this opportunity to point out that the first six theories are probably true within a very limited field, and the last six are of wider applicability, but doubtful truth.

The theories that appear to be of chief importance are as follows:—

(1) A danger and guiding signal to the herd. This theory may explain the Rabbit's tail, but seems to have little application to the vast majority of brilliantly coloured creatures.

(2) A warning of poisonous or distasteful qualities. This theory appears to explain the possession of brilliancy in a number of noxious creatures, e.g., the Skunk, many poisonous snakes, wasps, the Cinnabar caterpillar, etc., etc., but the great bulk of creatures under discussion are neither poisonous nor distasteful.

(3) The theory of "Batesian" mimicry, where the coloration of harmless creatures closely imitates that of species well-known to be noxious. This theory may explain the coloration of certain butterflies and moths, notably the Hornet Clearwing and the Bee Hawks in England, but again its application is small.

(4) The theory of "Mullerian" mimicry, where many noxious species adopt the same type of "warning" colouring, e.g., numerous species of wasps, the Cinnabar caterpillar, etc., are striped black and yellow.

(5) The theories of associative or terrifying mimicry, where a creature, e.g., the Alligator Bug, resembles some terrifying animal or simply appears strange and frightful as in the case of the Puss Moth caterpillar.

(6) Eye spots (and tails, etc.) on the wings of some lepidoptera may act as attraction marks to their enemies. This is indeed probably a very serviceable device as much evidence has accumulated in recent years that birds often attack these insects on the wing and merely succeed in snatching off pieces of wing. But it is not a complete explanation, e.g., no moth can afford to discard its abdomen, yet it is most common for those with brilliant hind wings to have a brilliant abdomen.

(7) Smith Woodward suggested long ago that excessive ornamentation is to be interpreted as a final flare up of the lamp of life preceding extinction, that the orderly sequences of growth having fulfilled themselves, the material for further growth is expended in the development of colour and ornament. It might, however, be equally well argued that extinction merely followed in those species in whom the ornamentation happened to become excessive, but we shall refer to this theory again later.

(8) The chief theory that has attempted to explain brilliant colouring where this character is a peculiarity of the male is the theory of sexual selection, originally propounded by Darwin. As it held the field for many years,

and is still apparently regarded as all-sufficient by most we will discuss this theory at some length. By this theory it has been believed that the females of a species generally or invariably selected the most brilliant males, so that the duller-hued were gradually eliminated, and brilliance became more and more extreme. Now this theory (as Pycraft has well shown) assumes an unvarying taste on the part of the females from generation to generation, a taste, moreover, that tends not merely towards brilliance, but towards a particular pattern and arrangement of colours; it assumes an ability on the part of the females to distinguish between the usually excessively slight differences between the males of one generation; and it assumes that such a taste and discrimination not only occur in birds, but in such lowly creatures as insects. These are large assumptions, and the theory utterly fails to explain the fact (referred to above) that when the male has achieved a certain standard of brilliance the female follows.

Pycraft in criticism of this theory states that there is no evidence of sex selection in the development of brilliant colouring. (He can assign no reason for its development, but simply states that there appears to be a trend, or diathesis, that develops late in the history of a species and that progresses with gathering impetus and quite automatically in the direction of increased intensity, concentration and clarification of pigmentation.)

(9) Wallace, in *Tropical Nature*, believed that natural selection could account for secondary sexual dimorphism by supposing that only the strongest and most virile males gained mates, and that these males came to possess an excess of vital energy which became manifest in bright plumes, etc. But what does an excess of vital energy mean? All creatures presumably have a vital energy that is slightly in excess of their normal and average needs and that is kept in reserve for times of stress and emergency, and there is no evidence that the more brilliantly coloured species were more strong and virile.

(10) Bright colours in male birds have been explained as a device for keeping the number of males within proper bounds by rendering them conspicuous to their enemies. But such a device would apply with equal effect to brilliant females, of which there are many, and the whole species in this case would be kept within "proper bounds," which is ridiculous.

(11) Fisher, in *Watching Birds*, says: "It is highly probable that the bright colours and adornments of certain male birds have as their primary biological purpose intimidation and threat rather than attraction. This applies

to birds which have bright plumage only in the male (like pheasants and some buntings), only in the female (like phalaropes), in both sexes all the year round (like robins and jays), or in both sexes in the breeding season (like black-headed gulls)." This theory is closely bound up with the theory of bird territory defined by Lack as an "isolated area defended by one individual of a species or by a breeding pair against intruders of the same species and in which the owner of the territory makes itself conspicuous." As such, the intimidation theory, therefore, has no application to butterflies and moths.

(12) It has been shown that certain birds recognise other members of the same species and distinguish their sex by observation of colour pattern. Very likely this factor plays a part in the recognition by individual creatures of their fellows throughout a large part of the animal world. But we have no reason to believe that conspicuous colouring is necessary for this purpose: the vast majority of animal life manages just as well without it.

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These are the existing theories, and it would seem that they fail to explain a large part of brilliant and conspicuous colouring in animal life; that they may explain the phenomenon in most creatures that creep, crawl and walk and a few that fly; that the phenomenon occurs most commonly in flying creatures, and that the problem as it affects these has been inadequately answered. (The explanation might, of course, be different in different types of flying creatures, but we feel that the facts warrant the assumption that in general it is the same, as we will endeavour to show.)

I submit first that certain creatures by reason of their size or of their habits of life are necessarily conspicuous, and that if this is true, any type of coloration is from the point of view of producing invisibility, equally valueless. That under these circumstances brilliant colouring often develops and under no other circumstances, except for the few examples (snakes, caterpillars, etc.), that can be explained by existing theories.

Now at least 99% of camouflage consists in keeping still and indeed the great majority of cryptically coloured creatures behave as though well aware of this. But one cannot keep still in the air, so that creatures that fly cannot hope to conceal themselves from their enemies while in flight. It is probable that if the sea were always blue all sea birds would be coloured blue on top; and that if birds migrated by following closely one line of a railway track, they would develop a black stripe down the middle of the back. But in fact the sea is not always blue and birds do not migrate that way, and the aspect of the

earth varies notably from moment to moment as one passes over it. Camouflage in the air is useless, and birds that spend much of their time in this element, and butterflies and moths when in flight, are released from the need to employ cryptic colouring.

A certain number of larger mammals and large terrestrial birds are necessarily conspicuous on account of their size and habits. The large birds previously mentioned as exceptions to the rule of the cryptic coloration of predominantly ground birds are all waders in open shallow water or stalkers in the open veldt and as such are necessarily conspicuous. Moreover, it is well known that many big game hunters deny that camouflage occurs in the larger wild mammals. Camouflage is useless in such creatures and they are released from the need to employ it.

Now this theory raises a further question. If a species, by reason of its size or habits, is released from the need to employ cryptic colouring, one might expect that its coloration would develop in a purely haphazard way. Does it in fact do so? The answer seems to be: in domestic animals, usually; in wild animals, never.

Domestic animals are not subject to the ordinary laws of evolutionary survival and often exhibit colours that are not only grossly different in individuals, but are often asymmetrical in the same individual. The question, however, as it affects domestic animals is too complicated to be discussed in this article.

Wild animals rarely exhibit gross differences of colour as between individuals of the same species, and hardly ever exhibit asymmetry. Their colouring does not develop haphazardly and brilliant colour when it occurs progresses (as Pycraft says) in the direction of increased intensity and clarification of pigmentation. This type of coloration, therefore, appears to have some positive value, so we are led to ask the further question as to what this value is.

I submit secondly that brilliant colouring when it occurs in flying creatures is meant to be seen, or, to put this in a more scientific way, that it has a value which is related to the world of vision. This might appear rather obvious at first sight, but in fact many conspicuous colours are in no way related to the world of vision, e.g., the bright-green of most leaves and the black of a negro's skin have a purely physiological value.

Now what evidence supports the theory that brilliant colouring in flying creatures is meant to be seen?

Such colouring never occurs in purely night-flying creatures such as owls, night-jars, bats and purely nocturnal moths; and it does not occur in parts of the surface of the body that are never seen (e.g., the part of the hind-wing that is overlapped

by the fore-wing in lepidoptera), but always in parts that are visible in flight. Moreover, it seems most likely that the fact that such brilliant colouring as occurs in twilight-flying moths is confined to reds, oranges and yellows is due to the emphasis laid on the lower end of the spectrum by evening light. Such light, as compared with broad daylight, contains relatively few blue rays and many red. The colours are meant to be seen.

But why? Has brilliant colouring some positive protective value to its possessors when in flight? (One can imagine, for instance, that it might produce a flickering flight that was difficult for enemies to follow.) If, however, brilliant colouring had a positive protective value in the air one would expect to find it as universal in flying creatures as cryptic colouring is in terrestrial, but this is by no means so, as many birds and butterflies are dull at all times. One would expect to find it as well-marked in the females as the males, for the former are individually more essential to the survival of a species than the latter. One would expect to find it best marked in those birds, butterflies and moths that were most subject to attack and least marked in those that were comparatively free from attack. Now J. C. Mottram, in an article on the Secondary Sexual Characters of Birds, has classified birds in various ways in relation to their freedom from or liability to attack, and points out that oceanic, maritime, and aquatic birds are probably the least liable to attack. Yet such birds are almost invariably most conspicuously coloured in black (or very dark-brown) and white. Finally, such a theory of flickering flight does not touch the question of the brilliant colouring of the larger ground birds.

It would appear, therefore, that in brilliant colouring in flying creatures we see a quality that has no protective value, and apparently no survival value.

The quality appears to have arisen (like all other natural qualities) as an evolutionary experiment; it has arisen as a by-product of the pre-existing pigmentation of feathers and scales; and it has been perpetuated simply because it has been untrammelled by the ordinary laws of evolutionary survival. The reason for its steady enhancement in many species, on the lines described by Pycraft, remains obscure. But I submit that the fact that this steady enhancement occurs (quite independently of natural or sexual selection) is a strong argument in favour of certain aspects of the discredited orthogenetic theory of evolution.

By this theory the germ-plasm is assumed to contain a faculty that makes it tend to vary always in one direction from generation to generation. It would seem that this faculty does exist, but that it is usually modifiable and is only rarely allowed full play by a competitive environment. It is, moreover, quite

possible that if this faculty is allowed full play for too long it may become not merely irreversible (as has been demonstrated to have occurred in certain static biological characters, such as some elements of the reptilian skeleton), but, in a dynamic quality such as this, unarrestable. There is, of course, a limit to brilliancy of colouring, but in the case of other types of ornamentation such a state of affairs might well lead to extinction. The theory would thus explain Smith Woodward's observation, based mainly on a study of fossil reptiles and the bizarre forms of many of these, that excessive ornamentation is apt to precede extinction.

If we admit this explanation of the development of brilliancy it is surely not surprising that the quality occurs first in the male. For he, individually, is less essential to the survival of the species, and evolutionary experiments are less dangerous if they occur first in him. If he can get away with them the female follows on the same lines, unless her manner of life is so different as to debar this.

Before closing this essay it might not be irrelevant to point out that, if this explanation is correct, brilliant colouring has followed lines of development that are not unique in the world of today. One can think of several other biological qualities and faculties that appear to have been free to develop untrammelled by the ordinary laws of evolutionary survival, e.g., the song of birds, the play of birds and mammals, and many of the higher faculties of the human mind. And it is of interest to note that all such qualities, when released in this way, seem to develop on lines that can only be described as aesthetic.

To take one example among many, one might say that abstract thinking has simply arisen as a by-product of utilitarian thinking and that it has been perpetuated because the quality has been untrammelled by the ordinary laws of evolutionary survival. It is at present mainly a characteristic of the male, but, as an experiment, its success in this year of grace 1941 seems so slight that it is even doubtful whether the female will ever have a chance to follow.

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Which reminds us that the camouflage of aeroplanes is probably useless.

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EAST AFRICAN SUCCULENTS.

PART III.

BY PETER R. O. BALLY.

Continuing our descriptions in the sequence adopted in this paper we arrive at the important and interesting Order of *Euphorbiaceae*, which, with four Genera, is by far the most prolific group of East African Succulents. The succulent *Euphorbiaceae* are at present undergoing a thorough revision; this work being far from completed, an adequate account of the group can hardly been given at the moment.

The author, who is collaborating in this revision, intends to make the succulent *Euphorbiaceae* the subject of a separate paper in this Journal at a later date.

We now pass on to

N.O. MORACEAE.

This Order, or Family, (the terms are interchangeable) is widely spread in the Tropics, some genera being of great economic importance. The numerically large genus *Ficus* belongs here. Other representatives are the breadfruit tree, the jackfruit tree and the mulberry, all cultivated in East Africa, although their origin is in Asia.

One genus only, *Dorstenia*, has developed true succulents.

A few words may be said about the unusual arrangement of the flowers of *Moraceae*. The very numerous, inconspicuous and much reduced flowers are either crowded in heads (mulberry, breadfruit, jackfruit) or on the inner walls of an almost entirely closed receptacle (the "fruit" of the fig) or they are arranged on a flattened disc-shaped, open receptacle, as in *Dorstenia*.

The receptacles of the various species of *Dorstenia* vary considerably in shape: their outline may be circular, oval, star-shaped, oblong, rhomboid, triangular or irregularly angular; they bear bract-arms on their margins which are equally variable in length and shape.

Among the thirty-odd East African species of *Dorstenia* only a few can be classed as true succulents; the greater number are herbaceous plants, though often with fleshy rhizomes or with fleshy disc-like tubers.

Dorstenia crispa Engl.

This plant develops a solitary, unbranched,* fleshy stem, about 4½ inches high, erect from a slightly swollen base, which emits numerous very thin fibrous rootlets.

*Since going to press, larger specimens have been found up to 15" high and with branches up to 16 in number.—P.R.O.B.

The cylindrical stem may reach $1\frac{1}{2}$ inches in diameter, tapering upwards to $\frac{1}{2}$ inch. The surface of the stem is shiny and densely marked with rounded, tubercle-like leaf scars.

The few leaves are crowded at the apex; they are narrowly oblong, slightly fleshy, with a crisped and toothed margin. The inflorescences are solitary in the leaf-axils, on a stalk up to 4 inches long. The receptacle is rounded, up to $\frac{3}{4}$ inch in diameter, the margin is set with 6 to 10 spreading unequal bract-arms, $\frac{3}{4}$ to 1 inch long.

The plant is common in the arid country east of Garissa and at Tsavo, Kenya Colony; it is also known from the Galla Highlands and from Somaliland (Fig. 12).

Dorstenia crispa var. *lancifolia* Engl.

Resembles closely the former; it occurs in Ngomeni, Kenya Colony.

Dorstenia sp.

A small succulent plant with a stout, fleshy stem. The broad, sometimes nearly spherical, base is about 2 inches in diameter and loosely anchored in the soil by means of numerous thin fibrous rootlets. From the tapering main stem several fleshy branchlets are developed, up to 1 foot in length, but mostly much shorter. The surface of main-stem and branches is olive-green: smooth in the wet season when the tissues are turgid; but becoming somewhat wrinkled during drought.

The small, fleshy leaves are ovate, $\frac{1}{4}$ inch long by $\frac{3}{16}$ th of an inch wide, on very short petioles, arranged in whorls around the stems.

The receptacles are solitary in the leaf-axils, ovate, $\frac{1}{4}$ inch in diameter and surrounded by eight marginal bract-arms $\frac{1}{4}$ inch long alternating with much shorter ones which measure about $\frac{1}{16}$ th inch. The female flowers are spread evenly throughout the disk which is closely set with male flowers.

When cut, the plant exudes a yellowish latex which soon hardens to a brownish-yellow resin; it is often found cropped low by grazing game.

The plant is common in the dry areas of the Northern Frontier Province (Fig. 1).

N.O. ICACINACEAE.

In this Order the genus *Pyrenacantha* has alone produced xerophytic forms with much reduced leaves and—in some instances—with enormous development of water storing tissue.

Pyrenacantha malvifolia Engl.

Develops a huge irregularly shaped trunk which resembles a weather-worn rock in general appearance, a semblance which is increased by the grey, mottled, and smooth bark. It attains

5 feet and more in diameter, while rarely exceeding 4 to 5 feet in height.

Young specimens are more or less spherical (Fig. 6), but in the course of time the trunk assumes a more and more erratic outline, bulging and swelling in every direction (Fig. 7). The young plants begin by sending up one stout climbing branch, but as the plant ages, more branches are developed.

The deciduous leaves are rounded and flatly lobed. The inconspicuous flowers are arranged in small spikes. The plant is found in the dry savannahs round Mount Kilimanjaro, at the foot of the Pare Hills, and it reaches the Coast District in the Umba steppe in Tanganyika Territory.

Pyrenacantha Ruspoli Engl.

Is similar in appearance to the former species and occurs in the Ued Ruspoli in Somaliland.

Pyrenacantha vitifolia Engl.

"Kikalathé" in Kikamba, develops a large subterranean rhizome. The branches are slightly fleshy, semi-scandent and covered with a leathery-green bark. The leaves are rounded and deeply lobed; but the plant is leafless during a great part of the year. The flowers are minute, and arranged in a terminal spike. The plant is dioecious; the female plant develops a dense cluster of orange coloured, rhomboid fruits; the hard kernel is covered with soft fruit-flesh which is eaten by the Wakamba in times of famine.

The species occurs in the sandy soils of Witu (Coast District) on the plains near Kibwezi (Kenya Colony), in the savannahs of Usaramo, in the plains surrounding Mount Kilimanjaro and the Pare Hills in Tanganyika (Fig. 5).

N.O. AMPELIDACEAE.

This Order, to which the grape vine (*Vitis vinifera*) belongs, has evolved a number of interesting succulent species.

Most of them are tendrilled, climbing plants; some West African species of the genus *Cissus*, however, develop upright, thick, fleshy stems, which give the plant the appearance of stout small trees; their branches have lost their climbing faculties, and no tendrils are developed.

A species from Kenya Colony is noteworthy for holding an intermediate position; while developing a massive, upright, fleshy and perennial stem, its annual tendrilled branches climb into trees and shrubs.

The flowers of all species of *Cissus* are arranged in panicles; they are small and inconspicuous, greenish or yellowish-green in colour. The fruits are red, purple, or black berries, some said to be poisonous, others used medicinally by some native tribes.

Cissus rotundifolia (Forsk.) Vahl.

A strong climber with a green quadrangular stem, edged with a sharp, corky margin.

The rounded, very fleshy leaves are perennial and of a rich glaucous-green colour. The young leaves and shoots are tinged with maroon. The leaf-margin is serrated and the leaves represent the main water-storing part of the plant. Owing to its attractive foliage, *Cissus rotundifolia* makes a very ornamental climber which needs little or no watering. It wants, however, strong supports in view of the considerable weight of its weak branches. The axillary flowers are arranged in panicles; they are green, small, and inconspicuous. The fruits are berries which turn red when ripe.

The plant is widely distributed; in Kenya Colony it is found from the high-water mark at the Coast through to Lake Victoria, but only at an altitude below 5,000 feet. It is common in all arid savannah areas.

In Tanganyika, the distribution is similarly wide: from the Coast Districts opposite Zanzibar it occurs throughout the steppes and savannah country around the Pare Hills, around Mount Kilimanjaro, and in the Rusisi Valley.

In the north of the Continent it reaches Yemen, and in the south it extends into Mozambique.

Cissus quadrangularis L.

This climbing plant is leafless during the greater part of the year; the leaves are not fleshy; their margins are deeply lobed and serrated. The stems are quadrangular in section, thickly fleshy and green, their edges lined with a thin more or less corky margin; the diameter of the stems measures up to $\frac{1}{2}$ inch. Leaves, flowers and tendrils—the latter being modified inflorescences—are produced from constrictions which are spaced at intervals of from 4 to 6 inches along the stems.

The ripe fruits are black berries.

The plant grows in profusion in all arid areas up to an altitude of 5,600 feet; sometimes smothering the supporting vegetation with its growth.

The distribution of *Cissus quadrangularis* is even wider than that of the preceding species: it occurs in all savannahs in Africa from Etbai Coast in the north of the Continent down to N.-W. Rhodesia, and from Senegambia down to Angola.

Cissus cactiformis Gilg.

This heavy climber develops massive fleshy stems up to 2 inches wide, quadrangular in cross section, winged, and constricted at the nodes. The edges are wavy, and they bear a continuous, sharp, horny margin. The young plants, while still growing erect, bear a superficial resemblance to a cactus plant. The deciduous leaves are absent during the greater part

PLATE 40.



FIG. 1. *Dorstenia* sp.



FIG. 2. *Dorstenia crisper* Engl.



FIG. 3. *Adenium somalense* Balf.f.



FIG. 4. *Cissus cactiformis* Gilg.



FIG. 5. *Pyrenacantha vitifolia* Engl.

FIG. 6.



FIG. 7.



FIGS. 6 & 7. *Pyrenacantha malrifolia* Engl.



FIG. 8. *Adenium obesum* Balf.f.

of the year; they are developed from the nodes, as are the inflorescences and the strong tendrils. The inflorescence is similar to that of the other members of the genus; the berries are black when ripe.

Though much rarer than the two preceding species, the distribution of *Cissus cactiformis* is nearly as wide; it is found in dry savannah country from Somaliland in the north down to the Transvaal in the south. Localities in Kenya Colony are the plains around Voi and the arid bush country extending between the Ngong Hills and Lake Magadi. In Tanganyika, it is common in the "succulent steppe" between Kiurio and Mkomazi (Fig. 4).

Cissus sp. aff. *Cissus macropus* Welw.

This species differs from other East African *Cissus* spp. which are climbers, by developing a fleshy, upright stem, a foot or more in diameter at the base and tapering towards the apex, growing to a height of 6 to 8 feet. The trunk-like stem is covered with a grey bark. From the apex a few rapidly growing slender branches are developed twice a year; the branches are densely covered with short, reddish and slightly viscid hairs. By means of long tendrils they climb into the surrounding vegetation, or, should the plant happen to stand free, the branches form a drooping bunch, their tendrils intertwining. The triplicate leaves are slightly fleshy and have a glossy surface. After flowering (a panicle of inconspicuous, greenish flowers typical of the genus) and fruiting, the leaves shrivel, the branches dry up, and they are soon shed altogether, leaving the unbranched fleshy stem entirely bare. The plant has entered another resting, or dormant, period.

The nearest allies to this interesting species are found in Namaqualand and in Angola.

In Kenya Colony, the plant is found in various localities along the course of the Athi River, such as around the Mbagathi-Gorge near Nairobi, near Thika, and near Donyo Sabuk. Plate 7, Fig. 1 in the first part of this paper shows two plants of this species; one with fully developed branches (right) and another in its dormant stage (left).

N.O. APOCYNACEAE.

This Order is well-known to gardeners at home and in the Tropics through the periwinkle, the various species of *Allamanda*, the oleander, the climbing *Beaumontia*, to mention only a few. The African rubber vines also belong here, and the medicinally important *Strophanthus*.

Two of its genera can be ranged among the succulents; both are well worth cultivating, their brightly coloured flowers being very attractive.

The genus *Pachypodium* is almost confined to Madagascar; only a few species occur in South Africa.

The genus *Adenium* is represented in Africa by several species, two of which are known definitely to occur in East Africa.

Adenium obesum Balf. f. (syn. *Adenium coetaneum* Stapf.).

“Mock-Azalea” or “Desert Rose,” is a low shrub, attaining rarely more than 5 feet in height; it has a thick, fleshy, often contorted, trunk with short fleshy branches. The growth resembles that of a miniature baobab tree, and it is accordingly called *mbuyu* (=baobab) by some native tribes.

The stout, tuberous root frequently forms curious bulges above the ground (see Part I, Plate 7, Fig. 2). The obovate-cuneate leaves have a glossy, dark-green upper surface and a mat, pale-green underside. When young, they are often covered with a soft tomentum; they vary considerably in size and have been measured from 1½ to 4 inches long by ¾ to 1½ inches wide. They are arranged in spirals and terminal fascicles. The inflorescence is in cymes of two to ten flowers on short pedicles. The flowers are large, showy, with a tubular, five-lobed corolla. The tube measures up to 1½ inches in length, the diameter across the pointed lobes being up to 2 inches. The colour varies from pale-pink to deep crimson, being most intense at the edges of the corolla.

In the main flowering season the plant is covered with hundreds of flowers which are the more conspicuous as no leaves are then developed; in the second, and less profuse, flowering season the plant is in leaf. The distribution of *Adenium obesum* is fairly wide throughout East Africa: it reaches from Uganda down to Portuguese East Africa. In Kenya Colony, it is common in the plains extending between Mount Kilimanjaro and the Coast.

In Tanganyika large stands are found in the Jipe basin between Lake Jipe and the Pare Hills (Fig. 8).

Adenium somalense Balf. f.

Very similar to *Adenium obesum* in general appearance, the distinctive feature of this species is the longer and narrower leaf with wavy edges and with a more glaucous-green colour. The flowers are slightly smaller and they vary in colour from almost pure white to pink (Fig. 3).

The species occurs from Somaliland in the north, through Kenya Colony along the Great Rift Valley (Lake Baringo and Lake Magadi) into Tanganyika, where it is found in Engaruka.

In the Western Pare Hills in Tanganyika, a variety with linear leaves occurs.

(To be continued)



THE NAMES OF SOME BIRDS AND REPTILES IN SEVERAL NYANZA LANGUAGES.
 COLLECTED BY R. L. HULL, Maseno School, Central Kavirondo.
 (Continued from page 55)

NAME	SCIENTIFIC NAME	LUO	KISII	KITOSH	KAKAMEGA	MARAGOLI	SAMIA	BUNYORE	HANGA	TERIKI	SUK	NANDI	KIPSIGIS
DS													
Sparrowhawk	<i>Accipiter rufiventris</i>	Olith	Egesami	—	Shidigalila	Kinamasiagali	Esiricha	Olukak'a	Eki'ikakalira	—	Kapchereres	Kiporokyt	—
	<i>Milvus migrans parasitus</i>	Otenga	Ekiwaki	Kisihli	Lik'ongotsa	Live	Eungu	Lik'ongotsa	Lihungu	Lik'ongotsa	Siroro	Chepsireret	Chesireret.
Sparrow	<i>Passer griseus ugandae</i>	Abang'chieth	—	—	Lirollitsi	Litondellitsi	Edolafwiri	Liroberisi	Liloleresi	Lirolerital	—	Chememerut	—
Waxbill	<i>Lagonosticta senegala ruberrima</i>	Oyundi makwar	—	Namundiri	Shihindigiri	Kiyundi	Esindikiri	Esiyundi	Eshiyundi	Shiyundi	—	Chesilyot	Chesilyot.
Hydoh	<i>Vidua macroura</i>	Osimbo	Echuria	Simbik'iria	Lubanzi	Kis.mbakira	Es.mbak'ira	Isimbik'ira	Isimbik'ira	Lubinzo	Chwachwa	—	Kiplalang'.
bin	<i>Corypha heuglini</i>	Hundhwe	Engoncho	EK'unjwe	—	Imbirabiritsa	Ehunjwe	Imbirabirisa	Imbirabinzo	Imbirabiritsa	—	Chepololet	—
tal	<i>Budytes flavus</i>	Okwadha	Ekiguyi	Ongunyi	Isuna	Kitsirie	—	Esik'unyi	Eshukunyi	Shitsirie	Chepkuliny	Chepkulinyet	Chepkulinyet
	All species	Opja	Egsingururu	Opjo	Iminyi	Iminyi	Obicho (?)	Eminyi	Iminya	Imiri	Wissian	Kibiswet	Cheblawet.
	<i>Vinago delalandii</i>	Ninga	—	Eninga	Liluma	Ininga	Eninga	Ininga	Ininga	Ininga	Roronyon	Nenget	Sororyet.
	<i>Lophaelus occipitalis</i>	Okunekune	Ekgunchururu	Kwesule	Inangovia	Inavongoa	—	Lik'ongofwa	Namak'ofa	Inangovia	—	Chesululit	Chesulul.
k-eagle	<i>Actophilornis africanus</i>	Onyango-sandra	Etivivi	Lijoki	—	Kizuluv	Namwenge	—	—	—	Kachilikokot	—	—
una	<i>Coturnix delegorguei</i>	Aluru	Ekirindo	Esindu	Isindu	Isindu	Esindu	Isindu	Isindu	Isindu	Aluru	—	Chepyakwaet.
	<i>Hagedashia hagedash</i>	Ng'ang'a	Ebarara	Ling'ang'a	Ling'ang'a	Ling'ang'a	Eng'ang'a	Ling'ang'a	Ling'ang'a	Ling'ang'a	—	Chepakwakwa	Chebakibaba.
Stork	<i>Sphenorhynchus abdimii</i>	Ogunu	Obutere	Lik'uyi	Ligungu	Ligungu	Shiyoyo	Likungu	Shiyoyo	Lik'ungu	—	Cheptalamyat	Cheptalamyat.
	<i>Struthio camelus massaicus</i>	Udo	—	Enyefwe	Yahudu	Ludo	Eudu	Lihuto	Lihuto	Lihudu	Cheptusongor	Tiondapsongolit	Mbunit (?)
	All species (?)	Achuth	Ensolu	Engosia	Ingosia	Esoti	Engosia	Isori	Ingosia	Tsingosia	Chesambo	Chepsangwet	Sangit.
ILES													
	<i>Crocodilus niloticus</i>	Nyang'	Enyanji	Egona	Igweno	Ing'uina	Egwena	Ing'wena	Egwena	Ing'wena	Kukugh	Ding'ong'et	Ting'ong'et.
	—	Opuk	Enkuru	Ek'utu	Lik'udu	Likudu	Ek'udu	Lik'utu	Lik'utu	Lik'udu	Pkokoch	Chepkokochet	Chepkokochet.
	—	Olele	Ekigo	—	Lihumbagira	Lihumbagila	Bwirebangu	Lihumbachira	Lihumbichula	Lihumbajira	Chemnayat	—	—
	—	Ogwe	Ensagara	Emabakilia	Lisiagali	Lisiagali	Embakala	Lisiri	Lisakala	Lisiagali	Cheringisiet	Cheringisiet	Cheringisiet.
	—	Obongo	—	Namuk'ok'ome	Ligong'o	Lisiagogoma	Ek'ok'ome	Lipongopongo	Lipongo	Lisiagogoma	Kapmet	Cheringisok	Chepenet.
ard	<i>Varanus</i> sp	Ng'ech	—	Embulu	Imbulu	Imbulu	Embulu	Imbulu	Imbulu	Imbulu	Martas	—	Mengubet.
	<i>Chamaeleon</i> sp	Ong'ong'ruok	Enyambu	Ek'aniafu	Inambu	Inyambu	Ek'aniafu	Inyambu	Lik'aniafu	Inyambu	Nyirit	Ng'iritiet	Nyiritiet.
	<i>Typhlops</i> sp	Andhagoria	Ekeromera	Enywa mafura	Shigoshi	Ekogoki	Muka	Eshikoshe	Shigoshi	—	Kapsokoch	—	Ndaret.
	<i>Python sebae</i>	Ng'ielo	Ebasueti	Mugoyevaka	Ivaga	Ivaga	Erimi	Ebaka	Ivaga	—	Ntara	Maswetit	Maswetit.
	<i>Bitis arietans</i>	U	Ringere	Nafwo	Lihili	Kihiligoma	Nadwangi	Eshilikoma	Lihiri	Mny	—	Kipehuseit	Munywet.
ra	<i>Naja nigricollis</i>	Rachir	Rirubi	Namaswak'e	Luni	Luni	Efubi	Ink'alasima	Ik'alasima	Luni	Okgu	Cheplelet	Erenet.

LUO CUSTOMS WITH REGARD TO ANIMALS (WITH PARTICULAR REFERENCE TO CATTLE).

BY WALTER ODEDE,*

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THE SIGNIFICANCE OF STOCK TO THE LUO.

The Luo are both pastoral and agricultural people, and so any discussion involving a group of young and old men with regard to the relative importance of animals and crops usually results in an endless debate. As a rule the view is unanimously held by the elders that animals are more important to them than crops; but the young men will often support crops, because since the advent of Europeans to the country the Government has introduced cash crops which are easily grown and marketed to obtain such articles as clothes, soap, lamps, etc. The elders on the other hand support their argument by saying that during a very bad famine poor people die unless they become the servants of cattle-owners who live comparatively normally during hard times. They urge that children brought up in homes where there is plenty of milk grow up finer and more handsome than those in homes where there is only grain. Again those who stress the importance of animals, go so far as to say that women in poor homes develop scaly backs. Poor homes for the Luo are homes where, no matter how much grain is stored, there are no cattle, and women usually run away from such homes. Strictly speaking, the word "rich," when used by a typical Jaluo, signifies a man with a large number of stock.

The chief animals owned by the Luo are cattle, goats, sheep and poultry. In discussing the importance and uses of these animals to the people of this tribe it would probably be better to take each of them separately.

Cattle produce milk which is a valuable and nourishing food and which has other important uses besides being drunk as such. From it the Luo make butter which is used by women and old men for anointing their bodies. Besides this, butter can be turned into ghee which is the favourite animal product used in cooking. Fresh or whole milk is not drunk by the Luo unless it is mixed with a little sourmilk or buttermilk which has been treated with cow urine. The reason why the milk is not drunk pure is because it is believed that this practice is the cause of human tapeworm infestation. Women and girls who have passed the age of puberty do not drink milk. Stored

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buttermilk is used for making gruel which can be consumed by both sexes. Both buttermilk and fresh milk are used for cooking vegetables and fresh bovine blood for human consumption. The Luo do not slaughter their cattle for beef except for some special reason, for example, on the occasion of a special feast. The ordinary meat eaten is that of animals which have died as a result of disease or accident. If there is an outbreak of a serious disease and many animals die, their meat is made into biltong which can be stored for future consumption. Such biltong forms a very palatable diet when properly cooked with ghee. Girls do not eat the meat of cattle paid for their dowries.

Hides are used as sleeping mats, and for making shields, drums, sandals and special head-dresses on which ostrich feathers are fixed. Those of very young animals are used as clothes.

Cattle can be exchanged for millet or maize at any time, i.e., during famine or in good years; but cattle-owners tend to refuse millet or maize for their cattle after good harvests. This is one of the facts which support the argument of the Luo elders who prefer animals to crops. In exchanging cattle for goats and sheep, a bull is worth three to four goats and a heifer, six to eight goats or sheep. A goat or sheep is worth six to eight fowls.

The young men use young oxen for riding, and they sell heifers to buy buffalo hides for making shields or ostrich feathers for their adornment at funeral dances. Cattle accompany the mourners when attending funerals and, during inter-tribal wars, oxen were the companions of warriors on the battlefield. The horns make valuable trumpets and are used as containers for keeping powdered drugs. Tendons make strong strings for harps and bows. Cattle dung is useful for smearing houses and dry dung is good for the fire. Fresh blood as mentioned above makes a palatable food when mixed with milk and cooked. The scapula of small animals is used as a butter-scoop and for other domestic purposes. Hoofs are used for storing drugs and for running liquid medicines into the noses of both human and animal patients, e.g., an infusion of a plant known in Luo as *jandarusi** is given in this way to cattle suffering from east coast fever. The long hair of the tail is used for trapping birds. The scrotum forms a valuable pocket.

Goats' milk is the food of the herd-boys when looking after animals in the pastures. They add the juice of a fruit† to the fresh milk and after a few minutes the milk coagulates and is ready for consumption. Goat skins are worn by both men and women and goat's meat is eaten by both sexes. The goat is the animal usually slaughtered for female visitors such as mothers and sisters-in-law. The chief produce from sheep is mutton

**Dolichos* sp. probably *D. Maitlandii*.

†*Solanum* sp. probably *S. incanum*, Sodom apple.—EDITOR.

which is only eaten by men and young girls. Women despise sheep saying that they are the most foolish of animals and remark that their meat has a horrible odour. Poultry are placed by women in the same category as sheep because they eat dirty things, e.g., excreta and some ugly insects.

There are certain parts of a cow which are usually only eaten by special groups of people, e.g., the kidney and the abomasum are reserved for girls, the brisket and the abdominal muscles which originate from it for young men, the tongue and the hump for old men, and the diaphragm for those who take fresh blood from cattle for human consumption.

Cattle and goats are the chief animals used for the payment of dowries. Sheep are seldom used for this purpose because every girl believes that if a sheep is paid for her dowry it means that she is despised by her sweetheart. Sometimes this is enough to break off the marriage. The number of cattle paid for a dowry is usually between fourteen and twenty-four. More cattle are paid for the daughters of rich people and chiefs because these girls will, during their wedded life, take much property to their husbands: property collected during the frequent visits they pay to their fathers.

In the course of paying a dowry, discussions go on between the father, uncle, full and step-brothers of the girl as to who will receive some of the special animals paid for her dowry. The same applies in the case of the payment of the dowry by the man, for although the father is responsible for paying most of the cattle, he is helped by some of his uncles and brothers.

The first eight to twelve cattle paid, three to five of which are females, are taken by the full brothers of the girl. Sometime after this payment has been made the girl is caught in the morning by relations of her sweetheart who take her to him. From this day the girl is known as *miaha* (the bride) and the husband as *wuon kiseru* (the bridegroom). In the afternoon of the day on which she is caught, her sisters follow her and stay with her at the bridegroom's home for a night, after which they return to their own home early in the morning. The bride is left with one of her girl-cousins who stays with her until she is brought back to her home so that payment of special cattle for her different relations may commence. The first eight to twelve cattle which were paid before she met her husband are not special cattle because they can be inherited by any of her full brothers. Sometimes in the morning of the first night that the bride stays with the bridegroom, her sisters-in-law (the wives of her brothers) go to the bridegroom's kraal and choose a bull. This bull is inherited by the bride's eldest brother. About two weeks after the bride and her cousin have been at the bridegroom's home, her father slaughters an ox and the meat is taken to the bridegroom's house, some cooked

and some raw. This meat is carried by her sisters and sisters-in-law. The girls from her home and those at the bridegroom's home together with the bride, join in eating the cooked meat. The uncooked meat is left for the rest of the people at the bridegroom's house. A day or two after this, the bride is taken to her father's home accompanied by women and girls from the bridegroom's. Before they leave the house, the bridegroom presents a goat to the bride's cousin who has been staying with her at his home. The bride's father prepares a great feast for his daughter's companions. After the companions have gone home the girl now stays with her father while the special cattle of the dowry are being paid to her relations. The first one to be paid is usually a heifer which is inherited by one of her uncles. This is followed by a cow and her calf which are inherited by her father or one of her uncles. After this, if the marriage arrangements have been completed, the husband pays a bull known as "the bull for the fetching-girls,"—the sisters of the bride who accompany her when she first goes to the bridegroom. After this the bride with her sisters goes to the bridegroom who prepares a special feast for them. For this feast he slaughters an ox which is eaten by his sisters-in-law and the bride, while presents are being given to her by her brothers-in-law. This occurs in the evening and one gift consists of a goat known as *diend yanyo maro* (the goat of abusing the mother-in-law). This goat is presented to her so that her husband may abuse her at any time during the period they live together. It is called the goat for abusing the mother-in-law because husbands usually abuse their wives comparing their foolishness with that of their mothers. The goat is usually inherited by the mother-in-law's last son.

The last and the most important animal is a cow with her calf known as "the mother-in-law's cow." It belongs to the mother-in-law and is paid at any time she asks for it. This is usually some years after the marriage. As a rule it is inherited by the mother-in-law's eldest son. There are some other special animals paid, but they are of less importance and are paid only when the girl or her relations accept the dowry reluctantly. During payment of the dowry each of the girl's relations is responsible for providing a small feast when his portion is brought, e.g., when a cow with her calf is brought to the girl's father or uncle, he must slaughter a ram or more and make beer for those who bring them. Long ago the relations of a girl did not slaughter so many sheep and goats for their son-in-law's relations, but nowadays some people slaughter so many that if the arrangements for the marriage are broken off, the son-in-law's relations may only have six or nine cattle back out of sixteen they paid. Deductions are made to compensate for the small stock slaughtered for the feasts.

Besides dowry payments the Luo had other means of obtaining cattle before the advent of the Europeans. Two of these ways, which no longer exist, were the capturing of enemies' cattle during inter-tribal wars and robbery during the night. Because there were only few cattle in those days the number of cattle paid for dowries was very limited, not even half of what it is today.

Inheritance and exchange are now the natural means by which the Luo obtain cattle. As mentioned above in discussing dowry the first eight to twelve cattle paid for a dowry, though nominally known as the property of the father of the girl, are in the real sense the inheritance of her full brothers. The father can do anything he likes with them during his life-time, provided he consults the girl's eldest brother. It frequently happens that there is disagreement between the sons and the father, who may try to dispose of these animals without consulting the sons. The other animals belong to certain individuals, e.g., father, uncles and mother. Those of the father if he is a polygamist are inherited by one of his sons who has no sisters. If the father has two or more sisterless sons born of different mothers they inherit equally the special cattle he gets from the dowry of those daughters who have full brothers. These sons also inherit the cattle, goats or sheep that he gets by other means, e.g., those obtained by exchanging millet or maize and those paid to him for the dowries of his nieces. Cattle paid to the mother-in-law by her son-in-law are inherited by her eldest or last son. Usually a father gives more to a son whose mother has died if he is a good son. He calls this son his orphan. If a father loves one of his sons more than the others he may take some of his cattle to one or other of his friends, and tell him that they can only be taken after his death by the loved son.

A man inherits his brother's animals if the brother dies and leaves no son. If a man, having a brother, dies before having children by his wife, and the widow marries someone else of her husband's clan, children born to her by her new husband belong to the brother of her former husband, and so, if they are girls, the brother inherits most of the cattle paid for their dowries. If, however, these girls have a brother, he inherits the cattle.

Some people start to obtain cattle by exchanging their millet or maize for sheep, goats and poultry in the first instance, and when the number of these small stock has increased, they, in turn, are exchanged for cattle. Sometimes a man gives his friend an assurance that if he gives him some goats he will in return give a heifer which can be kept until she calves. After weaning, the calf remains the property of the friend while the cow is returned.

MANAGEMENT OF ANIMALS.

Rich people do not keep all their stock together in their own kraal. Usually they give some of them to their friends or relations to look after. The latter take the milk as a reward for their trouble. Owners of animals when visiting those friends or relations who are responsible for them, take careful notice of the colour of the offspring in order to check any mischief on the part of an untrustworthy friend or relation. Keen cattle-owners rarely give their animals to doubtful friends or to those living in remote places where frequent visits would be difficult. During dry seasons when grazing becomes scanty some owners remove their herds to better pastures and return them only when their own pastures have improved. This is not, however, the usual custom and it is more usual to take the cattle to better pastures early in the morning and return them late in the evening. The former practice is adopted during a general dry season when wide areas of veld become useless for herding. The length of time that the animals are allowed to remain out grazing each day varies with the quality of the pasture. The quality of the grazing around the Kavirondo Gulf depends upon the season of the year. In winter when there is much rain, cattle remain on the pastures for a very short time, roughly about seven hours; whereas in summer, they may remain as long as twelve hours. Sheep and goats remain on the pasture for about five to six hours in winter and in summer for about seven hours a day. These animals are usually herded together with the unweaned calves. Weaned calves go with the main herd of cattle unless owing to climatic conditions or disease they are somewhat debilitated.

During the night cattle are brought in and tied up with ropes inside the kraal. Bulls, oxen and strong cows are tied near the gate while young beasts are tied in the centre. Goats, sheep and young calves are stabled in a stable where a smouldering fire made from dry cow or goat dung is kept every night. At sunrise they are brought out and tied in the sun in front of the stable until herding time.

An intelligent cattle-owner usually castrates all the bulls that he thinks are useless for stud purposes and keeps only one good one for breeding. The effect of this good bull on the herd is often spoilt by casual services from bad bulls belonging to less progressive people in the village who think they will be noticed and honoured when their bulls run after cows. As a rule a bull is not allowed to serve its mother or sisters, although this may happen when there is no unrelated bull in the herd. Expert owners usually castrate bulls before they are allowed to run with their mothers and arrange the services of their female stock so that they calve at the beginning of the long rains. Unfortunately only a few people think of these methods of improving their herds.

When a cow calves about two days are allowed to pass while the calf is suckled before milking commences. The milk obtained from the cow during the first two weeks or until the umbilical cord of the calf drops, is all drunk by young men in the village. This milk is stored in a pot in which a little buttermilk, which has been treated with urine, has been placed. As mentioned before the Luo believe that drinking fresh whole milk is the cause of tapeworm infestation, and the buttermilk is added to the fresh milk so as to eliminate this danger. When the umbilical cord of the calf has dropped the woman who owns the cow is allowed to use the milk for churning butter. The roots of a plant known in Luo as *obuwo* is added to the churning calabash as a preserving agent because fresh milk is stored in the calabash for about twelve to twenty-four hours before churning. During the churning process a little bovine urine, which has been stored for a few days, is added to the milk to accelerate the formation and facilitate the separation of the butter. This urine is also believed to be a good preservative for both the butter and the buttermilk, which will be stored for use in cooking various kinds of food. On the day the first butter is made into ghee, a little of the ghee is fed to the calf and the rest eaten by a group of people in the house. The reason why a sample of the first ghee is given to the calf is not very clear; but some people say that it protects the calf from developing diarrhoea and indigestion when the later butter of the dam is boiled and made into ghee. They believe that otherwise the boiling of the butter during ghee-making would cause diarrhoea in the calf.

Milking is done twice a day, in the morning and evening, by the boys and young men. Girls, women and old men are only allowed to milk in homes where there are no young men. Before commencing milking, the calf is allowed to suck its dam for a minute. It is then tied in front of the dam while she is milked. After some milk has been drawn the calf is allowed to suck for another minute and then re-tied while more milk is taken. Finally, the calf is allowed to suck and stay with the dam for about an hour, after which it is separated from the mother for at least ten hours before the next milking.

If a cow is slow to wean her calf a method used for drying her off is to fix a muzzle (*osembo*) on which strong thorns are fixed around the mouth of the calf so that when it tries to suck, the thorns prick the dam and cause her to kick the calf away. Another device is to smear the teats of the dam with cow dung, the taste of which stops the calf from sucking.

If the calf dies, its hide is dried, folded properly and a little salt solution is sprinkled on it to make it taste pleasant when licked by the dam while being milked. Before milking, the teats are washed or cleaned with warm water to stimulate the milk flow.

Old cows which have stopped producing are usually killed and their meat exchanged for millet or maize which in turn is bartered for new young heifers, bulls, goats or sheep, or if necessary used for consumption. The same applies to oxen although these are usually exchanged directly for other stock. A heifer is usually worth two bulls or young oxen. The special oxen used by their owners as companions when they attend funeral mournings are seldom exchanged, but are slaughtered when they get old, the owners preparing special feasts as a tribute to their past service. A young man who has ridden a special ox at funeral dances does not eat the meat when the ox dies as a result of disease or accident. These "companions" are usually honoured by having bells fixed on special leather straps fastened around their necks. Some he-goats are also so honoured. The ringing of these bells will sometimes stop hyenas from entering the kraal and may help in tracing animals when grazing in bushy country. The ears of the owners are usually sensitive to the sound of the bells of their own oxen.

The Luo do not like polled cattle because some of them believe that such animals are unlucky. They say that if a polled animal is paid as part of a dowry the woman is likely to be sterile. They are very fond of oxen with long horns or those with peculiarly or funnily placed horns. During drinking parties the owners of such oxen "show off" by placing their arms in different positions to demonstrate the directions of the horns of their oxen. This performance is a sign of wealth because the average man does not possess a number of oxen with abnormally-placed horns. Long-horned cows are not of special value. The horns of dangerous animals are cut so as to reduce the risk of people and young animals being horned.

Beautifying animals by branding which is practised by some African tribes is not favoured by the Luo. The only method that is used to increase the natural beauty of cattle, especially bull calves, is to trim the ears. Trimming is, however, also done as a treatment for east coast fever because in this disease the animal appears dull and heavy as if suffering from headache, and the Luo believe that by letting a little blood from the ear the headache is eased.

Luo cattle-owners do not usually go in for special colours, but there are some colours which are considered objectionable. Pure white is not liked because white animals are usually susceptible to skin diseases, accidental skin lesions and to marking by tick-bites which usually remain permanently conspicuous. Another objectionable colour is striped, dark, dull-brown. Animals with these mixed colours are not accepted for dowry because the disagreeable colours may cause disagreement during the arrangement of the marriage or between the wife and her husband. Brown is unanimously favoured because it is considered resistant to skin diseases and accidental injuries.

Black and white or red and white are favoured in oxen used as companions during funeral dances and other ceremonies.

TREATMENT OF ANIMALS.

Although the Luo are ignorant of the use of specific drugs for the treatment of different animal diseases, yet, when an animal is suffering they make keen attempts to cure it. As a result of such trials, cures have been reported in east coast fever, anthrax, blackquarter, mange, etc. Sometimes the treatment of one disease is so complicated that it is impossible to tell what agent may have been effective. It is clear that in some diseases animals may recover after empirical treatment. In the case of east coast fever, the treatment consists of cutting the ear, cauterising the glands and pouring into the nose a liquid infusion of a plant known in Luo as *jandarusi*.* This drug causes a great deal of sneezing and is, therefore, said to free the blocked-up and congested sinuses. It is generally believed that many animals are saved by the use of this drug.

The Luo believe that they cure blackquarter by bleeding and by cauterising the affected quarter or even the whole body. Nowadays, some people who can procure potassium permanganate make large incisions of the affected part and rub in crystals or a saturated solution of the drug. Mange in goats and dogs is cured by washing the animals with tobacco infusion and the urine of cattle which has been stored for a few days. There are several drugs which are believed to be quite effective in expelling retained foetal membranes.

It is quite certain that the Luo have no method of immunising animals against diseases.

*See footnote to page 128.

OCCASIONAL NOTES.

CUSTOMS CONNECTED WITH SEA FISHING.

- (1) It is bad luck for a fisherman, on going out to fish early in the morning, to meet a one-eyed man. Should this occur no fisherman would proceed to sea.
- (2) It is bad luck for a fisherman to pick a fish up by its tail, for this is sure to bring very bad luck.
- (3) The owner of a "uzio" fish trap always places a small offering of food so that the spirits will bring plenty of fish into the trap. H.C.

NANDI BEAR AGAIN. The Game Warden received the following letter from Mr. H. K. Fell, Gallway, P.O. Kitale, dated 29th September, 1941, and forwarded it to be published in the Journal:—

"I received the *Field* of May 31st, just the other day. On seeing the picture of the pug marks of the Kerit or Chemosit, I showed it to a Nandi that I have working for me. He said: 'Yes, I have seen one.' So I asked him to tell me all about it, and this is what he told me.

"A Wanderobo had shot one with a poisoned arrow, just about where Captain Hislop reports having seen one. The Wanderobo told my Nandi, that he had known this one for sometime, as it had been in the habit of coming out into the road nearly every day at about 4 o'clock. This day he saw it, so climbed a near-by tree and waited for it to come close and he fired his poisoned arrow at it, hitting it. On being hit, it went into the forest and then came out again, trying to get the wind of him, then went back into the forest a little way and died. It was just shortly afterwards that my Nandi friends with others saw it.

"The description of it, as he gives it to me, is as follows:—

Size	...	...	Like a Great Dane dog.
Forehead	...	...	Like a man (short-haired).
Ears	...	...	Smaller than a hyaena and round.
Nose	...	...	Long like a dog, but not heavy.
Eyeteeth	...	...	Longer and bigger than lion.
Shape	...	...	Like a hyaena with longer legs (heavy forequarters).
Hair	...	...	Long, black, soft.
Mane	...	...	All the way down its back, also had a shaggy beard.
Tail	...	...	Like a donkey.
Feet	...	...	Not very big.
Claws	...	...	Like a dog, but the size of an antbear.
Sits up like a monkey.			

"I am sending this along to you although it happened some years ago, thinking it may be of some interest to you."

CONVERSAZIONE.

For the first time in its history, the Society, with the co-operation of the Museum Board of Trustees, held a *Conversazione* in the Coryndon Museum.

From 8-30 p.m. to 11 p.m. on the evening of the 15th October, 1941, the Society and the Trustees were the hosts to a number of invited guests, including His Excellency the Governor.

From 9 a.m. to 4 p.m. on the 16th October, the *Conversazione* was open to parties of school children and from 4 p.m. to 11 p.m. of the same day, the public were able to visit the exhibition.

Both evenings were well attended and at least 200 school children must have been conducted round the exhibits and had them explained.

For the occasion, the Central Hall had been cleared and special exhibits staged. For the purposes of this description, the exhibition will be divided into sections and not as they were arranged in the Hall.

THE BOTANY EXHIBIT.

(a) One large exhibit demonstrated the numerous uses to which the coconut tree and its fruit have been put by mankind. Coir, with its products such as mats, ropes, brushes, formed one side of the exhibit, whilst the other side was devoted to copra and its various uses. Samples of coconut oil and its derivatives, soap, candles and cosmetics, grated coconut meat, as used in confectionery, demonstrated the great uses copra has in the commercial world. Hydrogenated odourless cooking fats made from the crude copra oil were also on view. A native-made coconut-grater and strainer was also shown alongside the more modern type. Samples of coconut shells for ladles, bowls, and even for making a packing needle were also on view.

(b) *Kenya Succulents*.—A delightful miniature rock garden, with painted scenery as a background, was the chief feature of this exhibit. This little garden contained twenty-three species of Kenya succulents a number of which had been presented by Mrs. Copley.

(c) *Native Dyes*.—Samples of wool, dyed by means of indigenous plants were on show, with living specimens of the plants yielding the dyes. Full details of native names, the part of the plant from which the dye was extracted and the range of colours, helped to explain this most instructive exhibit.

(d) *An Exhibition of "Floatite"*.—The uses to which the kapok-like root bark of *Lannea alata* (known in the trade as "Floatite") were illustrated. Actual roots were shown with the "Floatite" growing, as well as its practical use in cushions, lifebelts, life-saving jackets, and mattresses.

(e) *The Giant Stinging Nettle*.—Dr. Leakey showed longitudinal and cross sections of the trunk of the giant nettles (*Obetia pinnatifida*) as well as fresh cuttings and photographs of the tree *in situ*.

The whole of the Botanical Section was in charge of the Museum Botanist, Mr. P. R. O. Bally, ably assisted by his wife.

COLLECTION OF FOSSILS FROM OLDOWAY GORGE, TANGANYIKA.

As a result of a recent expedition organised by the Honorary Curator of the Coryndon Museum, Dr. Leakey, the *Conversazione* was graced by an imposing exhibition of fossils from the Middle Pleistocene beds exposed at Oldway. The following fossils were shown:—

- (a) The skull of *Hippopotamus gorgops*.
- (b) One Tusk, one lower jaw and dentition of *Elephas antiquus recki*.
- (c) The horn core of *Bularchus arok*.
- (d) The skull and horn core of *Hippotragus* sp.
- (e) The skull and horn core of *Paleoreas* sp.
- (f) The upper and lower dentition of *Sivatherium olduvaiensis*.
- (g) The mandible fragment with teeth of *Afrochoerus nicoli* sp. and gen. nov.
- (h) The mandible fragment with teeth of *Koiropotamus majus*.
- (i) Teeth of *Hipparion albertensis*.
- (j) Teeth of *Hippotigris*.

In many cases skulls, teeth, etc., of present-day corresponding species were shown to enable the visitor to gain an idea of the size of these extinct animals. The fossils themselves represent animals that were living in East Africa at the time when stone-age men of the hand-axe culture were living in the country. Associated hand-axes were also on exhibition. It is good to know that this exhibition is now permanently in the Museum.

ENTOMOLOGY.

1. The first exhibit in this section was a double show case showing practically all the butterflies which can be collected in an area of ten miles round Nairobi. This had been beautifully arranged by Mr. Barton Eckett from the collections of the Museum, augmented by specimens from his own collection.

2. The second exhibit was also a double case, but this contained a collection of butterflies which had been collected on the Society's monthly ecological expeditions in the Karura Forest. This exhibit had been arranged by Mr. A. J. Wiley. The collection, which had been made between March-October, 1941, contained about sixty species.

FISHES.

In addition to the new show cases being on exhibition, with a new arrangement of the fish exhibit, there was an excellent show of fish in aquaria. The high light of the show was a seawater aquarium containing fishes from Malindi. One of the *Dasybates* and two silversides were shown for the first time in Kenya. A fine collection of ordinary *Lebistes* were shown, whilst directly opposite was an aquarium of the golden *Lebistes*. A male and female *Lebistes* with a two-weeks old brood was a great attraction as was also a collection of tiny goldfish. *Gambusia* and *Platypanchax playfairii* each had an aquarium to themselves. A rare exhibit was *Discognathus hindii*, whilst a small shoal of young *Tilapia nigra* were a pretty sight. The principal fish of a balanced aquarium were *Barbus nairobiensis* and another large aquarium contained some fine specimens of *Labeo thikensis* and *Barbus hindii*, two very typical Athi River fish.

This beautiful and instructive collection of fish was in charge of Major Cade, and the specimens shown were from his collection, Major Imbert's and the Fish Warden's.

VETERINARY DEPARTMENT.

The Veterinary Department displayed two exhibits, one being the first section of a series dealing with the classification of worms which it is intended to produce for permanent exhibition in the Museum. The case shown covered the phylum Platyhelminthes and was prepared by Miss B. L. Duthy, B.Sc., and Mr. S. I. Hassan.

In addition, two skulls and some photographs of the small, black, feral pig from Pemba Island were on view together with a skull of a modern domesticated pig for comparison.

GEOLOGICAL AND MINING DEPARTMENT.

This department put up an excellent and special display which was designed with the idea of showing the public what a number of minerals there were in Kenya, awaiting commercial exploitation. Not only were the crude ores and metals on show, but also the finished commercial products. The range and diversity of these products were certainly an education to the public. It is hoped the whole exhibit will be put on permanent show in the Museum.

AGRICULTURAL DEPARTMENT.

The exhibit of the Department of Agriculture demonstrated the methods employed in utilising introduced parasites for the control in Kenya of the common mealy bug *Pseudococcus kenyae* Le Pelley. A large map of Uganda showed the range of the mealy bug in that country and the localities in which various species of internal parasites were obtained and collected for

shipment to Kenya. A map of the Central Province of Kenya showed the area into which the mealy bug has been introduced and the extent to which it has spread. The liberations of various parasite species were indicated on this map, where it was shown that both the coffee areas and native reserves had received large numbers of liberations of all available parasites.

Living and pinned specimens of five species of parasites, all in regular production at the Scott Agricultural Laboratory, were shown, and the methods of rearing and liberation were indicated, with examples of the types of apparatus specially designed for these purposes. Actual oviposition by parasites in mealy bugs was demonstrated under the binocular microscope, and drawings of parasite eggs and larvae dissected from mealy bugs were shown. An important part of the exhibit was a large diagram showing in graphical form the weekly production of five species of parasites from September, 1938, to the present time, the numbers frequently varying around 10,000 parasites a week. Further figures were also given of approximately 1,200 hurricane lamp glass breeding containers always in use, and of a total of well over half a million parasites already liberated. No attempt was made in this exhibit to demonstrate any of the results of the work, though these have already not been inconsiderable.

BIRDS.

No special collections of birds were shown, but the Museum had on show a cabinet of birds' eggs and many of the schoolboys looked at the collection with envious eyes.

In addition to the specialised exhibits, there were a number of exhibits of a more general nature. In the botany room, an exhibition of nature photographs sent in by various people was staged and these were of great interest to photographers. A glowing patch of colour was a series of watercolour studies of Kenya birds by Mrs. S. Wilson. One or two were really exquisite and of an outstanding character.

In the main hall, there was a stand showing freaks of nature. A specimen of a two-tailed zebra; twisting elephant tusks; a bezoar stone from the stomach of a hippopotamus; a stomach stone of wood pulp; a freak greater kudu head; and other weird monstrosities were arranged for public view. These were loaned by the Game Department from their unique collection of such oddities.

Halfway up the staircase, where the lion usually stands, two small groups of Wakamba respectively demonstrated the making of fire by means of friction and the making of fine chains. These were of the greatest interest, especially to the school-children, but one elderly retired business man informed the writer that the firemaking show alone was worth going a long way to see, and he would have been quite satisfied if he

had seen nothing else. The making of fine chain was not so spectacular but of absorbing interest, showing very fine and ingenious craftsmanship.

Upstairs, the insect room had been converted into a cinema hall, where a cinematograph show was given with Mr. Duncan Fletcher in charge of the projector, whilst the Fish Warden gave a running commentary on the films. The first was a Game Department film entitled "Fighting Rainbows—A Day on a Kenya River," and the other was a Lt.-Col. Brown film in colour showing the Ripon Falls and then the Murchison Falls. This show proved so popular that it had to be run through twice on the public night by special request.

Under the supervision of Miss Attwood, the Honorary Treasurer of the Society, there was a display of the Journal, reprints available, and brochures issued by the Society. Judging by the numerous enquiries Miss Attwood received, the Society should have some useful new members.

One special feature was the illumination. Instead of the inadequate and dingy illumination of the Museum in the past, the whole place was a blaze of light and it is a pleasure to note that this is a permanent fixture and not a "flash in the pan" for the occasion of the *Conversazione*.

The pillars, staircase, some of the stalls, etc., were decorated with palms, ferns and flowering plants, which had been lent by Mrs. Hugh Copley and the Forestry Department.

The *Conversazione* was made all the more enjoyable by a number of ladies and members who acted as unattached guides, to see nobody felt at a loose end; these kind people must have been very tired when closing time came from the way in which their services were utilised.

The show was a great success and as one looked on the animated and really gay scene, one's thanks must go out to those who had worked behind in the work-rooms of the Museum for weeks beforehand, to produce such a well balanced, instructive and really beautiful show, and also it may interest the members to know, that the Museum was functioning "business as usual" by 11 o'clock next morning, after the *Conversazione*.

The best praise was from one member, who said: "This is a good show and you have got to have one every year from now on, for it will become an important annual function in the lives of the people of the Colony."

THE THIRTIETH ANNUAL REPORT OF THE EAST AFRICA
AND UGANDA NATURAL HISTORY SOCIETY, FOR THE
YEAR ENDING DECEMBER 31ST, 1940.*

The past year is the first the Society has experienced cut away from its obligations to the Coryndon Museum. It has been a most difficult year and the best that can be recorded is the fact that the Society has held its own and carried on its functions.

Membership, considering the times, has been maintained throughout the year; but every effort will have to be made to increase greatly the number of supporters for the work of the Society.

The Executive Committee met eight times during the year and despite the many extra duties of a military and civil nature which members carry, there was no lack of a quorum.

Changes occurred in the office bearers, both as Honorary Treasurer, Honorary Secretary and in the Trustees on behalf of the Society on the Museums' Board of Trustees. The situation at the end of the year had clarified itself and the following persons held office. The Acting Honorary Secretary was Hugh Copley, the Acting Honorary Treasurer was Miss K. Attwood and Dr. L. S. B. Leakey was the representative of the Society on the Board of Trustees. There is still a vacancy on the Board of Trustees and this will be filled at this meeting. The thanks of the members of the Society are herewith recorded to those officers who have carried on the affairs of the Society during the past year.

LIBRARY.

In these troublesome times the exchange of periodicals is both difficult and sadly interfered with; but it is remarkable that the exchanges for our Journal have been received at all and that the continuity of our records is being upheld. Mr. Gedye acted as Honorary Librarian during the year.

PUBLICATIONS.

A double number of the Journal was issued in August and another is ready for the press. Again there are many troubles to be surmounted in these days and members will readily appreciate the difficulties of the Journal Sub-Committee in their endeavours to get out to them a smooth and regular flow of Journals.

*The Editor regrets that through an oversight this report was omitted from the last number of the Journal.

ARCHAEOLOGICAL MEETINGS.

During the year a section of the Society was formed to study the prehistory of the Colony. It was arranged to have a monthly field excursion starting in April, 1940. After a survey of all possibilities, it was decided to devote the energy of these monthly excursions to the excavation of a site on the slopes of Lukania Hill. Captain Irvine, the owner of the land, most kindly gave permission for this work and showed great interest in the field operations.

These meetings occurred on the third Sunday of each month under the leadership of Dr. and Mrs. L. S. B. Leakey. A band of enthusiasts have done great work on this site and have already unearthed some 5,000 specimens of the Wilton B culture of the East African stone-age. All these specimens have been classified, catalogued and will form a valuable addition to the Archaeological Collection of the Coryndon Museum.

Before these excavations were undertaken the Wilton B culture was only known from sites in Northern Tanganyika, which make the excavations, still in progress, of a special scientific importance extending the range of the culture by several hundred miles. It is a great pleasure to be able to congratulate Dr. Leakey and his band of helpers on the results of their work and to thank Captain Irvine for allowing the work to be carried out.

NATURAL HISTORY EXCURSIONS.

Excursions were also organised, under the leadership of Mr. G. R. Cunningham van Someren, to make an intensive study of the flora and fauna of one locality. The site chosen was on the Stony Athi River and trips to this area were made on the first Sunday of every month starting in April.

Comprehensive collections of both zoological and botanical material were made and deposited in the Coryndon Museum. Fuller reports of these collections and of the work done, will be given to members of the Society in future issues of the Journal. The thanks of the Society are due to all who took part and to the staff of the Museum for their interest and help.

DONATIONS TO THE MUSEUM.

Changes have occurred in the organisation of the Museum and, as a result, specimens are required for the collections. Moths, insects of all kinds, birds and fish are urgently wanted and the members of the Society can and must help in this work. The Museum is still "our" Museum so let us try and make it the best museum we possibly can. No material of any kind will be refused; but it will be of the greatest help if anyone wishing to assist, will consult with the Acting Curator, Dr. Leakey, before beginning to work.

BOOK ON BIRDS.

An excellent suggestion was made to the executive Committee, the production or sponsoring of the production of a handy, pocket-sized book on the birds of East Africa. This was carefully gone into by the Committee and, although shelved for the time being, will be brought up again when better times come.

FINANCE.

It will be understood that the handing over of the assets of the Society to the Museum Board of Trustees has simplified the balance sheet of the Society. The accounts are presented this year as a simple statement of the receipts and the payments made on behalf of the Society. No attempt has been made to value the stock of Journals owned by the Society; but this will be done as soon as possible and a report made to the Executive Council.

The financial position looks strong; but members must remember that a number of the Journal, which should have been ready in 1940, has to be paid for, and this will sadly reduce this balance.

CONCLUSION.

In conclusion it may be repeated that there are, or there should be, two objectives before all members of this Society: firstly, a greater membership and secondly, collections for the Museum.

THE EAST AFRICA & UGANDA NATURAL HISTORY SOCIETY

CASH STATEMENT FOR THE YEAR ENDING 31-12-40.

	Shs. cts.
To Balance brought forward, 31/12/39—	
Cash as per Cash Book	90 10
Bank as per Pass Book	3,924 90
Cash at Post Office	1,205 13
Instalment from the Museum Trustees.	2,000 00
Subscriptions received as per Members' Register	4,035 00
Sale of Journals	251 50
Donations	21 00
	Shs. 11,527 63

NOTE.—It is expected that a part of the unaccounted-for balance will be traced.

	Shs. cts.
By Postages (Journals and Letters)	134 20
Audit (Messrs. Gill and Johnson)	100 00
Mr. Amin (Book-keeper)	100 00
Salary, Librarian (January/February, 1940)	200 00
Refund of Subscription	20 00
Subscription to Zoological Record	100 00
Journal (J. W. Junk)	147 63
Photographs for Journal	18 10
Exchange and Stamp Duty	10 50
Printing and Publication of Society's Journals, 1940	2,365 25
Payment for Plates for Journal issued in 1939	2,061 25
Subscription: Imperial Institute of Entomology	75 00
Paid to Trustees of the Museum as per agreement	1,000 00
Balance	5,195 70
	Shs. 11,527 63

N.B.—Cash at Bank, 31/12/40	3,917 77
Cash at Bank, G.P.O.	1,205 13
Cash in Hand	— —
Balance as per Books of the Society.	5,122 90
Balance unaccounted-for	72 80

NOTE.—No provision has been made to take in the assets of the Society as represented by the stock of Journals. It is proposed to have a complete stock-taking of these Journals as soon as possible and to present a statement of the actual numbers and value to the Society.

(Sd.) HUGH COPLEY,
Acting Honorary Secretary.
(Sd.) K. W. ATTWOOD,
Acting Honorary Treasurer.

EAST AFRICA AND UGANDA NATURAL HISTORY SOCIETY.

PUBLICATIONS OF THE SOCIETY :

THE FOLLOWING BACK-NUMBERS OF THE JOURNAL ARE AVAILABLE :

Journal No. 3	...	...	Shgs. 20/-	Journal No. 30	...	...	Shgs. 10/-
" " 8	...	...	" 10/-	" " 31/32	...	...	" 7/50
" " 13	...	...	" 20/-	" " 33/34	...	...	" 7/50
" " 14	...	...	" 20/-	" " 35	...	...	" 7/50
" " 15	...	...	" 10/-	" " 36	...	...	" 7/50
" " 17	...	...	" 5/-	" " 37	...	...	" 7/50
" " 18	...	...	" 5/-	" " 38/39	...	...	" 7/50
" " 19	...	...	" 4/-	" " 40/41	...	...	" 7/50
" " 20	...	...	" 2/-	" " 42/43	...	...	" 7/50
" " 21	...	...	" 4/-	" " 44	...	...	" 7/50
" " 22	...	...	" 5/-	" " 45/46	...	...	" 7/50
" " 23	...	...	" 5/-	" " 47/48	...	...	" 7/50
" " 24	...	...	" 5/-	" " 49/50	...	...	" 7/50
" " 25	...	...	" 5/-				
" " 26	" 6/-	Vol. XII, Parts 1—6, each			" 7/50
" " 27	" 6/-	Vol. XIII, Parts 1 & 2, each			" 20/-
" " 28	" 5/-	Vol. XIII, Parts 3—4, each			" 20/-
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by P. R. O. BALLY,

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Journal

OF THE

East Africa Natural History Society

OFFICIAL PUBLICATION OF THE CORYNDON
MEMORIAL MUSEUM
(MUSEUMS TRUSTEES OF KENYA)

June, 1942

Vol. XVI

Nos. 4 & 5 (73 & 74)

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EDITOR:

J. RICHARD HUDSON, B.Sc., M.R.C.V.S.

Date of Publication: June, 1942.

Additional copies to members: 7/6; non-members, 15/-.

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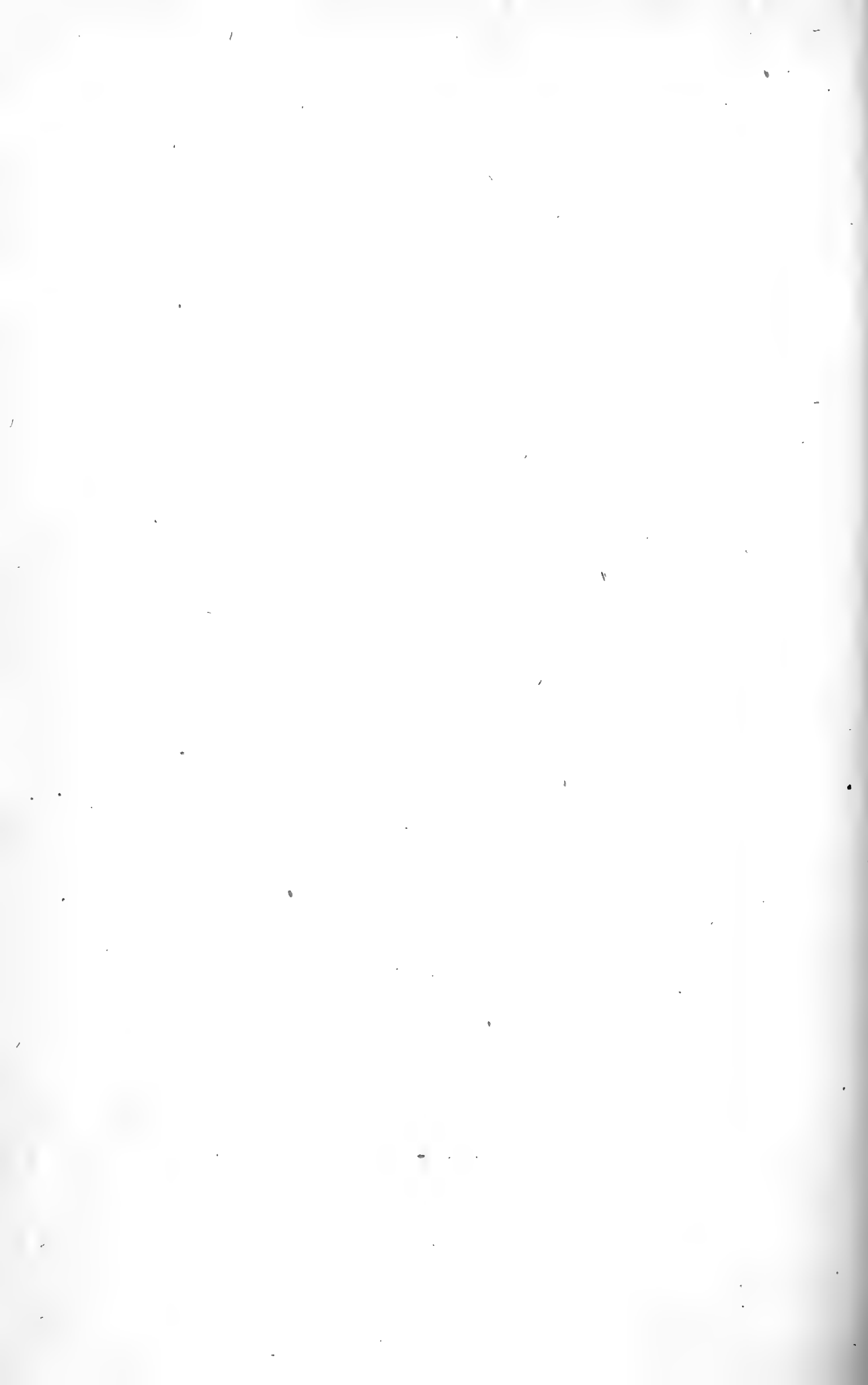
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EAST AFRICAN SUCCULENTS.

PART IV.

BY PETER R. O. BALLY,

Botanist, Coryndon Memorial Museum.

(ALL DRAWINGS AND PHOTOGRAPHS BY THE AUTHOR.)

PUBLISHED BY PERMISSION OF THE TRUSTEES.

N.O. ASCLEPIADACEAE.

In this order we find an extraordinary wealth of succulent forms; first rank among these is indubitably held by the large and interesting tribe of *Stapelieae*. Other succulent species are found among the genera *Ceropegia*, *Cynanchum*, and *Sarcostemma*.

This chapter gives a complete survey of the Stapeliads known to date from Kenya, Tanganyika, and Uganda. The short individual descriptions do not claim to be in any way complete as to every botanical detail; they are intended only to give the main and the most striking features of every plant; together with the numerous and carefully selected photographs they will enable the amateur to recognize these plants in the field and, — it is hoped — to stimulate his interest in this fascinating group.

The task could not have been undertaken without the active support of Miss Eileen A. Bruce of the Herbarium, Kew, who has described most of the recently discovered species, some with the author's collaboration.

Messrs. Alain White and Boyd L. Sloane's comprehensive publication "The Stapelieae," three volumes, published by Haselton, Pasadena, 1937, was also indispensable for the present survey, and the author has quoted freely from their admirable descriptions.

Special recognition must be given in this place to Mrs. Gwendolyn Copley; Capt. A. T. A. Ritchie, Game Warden for Kenya Colony; and to Mr. C. G. MacArthur, Assistant Game Warden; for their intensive and enthusiastic collecting in remote parts of the Colony, which resulted in the discovery of several new species, besides yielding much information on the distribution of the Stapeliads.

STAPELIEAE.

With their almost unlimited variety of form and with their strangely attractive flowers, the *Stapelieae* have arrested the attention of plant lovers more than any other group of succulents.

In the present brief summary there is no space to enter into a full description of their anatomic structure, their unique and complicated mechanism of pollination or into other interesting details; we refer our readers who seek more information on the subject to the above-mentioned monograph by White and Sloane. This excellent publication describes the world's *Stapelieae* very exhaustively, and it is magnificently illustrated.

The flower in the N.O. *Asclepiadaceae* is, however, highly specialized and for the assistance of those unfamiliar with its structure, a line drawing showing the names of the various parts is given opposite.

Stapelieae are at their best in Southern Africa, but in East Africa, too, they are well represented; out of twenty recognised genera, six are found in East Africa. They are:

- Caralluma* with sixteen species.
- Edithcolea* with one species.
- Stapelia* with one species.
- Duvalia* with one species.
- Huernia* with two species.
- Echidnopsis* with six species.

GENUS *CARALLUMA*.

This genus has been divided up into nine separate groups, four of which are represented in East Africa.

GROUP *Eucaralluma*.

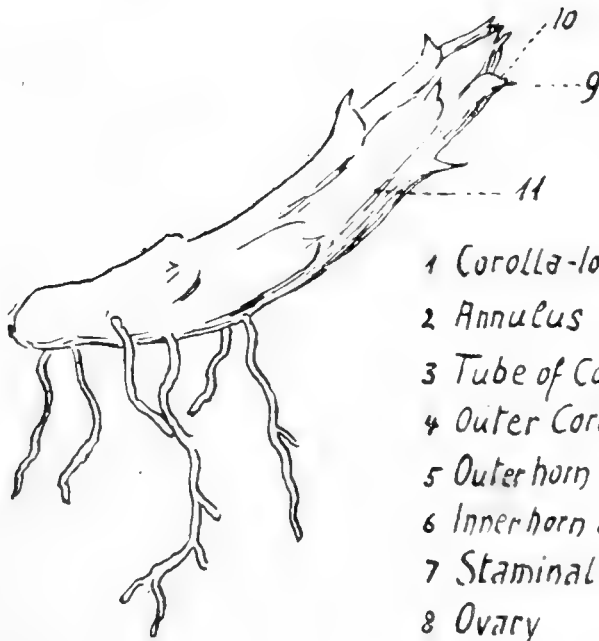
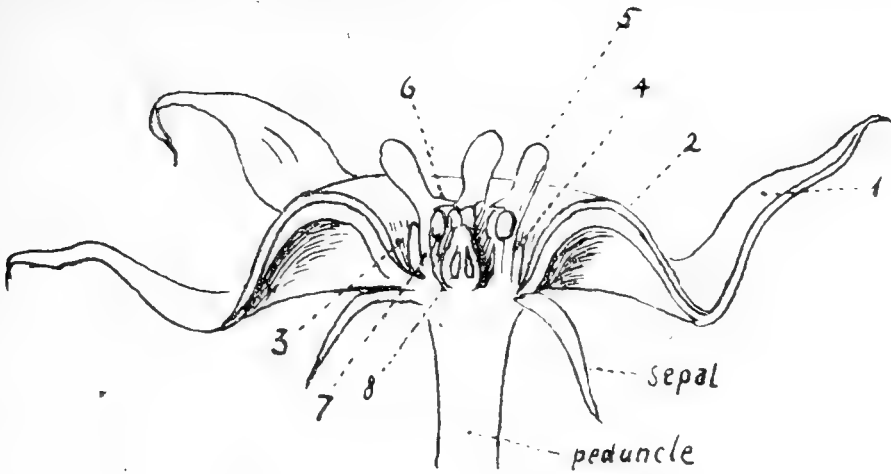
The group is characterized by the tapering stems which run into a long, slender point in the flowering stems.

Caralluma priogonium K. Schum.

Is the largest representative of this group; its flowering stems are up to 26 inches high. They are four-angled, with toothed margins, fleshy, up to 2 inches in diameter at their base.

Twenty or more stems grow from one-rooted plant. The root system is small and fibrous. The flowers are grouped in small fascicles of 4 to 5 along the upper tapering portions of the flowering stems; they flower in sequence. The five spreading corolla lobes are fringed with vibratile hairs. Their colour is a dark maroon at the base, variegated with a few white bands, and fading into a uniform purplish-olive towards the tips. The corona which is small and not very distinctive is purple.*

*In this and other descriptions, where the illustration with centimetre-scale shows the exact size of the flower or of other parts of a plant, reference to size and measurements have been left out.



- 1 Corolla-lobe
- 2 Annulus
- 3 Tube of Corolla
- 4 Outer Corona-lobe
- 5 Outer horn of inner Corona
- 6 Inner horn of inner Corona
- 7 Staminal column
- 8 Ovary
- 9 Rudimentary Leaf
- 10 Stem tooth
- 11 Groove between stem angles

The parts of a Stapeliad
based upon *DUALIA TANGANYIKENSIS*

The distribution of this species seems fairly limited. It was first collected in Tanganyika in the dry bush-country between the Western Usambaras and the Pare Hills, at 2,100 feet. It occurs apparently all around the foot of the Pare Hills (Kiurio, Makanya). In Kenya Colony, the only locality known so far is the Tsavo River, five miles east of Tsavo Station. Fig. 2.

Caralluma sp.

Perhaps only a variety of *C. priogonium*, this plant has smaller flowers. The corolla lobes are maroon except for white bands at the base; the marginal vibratile hairs are very sparse. The corona does not differ materially from that of *C. priogonium*. Collected by Capt. A. T. A. Ritchie, in Mariget, near Lake Baringo, and near Adable, in Tanaland, in 1940. Fig. 3.

Caralluma gracilipes K. Schum.

This and the following species of *Eucaralluma* are characterized by their sharply replicate corolla lobes. *C. gracilipes* is one of the smallest species of *Caralluma*. The erect stems are not more than $2\frac{1}{4}$ inches to $2\frac{3}{4}$ inches high; the flowering peduncles are about one foot long.

Little was known about the flower of this plant which was collected by Hildebrandt in 1878, and of which only one poorly preserved specimen remains in the Berlin Herbarium. Recently, the author has collected the plant again in the type locality, which was given by Hildebrandt as Kitui, Ukamba. Fig. 1 gives an accurate picture of a branch in bud and of the flower. The fleshy, quadrangular stems are toothed along the margin, and the teeth, though not very prominent, are well defined by the rudimentary lanceolate leaflets which crown them.

The narrow, pointed and sharply replicate lobes are uniformly purplish-green outside. When fully opened, the upper two-thirds of the lobe are replicate, thus showing the inner surface which is a dull-yellow, finely dotted with maroon spots. The fringing ciliate hairs are comparatively stout, club-shaped and set closely together near the base. Further up the lobe they are followed by very minute, sparsely set hairs with pointed tips. They increase in size towards the tip of the lobe. When in bud the corolla is inflated above the base, where it encloses the stalked corona.

Characteristic—and aptly expressed in its specific name—is the corona which is raised conspicuously high on the staminal column. The outer corona is dentate, the inner corona lobes are spatulate and tinged with purple at base and tip.

The species seems to occur exclusively in the Kitui District. Since its discovery no other locality has been reported. The author collected it on top of Mutomo Hill, Kitui District, Ukamba, at 3,100 feet altitude, on 19th January, 1942, and more recently Mr. MacArthur has obtained specimens on Zambani rock three miles east of Kitui. Fig. 1.

Caralluma spp.

There are a number of undescribed species of *Caralluma* which are closely allied to this species, although they have not the typically raised corona. The outer corona lobes are in most cases markedly bifid.

Their common characteristic is the corolla of five spreading, replicate lobes, which are speckled maroon in colour, fading to greenish-yellow towards the base. The spreading lobes give the flower an unmistakable "spidery" appearance. They have been collected in numerous parts of Kenya and also in Tanganyika; at present it would appear that they are varieties or local races of one and the same variable species, but more material needs to be compared before a definite classification can be undertaken. Fig. 4 (*Caralluma* sp. from Hola, Tana River. Flowering plant in cultivation).

Caralluma Turneri E. A. Bruce.

Very closely allied to the above "spidery flowered" species, this and several others have an almost identical corona. The main distinguishing feature lies in the corolla lobes, which are not spread out rigidly, but are pendulous, their bases being very narrow and apparently consisting of flabby tissue. The flowers have thus the appearance of little tassels. In growth, there is little to distinguish *C. Turneri* from the previously described *Caralluma* spp. In size, it is between *C. priogonium* and *C. gracilipes*. The stems are four-angled, acutely toothed, sometimes mottled with purple on a dull-green surface. The drooping corolla lobes are sharply replicate; they are pointed, very characteristic in shape, being widest about two-thirds of their length from the base. They are dark maroon with fairly large greenish-yellow spots. Varieties, or local races, occur which differ mainly in coloring; a uniformly dark maroon variety from Kacheliba has shorter and broader corolla lobes and the corona is slightly raised.

The species seems to have a comparatively wide distribution; it was discovered by Allen Turner on Homa Mountain, near Homa Bay, on Lake Victoria. It occurs on the western slopes of the Ngong Hills, near Nairobi, and also near Baringo, and on the Kacheliba Escarpment; there is no record of the plant having been collected outside Kenya Colony. Fig. 5.

Caralluma sp. nov. (Bally, S27):

This new species belongs to the "tassel-flowered" group; some distinctive features in growth and structure of the flower justify its description as another species. The stems and angles are definitely blunt-edged, and the teeth with rounded tips do not point upwards, but protrude horizontally from quadrangular stems.

The stems are grooved longitudinally and they are cross-shaped in section. The corolla lobes are very narrow and elongated, with nearly parallel sides, and with a mucronate tip. Their colour is purplish-maroon, shading to green towards the base. The shaded effect is produced by minute maroon spots which are crowded more densely towards the tips of the lobes. The base is fringed with stiff ciliate hairs, the whole length being covered with very minute purplish hairs. The corona is sessile; the outer horns are very short, the inner horns, spatulate with a constriction in the middle, are tinged with maroon.

This interesting species was discovered by Capt. A. T. A. Ritchie, near Lake Baringo, in April 1940, and, later, near Bura, in Tanaland. Fig 6.

Caralluma sp. nov. (Bally, S61).

This very distinctive plant combines some characters of most of the preceding species of *Eucaralluma*. Its size is small; the whole plant, including the flowering spikes being only 6 inches high. The quadrangular stems are blunt-edged and longitudinally grooved, the teeth are sharp and point upwards. The flowers grow in fascicles of two to three along the tapering portion of the flowering stems; they bloom consecutively.

The corolla lobes are pendulous and very broad, tapering abruptly to the tip; their colour is yellow, speckled with maroon. Their margins are set densely with minute vibratile hairs; at the base these hairs are scarce, stouter, and club-shaped.

The short-lobed corona is remarkable through being raised to over half the length of the flower on its inflated staminal column.

The outer corona has not developed the characteristic bifid horns; the inner corona lobes are as short as in *C. priogonium*.

The type locality for this plant is Archer's Post, in the N.F.D., Kenya Colony, where it was discovered by Capt. E. A. Peck, in December, 1941. Fig. 7.

GROUP *Umbellata-europaea*.

In this group the flowers are crowded in a dense cluster near, or at the blunt apex of the stem.

Caralluma retrospiciens var. *glabra* N. E. Brown.

This giant among the *Stapelieae* forms clumps of 6 feet or more in diameter, with thick, fleshy, quadrangular stems which attain a height of 4 feet.

The teeth along the acute edges are small, blunt, and fleshy, but well defined.

The inflorescence is very striking: it crowns the stem in a tight, spherical cluster, about the size of a tennis ball. It is composed of a great number of blackish-maroon flowers, which are in themselves comparatively small, about $\frac{1}{2}$ inch in diameter,

and which have spreading lobes. The delicately-shaped cherry-red coronas stand out like filigree against the black corollas.

This species was first discovered in Witu, in Kenya, and it has since been found to be comparatively widely spread all over the Northern Frontier District up to the Abyssinian border. The illustration shows a longitudinal section of a flowering branch. Fig. 8.

Caralluma tumbuctuensis N. E. Brown.

First discovered near Timbuctu, in West Africa, by Chevalier, this *Caralluma* was believed to be a West African variety of *C. retrospiciens*, owing to the similarity of the coronal structure.

It is now recognized, however, as a separate species, and in Kenya, it occurs side by side with *C. retrospiciens*. The growth of *C. tumbuctuensis* brings it much nearer to *Caralluma speciosa* with which it agrees in having continuous horny margins to the stems and thorny teeth; in fact, when not in flower, it is hardly possible to distinguish the two latter species in the field.

C. tumbuctuensis forms clumps; the four-angled stems attain barely more than 1 foot in height. The flowering head is spherical, and composed of 120 to 140 individual flowers which are just under 1 inch in diameter; the five-lobed corolla is greenish-yellow, but it is so closely dotted with maroon papillae that the effect is that of a nearly uniform maroon. The lobes are densely fringed with club-shaped maroon vibratile hairs. The long recurved outer corona lobes are bifid and they stand out conspicuously by their lemon-yellow colour. The inner corona horns are deltoid and point towards the centre; they are speckled with maroon dots.

So far *Caralluma tumbuctuensis* has been collected at Archer's Post and on the Kamasia Plains in Kenya Colony, but judging from its occurrence in West Africa, it is probable that its distribution in East Africa is wide. Fig. 9 (drawing of a cultivated plant with poorly developed inflorescence).

Caralluma speciosa N. E. Brown, syn. *Caralluma codonoides* K. Schum.

While resembling *C. tumbuctuensis* very closely in habit, the difference in the inflorescence is very marked; fully open it measures nearly 5 inches across. The corolla is much larger, about 2 inches in diameter and deeply cup-shaped. The lobes are a uniform deep maroon, and the cup-shaped tube ranges from orange to yellow. A local form found at Magadi has a speckled-maroon zone between the lobes and the yellow tube. The pale lemon-yellow corona has characteristic bifid outer lobes which are flattened close against the tube.

C. speciosa is the most widely distributed species of this group in East Africa; it occurs from Italian Somaliland through Kenya Colony to Tanganyika, where it is found in very dry country at low altitudes. Some localities recorded are:—Kenya Colony: Magadi, 1,900 feet; Maktau, 1,800; Ndara, 1,800 feet; foot of Sagalla Hill, 1,800 feet. Galmagala and Balambala in Tanaland, about 1,500 feet. Tanganyika: Kiurio, between Usambara and Pare Hills, 1,800 feet. Fig. 10.

Caralluma foetida E. A. Bruce.

Closely allied to *C. speciosa*, this is a much smaller plant, growing only 4 inches to 5 inches in height. The quadrangular stems, about $\frac{3}{4}$ inch thick at the base, have horny, toothed margins.

The inflorescence forms terminal, closely set heads composed of 30 to 50 flowers and measuring about $1\frac{3}{4}$ inches across. The individual flowers are $\frac{1}{2}$ inch in diameter; their corolla is blackish-purple, papillate on the inner surface. The corona is not unlike that of *C. speciosa*, but the bifid outer corona horns are erect. The double seed pods or follicles are always parallel, touching along their full length, thus distinguishing this plant from all other East African *Stapelieae* which have more or less widely diverging follicles.

The plant was discovered by W. J. Eggeling on the Moroto River, Karamoja, in Uganda.

GROUP *Ango*.

Is well represented in East Africa. The members of this group have their flowers not in terminal umbels, but solitary, or few together; or in fascicles at the tip and often along the sides of the stems. The stems are four-angled, often mottled purplish-red, with stout, conical, pointed teeth.

Caralluma Dummeri (N. E. Brown) White et Sloane.

Is a small, succulent herb up to 5 inches high, with quadrangular stems bearing well developed tapering teeth. The stems are mottled dark-green on pale-green during the wet season and during periods of growth; but the mottling turns purple during drought. The flowers are developed along the stems, preferably near the apex. They are large compared with the size of the plant, and measure about $1\frac{1}{4}$ inches across the five pointed lobes. The greenish-yellow surface is studded densely with white papillae, each bearing a stiff, erect hair. The corona with pointed, bifid, outer corona horns is ivory-white.

This species is widely distributed over East Africa; it is possible that man has contributed to its present distribution, for many native tribes cultivate it for obscure medicinal purposes. The localities where the plant is found in Uganda (Bukoba, Kampala, Mengo) seem to indicate that the plant does

not occur there in the wild state, but only in cultivation. In Kenya Colony, *C. Dummeri* seems more widely distributed; it is common in most of the drier districts at medium altitudes between 2,400 feet to 5,500 feet. Lukenya, 5,500 feet; Mwingi (Kitui), 4,000 feet; Stony Athi, 5,400 feet; Sultan Hamud, 4,000 feet; Thika Falls, 3,800 feet; Taveta (Latema Hill), 3,400 feet.

In Tanganyika Territory: Manjara Escarpment, 3,800 feet; Ngaruka, 3,800 feet; Soko Plains (between Kilimanjaro and Pare Hills), 3,000 feet.

The above localities are only those recorded in the Herbarium of the Coryndon Memorial Museum, but it is certain that they cover only a small part of the actual distribution of *Caralluma Dummeri*. The illustration shows particularly well the curious radiating effect produced by the transparent bristles crowning the papillae on the corona lobes. Fig. 11.

Caralluma subterranea Bruce et Bally.

This plant, discovered by the author as late as November, 1938, in the Ngong Hills, near Nairobi, seems to have a wide distribution as well as a great variability. It is one of the smallest and least conspicuous members of the group. It is characterized by long, subterranean rhizomes which are apparently perennial, while the stems showing above ground seem to be annual or at least less persistent. Since 1938, the plant has been collected in many other parts in Kenya, and Fig. 1231 in White and Sloane's "Stapelieae," showing an unidentified *Caralluma* from Shinyanga, Tanganyika Territory, collected by the late B. D. Burt in 1937, is without doubt *C. subterranea*.

In almost every locality the plant shows slight variation in growth, coronal structure and length of peduncle. The plants in the Ngong Hills rise rarely more than 2 inches from the ground, and the rhizomes are especially well developed. Few flowers are developed at a time. A variety which occurs in the Ngorongoro crater, in Tanganyika, has stems up to 4½ inches high, the rhizomes are much less developed, and up to fourteen buds have been counted with three flowers in bloom simultaneously. The colour of the flower also varies considerably, and apparently is not dependent on locality.

Flowers with dark-maroon lobes are often found side by side with others of a pure lemon-yellow, including the corona. The length of the peduncle varies from nought in the practically sessile flowers from Ngong Hills, to three lines in the variety from Sagalla.

The corolla is up to ¾ inch in diameter, with tapering, pointed lobes which are covered with very minute silvery bristles. The corona varies in length and in the number of horns of both outer and inner coronas.

The wide distribution of *C. subterranea* may be judged by the following recorded localities:—Kenya Colony: Gilgil, 6,500

feet; Longonot, foot of hill, 6,000 feet; Ngong Hills, 6,000 feet; Mbagathi, 5,400 feet; Narok District, 6,000 feet; Syabei Gorge, 6,000 feet; Uaso Nyiro, 6,000 feet; Ulu, 6,000 feet; Sagalla Hill, Onjika near Kisumu, 3,600 feet. In Tanganyika, the plant is found at the bottom of the crater of Ngorongoro, 5,100 feet; probably on Mount Kitumbeini, as well as in the Shinyanga District, 3,600 feet. The illustration shows a richly flowering plant from Ngorongoro in two colour varieties, in cultivation. Fig. 13.

Caralluma subterranea Bruce et Bally (var. *minutiflora*)?

In Mbagathi, near Nairobi, and on Juja Farm, there occurs a variety with sessile flowers, a much reduced corona, only $\frac{1}{2}$ inch in diameter, and in which the corona shows a distinct feature in having papillate inner corona horns. Fig. 12.

Caralluma Baldratii White et Sloane?

The plant shown in Fig. 14 is tentatively identified as this species. Although comparative material of *C. baldratii* is not available at present, White and Sloane's description shows that there are some distinguishing features between the two. The growth of both plants seems identical: fairly slender, four-angled stems with tapering, nearly horizontal teeth, their tips pointing upwards. The structure of the flowers shows some differences. The flowers of *C. Baldratii* are sessile, while those of the plant from Kenya Colony have a peduncle $\frac{1}{4}$ inch long. The coronal structure of the Kenya specimen answers very well to White and Sloane's description. The colouring of both plants, however, differs considerably; White and Sloane's flower has dark, mahogany-coloured corolla lobes, while the corona is described as being blackish-purple with cherry-red. The Kenya plant has dark, carmine corona lobes, which contrasts beautifully with a golden-yellow corona. If we bear in mind the considerable variation in length of peduncle and in colour shown by *C. subterranea*, we are tempted to assume that the plant discovered in Kenya is but a variety of *C. Baldratii*, known hitherto only from the high plateau near Asmara in Eritrea, many hundred miles to the north.

The Kenya specimen was discovered by Capt. A. T. A. Ritchie, in Baringo, 3,400 feet, in April, 1940. Fig. 14.

Caralluma vibratilis Bruce et Bally.

This species, although apparently widely distributed over East Africa, escaped discovery until recently.

The following short description is extracted from a description published by E. A. Bruce and P. R. O. Bally in the *Cactus Journal of America*, Vol. XIII, No. 11, November, 1941. The specific epithet "vibratilis" aptly describes the flower which is characterized by the mobile clavate hairs fringing the corolla

lobes. *C. vibratilis* resembles closely *C. subterranea* in its habit of growth and, like the latter, develops long underground rhizomes. The corolla is a dark purplish-maroon within, minutely spotted with yellowish-green, whilst outside it is greenish, tending to purple towards the tips of the lobes; in the campanulate form of the corolla tube the species is most nearly allied to *C. venenosa* and *C. sacculata*, in both of which the lobes are subequal to the tube.

The corona in *C. vibratilis*, however, is rather different from those in either of these species. It is dark-purple in colour and more or less spherical in shape, the lower half being cup-shaped, whilst the lobes arise from the upper edge; the outer "lobes" are divided into two small, blunt, erect teeth, whereas the inner lobes are entire and broadly linear, curving over the anthers and touching one another, so completing the "sphere."

In Kenya Colony, the plant was discovered by Capt. A. T. A. Ritchie, near Mariget, on March 25th, 1940, and simultaneously, on the same date, by Mr. C. G. MacArthur at Athi River Station, 5,000 feet. It also occurs nearby at Embakasi, where it was collected by Miss MacDonald. Later, it was collected near Nanyuki, by Mrs. Joy Bally.

In Uganda, *C. vibratilis* was collected on the flats of Lake Albert, by Mr. W. J. Eggeling.

In Tanganyika, the plant occurs also; it is cultivated at Mtotohovu, Moa, by Col. Boscawen. Fig. 15.

Caralluma distincta E. A. Bruce.

This remarkable species has a very characteristic tubular corolla. The pointed lobes with reflexed margins are suberect and the fully-developed flower appears thus to be only half open.

The structure of the corona is typical of the genus *Caralluma* and analogous to that of *C. venenosa*, but the inner horns are laterally more compressed and supplied with dorsal horns.

The growth is comparable to that of *C. piaranthoides*, inasmuch as the procumbent stems are linked together in a sequence of loose joints. They are cylindrical in cross section, with well developed, tapering teeth.

C. distincta was first discovered in the Uмба Steppe, in Tanganyika, by P. J. Greenway, Systematic Botanist at the Agricultural Research Station at Amani, and collected more recently in Kenya Colony near Kosi, in Tanaland, by Capt. A. T. A. Ritchie. Fig. 16.

Caralluma tubiformis Bruce et Bally.

"This new species is closely allied to *C. distincta*; both have the comparatively long campanulate corolla tube and more or less erect corolla lobes with reflexed margins. *C. tubiformis*,

however, differs in the smaller flowers which are dark purplish-maroon within and green outside with raised maroon markings; the lobes and upper part of the tube are covered with long, fine, white, downward pointing bristles which direct the insects to the essential organs of the flower and are thus an aid to pollination. The outer corona is interesting as it is divided into five very pronounced, deep, sack-like pouches. The habit of the species, in the erect, four-angled mottled stems with well developed teeth, is similar to that of *C. Dummeri*, but slightly sturdier. The form of the corona closely approaches that of *C. sacculata* and only differs in that the interior corona lobes are not erect at the tips but are horizontally inflexed over the anthers. The tubular corolla and the erect four-angled branches are also comparable to *C. sacculata*, which must be considered to be the nearest ally of *C. tubiformis*. The only known locality for this plant is Archer's Post, in Kenya Colony, on rocky ground. It was discovered by Mrs. Gwendolyn Copley in December, 1939."—(Description reprinted from the *American Cactus Journal*, Vol. XIII, No. 10, October, 1941.) Fig. 17.

Caralluma commutata Berg.

In general habit this species is not unlike *C. subterranea*, although no rhizomes are formed. The size of the flowers is the same, and also its general appearance, but a closer inspection shows that the corolla lobes are glabrous, and rugulose on the inner face. The corona is fundamentally different in structure, the outer corona being bowl-shaped with five bluntly rounded and slightly indented corners. The inner corona has its outer lobes adnate to the corners of the outer corona, with an abrupt, two-toothed tip incumbent over the anthers. The colour of the corolla varies from orange-brown to nearly pure-green; the corona is cherry-red.

The type locality for this plant is not definitely known; it is supposed to be in Southern Arabia. If this assumption is correct this little *Caralluma* has an unusually wide distribution; it occurs in Uganda, where it was collected by J. W. Eggeling on Lake Albert flats in Bunyoro. In Kenya, Capt. A. T. A. Ritchie found it in Mariget in the Baringo Area. Fig. 18.

Caralluma piaranthoides Obermeijer.

This interesting *Caralluma* shows an annular thickening of the corolla disk, which suggests a possible relationship with the genus *Stultitia*. The corolla with its comparatively short, pointed lobes is papillate on the inner surface; it is bright-yellow, and dotted with wine-red spots. The corona, five-lobed, but appearing to be ten-lobed, is irregularly toothed, and slightly convex. It is cream- to salmon-coloured, minutely spotted with red. The four-angled stems with pointed, tapering

teeth are up to 4 inches high, they are of trailing habit, linked together, and thus forming long chains, rooted at intervals.

Until recently *C. piaranthoides* was thought to be confined to Southern Rhodesia; in December, 1939, however, the species was collected near Fort Portal, Uganda, by Mrs. Joy Bally. Fig. 19.

GENUS *EDITHCOLEA*.

This genus is entirely East African; the two known species occur in Socotra, and in British Somaliland, Kenya, and Tanganyika respectively.

Edithcolea grandis N. E. Brown.

Is the largest flowered and the most strangely beautiful East African stapeliad. In Kenya, it bears the very apt name "Persian Carpet Flower." The spreading corolla measures to 5 inches across. It is broadly five-lobed halfway to the centre, the lobes terminating in recurved tapering points.

The lobes are bordered with clavate, vibratile hairs, not only along the outer margins, but also along the line which separates them from the disk.

The lobes are purple-brown without markings, often shading into a dull-green or sulphur-yellow towards the tip, with a peculiar velvety surface.

The spreading disk has a lemon-yellow surface with an intricate pattern of purplish-maroon dots which are fused into concentric rings in the central tube, and into irregularly-shaped patches towards the edge.

The tube is about $\frac{1}{4}$ inch in diameter; it encloses the corona which is comparatively small and differs in structure from that of the genus *Caralluma* through the dilated inner corona lobes with a peculiar spiny or tuberculate upper surface.

The stems are trailing, erect at their tips only, five-angled and glabrous. The angles are armed with hard, yellowish-brown, very acute, spine-like teeth. They branch freely. The flowers grow singly from near the tips of the branches.

Edithcolea grandis is widely distributed over East Africa; it extends from Somaliland through British Somaliland, Abyssinia, and Kenya Colony into Tanganyika, and in suitable localities of low rainfall and at low altitudes it is sometimes extremely common; it is usually found in the half-shade of low-spreading thorn bushes. Fig. 20.

GENUS *STAPELIA*.

The genus *Stapelia* is characterized by the outer corona consisting of five separate lobes which are free to their base.

While Southern Africa is extremely rich in species—over one hundred have been described, and these separated into ten

well defined groups—there is only one species known to occur in East Africa to date.

Stapelia semota N. E. Brown.

This belongs to Section I, the *Stapelluma* group, which stands closest to the genus *Caralluma*.

It is a decumbent, fleshy plant, with four-angled stems and acute, slightly recurved teeth. The corolla consists of five long, tapering lobes, separated down to the raised disk, both corolla and disk having a rugose surface. The margins are fringed with ciliate hairs. The diameter is up to 2½ inches. The spreading outer corona lobes are variably denticulate at the apex; the inner corona lobes are horizontally incumbent over the anthers, sometimes without any processes, sometimes toothed at the apex.

The colour variation of this species is unusually wide: Flowers of an almost uniformly dark-maroon with only a few golden-yellow specks in the upper half of the corolla lobe (var. *Molonyae*) are most common in the Nairobi and Machakos Districts, and near Thika. Plants with a mottled corolla, in which maroon and yellow are about equally balanced occur in Tanganyika, near Kondoa Irangi, the type locality, where the species was discovered by the late B. D. Burtt, in 1931.

Pure-yellow varieties have also been found near Nairobi, and an attractive sport with a pale-lemon corolla contrasting with the dark-purple corona is known. Fig. 21 (maroon variety). Fig. 22 (pure-yellow variety).

GENUS *DUALIA*.

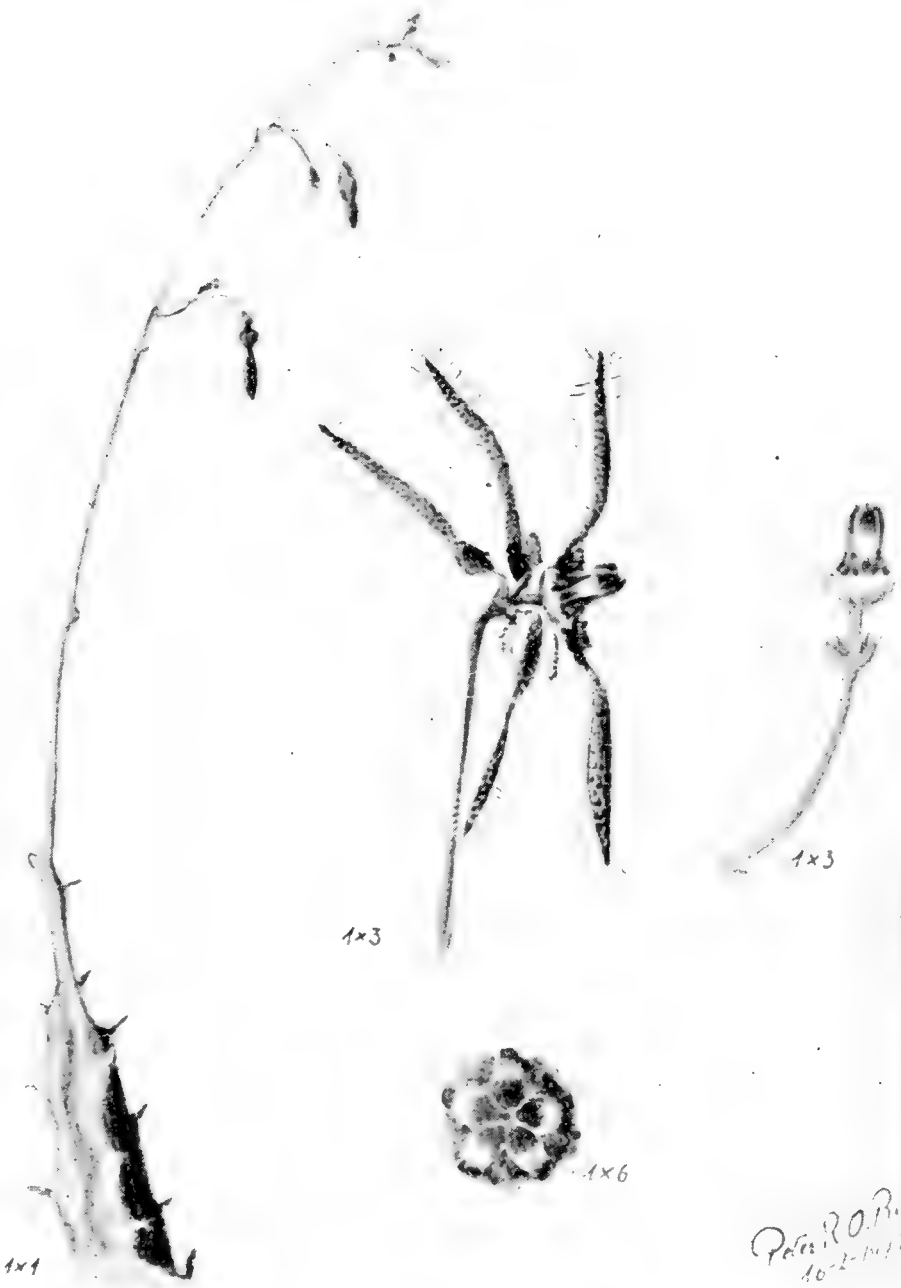
The outer corona of this genus forms a solid disc; another typical feature of many *Duvalias* is the raised annulus surrounding the corona.

On the whole, *Duvalia* seems limited to South Africa with fifteen species. So far only two species have been collected outside South Africa; these are *Duvalia sulcata* from the Hadramaut in Southern Arabia, and *Duvalia tanganyikensis*. With the exception of these two isolated species the northern limit of the genus is that of *Duvalia polita* in Ngamiland.

Duvalia tanganyikensis Bruce et Bally.

This newly discovered species is the first record of a *Duvalia* in Tanganyika Territory and forms an interesting addition to the distribution of the genus. *D. tanganyikensis* is most closely allied to *Duvalia polita*, but it differs in the narrower, more acuminate corolla lobes which are salmon-pink in colour, the glabrous, deep wine-red annulus, and the small, blunt stem-teeth which are more widely separated from one another.

PLATE 43.



Caralluma gracilipes K. Schum.
Mutomo Hill, Kitui-District
"mwelia" (Kamb)

FIG. 1. *Caralluma gracilipes* K. Schum.

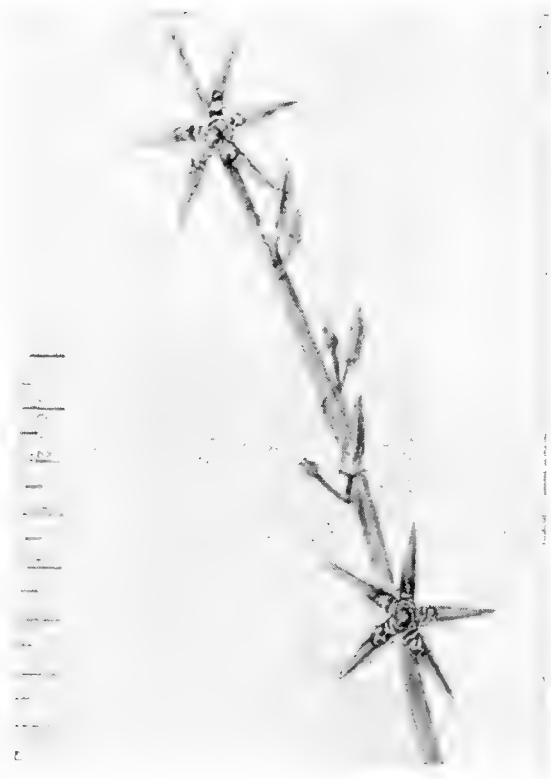


FIG. 2. *Caralluma priogonium*
K. Schum.



FIG. 3. *Caralluma* sp.
nr. *C. priogonium*.



FIG. 4. *Caralluma* sp. (Bally, S63).

PLATE 45.

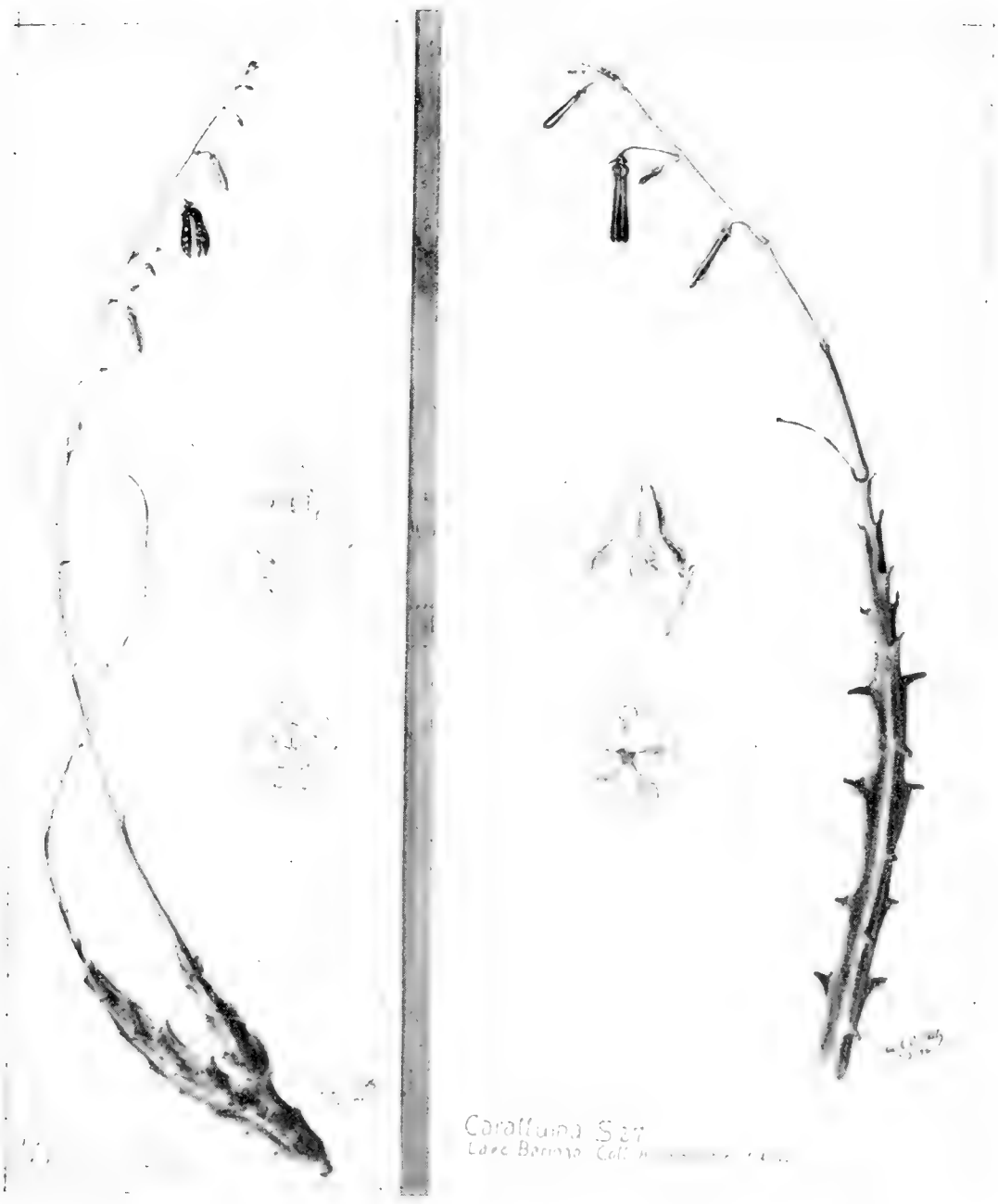


FIG. 5. *Caralluma Turneri*
E. A. Bruce.

FIG. 6. *Caralluma* sp. nov.
(Bally, S27).



FIG. 7. *Caralluma* sp. nov. (Bally, S61).



FIG. 8. *Caralluma retropiciens*,
var. *glabra* N. E. Br.



FIG. 9. *Caralluma tumbuctuensis*
N. E. Br.



FIG. 10. *Caralluma speciosa* N. E. Br.

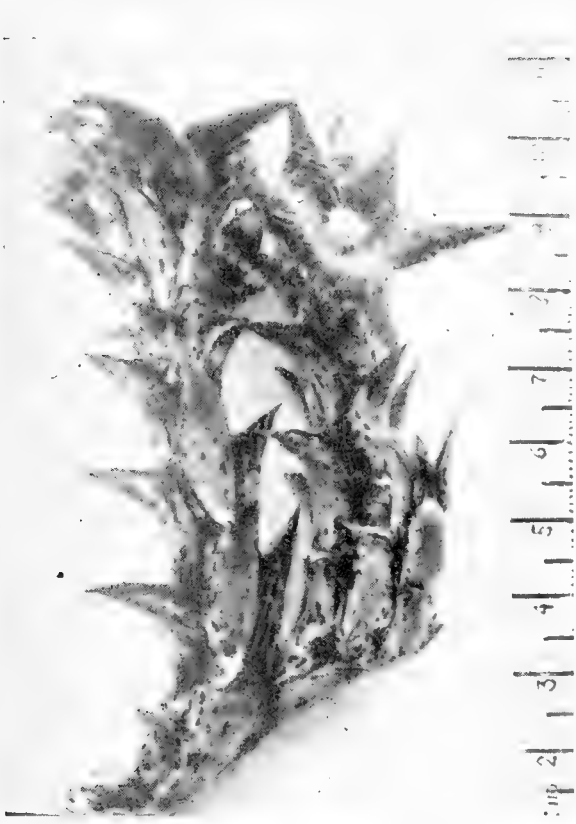


FIG. 11. *Caralluma Dummeri* (N. E. Br.)
White et Sloane.

FIG. 12. *Caralluma subterranea* Bruce
et Bally (var. *minutiflora* ?).



FIG. 13. *Caralluma subterranea* Bruce et Bally.

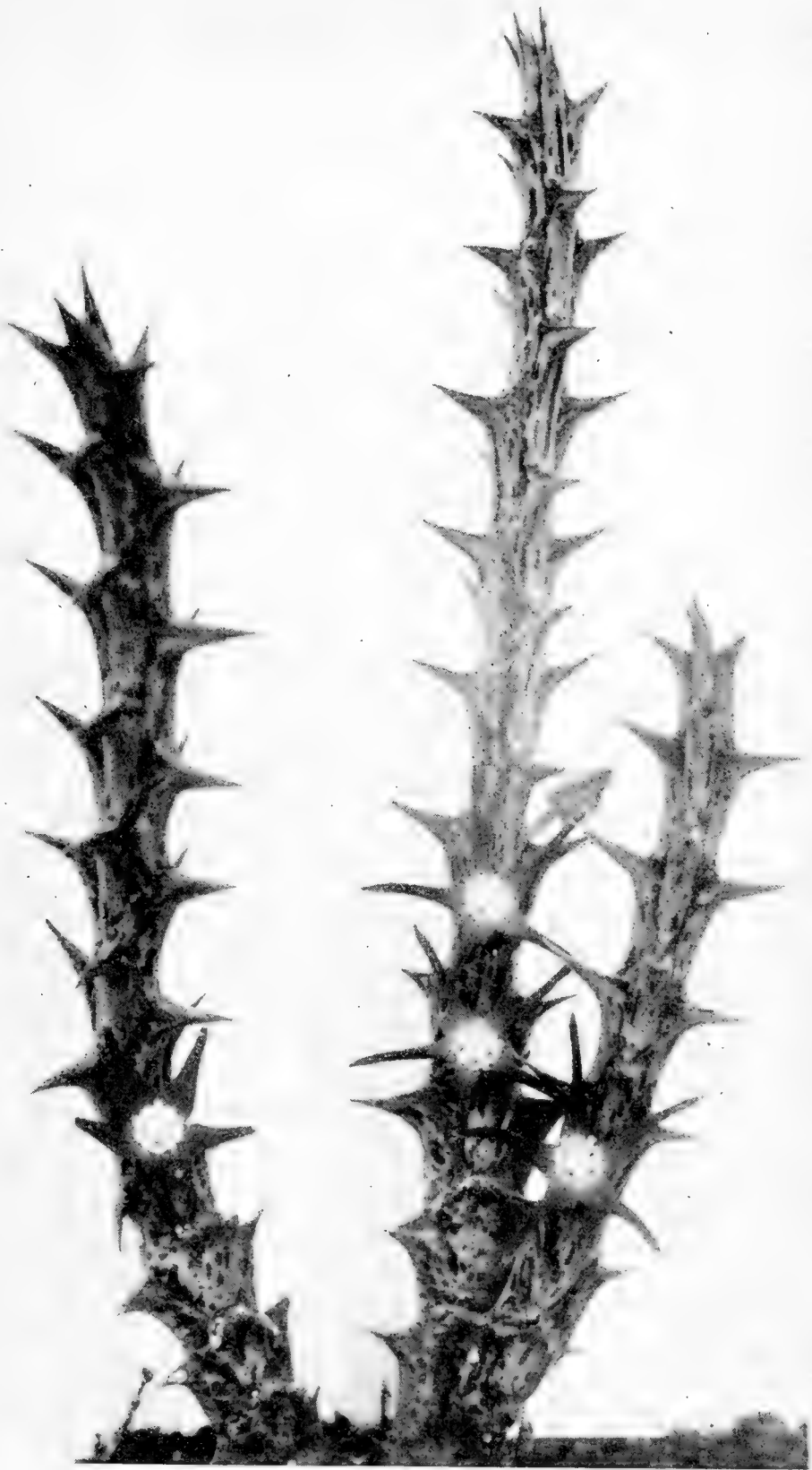


FIG. 14. *Caralluma Baldratii* White et Sloane.



FIG. 15. *Caralluma vibratilis* Bruce et Bally.



FIG. 16. *Caralluma distincta* E. A. Bruce.



FIG. 17. *Caralluma tubiformis*
Bruce et Bally.



FIG. 18. *Caralluma commutata*
Berg.

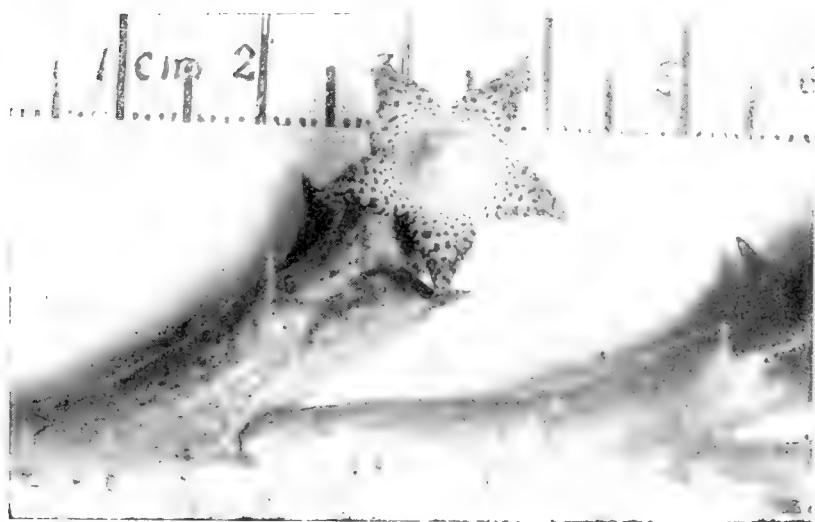


FIG. 19. *Caralluma piarantoides* Obermeijer.



FIG. 20. *Edithcolea grandis* N. E. Br.

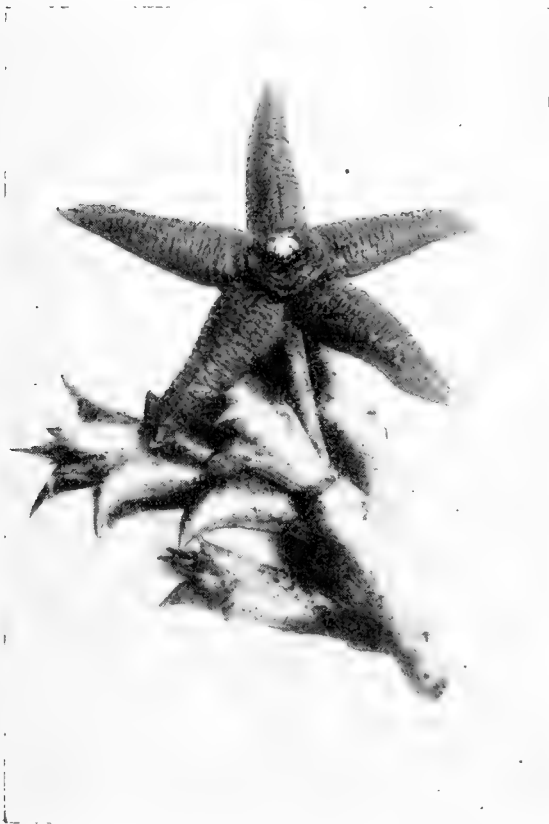


FIG. 21. *Stapelia semota* N. E. Br.
(maroon variety).



FIG. 22. *Stapelia semota* N. E. Br.
(pure-yellow variety).



FIG. 23. *Divalia tanganyikensis* Bruce et Bally.

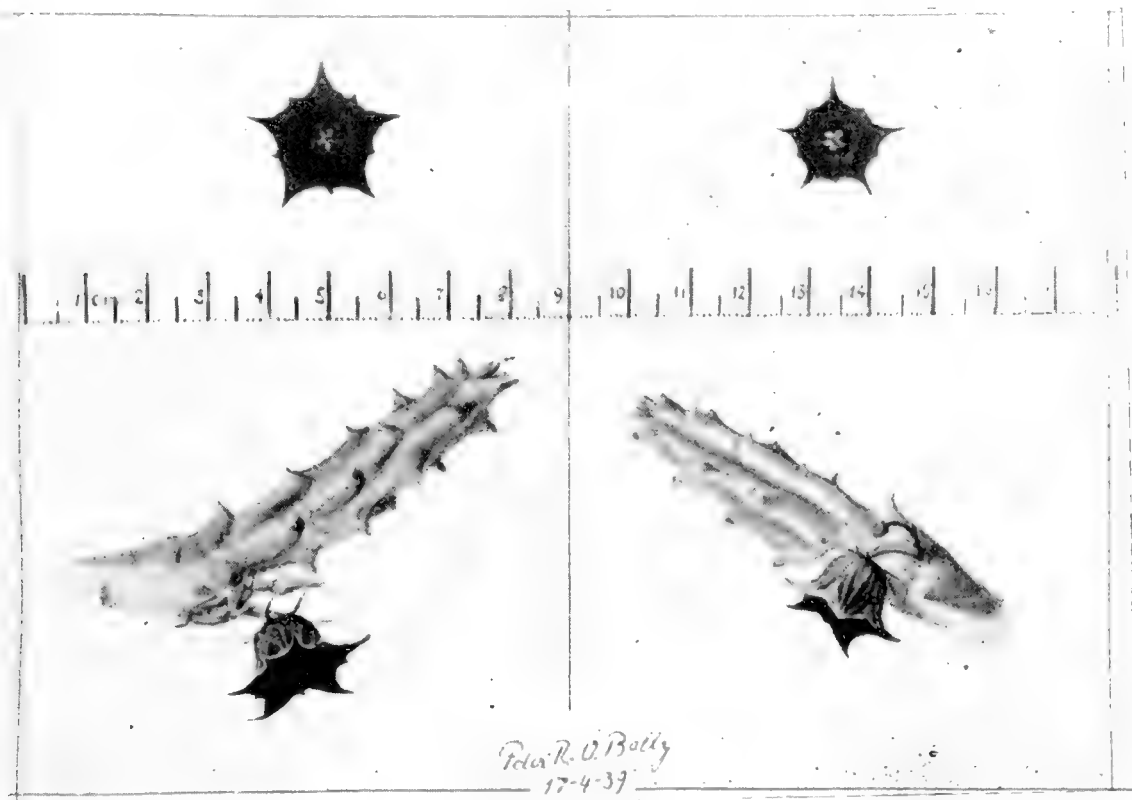


FIG. 24. *Huernia aspera* N. E. Br.

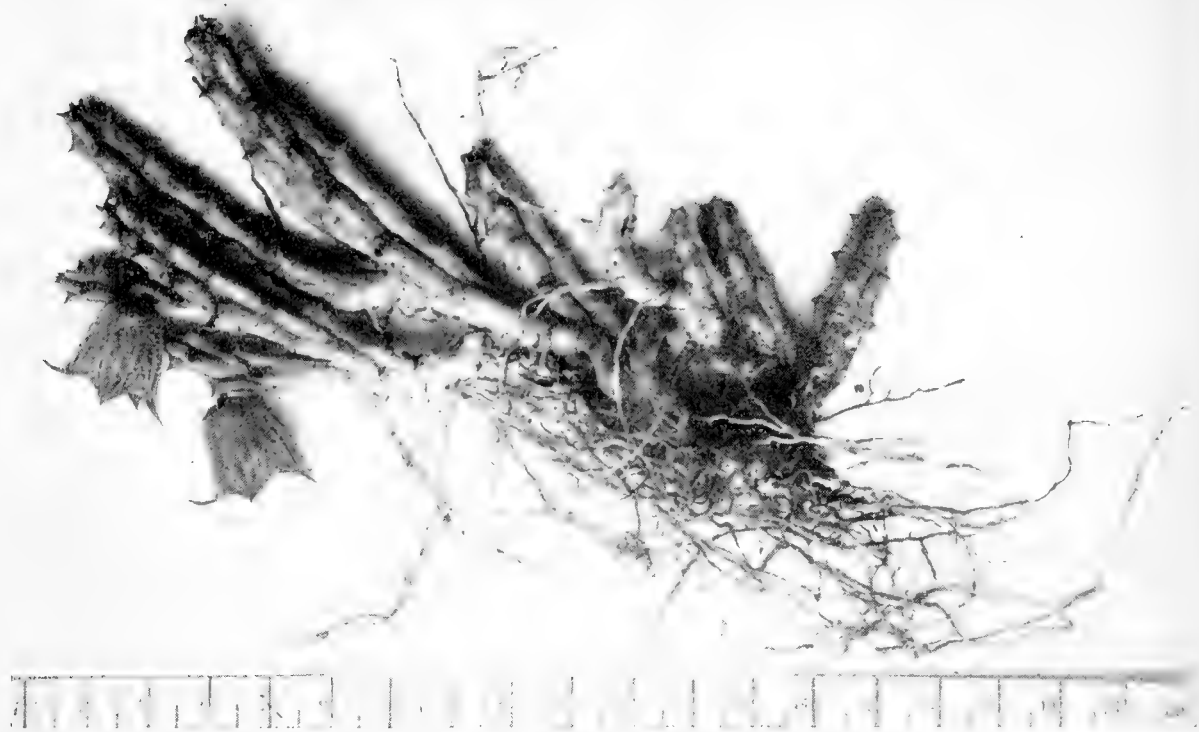


FIG. 25. *Huernia keniensis* R. E. Fries.

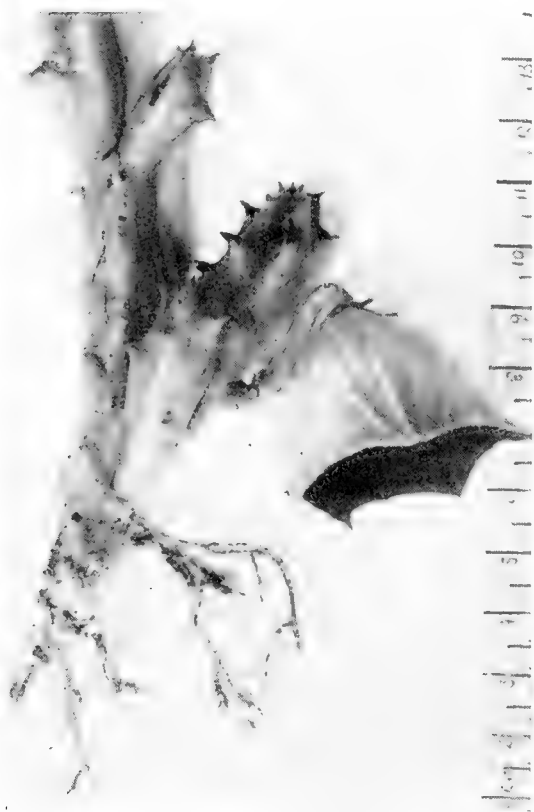


FIG. 26. *Huernia keniensis* R. E. Fries.
var. *nairobiensis* White et Sloane.



R. R. B. 11

FIG. 27. *Echidnopsis Sharpei* White et Sloane.



FIG. 28. *Echidnopsis angustiloba* Bruce et Bally.

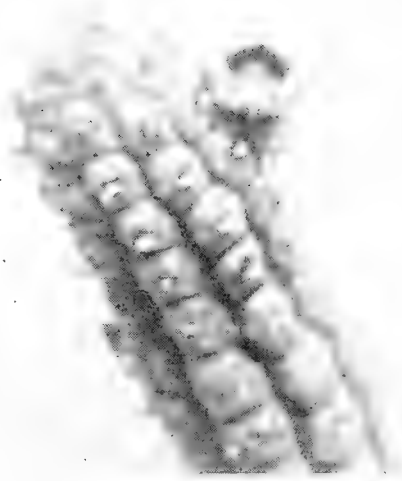
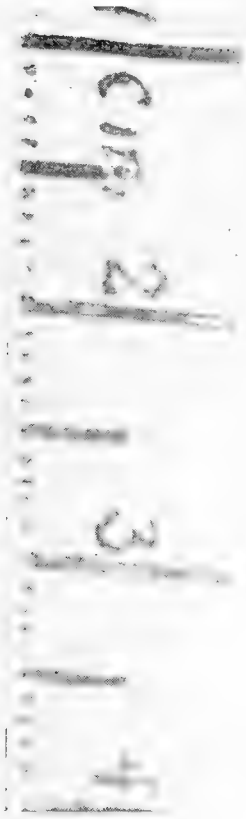


FIG. 29. *Echidnopsis* sp. nov. (Bally, S47).

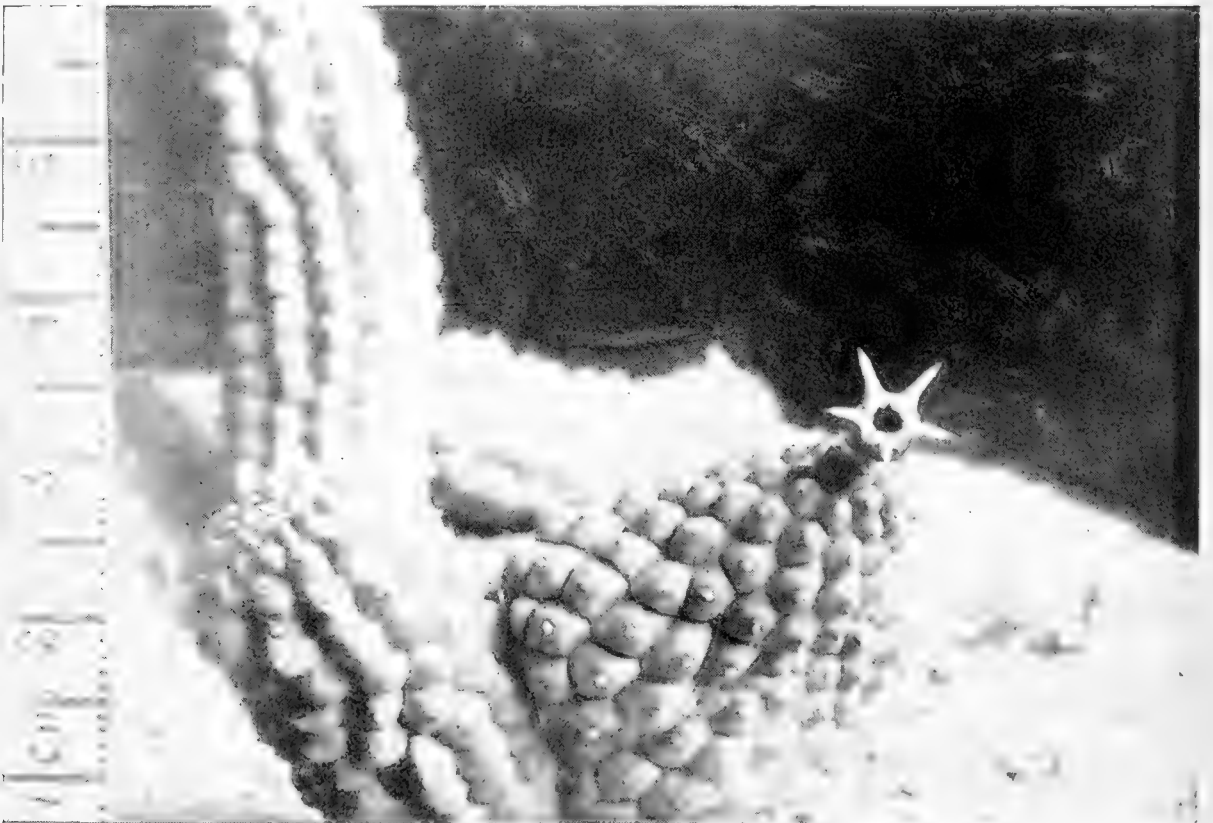


FIG. 30. *Echidnopsis* sp. nov. (Bally, S49).



The stems are decumbent, sparsely branched, four-angled with obtuse teeth rooting where the long trailing branches are in contact with the soil; in general appearance the growth is not unlike that of *Huernia aspera*. The flowering growths are developed near the apex of the stems; they are up to 2 inches long, growing as the flowers are developed in fascicles at the apex.

The flowers develop in pairs.

The species was discovered by the author on Mount Longido in Tanganyika Territory, on March 9th, 1939. Fig. 23.

GENUS HUERNIA.

In this genus the outer corona is sessile, or adnate to the base of the corona, or it is entirely absent. About fifty species are known, most of them from South Africa; they have been sub-divided into five distinct groups.

The two East African species are closely allied to one another, and it has been suggested that they represent varieties of a single species; they belong to group I, the *macrocarpa-brevirostris* group, in which the inner corona lobes are incumbent on the anthers and not produced above them.

The corolla is ten-pointed, the conventional five lobes being supplemented by five smaller points at the sinuses.

Huernia aspera N. E. Brown.

The corolla is campanulate, $\frac{3}{4}$ inch to 1 inch in diameter, with the pointed lobes bent slightly backwards at the tip. It is about $\frac{1}{2}$ inch deep. Outside it is a dull greenish-purple, rough with numerous small-pointed papillae. Inside it is uniformly blackish-purple and densely covered with papillae. The outer corona is closely adherent to the corolla, annular, narrow, blackish-purple, and hardly visible. The inner corona has five erect lobes, their tips very slightly upturned and contrasting vividly by their yellowish-orange colour.

The flowers, developed in small fascicles from the stems, as a rule appear successively.

In habit, *Huernia aspera* is decumbent, the trailing stems often reaching a considerable length. Stems 4 feet long and more have been measured. They branch sparsely and irregularly, are five-furrowed, and have very slightly raised angles. The teeth hardly protrude, are pointed, and are crowned with non-persistent rudimentary leaves.

The distribution of *H. aspera* reaches far inland from the coast of Tanganyika and Kenya, including possibly Zanzibar. It occurs in the Bura Area, in the Chyulu Hills, on Emali, and it is common along riverbeds on rocky ground near Nairobi. Fig. 24.

Huernia keniensis R. E. Fries.

This species was discovered in 1922, much later than the foregoing by the botanist brothers R. E. and Thomas Fries, at the foot of Mount Kenya. It differs from *H. aspera* by the shorter, thicker and more erect stems, by the larger and deeper corolla, and by the blackish-purple inner corona, which, is, however, very similar in structure to that of the latter.

The size and shape of the corolla seems to vary greatly; in the plant from the type locality the depth of the campanulate corolla is about equal to its diameter, the sides of the tube being nearly parallel. Plants found at the foot of Mount Elgon have a far more spreading corolla, its depth being only half of the diameter across the tips of the lobes. The inner surface of the corolla is covered with papillae which are considerably larger than those of *H. aspera*.

Since its discovery, *H. keniensis* has been collected in other localities, such as Kabarnet, and Mount Elgon, 6,000 feet. Fig. 25.

Huernia keniensis var. *nairobiensis* White et Sloane.

This species has a larger and more cone-shaped corolla. The outer surface is more scabrid and the inner surface is covered with very small, closely set, papillae, which give it a velvety appearance. The colour is a rich reddish-purple. This variety is known from the Ngong Hills, 6,000 feet; from Kajiado, 5,300 feet; from the Siybei Gorge, 6,000 feet; and from Baragoi, 2,500 feet. Fig. 26.

GENUS *ECHIDNOPSIS*.

This genus of, as the name aptly indicates, "viper-like" Stapeliads, is distributed over Southern Arabia, Socotra, and Tropical and South Africa. Up to 1937, eight species only had been described (see White and Sloane's Monograph on the *Stapelieae*).

To-day we know of five species in East Africa alone, and it is more than likely that this number will be further increased with more intensive collecting.

The *Echidnopsis* are dwarfs among *Stapelieae* not only in growth, but also in the diminutive size of their flowers.

The stems of this genus are decumbent as a rule, although species with erect growth have been found, and the six-angled to thirteen-angled tessellate stems trail snake-like on the ground. The flowers are developed in the grooves of the cylindrical stems, mostly towards the tip, but occasionally at other points along the stems. According to Dr. Brown, the genus cannot be distinguished technically from *Caralluma* by its floral structure, but as all the species are well characterized by their peculiar many-angled tessellate stems, it is more convenient to keep them generically distinct.

Echidnopsis Virchowii K. Schum.

The decumbent stems are tessellate, six-angled, up to five lines thick, and 4 inches to 6 inches long. The minute flowers are dull greenish-yellow, dotted with purplish-brown merging into entirely purple-brown towards the apex of the lobes. They are three and a half lines in diameter. The outer corona is cupular, rising to half the height of the corolla, and to the height of the inner corona lobes, which are deltoid and extend horizontally towards the centre, but not beyond the back of the anthers. Characteristic are the cup-shaped pouches formed by the outer corona.

Echidnopsis Virchowii was discovered in 1890, by Hildebrandt, near Tanga, in Tanganyika; it is common on Lasa Hill, near Mkomazi, also in Tanganyika.

Echidnopsis Sharpei White et Sloane.

This new *Echidnopsis*, small-flowered like all other members of the genus, attracts the eye by the bright ivory-coloured outer corona which is raised above the corolla-disc surrounded by the five slightly recurved, spreading, and dark-crimson corolla lobes.

The diameter of the corolla is just under $\frac{1}{3}$ inch. The growth is similar to that of *E. Virchowii*, but the tessellate stems are eight-angled, their surface a duller greyish-green.

Echidnopsis Sharpei was discovered by H. E. Sharpe in 1937, South of Lake Rudolph. It has been collected since in several localities in Tanaland. Fig. 27.

Echidnopsis repens Dyer et Verdoorn.

This little plant is closely allied to the two previously-described species. It has the eight-angled stems of *E. Sharpei*, and the flowers are of the same size. With *E. Virchowii* it shares the cup-shaped corolla. The coronal structure is very near that of *E. Virchowii* from which it differs by having a few long hairs on the outer corona, and by the entire tips of the deltoid inner corona horns.

The plant was discovered by J. Erens, a member of the Pole-Evans Central and East African Expedition, in 1938, near Mount Meru, in Tanganyika.

It has since been collected by C. G. MacArthur on Latema Hill, near Taveta, 3,300 feet; and near Maktau, 3,400 feet; in Kenya Colony.

Echidnopsis angustiloba Bruce et Bally.

This species differs from other members of the genus in the erect, eleven-angled to thirteen-angled, much-branched stem, in the profusion of simultaneously developed flowers, and in the narrow, elongated corolla lobes. The many-angled erect stems show affinity to the genus *Trichocaulon*, but the structure of the outer corona excludes it from that genus. The plant is greyish

olive-green in colour; the rudimentary leaves are reddish. The slender corolla lobes are pale lemon-yellow with a greenish tinge, whilst the central portion shows a regular, star-like pattern of dull-maroon. The flat corona is lemon-yellow. The outer corona has an undulate margin, the inner corona lobes are deltoid and their processes are prolonged beyond the anthers and meet in the centre.

E. angustiloba was discovered by Mrs. Gwendolyn Copley, near Archer's Post in the Northern Frontier Province, Kenya Colony, in December, 1939.

The illustration shows the type specimen (immature). Fig. 28.

Echidnopsis sp. nov. (Bally, S47).

This undescribed species shares the eight-angled, decumbent stems with *E. Sharpei*, from which, when not in flower, it is hardly distinguishable. The floral structure, however, is entirely different.

The corolla is deeply campanulate, showing a slight constriction at the base of the lobes which are narrow, semi-erect, and subequal to the tube.

The tube is reddish-purple, the lobes pale lemon-yellow. The outer corona with two-horned lobes spreads horizontally; the inner corona lobes are semi-erect and their long, filiform horns meet above the raised anthers.

This new species was discovered by Capt. A. T. A. Ritchie, 30 miles west of Garissa, 1,000 feet, in January, 1940. Fig. 29.

Echidnopsis sp. nov. (Bally, S49).

This is another undescribed species; it shares the multi-angled, deeply tessellated stems of *E. angustiloba*. The corolla has a nearly spherical tube markedly constricted at the base of the elongated lobes which are slightly longer than the tube and blunt-tipped. The tube is purplish-red, the lobes are lemon-yellow. The outer corona lobes are erect, irregularly dentate and raised to the height of the anthers. The deltoid, inner corona horns are narrow and project above the centre of the corona. It was collected by G. Adamson, on Mount Nyiro, South of Lake Rudolph, in May, 1940. Fig. 30.

With this description we close our survey of the recorded East African *Stapelieae*.

The numerous discoveries of new species made in recent years make it certain, however, that many additions will have to be made before anything like a complete record has been achieved. The author has in cultivation several *Stapeliads* from various parts of Kenya Colony, which have not yet flowered, and which are not included here.

The succulent forms evolved by the order of *Asclepiadaceae* are not limited to the tribe of *Stapelieae*; succulents are found among the interesting genus *Ceropégia*, in the genus *Sarcostemma*, and in *Cynanchum*. These will be dealt with separately at the beginning of Part V of this series.

(TO BE CONTINUED)

SOME NOTES ON THE NESTING HABITS OF THE YELLOW-BREASTED SUNBIRD, *EUCINNYRIS VENUSTUS FALKENSTEINI* (FISCH. AND REICHW.).

BY F. L. VANDERPLANK, B.Sc.,

Old Shinyanga.

The Yellow-breasted Sunbird (*Eucinnyris venustus falkensteini*) (previously described in Swynnerton's Key as the Kenya Yellow-bellied Violet Sunbird, *Cinnyris venustus falkensteini* Fisch and Reichw. and by other authors as *Cinnyris venustus niassae*) is distributed according to Roberts from West to East Africa, southwards to Nyasaland and Eastern Southern Rhodesia. The author found while motoring through the Rhodesias that they were well distributed and common as far south as Bulawayo, also they appear well distributed throughout Tanganyika, although perhaps not so common as some of the other species of sunbirds.

The writer first noticed a pair of these birds about his garden at Old Shinyanga (Tanganyika) during December, 1940, where they seemed fond of visiting the numerous *Zinnia* flowers, and later aloës (*Aloë mwanzana* Christian).

However, it was a surprise when early in March, 1941, the female commenced building a nest, less than two yards away from the sitting-room window. When first observed the apex of the future pendant nest had already been constructed by intertwining numerous pieces of grass and fine threads of bark around the stem and leaf stalk. The site had been chosen in the middle of a small oleander (*Nerium oleander*) bush, fifty-nine inches from the ground. The nest was woven from the top downwards and the outside structure was completed on the first day. All the work was done by the female, the male watched and accompanied her to and fro, and was seen to pass pieces of material to her in the garden. However, he did not bring any pieces to the nest, but perched in the neighbouring bushes between one and three yards away. The female continued bringing material throughout the day, except for a period of two hours from 11-30 a.m. till 1-30 p.m., and for a short spell (about twenty to thirty minutes) during the early morning and late afternoon.

On the second day work was continued lining the nest with fine grasses and down from hawkweeds. On the third and fourth days the nest was lined with small feathers. Subsequent

examination revealed that a total of fifty-nine feathers had been used and of these, thirty were between one and one and three-quarters inches in length, all from domestic fowls; and twenty-nine smaller feathers from fowls and probably other birds. (All the latter were white downy feathers.) The female had brought pieces of material at intervals of every two minutes, and since she worked from 7 a.m. to 11-30 a.m. and 1-30 p.m. to 6 p.m., this would account for 240 pieces per day. The nest was later taken to pieces and each blade of grass, bark, and other material was counted. Approximately 600 (± 100) pieces had been used. Naturally, while taking the nest to pieces some of the blades of grass broke, these were not counted, since the remaining half was counted later as the nest was disentangled.

The birds were active around the nest for several days after it was completed, but no eggs were seen. Some days later the birds were observed to be carrying feathers to another part of the garden and a second nest was found hanging from a bougainvillea branch, four feet above the ground. Subsequent examination showed that this nest had been constructed with 550 (± 100) pieces of material. It was covered on the outside with pieces of bark stuck together with cobwebs.

A day or two later the nest was found to contain one egg, and the second egg appeared by the next day. Unfortunately, the writer had to go away on safari at this time and so was not able to continue his observations. However, on returning ten days later only one egg remained and this hatched on either the fourteenth or sixteenth day (depending whether the surviving egg had been the first or the second to be laid). The writer was away again and the next time he noticed the birds was May 14th, when he observed the youngster flying around after its mother and receiving food at intervals.

On May 16th, the writer saw the same female (only one pair of this species has ever been observed in the neighbourhood of the writer's garden) perched on a branch of a shrub, *Tecoma stans*, less than one yard away from the gauze covering the sitting-room window, and two yards away from the first nest. She was weaving a grass around the branch at a leaf-stalk junction. Her offspring and mate were perched in a nearby bush watching. She returned at short intervals (one, two or three minutes) and soon had the apex of a new nest completed. The outside "frame" of the nest was completed by the end of the day. On the second day the nest was lined with grass and completely lined with feathers by the end of the third day. The nest was five and a half feet above the ground level, and as on previous occasions the male followed the female around and watched, the youngster still followed the female around and received food from her occasionally. On the fourth day a few more feathers were added. Subsequent examination revealed

that the nest had sixty-two feathers and 580 (± 100) pieces of grass and bark-fibre. This nest was not covered with bark as No. 2 nest had been, but the outside grasses were bound together with cobwebs.

On May 20th, the fifth day, one egg was laid sometime in the morning before 10 a.m., and on the following day the second egg was laid. The coloration of these eggs was as already described in the *Birds of South Africa*, by Roberts; namely, greenish-white finely-speckled with pale lavender-grey, much thicker round the larger end, forming an indistinct ring. Only the female incubated the eggs, neither did the male bring food to her, but he occasionally came and observed the nest from branches about three feet away. The female was never observed to leave the eggs longer than fifteen minutes usually leaving them for several short periods early morning and late afternoon.

The incubation temperature was measured by inserting a thermocouple inside the nest and between the eggs, the galvanometer and the cold "point" of the thermocouple being inside the house. The temperature varied usually between 36.5°C. and 37.4°C., the lowest temperature was observed after the female had left the nest for ten minutes during the early morning, this was 34.2°C. when the outside temperature was 22°C. The highest temperature recorded was 41.0°C. at 11-30 a.m., probably the point of the thermocouple was in contact with the sitting hen.

The first egg hatched during the morning of June 3rd, after fifteen days' incubation, and the other had not hatched by mid-day on June 4th, but had hatched by 9 a.m. on June 5th, after fifteen and a half days' incubation. The female now left the nest more frequently and brought food at one and a half hour intervals to the youngsters. The male still followed his mate about, but did not help in bringing food at this stage. The first offspring (from nest No. 2) had now disappeared. On the third day, after the first egg had hatched, the adult male was observed to pass food to his mate in a nearby bush, it appeared to be a small insect. On the sixth day a rather extraordinary occurrence took place, a male Marico Sunbird (*Maricornis mariquensis*) was observed bringing food to the nest and feeding the young; the rightful parents made a great deal of noise and both made feint attacks upon the stranger, who persisted and fed the young. This was observed four or five times during the day. When the stranger left the female parent fed them, and at 5 p.m., the young refused food brought by the Marico Sunbird. They were then left unmolested the rest of the evening and the female parent brooded them as usual at night. The young were not heard to make any noises, as most fledglings do at this stage.

The next day the male Marico Sunbird returned and insisted on feeding the young birds, even chasing the rightful parents away. This continued the following day (the eighth after

hatching), but on the ninth day the parents were successful in chasing the stranger away. The young birds now required and received food at shorter intervals throughout the day.

On the tenth day the male parent was observed on several occasions to bring food and hand it over to the female a yard or so away from the nest. The food appeared to be small dipterous flies. The male was not observed to feed the young himself nor were the young fledglings heard to make any noises.

On June 14th, the twelfth day, it was noticed that the beaks of the young were now becoming elongated and they made a hissing sound like certain snakes when disturbed.

On June 15th, the young then had an obvious covering of "down" over their bodies and both male and female parents were observed to feed them with dipterous flies, some as large as house-flies.

On June 19th, my diary records that the young sunbirds were nearly fully-fledged, and on June 21st, they flew from the nest when disturbed. So they had taken eighteen and seventeen days from hatching until they left the nest. They returned to the nest each night and were still doing so on June 26th, and were fed by their parents daily in the open. The young birds and their parents were observed for several days about the garden after which they disappeared. The temperature in the nest was taken daily while the young birds were growing and varied within the limits given for the incubation of the eggs.

During January and February this year (1942), a pair of Yellow-breasted Sunbirds have been observed about the garden; perhaps the same pair as last year?

THE NAIVASHA FOSSIL SKULL AND SKELETON.

By DR. L. S. B. LEAKEY, M.A., Ph.D.,

Honorary Curator of the Coryndon Memorial Museum.

(PUBLISHED BY PERMISSION OF THE MUSEUM TRUSTEES.)

INTRODUCTION.

In 1928, I located a very rich prehistoric living site at the base of a cliff a few miles from Naivasha. No opportunity to excavate this site presented itself until December, 1939, when it was learned that a new alignment of the Railway was being planned, the embankment of which would be carried right through the occupation zone. The Railway and the Government were informed that the projected alignment would damage an important prehistoric site, and, since it was found impossible to alter the existing plans, the Railway authorities very generously offered to provide some funds for an immediate scientific excavation of part of the site before it should be damaged by the constructional work. This offer was made dependent upon Government making a further grant, to which they subsequently agreed.

As I was engaged upon full-time war work, my wife, Mrs. M. D. Leakey, undertook the excavations, which lasted for three months from December 15th, 1939. During the last month work was transferred to a promising new site, closer to Naivasha, which had been revealed by further constructional work.

The results of these excavations will be published in due course, when the 73,000 specimens obtained have at length been examined and classified. One result was to establish a sequence of strata containing stages of culture apparently derived from the Upper Kenya Aurignacian, and the existence of old lake beaches and associated silts which proved to be implementiferous.

At the end of two months' excavation, on February 15th, 1940, the contractors at once began to build up the embankment over the site. In order to do this they had to excavate immense quantities of soil from borrow pits in the surrounding area, including the prehistoric occupation zone. This destruction of a large part of the site could not be avoided, and was not so serious as it would otherwise have been, owing to the fact that scientific excavation had already taken place. In addition, the Railway engineers agreed that a part of the site, destined for use as a borrow pit, should be preserved for future work. Apart, however, from this small reserved area the borrow pits were entirely dug into the implementiferous deposits, and the Railway

embankment at this point is composed of soil containing thousands of obsidian artefacts.

On July 11th, 1940, when on duty in Naivasha, I took the opportunity of visiting the site, accompanied by Mr. A. J. Poppy of the C.I.D., Nairobi, in order to see if any outstanding archaeological material had been unearthed by the contractors' labourers during their digging of the borrow pits. Just as darkness was falling Mr. Poppy, who was in one of the many borrow pits, called to me that he had found some human skull fragments. There was a small heap of fossilized bone fragments, including parts of a skull and fragments of limb bone, lying on the floor of the pit. In the growing darkness only the skull fragments were collected, while the rest of the bones were temporarily left to mark the exact spot for examination in daylight. A brief visit to the site next day showed that there was just a possibility that only a part of the human skeleton had been disturbed and that the rest was still *in situ*. It seemed likely that as soon as the native labourers had realised that they were disturbing a human skeleton their superstitions had made them desist and leave that part of the borrow pit severely alone.

At the earliest opportunity, Sunday, July 28th, 1940, I visited the site again with my wife, who soon discovered a part of the face and some dorsal and cervical vertebrae *in situ*. It was then decided that proper excavations must be carried out. On August 9th, we went with some trained native assistants to Naivasha and made careful excavations, and a study of the site and of the deposits in which the bones were found embedded.

As the result of a week's work the exact position of this fossil human skull and skeleton in relation to the known sequence of implementiferous deposits was determined and a number of further parts of the skull and skeleton were recovered *in situ* in lake silts. An interesting fact that emerged was that whereas the skull and the main bones of the skeleton were all together, such of the smaller bones of the extremities as were recovered were scattered through the lake silts up to a distance of fifteen feet away. Moreover, where the main part of the skeleton was found there was no sign of any grave. There would appear to be two explanations of this, either that the body somehow got into the muddy edge of the lake or that it was buried in a shallow grave near the water's edge during temporary recession of the lake. If the first explanation is correct, it must be assumed that the individual was either drowned and sank into the mud, or else that the body by accident or design found its last resting place in the water at the edge of the lake. However the body came to be in the water, there would be every likelihood that the decomposing

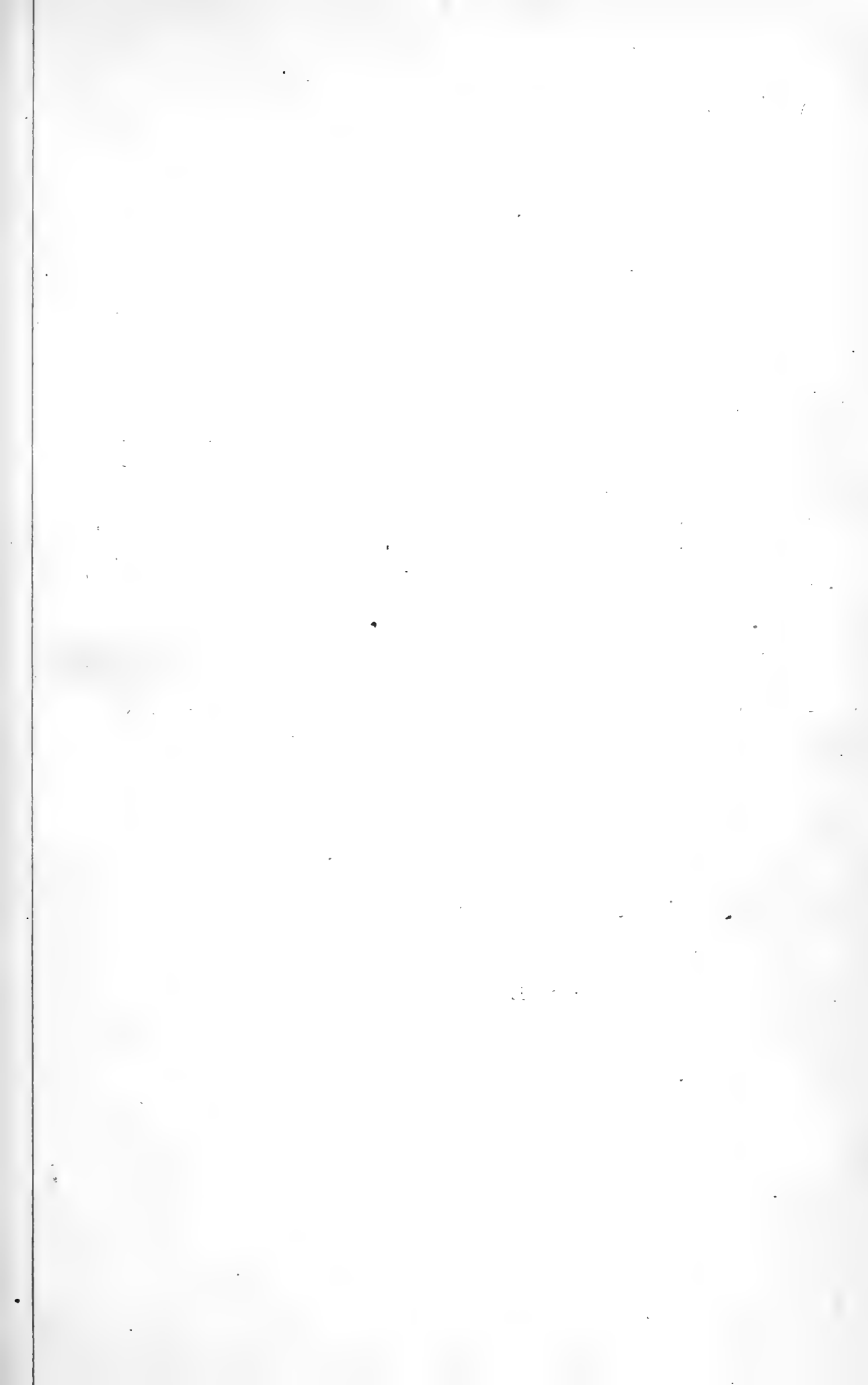
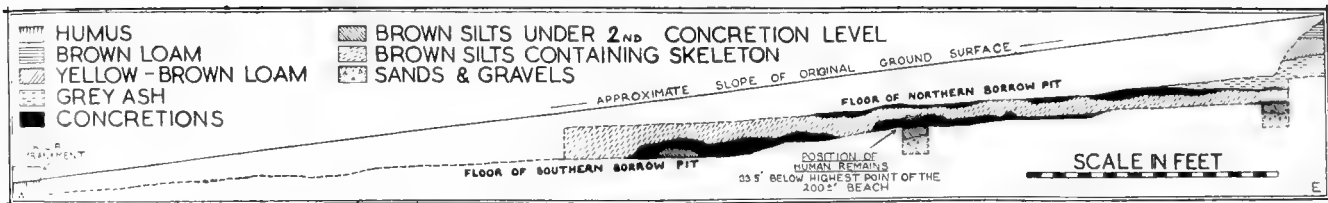


PLATE 57.

NAIVASHA RAILWAY ROCKSHELTER 1940



EAST-WEST SECTION THROUGH
SITE OF DISCOVERY OF
THE HUMAN REMAINS

FIG. 1.

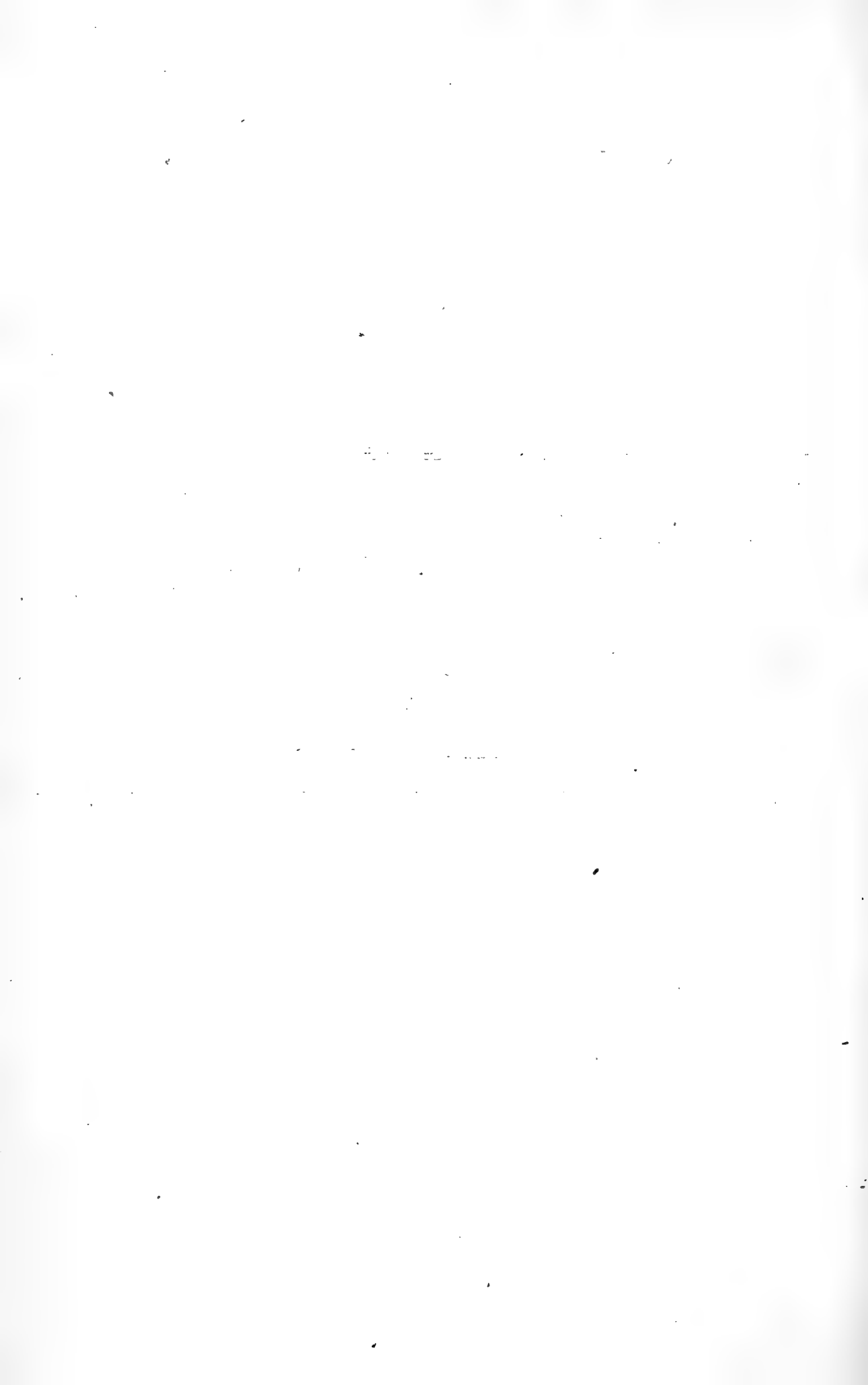




FIG. 2A.
The profile of the Naivasha fossil skull in the Frankfurt plane.



FIG. 2B.
The face view of the Naivasha fossil skull in the Frankfurt plane.

(DRAWN WITH LEAKEY-HARPER DRAWING MACHINE.)

fingers and toes were removed from the body by fish or crabs. This would explain the dispersal of the bones recovered and the fact that the rest were not recovered at all. If the second alternative is regarded as the more probable the scattering of the smaller bones of the hands and feet can be explained by wave action of the lake when it rose again after its temporary recession.

Although it is not possible to be absolutely precise as to the date of the lake deposits in which the skeleton was found, it is possible to give both a backward and a forward limit and thus give an approximate age to this find.

The 200 feet \pm beach of Lake Naivasha, which is banked against the cliff just behind the site where the skeleton was found can be dated to the second peak of the Gamblian Pluvial. This dating, first made in 1929, was confirmed in 1940, by my wife's discovery of rolled tools of developed Levalloisian type in the beach. The silts containing the skeleton are 33.5 feet below the highest point of the beach revealed in the trial trench of the first excavation. As the highest beach of the Makalian Wet Phase in the Naivasha basin does not go above the 120 feet mark, the skeleton must be dated to some time between the second peak of the Gamblian Pluvial and the end of that period. It is not easy to determine to which of the many minor climatic fluctuations of the declining Gamblian Pluvial these silts should be attributed.

On the other hand, the artefacts found in the same silts during the excavations fortunately help to determine the cultural horizon to which the skeleton belongs. The total number of artefacts found *in situ* in the deposits around the skeleton was 866 obsidian implements or fragments of implements, 5,797 waste flakes of obsidian, two waste flakes of chert, one waste flake of quartz, eight fragments of pottery, including one rim sherd (undecorated), and one fragment of a small quartzite palette stained with ochre, similar to those found in the Upper Aurignacian levels of Gamble's Caves at Elmenteita in 1929.

An analysis of the 866 specimens gives the following results:—

- 80 crescents (varying from 2 inches to less than $\frac{1}{2}$ inch long).
- 46 backed blades, some of the chatelperron but mostly of the gravette type.
- 287 fragments of crescents and/or backed blades.
- 22 end scrapers, including three well made double-ended specimens.
- 74 micro burins.

- 31 burins, mostly poorly made angle burins, with a few bec-de-flute types.
- 47 burin spells.
- 47 triangular fabricators.
- 6 sinew frayers.
- 5 two-edged blades.
- 40 fragments of two-edged blades.
- 38 cores.
- 8 core rejuvenators.
- 29 rolled flakes and implements.
- 2 burned flakes.
- 8 pottery fragments, including one rim sherd.
- 1 palette fragment.

This assemblage somewhat resembles Upper Kenya Aurignacian Phase "C" for both the high proportion of micro burins and low proportion of sinew frayers indicate a stage later than either "A" or "B". The pottery appears to be a little too developed for Phase "C" and on the whole it would probably be best to regard it as representing a slightly later stage in the evolution of the Upper Kenya Aurignacian.

When the full results of the excavations made by my wife at the main site near-by have been worked out, it may be possible to make a more precise determination of the assemblage found round the skeleton.

The exact position of the skeleton in relation to the deposits which occur at this site as shown in the accompanying diagram was on the boundary between two borrow pits which had been dug to slightly different levels. This fact was of considerable assistance. The skeleton lay in a thin layer of lake silts between two bands of concretion of varying thickness. In the southern and deeper borrow pit the skeleton had been disturbed by the labourers, but the part of it which lay within the area of the northern pit was undisturbed and the position of the bones was determined in the low wall or step between the pits. The whole of the overburden had, of course, been previously removed by the labourers, but the complete section was very clearly exposed in the east wall of the pit.

THE SKULL.

The skull is that of an adult, probably male, and the condition of the sutures which are almost completely closed suggests that the age at death was over fifty. The limb bones and the fragments of pelvis also indicate the sex as male.

The left half of the face is missing and the right half is incomplete with the nasal bones and the upper portion of the maxilla missing. The right maxilla contains one single tooth, the first molar and the alveolar region exhibits an extreme degree of absorption which has completely obliterated all trace of the other root sockets, proving that all these teeth were lost during life. The roof of the palate is on a level with the alveolar margin as a result of this absorption. At the position of the posterior premolar there is a deep cavity with rounded margins indicating a severe alveolar abscess. The existing first molar is worn down to such a degree that only a very small amount of enamel remains and there is a small carie on the posterior aspect.

The whole of the left side of the sphenoid is missing as well as a part of the basi-occipital, including most of the *foramen magnum*. The mastoids are small and the digastric grooves of unusual size. A large fragment of the left parietal was not recovered, although the freshness of the breaks shows that it was only broken when the workmen disturbed the bones. A small fragment of the right parietal is also missing.

THE MANDIBLE.

The mandible is incomplete. The whole of the left ramus is missing, having been broken off just behind the position of the third molar, which had been lost during life. The angle and the posterior portion of the right ramus, including the condyle are also lacking.

The mandible contains the following teeth; on the left, the first molar, both the premolars, the canine and both incisors. On the right side only the lateral incisor, the canine and the second premolar are present. All the other teeth of the mandible were lost during life. Behind the right second premolar the *corpus* of the mandible shows an extreme degree of absorption, comparable only to that in the right maxilla. On the left side behind the first molar this extreme absorption is not seen, suggesting that the second and third left molars were lost at a much later time, though definitely before death. The mental eminence is well developed, but not large. The mandible though small, is thick and strongly built.

THE SKELETON.

The following bones of the skeleton were found: both femora, the right tibia and fragments of the left, both humeri, the left radius and a fragment of the right, fragments of one ulna, both fibulae, both clavicles, both scapulae (damaged), a large fragment of the right innominate bone and a small fragment of the left, both astragali, one patella, eight carpals and tarsals, ten metacarpals and metatarsals, two phalanges, and an assortment of fragmentary vertebrae and ribs.

MEASUREMENTS OF THE SKULL.

The following table sets out the principal measurements of the skull, all of which were taken in accordance with the methods set out in *Stone Age Races of Kenya*, page 37, *et seq.*

	mm.		mm.
L'	194.5	DC	—
L	197	DA	—
B	125.5	O1r	38.5
B1	97	O1l	—
B2	95.5	O2r	33.5
B3	96.5	O2l	—
H'	135	G1	—
H	135	G'1	—
OH	116	EH	—
LB	103	GL	99.5
Q	302	fmb	—
Q'	300	fml	—
S	400?	P	83
S1	151	N	76
S2	—	A	69
S3	—	B	30
S3'	—	Oc. Ind.	—
U	522	100B/L'	64.52
PH	13.5	100H/L	68.53
G'H	60	100H/L'	69.46
GB (estimated from right half) ...	105	100B/H	92.96
J (estimated from right half) ...	126	100NB/100NHr ...	55.93?
NHr	46.5	10002r/O1r	85.7
NHl	—	100fmb/fml	—
NB (estimated from half)	26	100DS/DC	—
DS	—	100SS/SC	—
		100EH/G2	—

The mandible is in such condition that no measurements of any comparative value can be taken.

MEASUREMENTS OF THE SKELETON.

Only a few bones of the skeleton are sufficiently well preserved for accurate measurement. These have been taken by the methods described in *Stone Age Races of Kenya*, page 40; et seq.

mm.		mm.	
<i>The femora:</i>		<i>The tibia (right only):</i>	
Maximum length ...	415.5 (R)	Maximum length ...	346
	415.5 (L)	Minimum length ...	—
Oblique length ...	411 (R)	Mid-shaft APD ...	28
	411 (L)	Mid-shaft TD ...	20
Minimum length ...	398.5 (R)	Foramen nutricium	
Bi-condylar-width ...	70 (R)	APD ...	32
	70 (L)	Foramen nutricium	
Platemic APD ...	24.5 (R)	TD ...	21
	24 (L)	Mid-shaft index ...	71.42
Platemic TD ...	31.5 (R)	Foramen nutricium	
	30 (L)	index ...	65.62
Pilastric APD ...	28 (R)	<i>The humeri:</i>	
	27.5 (L)	Maximum length ...	284 (R)
Pilastric TD ...	27 (R)		290 (L)
	26 (L)	Bi-condylar width ...	58 (R)
Popliteal APD ...	31 (R)		— (L)
	28.5 (L)	Maximum mid-shaft	
Popliteal TD ...	37.5 (R)	diameter ...	19 (R&L)
	37.5 (L)	Minimum mid-shaft	
Platemic index ...	77.77 (R)	diameter ...	14.5 (R&L)
	80 (L)	Minimum	
Pilastric index ...	103.7 (R)	circumference ...	54 (R&L)
	105.76 (L)	Deltoid APD ...	18 (R&L)
Popliteal index ...	82.66 (R)	Deltoid TD ...	25 (R)
	76 (L)		22 (L)
<i>The radius (left only):</i>		Maximum APD ...	18 (R)
Maximum length ...	228		16 (L)
Physical length ...	222	Maximum TD ...	20 (R)
Mid-shaft APD ...	12		19 (L)
Mid-shaft TD ...	11	Mid-shaft index ...	71.41 (R&L)
Maximum shaft APD ...	13	Maximum shaft	
Maximum shaft TD ...	11	index ...	90 (R)
Minimum			84.2 (L)
circumference ...	38	Gracility index ...	18.43 (R)
Mid-shaft index ...	109.09		16.62 (L)
Maximum shaft			
index ...	118.18		
Gracility index ...	17.12		

The fragment of innominate bone has the sciatic notch preserved. The form of this strongly suggests that the individual was a male.

COMPARISONS.

The relationship of this Naivasha skull and skeleton to other East African prehistoric skulls is not at all easy to determine. It is a long and very narrow skull with a cranial index of 64.52, as compared with the indices of 71 and 73.7 in

the two Upper Kenya Aurignacian skulls from Gamble's Cave. In the series of skulls belonging to the makers of the Elmenteitan Mesolithic culture the lowest cranial index is that of skull Elmenteita "A" with a figure of 67.45, all the others in the series having indices of over 71. Such is the difference between the nasal and also between the orbital indices of this Naivasha skull and the nearest comparable specimen from the Elmenteitan series that the similarity in the cranial indices cannot be sustained; for the nasal and orbital indices of Elmenteita "A" are respectively 49.7 (the highest in all that series), and 70.07 (the lowest in all that series), as compared with a nasal index of 55.93 and an orbital index of 85.7 in the Naivasha skull. Moreover, when compared with the Neolithic skulls from Kenya, the Naivasha skull shows considerable differences.

Unfortunately there are not in any Kenya prehistoric series sufficient skulls to establish racial means capable of determining if the Naivasha skull could be regarded as within the limit of proved variability.

It is also to be regretted that the Oldoway Aurignacian skull is too crushed for accurate measurement, since a comparison by simple appreciation suggests that there may be affinities to the Naivasha skull.

SUMMARY AND CONCLUSIONS.

The Naivasha skull probably represents a male of *Homo sapiens* type and is dated as belonging to the closing phase of the Gamblian Pluvial, after the second maximum of that Pluvial had been passed. The associated industry somewhat resembles that known as Upper Kenya Aurignacian Phase "C", but may prove to be a slightly later stage, as yet unnamed. The type represented by the skull has no very close affinity to any other prehistoric types from Kenya, although it bears a certain resemblance to the Oldoway skull from Tanganyika Territory which is also attributed to the closing stages of the Gamblian Pluvial and is probably connected with a late stage of the Upper Kenya Aurignacian culture.

FOSSIL *SUIDAE* FROM OLDOWAY.

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(PUBLISHED BY PERMISSION OF THE MUSEUM TRUSTEES.)

The fossils described in these notes are from the Middle Pleistocene lake deposits which are exposed in the famous Oldoway Gorge, at the south-east corner of the Serengeti Plains of Tanganyika Territory. The term Middle Pleistocene is used in the sense defined by Haug in 1911. The stone age cultures of the Oldoway deposits ranges from Pre-Chellean in Bed I to Acheulean Stage VI in Bed IV (top).

The fossils come from Beds I, II and IV, no fossils of the *Suidae* group having been found on this occasion in Bed III.

The specimens were collected during the last two weeks of August, 1941.

The fossil *Suidae* of Oldoway are well represented in the German collection in Berlin, and in the various collections made by my East African Archaeology Expeditions in 1931, 1932 and 1935, and which are now in the Natural History Museum, London.

A study of the Oldoway *Suidae* was prepared by Professor Dietrich of Berlin, and was published in 1937, in *Wiss-Ergben, Oldoway Expedition*, under the heading of *Pleistozäne Suidenreste aus Oldoway*, but no reprint of it has ever been received, no review of it seen, and I have been unable to find out what new species or genera he may have described or under what names.*

Apart from this German paper, the only other known notes on the Oldoway *Suidae* are the very brief notes by Dr. A. T. Hopwood of the Natural History Museum, South Kensington, London. These notes were published in the *Annals and Magazine of Natural History*, tenth series, volume 14, number 83. In these notes Hopwood briefly describes a new species of *Potamochoerus* under the name *Koiropotamus majus*, and a new species of *Notochoerus* which he calls *dietrichi*.†

*But see *Postscript* to this article.

†As regards fossil *Suidae* from other parts of East Africa, Hopwood described a new genus under the name of *Metridiochoerus* in the ninth series of *Annals and Magazine of Natural History*, volume 18, page 266, and two new species in an appendix and memoir of *Geological Survey of Uganda*, in 1926.

A much fuller account of the Oldoway fossil fauna has been promised by Hopwood, but nothing appears to have been published. It has, therefore, been decided that the more important *Suidae* fossils in the recently-collected material should be described as soon as possible, in order that other workers in the African field may know something about them for comparative study purposes.

GENUS *MESOCHOERUS* SHAW AND COOKE.

***Mesochoerus olduvaiensis* sp. nov.**

DIAGNOSIS.

A *Mesochoerus* in which the third lower molars have five pairs of lateral pillars instead of four and in which the second lower molars have only the most rudimentary of medial pillars in front of the anterior pair of lateral pillars. The enamel is covered by cement. The crowns of unworn molars are low, compared with those of the genotype and average about 24 mm. instead of over 30 mm.

Holotype: A broken fragment of the left side of the mandible with damaged first molar and with the second and third molars intact. This specimen is from Bed II at Oldoway and is marked (A) in the fossil collection in the Coryndon Museum, Nairobi, Kenya Colony.

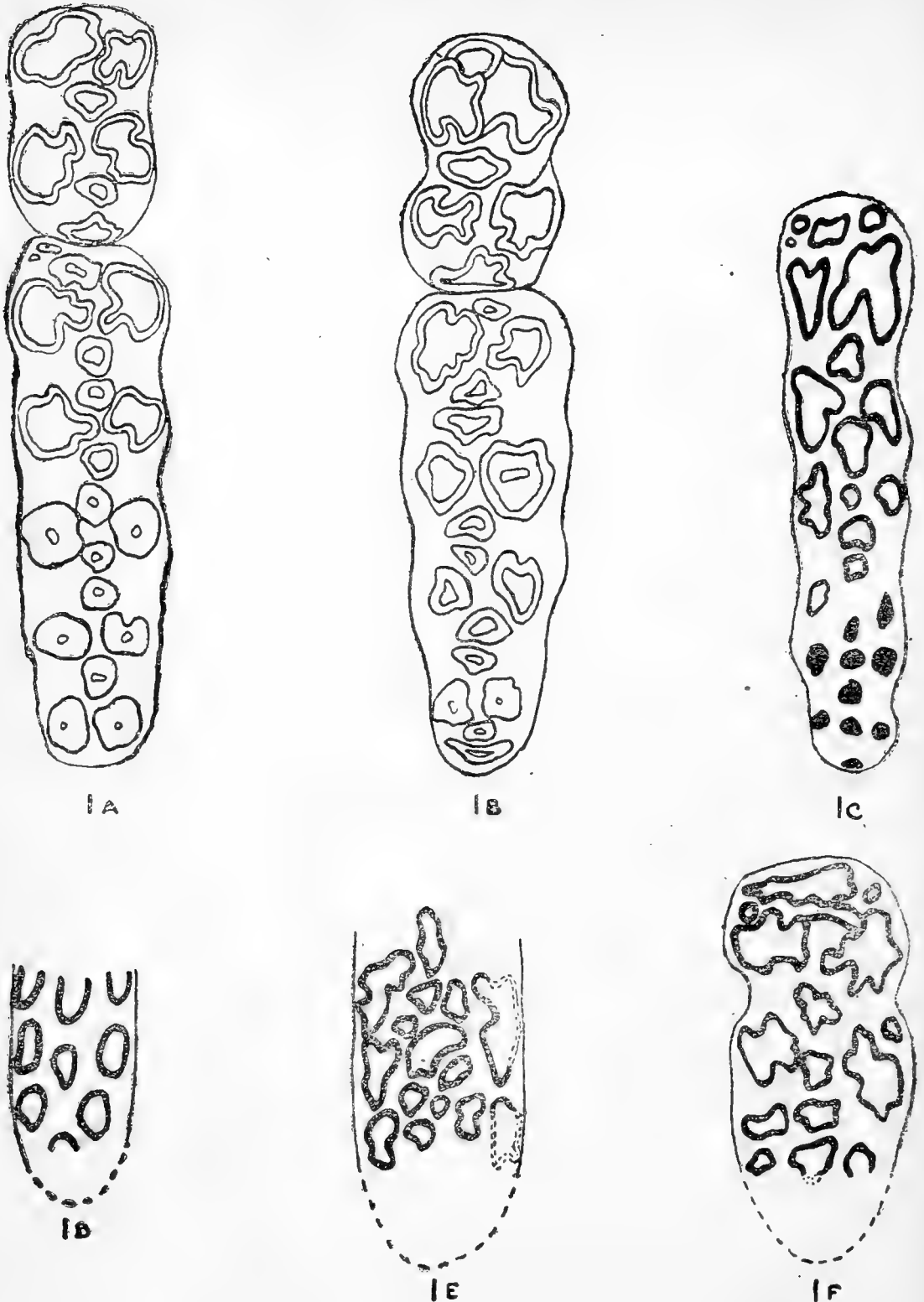
Paratype: A broken fragment of the right side of a mandible with damaged first molar and with the second and third molars intact. This specimen is from an older horizon and was found in Bed I at Oldoway at a site several miles away from that which yielded the holotype. It is marked (B) in the fossil collection in the Coryndon Museum.

DESCRIPTION.

Specimen (A). Holotype. A left mandibular fragment with the condylar and part of the coronoid processes broken away posteriorly, and broken anteriorly just in front of the first lower molar. The second and third lower molars are present and intact. The first molar is very incomplete. The lower half of the *corpus* of the mandible is much damaged, especially anteriorly, so that the depth of the mandible cannot be measured accurately.

The third molar (see Fig. 1a. and Plate 60) is composed of five pairs of lateral pillars and nine medial pillars, each pair of lateral pillars being separated from the next adjoining pair by two smaller medial pillars, except in the case of the fourth and fifth pairs at the posterior end, which are only separated from each other by one medial pillar. The medial pillars

FIG. 1.



- 1a. Holotype of *Mesochoerus olduvaiensis* (second and third lower left molars).
1b. Paratype of *Mesochoerus olduvaiensis* (second and third lower right molars).
1c. Specimen of *Notochoerus deitrichi* (third lower right molar).
1d. Specimen of *Phacochoerus* c.f. *aethiopicus* (fragment of third molar).
1e. Holotype of *Phacochoerus complectidens* (fragment of lower third molar).
1f. Specimen of *Sus limnetes* (fragment of third upper molar).

(All approximately natural size.)

whether in pairs or singly, are set along the long axis of the tooth. In front of the anterior pair of lateral pillars is a single medial pillar and two accessory conules and there is also a small medial pillar behind the posterior pair of lateral pillars. The anterior portion of the tooth was already in full wear, but the posterior portion was not yet fully erupted. The third molar has traces of a thick coating of cement, much of which has, however, broken away.

The second molar (see Fig. 1a. and Plate 60) is composed of two pairs of lateral pillars, the two pairs being separated from each other by a single medial pillar. Behind the posterior pair of lateral pillars are two small medial pillars, one behind the other in the line of the long axis of the tooth. At the anterior end of the tooth there is a trace of a very rudimentary medial pillar in front of the anterior pair of lateral pillars.

The first molar is too damaged to describe.

Specimen (B). Paratype. A right mandibular fragment. It is broken posteriorly in such a way that only a very small part of the ramus is preserved, whilst anteriorly, the whole of the area in front of the first molar is missing. The lower part of the *corpus* is also missing. The second and third molars are present and intact, but the first molar is very much damaged.

The third molar (see Fig. 1b.) is not fully erupted and the posterior portion *is not completely developed*. There are four well-marked pairs of lateral cusps or pillars, and a fifth pair in a small and undeveloped state. Each pair of lateral pillars is separated from the next pair by two medial cusps or pillars, these medial pillars being arranged in the line of the long axis of the tooth. There is a single anterior pillar and an accessory conule in front of the anterior pair of lateral pillars. The third molar bears traces of a thick coating of cement which has mostly broken away.

The third molar of the paratype thus agrees in all essential details with the third molar of the holotype, although it comes from a different horizon.

The second molar (see Fig. 1b.) is composed of two pairs of lateral pillars, separated from each other by a single medial pillar. Behind the posterior pair of lateral pillars is a single medial pillar, which, however, seems to be the result of a fusion of two small pillars as a result of wear. In front of the anterior pair of lateral pillars is a small fold of enamel, which may represent a rudimentary anterior medial cusp or pillar.

The first molar is much too damaged for study.

MEASUREMENTS.

	Maximum length of occlusal surface.	Maximum length.	Width of occlusal surface.	Maximum width.
Third molar ... (holotype)	59 mm.	67.5 mm.	17 mm.	25 mm.
Third molar ... (paratype)	54.5 mm.	65 mm.	17 mm.	24 mm.
Second molar . (holotype)	29 mm.	29 mm.	17 mm.	20 mm.
Second molar . (paratype)	29 mm.	29 mm.	18 mm.	21 mm.

The height of the crowns of the unworn posterior and medial pillars of the third molars is 26 mm. in (A) and 26 mm. in (B).

DISCUSSION.

The specimens described above are considered as representing a new species of the genus *Mesochoerus* Shaw and Cooke, as they differ consistently from *Mesochoerus paiceae* in the following respects:—

- (1) The third molars have five pairs of lateral pillars, instead of four pairs, the posterior pair being smaller than the other four pairs.
- (2) There are in all nine medial pillars.
- (3) The crowns of unworn molars are considerably shorter than in *Mesochoerus paiceae*.
- (4) Although the teeth of the new species are shorter in actual point of size, nevertheless they have more medial and lateral pillars than the type specimen of *Mesochoerus paiceae*, and are consistently broader. Length by breadth indices of third molars is 37.02 and 36.9 as compared with 32.3.

Middleton-Shaw and Cooke express the view that their new genus *Mesochoerus* "has affinities with the forest pig, *Hylochoerus*." They further state "in the genotype of *Hylochoerus* the length of the lower molar is 41 mm. which is considerably less than in either Broom's or the present author's specimens." In the collection of skulls of *Hylochoerus* in the Coryndon Museum is one in which the length of the lower third molar is 53 mm. and I would not regard this skull as representing anything like the largest *Hylochoerus* to be found in the East African forests.

I must emphasise that, in my opinion, it is very unwise to place too much value on relative size when comparing fossil teeth with those of living species. Fortunately, as Shaw and

Cooke observe in their paper on the new genus *Mesochoerus*, there are other important respects in which the two genera differ.

Out of eight *Hylochoerus* mandibles in the collection in the Coryndon Museum, only two have even a third pre-molar, whilst the always present fourth pre-molar is never molariform. From the picture accompanying Shaw and Cooke's paper, the lower fourth pre-molar of the *Mesochoerus* mandible is distinctly molariform.

GENUS *POTAMOCHOERUS* GRAY, NON. *KOIROPOTAMUS*
(NOMEN NUDUM).

Potamochoerus majus (Hopwood) (equals *Koiropotamus majus* Hopwood).

DIAGNOSIS.

Hopwood's diagnosis of this new species from Oldoway, which he described in *Annals and Magazine of Natural History*, tenth series, volume 14, number 83, page 547, is as follows: "A *Koiropotamus* with very large upper tusks; three well-marked areas of enamel on each tusk; the antero- and postero-superior areas 12 mm. to 14 mm. wide, inferior area up to 40 mm. wide, near the base of the tusk. Main cusp of lower fourth pre-molar more definitely bifid than in recent species. Length of lower pm2 to m1 about 40% greater than in recent species."

Apart from the statement that the main cusp of the lower pre-molar four is definitely more bifid than in recent species, this diagnosis depends entirely upon size. Moreover, apart from the tusks, the material described by Hopwood consists of the lower dentition, whereas the material to be described now is only the upper dentition.

Since one new species of *Potamochoerus* has already been described from Oldoway, it would be unwise to make a further new species out of the present material at the moment, and I, therefore, propose referring the new material to Hopwood's species, with the proviso that when a complete upper and lower dentition are found in association, it may be necessary to revise this decision. For the present, the new material may be regarded as *syn-types* of *Potamochoerus majus*, extending our knowledge of that species to the upper dentition.

Syn-types: Two maxillae of a single individual containing the third and fourth pre-molars and the first, second and third molars in each case. These two specimens were found in association in Bed I Oldoway and they are marked respectively (C) and (D) in the fossil collection in the Coryndon Museum, Nairobi, Kenya Colony.

DESCRIPTION.

Specimen (C). A left maxilla fragment containing a damaged third pre-molar, an undamaged fourth pre-molar, a damaged first molar, an undamaged second molar and an undamaged and partially erupted third molar.

The third molar is composed of two pairs of lateral pillars, behind which are five smaller pillars grouped irregularly as a talon. The area immediately in front of the anterior pair of lateral pillars is obscured by concretionary material, which it has not been possible to clear away. The two pairs of lateral pillars are separated from each other by a medial pillar.

The second molar is composed of two pairs of lateral pillars, separated from each other by a group of three small medial pillars. In front of the anterior pair of lateral pillars is a large irregular medial pillar while behind the posterior pair of lateral pillars, is a group of four small pillars. Three of these four form the posterior end of the tooth and are arranged transversely across the long axis of the tooth, the other is a medial pillar.

The first molar is too damaged to be described.

The fourth pre-molar is of approximately equal length and width and is composed of one pair of lateral pillars, with one group of small subsidiary pillars anteriorly and another posteriorly.

The third pre-molar is too damaged for description.

Specimen (D). A right maxilla fragment (see Plate 61) of the same individual containing the third and fourth pre-molars undamaged, a much damaged first molar, an undamaged second molar and an undamaged and partly erupted third molar.

The third molar is composed of two pairs of lateral pillars, behind which are five pillars grouped irregularly as a talon. The area in front of the anterior pair of lateral pillars is exposed and is seen to have one small medial pillar and two very small accessory cuspules on the bucal aspect. The two pairs of lateral pillars are separated from each other by a single medial pillar.

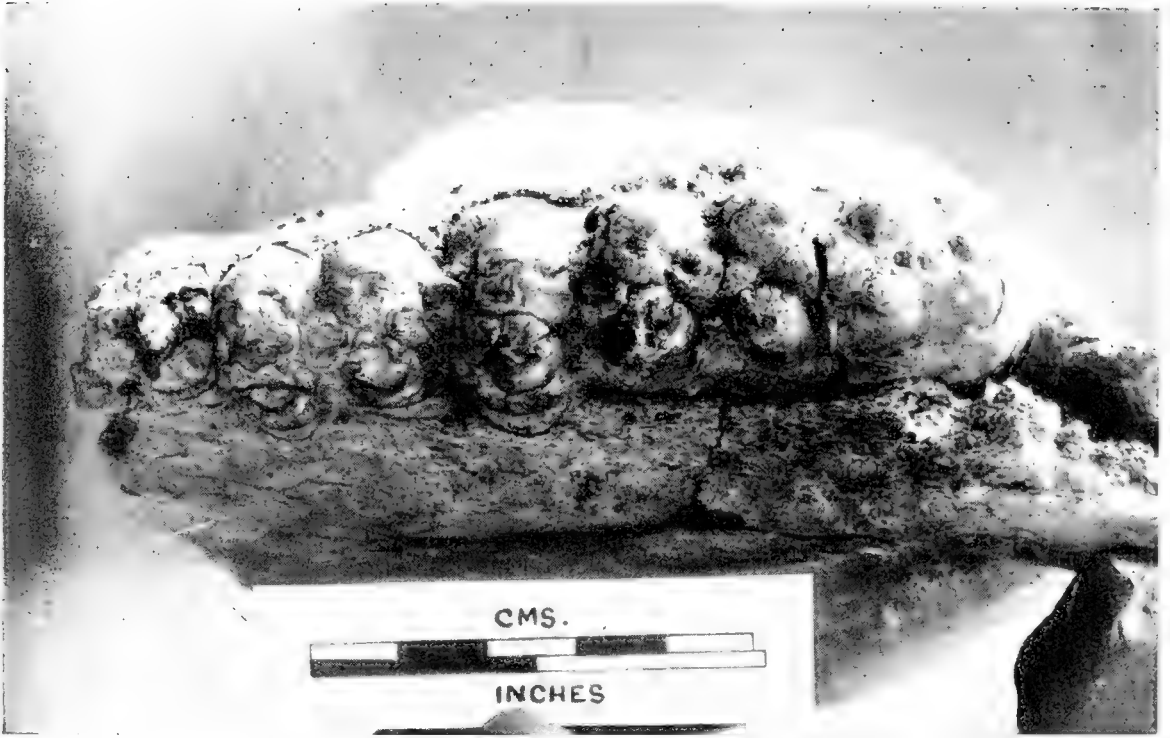
The second molar differs in no way at all from the second left molar already described.

The first molar is too damaged to be described.

The fourth pre-molar is approximately equal in length and width and has one main cusp on the bucal aspect which appears to be composed of the fusion of three cuspules which are clearly distinguishable in the slightly worn occlusal surface of the tooth. Anteriorly there is one distinct cuspule. There is also a small but distinct posterior cusp on the lingual aspect of the tooth.



The Naivasha fossil skull orientated in the Frankfurt plane (face and profile).

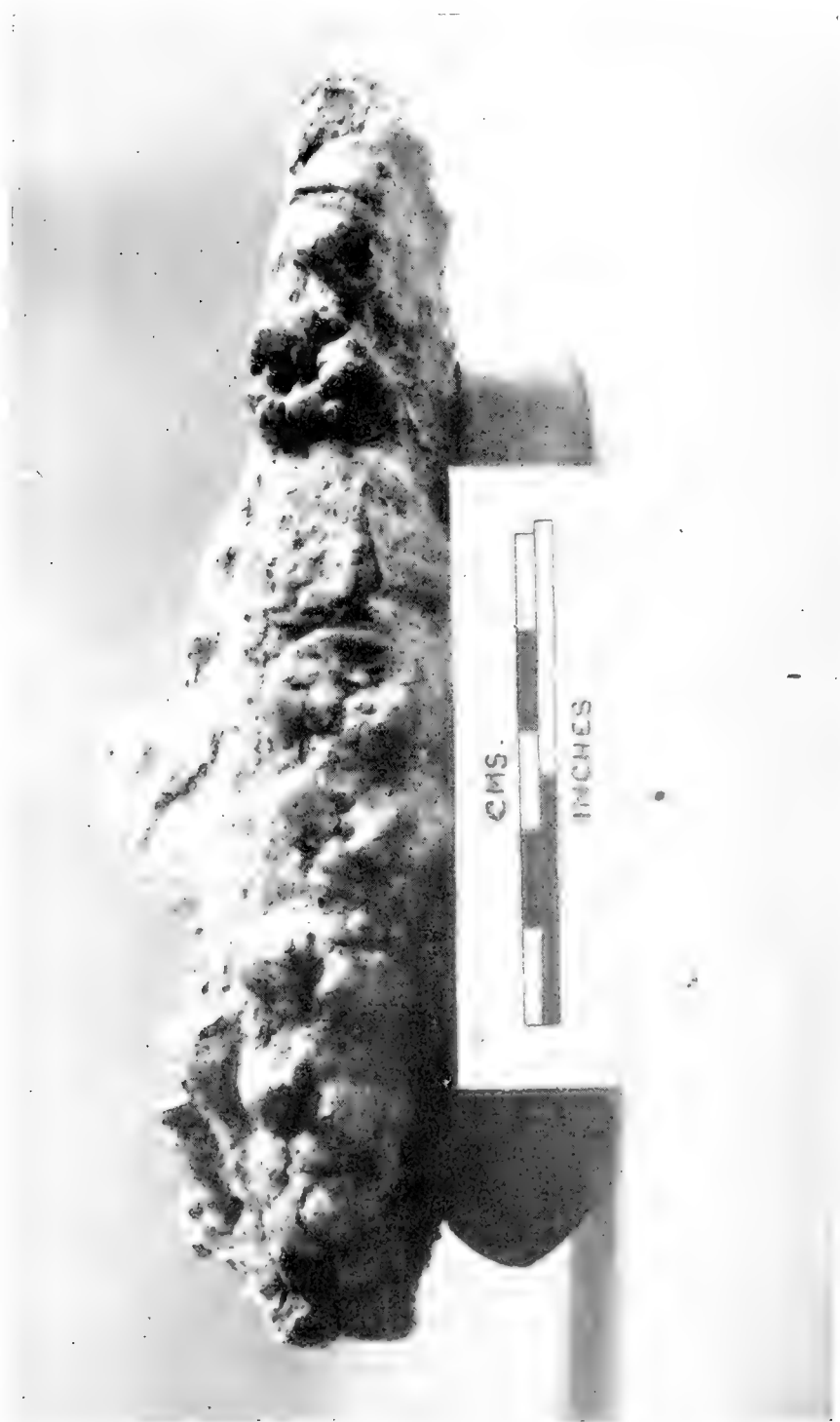


Type of *Mesochoerus olduvaiensis* sp. nov.



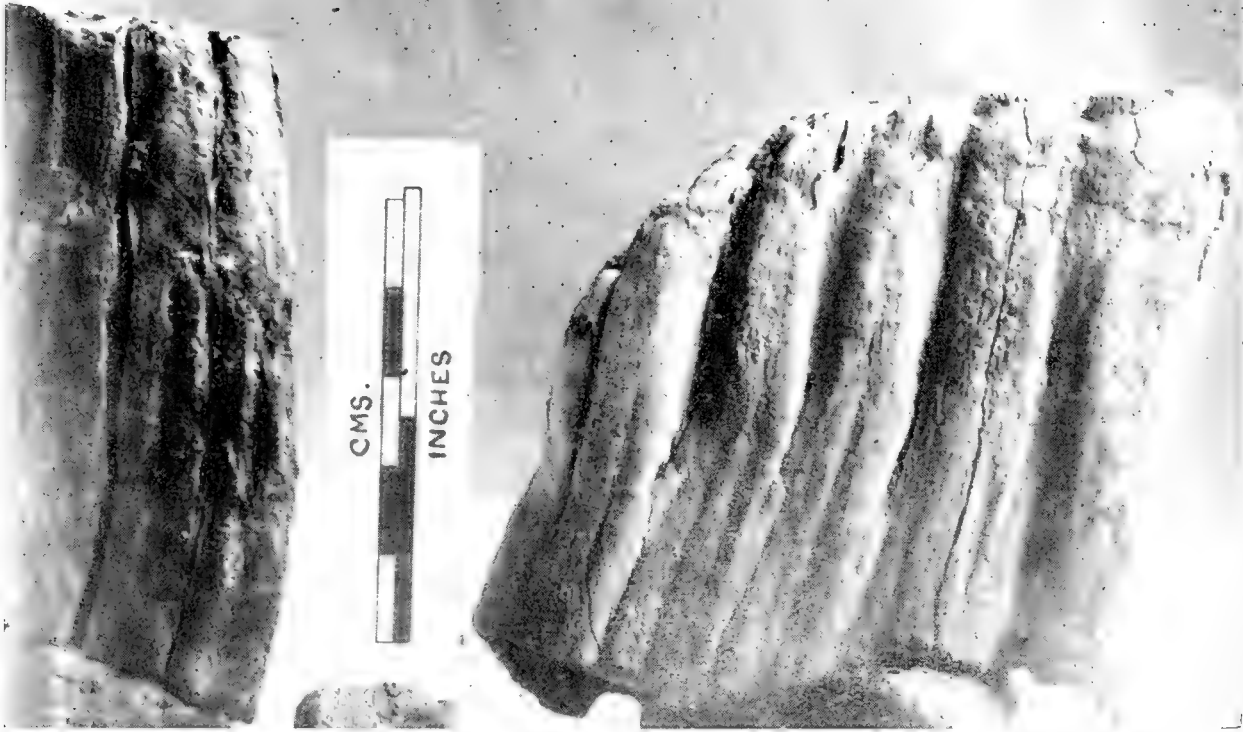
Type of *Afrochoerus nicoli* gen. et sp. nov.

PLATE 61.



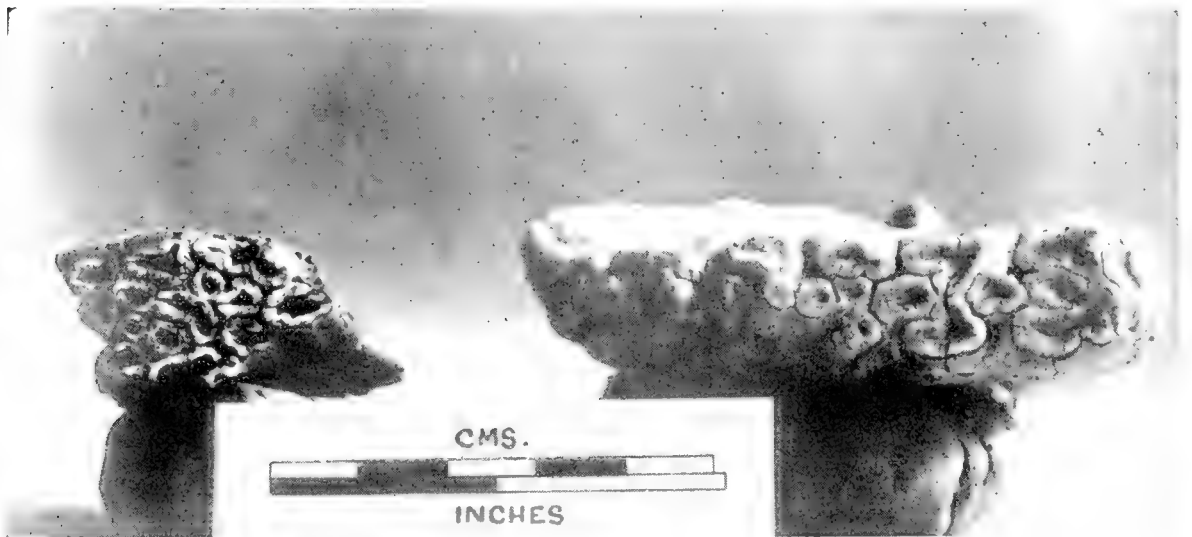
Upper dentition of *Potamochoerus majus* (Hopwood).

PLATE 62.



Type of *Phacochoerus*
complectidens sp. nov.

Notochoerus
deitrichi Hopwood.



Type of *Phacochoerus*
complectidens sp. nov.

Notochoerus
deitrichi Hopwood.

MEASUREMENTS.

	Lgth. p3-m3.	Lgth. m3.	Wdth. m3.	Lgth. m2.	Wdth. m2.
Specimen (c) ...	116 mm.	36 mm.	23 mm.	28 mm.	19.5 mm.
Specimen (d) ...	117 mm.	36 mm.	23 mm.	29 mm.	19.5 mm.
Largest modern maxilla of <i>Potamochoerus</i> available ...	103 mm.	36 mm.	21 mm.	24 mm.	23 mm.

	Lgth. m1.	Wdth. m1.	Lgth. p4.	Wdth. p4.	Lgth. p3.	Wdth. p3.
Specimen (c)	19 mm.	16 mm.	15 mm.	15.5 mm.	—	—
Specimen (d)	17 mm.	16 mm.	15 mm.	15.5 mm.	17 mm.	11 mm.
Largest modern maxilla of <i>Potamochoerus</i> available	17 mm.	16 mm.	12.5 mm.	15 mm.	14.5 mm.	11 mm.

DISCUSSION.

The specimens described are provisionally regarded as representing the upper dentition of *Potamochoerus majus*. They are clearly the remains of a species of *Potamochoerus* and as we do not know anything about the upper dentition of Hopwood's species, it is considered unwise at present to make another new species of this genus from the same locality and same horizon.

In respect of size, the fossils described above are larger than the largest example of a living species of the genus available. This is not, however, considered significant in itself.

It is in respect of the arrangement of the secondary pillars of the second and third upper molars and in the detail of the third upper pre-molar that the fossil species *majus* appears to be distinctly different from any of the living species of *Potamochoerus*. These differences, taken in conjunction with Hopwood's notes, seem to indicate that the separation of the Oldoway fossil species from known living species is justifiable.

GENUS NOTOCHOERUS BROOM.

Notochoerus dietrichi Hopwood.

DIAGNOSIS.

The only diagnosis given by Hopwood in his notes on this new species, which he created on specimens from Oldoway, is "a *Notochoerus* with smaller and less complicated upper molars than the genotype *Notochoerus capensis*." No description is given by Hopwood of the lower molars which he includes in

his new species and the measurements which he gives tell very little. In view of this, it is exceedingly difficult to know whether the specimen about to be described should really be included in the species *Notochoerus dietrichi*. As Hopwood has already made a mandible fragment with left molars two and three into the paratype of his new species *Notochoerus dietrichi*, and as the specimen about to be described is from the same area, it is not proposed to do more than describe the new specimen and discuss it in very general terms.

DESCRIPTION.

Specimen (E). This specimen is a lower right third molar of *Notochoerus* type. It comes from the surface of Bed I at Oldoway and is in the collection of fossils in the Coryndon Museum, Nairobi, Kenya Colony.

The tooth (see Fig. 1c. and Plate 62) is composed of five pairs of lateral pillars and eight smaller medial pillars. The tooth is markedly hypsodont, and the small root area is broken away. The enamel is thickly coated with cement.

In addition to the eight medial pillars, there are four small pillars in front of the anterior pair of lateral pillars and five small pillars behind the last medial pillar forming a sort of talon.

The enamel of the two anterior pairs of lateral pillars touches along the medial line, but in the case of the other three pairs of lateral pillars, the lingual and bucal pillars which comprise each pair, are separated by a small medial pillar.

Of the eight medial pillars, the two anterior ones occupy positions separating the first and second, and the second and third pairs of lateral pillars from each other respectively. The remaining six medial pillars are contiguous to each other and occupy the whole medial line of the posterior two-thirds of the tooth.

The enamel pattern of the various lateral pillars varies considerably and in the anterior pair of pillars, the bucal pillar is the larger and in the second pair of pillars, the lingual pillar is the greater.

MEASUREMENTS.

The principal measurements are as follows: Maximum length 75 mm. Length of occlusal surface (the posterior part of which is not worn) circa 69 mm. Maximum width 18 mm, width of occlusal surface 16 mm. Height of anterior pillars, exclusive of roots (which are broken away) 68 mm.

DISCUSSION.

The genus *Notochoerus* is regarded as related to the genus *Phacochoerus*. In the latter genus, it is known that there is a very great range of individual variation, not only in respect

of size, but also to a lesser extent in respect of the shape of the enamel of the pillars. Third lower molars of *Phacochoerus aethiopicus*, the living species in Kenya, range in length from 33 mm. to 75 mm. in extreme examples.

Shaw and Cooke have recently described a new species of *Notochoerus* under the name of *broomi* and they say "As will be seen it is a considerably smaller tooth than any *Notochoerus* teeth hitherto described. It seems probable in fact that it represents a dwarf species of *Notochoerus*." I consider it likely that the range of variation in *Notochoerus* will probably prove to be as great as in the genus *Phacochoerus* in which case in all probability, *Notochoerus broomi* and *Notochoerus dietrichi* will both have to be regarded as mere variations of *Notochoerus capensis*, unless other marked differences are found.

GENUS **AFROCHOERUS** GEN. NOV.

DIAGNOSIS.

Large *Suidae* with hypsodont third molars composed of closely-packed series of cusps or pillars. The enamel pattern of the lateral pillars, both bucal and lingual is not sub-cylindrical as in *Phacochoerus*, but is roughly "Y"-shaped, the fork of the "Y" being formed by a fold in the enamel anteriorly. This character is visible even in teeth which are only just coming into wear and is not due to a fusion of pillars. The teeth have a thick coating of cement.

(The specimen recently described by Shaw and Cooke as *Phacochoerus altidens* has a "Y"-shaped enamel pattern of the lateral pillars and not sub-cylindrical as in *Phacochoerus*. I am of the opinion that when more material of their species is available it may have to be transferred to the new genus *Afrochoerus*. The genus *Synaptochoerus*, van Hopen has certain close similarities with *Afrochoerus*, but Middleton-Shaw believes that the medial projections of the lateral pillars are in this case due a fusion of pillars and that these teeth originally had four rows of columns. It is possible that when more is known it will be found that *Afrochoerus* is a synonym of *Synaptochoerus*. If this is so it must be shown that the characters seen in worn teeth of the latter are already present in unworn ones.)

Before describing the Oldoway species of the new genus, it is proposed to discuss why a new genus has been created, instead of leaving the new Oldoway material in the genus *Phacochoerus*. In the British Museum, description of the generic characters of *Phacochoerus* are the words "last molars in both jaws very large, hypsodont and formed of a closely-packed series of small *parallel and vertical sub-cylindrical denticules*."

The genus already contains a large number of species and sub-species that do comply with this definition, as regards the third molars and, therefore, it seems unwise and unscientific to describe within the genus *Phacochoerus*, specimens in which the third molars do *not* fit in with this definition. More especially is this so when we know that true phacochoeres were present at the time that these allied animals were alive.

Middleton-Shaw has shown that occasionally modern phacochoeres do have more than one row of medial pillars, but such an occurrence is not ruled out by the generic definition of *Afrochoerus* or of *Phacochoerus*. It is even true that an occasional pillar in a *Phacochoerus* tooth is not quite sub-cylindrical, but in the teeth on which the new genus is based, *none* of the pillars of the lateral series have a sub-cylindrical enamel pattern, and the distinguishing characters are known from a long series of teeth.

The variation in size in the molars of individuals of living species of the genus *Phacochoerus* is very great, much greater than that mentioned by Shaw and Cooke in their paper on *Phacochoerus altidens*. These authors state that in an extensive collection of teeth of *Phacochoerus* at their disposal, the largest molar is 58 mm. long and the average is 49 mm., in lower molars.

The following measurements are of the lower third molars of ten adult specimens in the Coryndon Museum, of the living species of *Phacochoerus*: 33 mm., 40 mm., 41 mm., 45 mm., 49 mm., 51 mm., 54 mm., 58 mm., and 75 mm. The range is, therefore, from 33 mm. to 75 mm., and the average is 45.9 mm. Since the new genus *Afrochoerus* is clearly related to *Phacochoerus*, it may reasonably be expected that a similar range in size will be found.

***Afrochoerus nicoli* sp. nov.**

DIAGNOSIS.

A species of *Afrochoerus* in which the third molars are composed of two lateral rows of pillars, the enamel pattern of which is exposed on worn teeth as an elongate "Y", the fork of the "Y" being at the anterior end. The shape of the enamel pattern on the medial pillars in slightly-worn teeth is oval. It is a characteristic of the new species that even when the teeth are only slightly worn, the enamel of adjoining pillars tends to join up, this being particularly the case with the medial pillars. As far as the lateral pillars are concerned, the process of fusion of the enamel pattern tends to take place first at the anterior end of the tooth, but in respect of the medial pillars, the posterior ones tend to join up first.

Holotype: A broken fragment of the left half of a mandible, having the third molar in position. This specimen is from Bed II at Oldoway and is marked (F) in the fossil collection in the Coryndon Museum, Nairobi, Kenya Colony.

Paratypes: A right and left lower third molar in different stages of wear. These are marked (G) and (H) and are respectively from the junction of Beds III and IV, and from Bed IV. Both paratypes are in the fossil collection in the Coryndon Museum, Nairobi, Kenya Colony.

DESCRIPTION.

Specimen (F). *Holotype*. A fragment of the left side of a mandible containing the left third lower molar (see Fig. 2a. and Plate 60) which is very slightly damaged at its posterior end. The root sockets of the second molar are preserved, but that tooth is missing. The mandible is broken away in front of the second molar root sockets and posteriorly is broken off immediately behind the third molar. The underneath portion of the mandible is also broken away, leaving only a small part of the alveolar bone on either side.

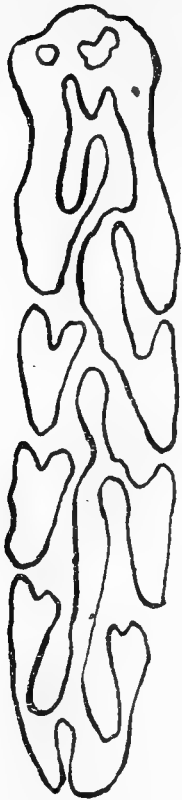
The third molar is in a fairly advanced stage of wear and, anteriorly, the crown of the tooth is only 17.5 mm. high, exclusive of the short roots. At the posterior end, the crown of the tooth is 32 mm. high, exclusive of the short roots, and 49 mm. high with the roots.

The greatest length of the tooth parallel to the occlusal surface is 90 mm. and the length of the occlusal surface as preserved is 78 mm. and, before being damaged posteriorly, the occlusal length was probably 81 mm.

The tooth has been composed of three rows of pillars, but owing to the fairly advanced stage of wear, the enamel of some of the pillars has joined up, somewhat confusing the original pattern. From a study of specimen (H), the second *paratype*, which is a slightly-worn tooth, and which has been sectioned to show what the enamel pattern would be like in a more advanced stage of wear, we know that this joining up of the enamel of some of the cusps is a definite characteristic of the new species *Afrochoerus nicoli*.

In a worn tooth, which has been chosen as *holotype*, the enamel of all except the two middle lateral pillars on the bucal aspect has joined up with the enamel of all the subjoined medial pillars to form two very complicated enamel patterns, as shown in the illustrations. It should be noted that in the teeth of species of *Phacochoerus* in a similar stage of wear, I can find no evidence of such a fusion of the enamel of the various pillars, although, when an absolutely *extreme* stage of wear is reached, a slight degree of fusion of just a few of the pillars is occasionally found.

FIG. 2.



2 A



2 B



2 C



2 D

- 2a. *Holotype* of *Afrochoerus nicoli* (lower third left molar).
2b. *Paratype* of *Afrochoerus nicoli* (lower third right molar).
2c. *Paratype* of *Afrochoerus nicoli* (lower third left molar).
2d. Section of 2c to show the change of enamel pattern as wear increases.

The full measurements of the tooth are as follows: Maximum length 90 mm. Length at occlusal surface (as preserved) 78 mm., (originally) circa 81 mm. Maximum width 18 mm. Width at occlusal surface 17 mm. Height at anterior end (without roots) 17.5 mm. Height at posterior end (without roots) 32 mm., with roots 49 mm. It is not easy to estimate the height of the tooth when unworn, but it must have been in the neighbourhood of 80 mm. high with the roots.

Specimen (G). First *paratype*. This is a third right lower molar (see Fig. 2b.) in a medium stage of wear and with the whole of the root area broken away. The tooth is composed of three rows of pillars, but owing to the stage of wear, the enamel of some of the pillars has joined up, somewhat confusing the original pattern, but not so much so as in the *holotype*. The enamel of the lateral pillars, when not confused with that of the medial pillars, is seen to be "Y"-shaped, as in the *holotype*. The enamel of the anterior pair of lateral pillars, together with that of the second lateral pillars on the lingual aspect, is joined up with that of the subjoined medial pillars to form a complex pattern, but the enamel of the three next pairs of lateral pillars is in each case intact and separate. The enamel of all but the two anterior medial pillars is joined up to form a single elongate island of enamel 42 mm. long. As in the case of the *holotype*, we know from the second *paratype*, specimen (H), that originally this elongate island of enamel was composed of a series of elongate oval medial cusps. The two extreme posterior lateral pillars have their enamel joined at the hinder end.

The measurements of specimen (G) are as follows: Maximum length 74 mm. Length of occlusal surface 72 mm. Maximum width 17 mm. Width of occlusal surface 16 mm. Height at anterior end (without roots) 38 mm. Height of posterior end (without roots) 51 mm.

Specimen (H). Second *paratype*. This is a third lower molar (see Fig. 2c.) only slightly worn. It is considerably smaller than the other two specimens and is probably of a female animal. This tooth has been included as a second *paratype* for the following main reasons:—

- (1) It shows that the teeth of this new species are subject to a considerable size variation.
- (2) It shows the nature of the enamel pattern of the new species before they have been subjected to much wear.
- (3) It shows [in a section which has been cut (see Fig. 2d.)] that the complicated joining-up of the enamel of some of the lateral and medial pillars is a development from an arrangement that is somewhat similar to that found in the genus *Phacochoerus*.

- (4) It also shows that even in a very slightly-worn stage the teeth of the new genus can be clearly distinguished from *Phacochoerus*.

The tooth is composed of three rows of pillars and is only slightly worn. The enamel pattern of the lateral rows of pillars shows the "Y" shape only to a very slight, but yet quite distinct, degree and in the absence of other more worn teeth, or of sectioning, this tooth might possibly have been regarded simply as a *very aberrant* tooth of the *Phacochoerus* group. The medial pillars have a more or less elongate oval enamel pattern, but are not otherwise unusual. The two anterior medial pillars have joined up and have a single enamel pattern, as have the next two.

The measurements of the tooth are: Maximum length parallel to the occlusal surface 71 mm. Length at occlusal surface 60 mm. Maximum width 16.5 mm. Width at occlusal surface 14.5 mm. Height 58 mm. (without roots which are broken away).

In order to compare the enamel pattern of this slightly-worn tooth with that of the much more worn specimens (F) and (G), this tooth has been sectioned about 30 mm. below the actual occlusal surface in order to see how the enamel pattern would have changed as the tooth wore down.

The description of the enamel pattern at the point of sectioning (see Fig. 2d.) is as follows: The enamel pattern of the lateral pillars (except where the enamel of two or more pillars has joined-up) shows the characteristic "Y" shape of the new genus to a marked degree. The two anterior pairs of lateral pillars have ceased to have separate enamel patterns and instead, the enamel of all four pillars has united into one single continuous line of enamel. In place of the anterior medial pillars, there are two elongate islands of enamel side by side with a very small circle of enamel anteriorly. The enamel of the third pair of lateral pillars has joined up with the enamel of five or six medial pillars to form another continuous line of enamel. The remaining lateral pillars posteriorly are all intact and there is one intact medial pillar posteriorly, but its enamel pattern is more complex than in the unworn tooth.

In respect of detail, the enamel pattern shown in this *sectioned* tooth differs a little from that seen in specimens (F) and (G), but in general the similarity is very great.

DISCUSSION.

A new genus has been created for a group of *Suidae* somewhat resembling the phacochoeres, but differing from it in certain well-defined characters. It has been shown that even in very slightly-worn teeth the essential characters of the new genus

are recognisable. In worn teeth, the characters are unmistakable. A fragmentary tooth described as *Phacochoerus altidens* by Shaw and Cooke, has a marked degree of resemblance with the new genus and it is suspected that when more complete material is found this species will have to be removed from the genus *Phacochoerus* and placed in the genus *Afrochoerus*. It is possible but I think improbable than van Hoepen's genus *Synapotochoerus* is the same as my *Afrochoerus* in which case that generic name will have to take precedence. The East African species of the new genus is named *Afrochoerus nicoli*, the specific name being taken from the maiden name of my wife, in her honour, as she found the first tooth of this type some years ago. That specimen is now in the British Museum of Natural History, with several others.

GENUS PHACOCHOERUS CUVIER.

Phacochoerus c.f. *aethiopicus* (Pallas).

The Oldoway fossil beds have yielded a number of teeth of phacochoeres which do not appear to differ in any way at all from those of the local living species of the genus *Phacochoerus*. These teeth come from the same horizons as the teeth described above as a new genus allied to the phacochoeres. In the fossil collection in the Coryndon Museum, Nairobi, Kenya Colony, there is only one fragment in the Oldoway material, that seems to represent the living species, but in the collections made by my Expeditions of 1931, 1932, and 1935, there were a number of other examples, which are now in the British Museum of Natural History.

The one specimen collected in 1941, is briefly described here in order to make the picture of the *Suidae* of Oldoway given in this paper more complete.

The specimen is marked (I) in the fossil collections of the Coryndon Museum, Nairobi, Kenya Colony, and was collected from Bed I Oldoway in August, 1941.

DESCRIPTION.

Specimen (I). A fragment of a third molar, broken anteriorly and posteriorly and with the roots damaged.

The fragment shows three rows of pillars (see Fig. 1d.) in all of which the enamel pattern is sub-cylindrical and indistinguishable from that to be seen in the living species.

The fragment as preserved has a length of 20 mm., a width of 15 mm. and a height (exclusive of roots) of 29 mm.

Phacochoerus complectidens sp. nov.

DIAGNOSIS.

A large species of the genus *Phacochoerus* in which the medial pillars are more than twice as many as the pillars in either lateral row (or more than twice as many as the sum total of the two lateral rows of pillars together); and in which the medial pillars are not arranged parallel to the rows of lateral pillars, but instead are grouped in a disorderly and complex fashion.

Holotype: A broken fragment of a very large lower third molar of general *Phacochoerus* type. The specimen is from Bed IV at Oldoway and is marked (J) in the fossil collection in the Coryndon Museum, Nairobi, Kenya Colony.

DESCRIPTION.

Specimen (J). *Holotype*. A fragment of a lower third molar (see Fig. 1e. and Plate 62) composed of three lateral pillars on the lingual aspect of the tooth and ten medial pillars. A part of one lateral pillar on the bucal aspect is preserved. The medial pillars are mostly smaller than the lateral pillars and they are not arranged parallel to the lateral pillars (as is normal in all known species of *Phacochoerus*), but in a confused and disorderly manner (see Fig. 1e. and Plate 62).

The measurements of the fragment, as preserved, are as follows: Length of the preserved part of the occlusal surface 30 mm. Width (exclusive of the external or bucal row of lateral pillars, which is missing except for foot of one pillar) 17.5 mm. Height (exclusive of roots which are broken away) 77 mm.

From these measurements, it is clear that the fragment is part of a very large tooth, but on size alone it would be unwise to make a new species. This has been done because of the number and arrangement of the medial pillars.

DISCUSSION.

For the time being, the Specimen (J) has been made the holotype of a new species of the genus *Phacochoerus*, because no record can be found of any species of this genus with the medial pillars arranged in such a complex way, or which has so many medial pillars in proportion to the number of lateral pillars. It is possible that when more complete material representing this animal is discovered, a new genus may have to be created, or, alternatively, it may be found that it really belongs either to the genus *Afrochoerus* or to *Metridiochoerus* (which it resembles in some ways) and not to the true phacochoeres at all.

GENUS *METRIDIOCHOERUS* HOPWOOD.

Metridiochoerus sp.

The 1941 collection of fossils from Oldoway has fragmentary teeth which are definitely referable to the genus *Metridiochoerus* Hopwood, but they are too damaged for specific determination to be safe, and are only mentioned in order to show the great range of the Oldoway *Suidae*. One talon, in particular, has great similarity in points of detail with the talon of the tooth illustrated by Hopwood in his paper in which the new genus was created.

GENUS *SUS* LINN.

Sus limnetes Hopwood.

A brachydont, broken and much worn third upper molar (see Fig. 1f.) with part of the talon missing would appear to be referable to this species, which was originally described by Hopwood from the Kaiso fossil beds in Uganda.

The specimen which is marked (K) in the fossil collections from Oldoway in the Coryndon Museum, Nairobi, Kenya Colony, has the following dimensions: Maximum length at occlusal surface as preserved 37 mm. Maximum width of occlusal surface 23 mm.

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The Oldoway fossil *Suidae* described in this paper are:—

- (1) *Mesochoerus olduvaiensis* sp. nov.
- (2) *Potamochoerus (Koiropotamus) majus* (Hopwood).
- (3) *Notochoerus dietrichi* Hopwood.
- (4) *Afrochoerus nicoli* gen. et sp. nov.
- (5) *Phacochoerus* c.f. *aethiopicus* (Pallas).
- (6) *Phacochoerus complectidens* sp. nov.
- (7) *Metridiochoerus* Hopwood. Species indet.
- (8) *Sus limnetes*, Hopwood.

The associated fauna includes *Deinotherium* (Beds I and II), *Chalichotherium* (Bed I), *Sivatherium*, *Elephas antiquus*, *Hippopotamus gorgops*, *Hipparion*, *Pelorovis*, *Simopithecus*, and about fifty other species, a high proportion of which are extinct.

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POSTSCRIPT. (25/3/42.)

Since this paper was completed I have seen, through the kindness of Dr. Stockley of the Department of Lands and Mines, Tanganyika Territory, a copy of Professor Deitrich's paper on the fossil pigs from Oldoway. Professor Deitrich, in this paper published in Berlin, in 1937, and referred to in my paper, describes the few fossil-pig remains that were in the collection made by the late Professor Reck during his expedition to Oldoway Gorge in 1913. No new genera or species are proposed, Professor Deitrich merely describing the material and assigning it to several genera without attempting to give specific names.

He recognises the following: a *Potamochoerus* (*Koiropotamus*), two species of *Phacochoerus*, and one species which he attributes to what he calls "the *Notochoerus-Metridiochoerus* group." The *Potamochoerus* is represented by a large part of the skull of an immature individual with milk dentition. It is probably a young *Potamochoerus majus* (Hopwood). Of the two species of *Phacochoerus* which Deitrich recognises but does not name, one is based upon a palate with both third molars in position. The second species of *Phacochoerus* is based upon a left, lower, third molar and a broken part of another third molar. The identification of some species belonging to the *Notochoerus-Metridiochoerus* group is based upon a broken third molar and a tip of a tush. Judged by the illustrations the species represented by this material is *Metridiochoerus* rather than *Notochoerus*.

FURTHER NOTES (No. 3) ON THE EARLY STAGES OF
HETEROCERA BRED IN THE NAKURU DISTRICT.

By A. L. H. TOWNSEND.

ARCTIIDAE.

Diacrisia jacksoni Roths.

FOODPLANTS.

Almost any low-growing plant; such as Sodom apple (*Solanum incanum*), macdonaldi (*Galinsoga parviflora*), black-jack (*Bidens pilosa*), etc.

LARVA.

This very common and very conspicuous larva is well known for the urticating quality of its hairs, which affect even a black skin. It is dense black, covered with long silky grey hair. Spiracles conspicuous white; head, legs and claspers bright red. When travelling it can get up a remarkable pace.

PUPA.

In a large cocoon spun among leaves. It is dark-brown, naked, with granulated surface. Cremaster consists of two small leaf-like processes placed centrally at the tip of the terminal segment. Duration of pupal stage very variable — up to six months.

Diacrisia investigatorum Karsch.

FOODPLANTS.

Many low-growing plants, including macdonaldi (*Galinsoga parviflora*), *Oxygonum*, etc.

LARVA.

Each segment has a raised black transverse band, studded with small blue tubercles, which emit long grey-white hairs. Between the bands, when the larva is extended, the skin is dull green. The bands are broken on the back by the yellow dorsal line. On either side of the black band is one of sulphur-yellow. The hair on the front half of the larva has often a fulvous tinge. Head, legs and claspers red. The larva stands with both ends raised.

PUPA.

In a flimsy cocoon among leaves, etc. It is stout, short, nearly black. The terminal segment is a blunt dome, having a small excrescence just out of centre on the dorsal side. From

the point of this spring a bunch of seven or eight stout stems, of circular section, slightly tapered, but not pointed. They terminate each in a circle of minute radiating points. Duration of pupal stage up to three months.

Seirarctia clara Holl.

FOODPLANTS.

A great number of low-growing plants.

LARVA.

A very typical "Woolly-bear." Stout, very hairy; ground colour black, greyish in lateral area. Length up to $2\frac{1}{2}$ inches. The dorsal hair on the front part of body is bright tawny, with a few long white hairs in it. The rest of the hair-coat is dark grey or black. The hair springs, in star-formation, from transverse rows of bright blue tubercles; these tubercles being "staggered" in the rows. There is a chain of small white spots on the dorsal line, and others latero-dorsal. Occasionally, there are tawny-yellow latero-dorsal and lateral lines. Spiracles white, legs and claspers red. Head red or yellow, with a black transverse bar, and black frontal spots.

PUPA.

In a web among stems, etc., on or near ground surface. It is dark brown, short and stout; girth at centre greater than at head. Terminal segment a short dome, from the central point of which springs a short pointed shank, ending in a sort of rosette. Duration of pupal stage may extend to nine months.

Secusio pustularia Wlk.

FOODPLANT.

Gymna scandens.

OVA.

Spherical, pearly-white: turning grey before hatching; laid in small batches on leaf surface.

LARVA.

Is very delicate, slender, transparent-looking. It is very strongly indented between the segments. When young, ground colour is pale, transparent green. A double black dorsal line has small black rings on either side. Head small, transparent brown, with a pencil of fine hair pointing forwards on either side. A good deal of fur on the body; some black, some silvery-grey. Ventral claspers ground colour: anal pair long, transparent white.

Later the ground colour becomes almost white: the dorsal line is seen to be a series of marks, roughly diamond-shaped, joined into a chain. Star-clusters of white hairs spring from small

tubercles all over the body, those tubercles on either side of the dorsal stripe being ringed and spotted with black. The larva eats patches of the surface of the leaf, both upper and under-sides, leaving the membrane intact. It feeds by night, and falls very readily, without a thread.

PUPA.

Is in a thin web between two leaves. It is dark red—almost claret colour—shiny, with black crossbars on abdomen, and black wing-venation. There is a cluster of many fairly long, separate hooks at the extreme tip of the terminal segment. Pupal stage lasts about fifteen days.

NOTE.—On June 17th, I took larva, pupa and a ♀ laying ova; on the same plant, at the same time.

Sommeria (Digama) meridionalis Swh.

FOODPLANT.

Carissa edulis.

LARVA.

Stout, smooth, except for a few scattered bristles. Colour drab, with a black interrupted dorsal thread-line, and a black transverse "smear" on Segment 4. There is a series of paler marks on each side of the central line, becoming more conspicuous towards the rear end: and ending in a long, oval, pale area on Segments 10, 11, and 12. Spiracles small, black: Head small, black: legs and claspers pale.

PUPA.

Is subterranean, in a flimsy cell. It is brown, with a rugose terminal segment having a bunch of several, rather long, separate hooklets on the dorsal edge. Duration of pupal stage about eight weeks.

LASIOCAMPIDAE.

Odontocheilopteryx myxa Wallengr.

FOODPLANTS.

Acacia, wattle.

LARVA.

Length 1 inch. Stout, much flattened below. First few segments thicker. A very short larva for its width and girth. Colour, in different specimens, bright umber-brown, greenish-ochreous, or dark brownish-grey. A dark grey dorsal patch on Segment 4. Dorsal line very narrow, black. Pairs of latero-dorsal tubercles on all segments, those on Segment 12 being larger, and springing from a common base. Below these is a row of smaller tubercles. A lateral tubercle on each segment

emits a thick downward-pointing tuft of greyish fur. Dorsal transverse slits on 3 and 4 show orange or scarlet slips with black and white spots when distended. Pronounced thoracic lappets; the first and second clothed in grey fur. Above the third is a thin pencil of dark hair, which is held out horizontally when the larva is on a leaf, but vertically downwards when it is on a twig. Head ground-colour with grey blotches; rather retracted into Segment 2. Ventral area grey, with a complicated central stripe of black, orange, and white spottings.

PUPA.

In a thin web among leaves. It is short and thickset, grey, with a thick crop of short, rather curly, blonde fur all over abdomen, and longer tufts on head and thorax. Antennae, legs, and wing-venation black. Abdomen covered with minute black spots, with a few larger ones among them. Terminal segment flattened at end; from the dorsal side project very many, short, brown hooklets, bunched closely together. Duration of pupal stage up to three weeks.

LYMANTRIIDAE.

Chilena donaldsoni Holl.

FOODPLANT.

Various grasses; most commonly found on "Watergrass."

LARVA.

Length 2 inches, stout, furry. The fur is mostly silver-grey, that on the dorsal area being tinged with yellow. The dorsal area is cream colour, with a square, black, velvety patch on each segment. Those on Segments 3 and 4 carry upright tufts of black hair, and there is a similar, but less compact, tuft on Segment 11. Divisions between segments black. Lateral area black, with a narrow, interrupted, white line. Ventral surface stained with orange-brown. Head, legs, and claspers yellow-brown.

PUPA.

Subterranean.

Psalis pennatula F.

FOODPLANT.

Various grasses.

LARVA.

Length $1\frac{1}{4}$ inches, tapering slightly towards rear. A black dorsal line is interrupted by the usual four brush-tufts, which are white-sided, fulvous-tipped. Dorsal area chiefly canary-yellow, with narrow black cross-lines, and deeper yellow latero-

dorsal patches. There are three whitish crossbars, with black edges, on the segments behind the brush-tufts. Where these cross the dorsal line, there are, on each segment, two white spots: and the last two of the three segments carry red central studs. Lateral stripe broad, dove-grey, black-edged. Area below it, salmon-pink. Ventral area grey and black. A pair of dark pencils of hair point forwards from Segment 2, and a similar one points backwards from Segment 12. Lateral tufts of grey bristles. Legs and claspers red.

PUPA.

In a rather transparent, oval, cocoon on grass stem. It is black, polished, covered with fairly short, thick, grey fur. Dorsum has a double line of lozenge-shaped, yellow marks; and there are similar marks on venter. Terminal segment has a long tapering process, not sharply pointed on dorsal side, flattened on the ventral side, set with a number of stiff bristles throughout its length. It ends in a close-set bunch of short, stout hooklets. Duration of pupal stage about three weeks.

Stilpnotia parva Plotz.

FOODPLANT.

Wedelia menotriche.

LARVA.

One inch in length. Ground-colour whitish, with dorsal and latero-dorsal stripes consisting of many small black spots. There is a pinkish shade in the latero-dorsal area. Half-rings of yellow tubercles emit thin tufts of grey hairs, the lateral hair being longer than the dorsal. The tubercles on Segments 5 and 6 are larger and cone-shaped. There are two thicker tubercles, pointing slightly forwards, on Segment 2. Head grey, mouth-parts yellow. Legs yellow; claspers yellow with a dark streak.

PUPA.

Pale green or sometimes yellow, legs and antennae outlined in black. On the two first abdominal segments are ventral, dark brown stains. There is a ring of black spots on each segment; those in the dorsal area join to form a black line on the last two segments. A row of yellow blotches in the latero-dorsal area. Tufts of whitish hair all over, mixed with black, especially at head and tail. Cremaster—a long stout black shank with a bunch of small hooklets at the extremity. Duration of pupal stage is three weeks.

Pteredoa monosticta Btlr.

FOODPLANT.

Grewia similis.

OVA.

Smooth, greyish-green; circular as seen from above; two depressed, concentric circles on upper surface.

LARVA.

Length $1\frac{1}{4}$ inches, slightly tapered to rear end. General colour, pinkish down to spiracles, green below. Two dorsal tufts of white hair on all segments, side by side: those on Segments 3, 4, 7, and 12 being larger and more compact; those on 8 to 11 lying closely to body, pointing backwards. On 5 and 6 there is a rectangular, grey patch, in which stand four, pale-grey mastoid tubercles, surrounded by short, dark bristles. From the tips of these tubercles a clear bead can be extruded at will. Behind the grey patch, the dorsal area is sparsely marbled with brown and black; except on Segments 10 and 11, where the colour is pale-grey, with a most inconspicuous, grey, central stud on each of the two segments. In lateral area the black and brown marblings are concentrated into the semblance of a stripe; below which a conspicuous swelling on each segment, salmon-pink or scarlet, emits a tuft of white hairs: those tufts on Segments 5 and 6 being horizontal pencils. Other smaller tufts spring from the bases of claspers. On the thoracic segments there is an extra, red swelling, with a tuft of shorter, white hair between the lateral swellings and the dorsal tuft. Anal tuft is dark-grey, and so are those pointing forwards beside the head. Head, legs, and claspers yellow-brown.

PUPA.

Spun on stem, or in leaf. Pale green; eyes, legs, antennae, and wing-margins strongly outlined in black. Rows of dorsal and latero-dorsal black spots; and two similar spots on venter. Covered with tufts of pale hair, mixed on head and thorax with stronger, black hairs. Cremaster—a long black shank with a number of small hooklets at the extremity. Duration of pupal stage about twelve days.

Laelia hemippa Swh.

FOODPLANT.

Acacia sp. (? *A. abyssinica* Hochst.)

LARVA.

One inch long. There are four wide, compact, dorsal brush-tufts. These are very variable in colour: being sometimes tawny, and at other times scarlet, dark brown, or greenish. Their sides are usually black or dark-brown, sometimes with a dark green tinge, especially in the hind pair. The dorsal area in front of the tufts is dark brown; between them (when the larva is extended) white. Behind them it is black. Segment-divisions reddish-yellow. The dorsal studs on Segments 10 and

11 are white, or very pale yellow. On Segment 12 is an upright tuft, light-grey in front, dark smoky-grey behind. Two very dark grey forward-pointing pencils of hair on Segment 2. Dorsal area is bounded by a grey interrupted line, below which is a mottled grey and brown area with a thin, interrupted, black line. Thick lateral fur, grey. Ventral area yellow with red dashes. Head, legs, and claspers red.

PUPA.

Is in a thin cocoon spun among leaves. Duration of pupal stage is one month.

NOTE.—In Vol. XIII, No. 3, p. 119 of this *Journal*, I described the larva of what was then considered to be a sub-species of *L. hemippa*. It now appears that that species is *L. promissa* Her. (I am much indebted to Col. Stoneham of Kitale for help with the determination of these two species, *hemippa* and *promissa*; and of several others dealt with in these notes.) The larvae of these two species are very difficult to distinguish, particularly when nearly full-fed. The main differences seem to be:—

- (1) In *hemippa* the brush-tufts are wider and more compact than in *promissa*.
- (2) In *promissa* the tips of the hairs of these tufts are, as a rule, lightly powdered with golden-yellow.
- (3) In my experience so far (and I have bred large numbers of both), *promissa* is always found on *Acacia xanthophloea*, while *hemippa* is always on *A. abyssinica*. Neither will touch the other's foodplant; and if both are put in a cage with the two kinds of food, they very quickly sort themselves out, each on its appropriate species of *Acacia*.

EUPTEROTIDAE.

Phiala flavina Gaede.

OVA.

Spherical, pale butter-yellow; with a small circle of deeper colour at the micropylar area.

LARVA.

When young, the larvae are gregarious. They live in a wide-flung web among grass, of which they feed on various species. Ground-colour black, with eight lemon-yellow lines. Each segment has a ring of tawny fur, with darker hairs among it. There are two, long, latero-dorsal pencils of black hair, pointing forwards and upwards beside the head. Similar but smaller pencils point backwards from Segments 11 and 12.

When full-fed, the length is $2\frac{3}{4}$ inches or more. General colour greenish-yellow, thickly sprinkled with black dots. A very conspicuous, lateral stripe, thick and rather wrinkled, sulphur-yellow. Between this stripe and its fellow are six longitudinal lines of the same colour; the central two in the dorsal area being close together. There are nine transverse, black, velvety cushions: but except when the larva is curled, these are hidden between fringes of blonde hair, one fringe in front of, and one behind, each velvet patch. The front fringes contain each two pencils of tawny-red hairs, black-tipped. These fringes, except the last pair, are held with all the hairs converging upwards to a central point. The segments that carry the second and third pairs of legs have similar pencil-tufts; but these do not converge, and are longer than the others. There is a good deal of whitish hair pointing forward round the head, and tufts of similar hair spring from the bases of the claspers. Head is reddish-yellow; face black with yellow markings. Legs reddish-yellow; claspers brown with yellow vertical stripes; spiracles white with a dark ring. A yellow plate over anal claspers. The larva is of a very thirsty habit, and will drink up a surprising number of raindrops after an evening shower.

PUPA.

The short thickset pupa is in a loose and flimsy cocoon just underground, or sometimes among grass stems. It is light-brown. The terminal segment, which is slightly darker, is a blunt dome, with a small, knobby excrescence on the ventral side; and on the dorsal two short, nearly flat, horns or leaves diverging at once, and curved back until their ends are at right angles to the length of the pupa. Duration of pupal stage very variable, lasting sometimes over a year, and sometimes for less than three months.

SATURNIIDAE.

Cirina forda Westwood.

FOODPLANTS.

Wattle, acacia, pepper-tree (*Schinus molle*), *Carissa edulis*.

OVA.

Pale greenish-white, without visible markings or sculpture. Roughly oval, but sharply tapered to one end; polished; laid in very large piles on leaves or stems. These ova are much subject to a small parasitic fly.

LARVA.

When about half-fed, is $1\frac{1}{4}$ inches long, fairly stout, black with a rather greasy-looking skin. Latero-dorsal lines yellowish-white. (In some specimens these are complete; in others they are represented by a few dots on each segment.) Upper and

lower lateral lines deeper-yellow; interrupted. Tufts of scanty white bristly hairs spring from the lower lateral line, and from latero-dorsal area. Head and Segment 2 shining black.

When full-fed, nearly $3\frac{1}{2}$ inches long. Lateral area has a broad stripe consisting of small yellow plates, or scales, close together. A few similar scales are scattered on ventral surface. At the rear end of each segment is a narrow transverse band of similar scales, but white. Scanty tufts of coarse white hair rise from these bands, and from the area in front of them. There are two lateral rows of similar tufts, a few hairs on claspers, and shorter ones on the black head-lobes. Spiracles black. A black horny plate on Segment 2. Legs and claspers black. A pronounced lateral wrinkle. These larvae are sometimes so numerous as to amount to a plague.

PUPA.

Subterranean; black, horny. Duration of pupal stage very variable: from six weeks to five months.

Lobobunaea tyrrhea Cr.

FOODPLANT.

Acacia, various species; pepper-tree (*Schinus molle*).

LARVA.

Stout; spiny. Head, legs, and claspers, when fresh-moulted, bright claret. Later, black. Body covered with small scale-plates, yellow except in the latero-dorsal area, where they are pale but vivid blue. A velvety, black, dorsal stripe, of irregular width, interrupted by a narrow transverse band, on each segment, of the yellow scales. Transverse half-rings of six short claret-coloured spines, with reddish bristles on them. (NOTE.—The central spines on Segment 12 do not combine to form one spine; but they are very close together.) When full-fed, spines are very short, claret-colour, situated in a half-ring of light blue scales, interrupted dorsally, and shading off to green in the spiracular region. On each side of this blue half-ring, the scales are bright yellow, shading off to pale yellow towards the segment-divisions. The ring behind the spines is complete; that in front is interrupted dorsally by the black dorsal stripe. Lateral wrinkle very pronounced, covered with yellow and blue scales, with black top edge. Spiracles black. Dorsal stripe velvety black, devoid of scales, except for a few blue ones on the thoracics, the black spreading out at right angles to the dorsal line at the segment-divisions. The black skin also shows as an interrupted latero-dorsal line. Ventral surface black, with a few yellow scales. Legs and head black; claspers and horny plates maroon. Thick, short, white bristles on claspers, spines, head, and Segment 2.

PUPA.

Subterranean, black, horny. Cremaster—a short tapered shank on dorsal side of the terminal segment. End slightly bifid; lateral serrations. Duration of pupal stage is three months.

Ludia hansali Fldr.

FOODPLANT.

“Leleshwa” (*Tarchonanthus camphoratus* L.).

OVA.

Laid in contiguous rows around twig. Shape—a short cylinder (length= $1\frac{1}{2}$ diam.), with domed end. Colour dirty-white, spotted and clouded with pale brown.

LARVA.

Length when full-fed about 2 inches. Covered with white fur, not very long, including thicker tufts on each segment, one on each side of the dorsal line, and others in lateral area. Those on thoracic and anal segments have a few black hairs mixed in them. Head black; legs and claspers brown. Dorsal area largely black or dark grey, with two black, transverse lines, enclosing a narrow grey area, at each segment-division. Lateral wrinkle yellow. In the last instar there is an interrupted, black lateral line, with a yellow stain on the hinder part of each segment, and various, small, black spottings above the actual line. Below the lateral line also are small, scattered, black spots, and there is a conspicuous, black line across the base of each clasper. The dark dorsal area of the earlier instars has disappeared, and the whole larva is pale greyish-green.

PUPA.

In a stout silk cell, either among the leaves of the plant, or more generally, among trash on the ground. Pupa is dark purplish-brown, granulated. Wing-sheaths more reddish, smooth. A stout shank on dorsal edge of terminal segment ends in a flat rosette of short points or spikes. Duration of pupal stage very variable: may last ten months.

NOCTUIDAE.

Anomis sabulifera Guen.

FOODPLANT.

Grewia similis.

LARVA.

When full-fed is nearly 2 inches long: bright velvety-green. Smooth, but with a few, short, black bristles rising from black, pale-ringed warts arranged in two irregular transverse rows on each segment. The skin at the segment-divisions is yellow. On

Segment 2 is a collar consisting of two, deep rose, latero-dorsal patches, with a smaller, ochreous patch on their upper-side. Head large, round, green. Above the anal claspers is a transverse yellow bar, with a deep rose stain at each end. Three wavy, indistinct, yellow lines run the whole length of the body on either side. Spiracles oval, buff, black-ringed. Ventral claspers four pairs, but the first pair small.

PUPA.

Subterranean, red-brown, rather slender. A cone on the dorsal edge of the terminal segment, fluted on its dorsal side, is furnished with two stout prongs at its extremity: and several slender hooks spring from its base. Duration of pupal stage about one month.

Diaphone eumela Cram.

FOODPLANTS.

Amaryllis lilies, *Crinum Kirkii*, *Anthericum* sp.

LARVA.

Length $1\frac{1}{2}$ inches or more. Stout; tapers slightly to anal end. Smooth. Ventral claspers four pairs. Ground-colour cream, sometimes with a slightly greenish tinge. Head yellowish-red, with two black marks behind the lobes. Each segment has a black, velvety, transverse band of very irregular width. The widest part is in dorsal area, where it forms two, almost rectangular patches, one on each side of the central line. Between these is a reddish blotch, bisected by a short, transverse line of the same colour. Each blotch is larger than the one in front of it. That on Segment 12 occupies almost the whole of the area that on the other segments is black. The black, transverse bands thicken also in the lateral area; and again just above the claspers. There are black latero-dorsal spots at the segment-divisions; a ring of black spots on Segment 2, and another above the anal claspers. Legs black; claspers tawny-red.

PUPA.

The red, stout pupa is in a very strong earthen cell underground. Duration of pupal stage about five months.

Diaphone lampra Karsch.

FOODPLANT.

Amaryllis lilies, *Anthericum* sp., *Albuca* sp.

LARVA.

Length $3\frac{1}{2}$ inches to $3\frac{3}{4}$ inches; obese, smooth-skinned, cream colour with a slight greenish tinge. Each segment has a black transverse band consisting of a large, roughly rectangular, dorsal patch, with an irregularly-shaped extension (rather like a map

of Africa!) on its hinder side, stretching down to, and including the spiracles. In front of each of these extensions, except the last two, is a black lateral spot: and below them, at the base of each leg and clasper, is a roughly circular, black spot, with its outer edge stained with red. On Segments 5 and 6 the black band is continued completely round the body, and on the segments behind the fourth pair of claspers it is continued as a line of dots on the ventral surface. Head, and plate on Segment 2 red-brown, with a row of black dots in front of the latter. A similar small plate over anal claspers. Legs black; claspers reddish-yellow; a black spot on the anal pair. Transverse rings of short, sparse, black bristles. Head partly retractile; thoracic segments-tapering. Towards maturity, all the black markings acquire a maroon tinge; especially the extensions to the transverse bands.

PUPA.

Subterranean, in a hard earthen cell. Stout; nearly black. Terminal segment has, on the dorsal side, a short, stout cone, with a very short central spike. Duration of pupal stage is from three to four months.

Eutelia discistriga Walk.

FOODPLANT.

Maerua sp.; pepper-tree (*Schinus molle*).

LARVA.

When full-fed is 1 inch long. Rather slug-shaped. Greyish or bluish-green, with conspicuous, white, latero-dorsal lines. Body is sprinkled with small, white spots; those in the lateral area seeming to be quite irregularly spaced, while those in the dorsal area are in a sort of crescent formation. On the last few segments there are vestiges of a white dorsal line. Legs and claspers green. (When full-fed, this larva is very difficult to distinguish from that of *E. aduatrix*. When young, they are much more distinct; the main differences being the bluish tinge of the present species, and the absence of yellow transverse lines.)

PUPA.

In a very tightly-fitting, earthen cocoon underground. It is bright brown, with slightly granulated surface; terminal segment a smooth dome, with no sign of cremaster.

Eublemma decora Walk.

FOODPLANT.

Albuca sp.

LARVA.

Length $\frac{3}{4}$ inch. Stout, with Segments 5 to 8 somewhat swollen; tapering off fore and aft. Ground-colour variable—greenish-white, yellowish-white, or pale-green. Each segment has a double, transverse half-band of red-brown, extending almost down to the spiracles. The hinder edges of these bands reach right down to the sub-lateral area. On the thoracics, and the two segments having claspers, there is a detached spot just below the lower end of the dark band. In a very few specimens this spot is visible on all segments. In the middle of these double bands the ground-colour is stained yellow; deeper in the lateral area. Sparsely scattered, short, black bristles over the body, thicker and shorter over anal claspers. Head black, polished; lobes slightly separated. Legs dark brown. Claspers orange-brown. Ventral claspers two pairs only.

PUPA.

Larva lives in the seed-vessels, boring a small hole near the base. It pupates either in the vessel, or in a cocoon attached to stem. The cocoon is somewhat boat-shaped, tapering to a sharp point at each end. It is formed of grey-white silk, plastered with fragments of the plant. Duration of pupal stage is from twenty-two to twenty-eight days.

Hadena fuscirufa Hmps.

FOODPLANTS.

Various, including blackjack (*Bidens pilosa*) and macdonaldi (*Galinsoga parviflora*).

OVA.

Laid in a large patch on the under-side of leaf.

LARVA.

When full-fed, is $1\frac{1}{2}$ inches long. Stout, smooth; tapers slightly to front. The interrupted, white dorsal line, which has greenish-brown edges, has on each side a rusty-brown area bounded by the white, dotted, latero-dorsal lines. Below this a dark green area, having a very indeterminate, white, dotted line in it. A broad lateral stripe; dull light green with white edges. Just above the latero-dorsal line there is a white spot on each segment; a few specimens have pairs of black spots astride the dorsal line. Spiracles yellowish, black-ringed. Ventral area pale green.

PUPA.

Red-brown; in a very slight subterranean cell. Terminal segment short, with a pair of stout prongs on the extreme dorsal side. Grouped round the base of these are four hooklets on shorter and more delicate stalks. Duration of pupal stage about four weeks.

Heliothis (Chloridea) peltigera Schiff.

FOODPLANT.

Withania somnifera: occasionally on antirrhinum.

LARVA.

Length $1\frac{1}{2}$ inches. Stout. Dull-green, sprinkled with small white pustules that emit very short white bristles. In the lateral and latero-dorsal areas are a few longer, white bristles. Dorsal line darker green than ground-colour. Lateral wrinkle pale, with a darker area below it. Head small, green, completely retractile. Legs and claspers green. In some specimens each segment has a pinkish flush, and there are darker green latero-dorsal lines.

PUPA.

In a slight subterranean cell. It is light red-brown, with two slender almost parallel spikes at the tip of the terminal segment. Duration of pupal stage is about twenty-five days.

Lycophotia albifrons Geyer.

FOODPLANTS.

Roots and leaves of very many, low-growing plants.

LARVA.

When half-fed is $1\frac{1}{4}$ inches long: stout, smooth. Pale but bright-green, minutely mottled with white. Dorsal and latero-dorsal stripes dull red with pale centres. Between these stripes are a few, pale, dark-edged spots. Lateral stripe wide, dull red above, bright pinkish below; with an ochreous centre line. Segment 12 very slightly swollen dorsally. In the lateral area of the thoracics are a few, small, black spots. Ventral area paler green than the dorsal. Spiracles ochreous, black-ringed; those on 2 and 12 conspicuously so. When full-fed is obese, $1\frac{1}{2}$ inches, with pinkish-green dorsal area, a faint, dark, interrupted dorsal line, blackish latero-dorsal lines, and a pink lateral stripe. Below this, bright-green.

PUPA.

Subterranean. Duration of pupal stage is from six to seven weeks.

Phlegetonia catephiodes Gn.

FOODPLANT.

Pepper-tree (*Schinus molle*) is the only food that I know for this species.

LARVA.

When full-fed is $1\frac{1}{3}$ inches long. Colour bright magenta, with a lateral line consisting of bright yellow, more or less

circular patches, containing conspicuous, black spots. Dorsal area contains very many, narrow, transverse lines of yellow and white. These are of irregular width, and the yellow ones thicken in the latero-dorsal area. Segment 2 has a white leading edge. Head magenta, partly retractile. Legs and claspers same colour. The larva is entirely smooth except for a few, short, pale bristles in the ventral area and round the mouth. A most brilliantly coloured and unusual looking larva.

PUPA.

In a tight earthen cocoon just below earth surface. Duration of pupal stage is two months.

Phytometra limbirena.

FOODPLANTS.

Very many: *Vernonia* sp., *Tinnea aethiopica*, lettuce, *macdonaldi* (*Galinsoga parviflora*), etc.

LARVA.

Pale bluish-green, smooth except for a few bristles. Ventral claspers two pairs. Dorsal line dark green, with three, wavy, white lines each side of it. On these white lines are a few, small pustules, emitting each a single bristle. A black shiny dot on each segment above the spiracular line, and two latero-dorsal, black spots on Segment 12, which has a slight dorsal hump. Transverse rows of black dots on the thoracics. Head light, polished green, with black spots on crown, and larger, black marks on cheeks. Legs green with black spots: the third pair most heavily spotted. Claspers and ventral area plain green.

PUPA.

In a web of very fine white silk. Pale green, with black, transverse bars on abdomen. Legs, antennae, and venation outlined black. Terminal segment ends in a wrinkled mastoid process with small hooklets. Duration of pupal stage is from three to five weeks.

Plusia ni Hubn.

FOODPLANT.

Frequently found on lettuce: will eat blackjack (*Bidens pilosa*).

LARVA.

Length when extended $1\frac{3}{4}$ inches. Ventral claspers two pairs only. Rather transparent pale bluish-green. The only markings are very faint, pale, dorsal and latero-dorsal lines, and a slightly more distinct, whitish, lateral stripe. There is a slight anal hump. Head very small, retractile; shiny yellow-green.

PUPA.

Is in a very flimsy cocoon in a partly-curved leaf. Duration of pupal stage is three weeks.

Pseudophia tirrhaca Cram.

FOODPLANTS.

Maerua sp., *Carissa edulis*, pepper-tree (*Schinus molle*).

LARVA.

When full-fed is 3 inches long, or more; much flattened and rather tapered. Ventral claspers four pairs; but the first pair rather small, and seldom used. Ground-colour various shades of grey, much marked with bright umber-brown. Head large, streaked with brown; two brown "bumps" on crown. (Head is held stretched out, with palpi horizontal and crown behind.) Legs long, brown. Claspers brown; anal ones long; held out straight behind body, often in mid-air. Wavy and irregular, light brown, latero-dorsal lines, with a yellowish patch on those segments between legs and claspers. On Segment 9 a central dark brown patch, including a black spot. On 12 a pair of light brown, backward-pointing tubercles, on a slight hump. A similar but much smaller pair on 13. Very small, latero-dorsal warts on all segments except thoracics. Dorsal area has brown hieroglyphic marks (almost lyre-shape) on the six central segments, with vestiges of a double dorsal line joining them. A number of very fine, interrupted, dark lines and streaks all over the lateral area. Below the pronounced, lateral wrinkle the colour is light-brown. Ventral area the same; grey centrally. Spiracles dark-grey in a black ring. Inside of claspers orange; large black patches between them. Inside of legs pinkish. A most peculiar looking larva; very sluggish; extremely well-protected by its resemblance to a partly-withered twig.

PUPA.

In a thick cocoon, covered with leaves, on ground surface. It is dark-brown, with a thin grey bloom. Terminal segment much wrinkled and fluted; cremaster two short, stout, slightly diverging prongs, with a few small hooks grouped round the base. Duration of pupal stage is two months.

Tarache apatelia Swh.

FOODPLANT.

Indigophora sp.

LARVA.

One inch, or slightly more; smooth; ventral claspers two pairs. General colour of skin pale olive-green, shading through dark green to black. Dorsal and lateral areas thickly-sprinkled with small, lemon-yellow markings gathered into broad dorsal

and lateral stripes. The lateral stripe has, on each segment, a large, oval mark, reddish-ochreous; and other lateral marks of the same colour, but smaller, occur near the legs and claspers; and dorsally on Segment 12. Between the bands of yellow markings the latero-dorsal area is dark grey, shading to black on the lower edge; especially dark just above the ochreous lateral marks. Thoracic segments rather swollen. Ventral area greyish-green, with faint markings of yellow. Head speckled-green, yellow, and white.

PUPA.

Subterranean.

Ulothricopus primulinus Hmpsn.

FOODPLANT.

Acacia sp.

LARVA.

When young, is light-brown with a greenish tinge, and has a narrow, white, dorsal line. Head slightly notched, square, greyish, with brown and white marbling round the lobes, and a brown spot at the top of each lobe. A row of small latero-dorsal tubercles, two pairs per segment, emit short, pale bristles. Two red-brown spikes stand side by side on Segment 11. A close crop of very short, grey bristles below spiracular line. Four pairs of ventral claspers, but the front pair is little used, and the larva half-loops when walking. When it moves, a black, transverse, dorsal streak appears between legs and claspers. Legs long and slender, brown. Claspers greenish, brown-tipped. Above the fourth pair, and running down the stem, is a brown stain. Ventral area pale, with large, circular, red-brown or purple patches. When half-grown, a dorsal swelling appears above the second and third pairs of claspers; and a dark-grey, extensile horn emerges from it. There are vestiges of greyish latero-dorsal lines; and many, small, yellowish warts in the lateral area. (On more than one occasion I have seen larvae of the same species biting, and apparently eating off, the dorsal horn from one of their number; apparently without discomfort to the owner, and certainly without prejudice to the successful emergence of the imago.)

PUPA.

Dark-brown, covered with a pale-grey bloom. In a loose cocoon covered with particles of earth, leaves, etc.; usually attached to a twig lying on the ground. Cremaster consists of a few, separate hooklets at the point of the terminal segment, and others further up the segment. Duration of pupal stage from one to two months.

Spodoptera mauritia Boisid.

OVA.

I have found these on a number of occasions, always in a large patch covered with anal fur, on the leaf of a fig-tree. Fig, however, is not their food; and I lost several batches before I discovered the following habit of the species.

LARVA.

When clear of the eggs, the young larvae immediately spin a thread, and drop to the grass below; which is their food. When very young they are yellowish-green, sprinkled all over with black spots. White dorsal line. When full-fed, the larva is $1\frac{1}{4}$ inches long, stout, smooth. Ground-colour dull-green, with a pinkish, dark-edged dorsal line. Latero-dorsal lines pale-green with a black, roughly triangular mark above them on each segment. The area below these lines is rather brighter green than ground-colour, and below it is a pinkish-green lateral stripe with paler upper edge. Another pale stripe below this, at the top of which are the black spiracles. Below this, and ventral area, green. Legs and claspers green. A small white mark, and a small black one, above each spiracle. The larvae lie about above ground, among the grass, and are very sluggish.

PUPA.

Subterranean. Duration of pupal stage about six weeks.

GEOMETRIDAE.

Ascotis reciprocaria Walk.

FOODPLANTS.

Very many; including *Maerua* sp., wattle, castor oil (*Ricinus communis*), pepper-tree (*Schinus molle*), *macdonaldi* (*Galinsoga parviflora*), etc.

OVA.

Pale-green, longish-oval, flattened at one end, covered with fine, raised, hexagonal reticulation. Hatched on the seventeenth day.

LARVA.

The young larva is very pale greenish-grey, with a pronounced, white dorsal stripe. After the first moult it becomes very dark greenish-brown, with a conspicuous bunch of bright yellow tubercles on Segment 6. In later instars it is very twig-like, and most variable in colour. It is sometimes pale greenish-grey, but may be greenish-ochreous, reddish-ochreous, buff, dark red-brown, or almost black. The intensity of markings also varies considerably. Skin is rough, with a few bristles, springing from tiny warts. On Segment 6 is a very conspicuous

ring of four tubercles; two dorsal, and two, smaller, lateral. These four tubercles are ochreous, sometimes bright-orange. They are always black-centred, sometimes black-ringed. There is a black patch behind the lateral ones, and in front of the dorsal pair is a small black V or U. Segment 12 has a pair of dorsal tubercles like those on 6 but smaller. The intermediate segments have each a pair of small latero-dorsal warts. Some larvae are almost devoid of markings. In others a series of pale, dorsal and latero-dorsal dashes almost form longitudinal lines. Others, especially those with pale ground-colour, have, on each segment, four, dark, linear patches; and these, together with the pale dashes and pale segment-divisions, give a chequered appearance. Head light brown, speckled with black. Legs brown, with a black ring. Length of full-fed larva is $2\frac{3}{4}$ inches.

PUPA.

Subterranean. Bright brown. On the extreme edge of the dorsal side of terminal segment is a short, thick, tapering shank, ending in two rather long prongs. Duration of pupal stage is about six weeks.

Ectropis ocellata Warr.

FOODPLANT.

Castor oil (*Ricinus communis*).

OVA.

Oval; pale green; reticulated surface.

LARVA.

When young is dark grey, with a wide, white, dorsal stripe and narrow, white, lateral stripes. When full-fed, there are two types: one brown, and the other pale green. Length $1\frac{1}{4}$ inches. Dorsal stripe yellowish, of irregular width. Lateral wrinkle very pronounced, yellowish-brown, with a swelling on Segment 6, white in front, dark behind. On the same segment are dark-brown latero-dorsal tubercles. A small anal tubercle is dark behind, whitish in front. A yellowish-white lateral mark above the ventral claspers, and a streak of the same colour on the claspers themselves. Anal claspers yellow-brown. Ventral surface brown, with grey central line. Head brown, with a white bar across the face. Base of third pair of legs much swollen. These legs are held out at right angles to the body, while the first and second pairs are held close to the head.

PUPA.

Loose on the ground among leaves, etc. Duration of pupal stage about fifteen days.

Nothobraxas commaculata Warr.

FOODPLANT.

Lantana sp.

OVA.

Pea-green; very long oval.

LARVA.

Stout, fleshy; up to 2. inches in length. Ground colour purplish-brown. Conspicuous, pale-mauve lateral stripe, with a white, black-edged line above and below it. (When nearly full-fed, the lower line turns yellow.) Interrupted latero-dorsal lines consist of minute, white, black-ringed spots. There is a pair of orange warts on each segment except the thoracics; on Segment 6 these warts are larger. Similar warts are in the sub-lateral area. A pair of very small, black tubercles above the anal claspers. Spiracles orange, black-ringed; surrounded by a purple-brown area. Lateral area spotted with black and white. Ventral area has three irregular yellow and white stripes, black-edged; or sometimes dark reddish-yellow stripes on a purple ground. Collar orange. Head mauve with a black spot on each lobe. Legs mauve, black-tipped; claspers mauve.

PUPA.

Subterranean; purple-brown. Terminal segment rugose, with a stout tapering shank on the dorsal side, ending in two short prongs. Duration of pupal stage about five months.

Omphaluca extorris Warr.

FOODPLANT.

Gymnosporia buxifolia.

LARVA.

A stout, wrinkled and bulgy larva, with the thoracic segments very much swollen. Ground colour whitish, but very thickly mottled and marbled with black and yellow. It has a rather shiny, enamelled appearance. Most conspicuous feature is a row of raised, crimson, lateral spots, associated with black patches. On Segments 6, 7, and 8 there are two similar spots in the latero-dorsal area, with white patches between them. Rings of small yellow patches on each segment. A brilliant yellow patch on ventral surface between the claspers. Head mottled black and yellow. Legs yellow and black-ringed. The larva sits doubled up, head to claspers, and is very well hidden among the buds of the foodplant.

PUPA.

Subterranean. Duration of pupal stage about five weeks.

Paragathia albimarginata Warr.

FOODPLANT.

Carissa edulis.

LARVA.

When full-fed is about $1\frac{1}{3}$ inches long, rather stout, smooth, shiny. Bright green, with four, brownish-ochreous, dorsal marks, somewhat shield-shape, on Segments 5, 6, 7, and 8. On 9, 10, 11, and 12, similar marks, but lighter in colour, join up to form a long dorsal patch, whitish-ochreous in centre, with brown edges. A similar coloured patch on the base of the ventral claspers is joined by a brown, vertical line to the dorsal patch. On the ventral surface, from Segment 5 to Segment 12, is a wide stripe of the same colours as the dorsal patch. A few, very small pustules, emitting very short bristles, are scattered over the body. Two widely diverging, rough-surfaced spines emerge from Segment 2; almost black, with a whitish patch between them. Head small, black, shiny: with lobes very slightly separated. Anal claspers green.

PUPA.

Is spun up in a curled leaf. Duration of pupal stage about three weeks.

Protosteira spectabilis Warr.

FOODPLANT.

Maerua sp.

LARVA.

Length $1\frac{1}{4}$ inches: very much flattened: translucent green, paler below spiracular line and on ventral area. The only marking is a red-brown, or sometimes bright-red lateral wrinkle. This colour is carried on along the sides of the head, and over the crown: and since the head is held with the face pointing downwards, and the crown advanced, the red line appears from above as a very narrow ellipse. In its final instar the larva develops reddish mottlings all over the top-half of the body.

PUPA.

The long, narrow cocoon, covered with scraped fragments of bark, is attached to a stem. It is pointed at each end; and after the first few days a slit appears on the dorsal part, through which the buff-coloured, black-spotted pupa is visible. Duration of pupal stage is about three weeks.

Semiothisa trinotata Warr.

FOODPLANT.

Acacia sp.

LARVA.

Ground-colour green. Four, white, longitudinal stripes, dorsal and latero-dorsal. Yellow lateral stripe, with red spots on it. Segment 2 shiny, the white latero-dorsal lines being carried across it. Head transparent-green.

PUPA.

In a flimsy cocoon of silk and earth on ground surface. It is brown, with dark green wing sheaths. A short cone on dorsal side of terminal segment ends in a long, stout shank tipped with two, short, diverging prongs. Duration of pupal stage about four weeks.

Xanthorhoe exorista Prout.

FOODPLANTS.

Many low-growing plants; most commonly on macdonaldi (*Galinsoga parviflora*).

LARVA.

Length about $\frac{7}{8}$ inch. Rather wrinkled. A few, very short, pale, scattered bristles. Colour, when young, pale yellowish-green, with yellow segment-divisions. A very indistinct, greyish latero-dorsal line. Head small, brownish. Legs same colour as head. In the final instar the larva changes considerably. Dorsal area is red-brown, with an interrupted, black central line. There are fine, greyish-white, irregular lines in this area which has a lower edge of white, with a black mark above the white on each segment. Below this white edge the body is green. Segment-divisions are reddish, and the ventral area has a reddish flush on the green ground-colour. The larva stands curled like a "?", and falls very readily.

PUPA.

Subterranean. Duration of pupal stage is from ten to twelve days.

Xylopteryx interposita Warr.

FOODPLANT.

Gymnosporia buxifolia.

LARVA.

Length 1 inch. Greyish or reddish-brown. Skin rather rough. Head small, square, with two white spots on crown. Almost black dorsal line over the thoracics, and again over anal claspers. The three central segments have silver-white dorsal marks, shaped like pairs of brackets, containing small twin brown tubercles, with a black V behind each pair. The next segment has a white diamond, and behind this are two smaller marks, roughly diamond-shape, outlined in white. A

pair of very small dorsal tubercles over anal claspers. Ventral area greyish-green, with a central line of brown spots.

PUPA.

In a loose earth cocoon, subterranean. Cremaster—a short cone, ending in a spike with two short prongs. Duration of pupal stage one month.

PTEROPHORIDAE.

Agdistis malitiosa Meyr.

FOODPLANTS.

Vernonia sp., *Solanum* sp., *Lantana* sp., and very many other plants.

LARVA.

Length up to $\frac{3}{4}$ inch. Colour, darkish brown, mottled vaguely with darker brown. Double spines on Segments 2 and 3: one on Segment 11, and two again on Segment 12. These emit short bristles. There is a lighter lateral dash on the three last segments, and very faint, dark, diagonal streaks on the lateral area of the central segments. A few small, scattered tubercles emit backward-pointing bristles. Ventral claspers three pairs complete, one rudimentary. The larva usually stands with head and body thrown backwards in a sharp curve.

PUPA.

Tail-attached to stem; remarkably thin and elongated; with external sheaths almost wholly detached. Duration of pupal stage is about eighteen days.

A FEW NOTES ON BIRDS IN THE NORTHERN LAKE RUDOLF AREA.

BY LT.-COL. B. G. LYNN-ALLEN.

Battalion arrived on July 24th, 1941.

1941.

JULY 25TH TO 31ST.

Fulvous tree-duck and Egyptian geese still bringing up young (about two to three weeks old) in some cases, though others of same species were already in small flights (possibly family parties?).

White-faced tree-duck seemed to be earlier as no flappers seen, though some were in pairs and some in flights.

No other species of duck seen until August 27th.

AUGUST 27TH.

First teal seen, in two or three small flights, identified a few days later as Hottentot teal. (These teal only seemed to stay a few weeks—after that I did not see another throughout the winter.)

SEPTEMBER 5TH.

First shoveler seen (one)—only seen in flight but quite unmistakable. From this date onwards shoveler became, very gradually, more common.

SEPTEMBER 15TH.

First snipe seen.

First knob-billed goose seen—this was definitely a bird of the year.

Big flights of white-faced tree-duck feeding in the freshly inundated area opposite Namaraputti.

SEPTEMBER 17TH.

Four Caspian tern seen—I *may* have seen them earlier but do not remember doing so.

SEPTEMBER 21ST AND 22ND.

Hundreds of wagtails (I think the yellow and the blue-headed) arrived. One species; greenish-brown above, yellow below, wing-coverts and outer tail-feathers picked out with darker brown, white when in flight; many birds (young?) with yellow vents only, remainder of under-sides yellow-washed white.

More snipe seen.

Saw a pair of shoveler.

Shot a knob-billed goose (female in easily recognisable plumage).

I was away from the west of Lake Rudolf from September 28th to December 5th, but was over on the east side of Lake Rudolf at Ilert on October 17th and 18th, where I saw and shot white-faced tree-duck, fulvous tree-duck, and African pochard.

I also saw shoveler and teal (I think garganey).

DECEMBER 5TH.

Pintail were now well in and fighting down the lake-shore every morning any time between 6-30 a.m. and 10 a.m. No evening flight. Shot my first pintail of the season on this day.

DECEMBER 17TH.

We shot a pool near the River Omo at Shunguru, a big evening flight came in at and after dark — shoveler, pintail, garganey teal, knob-billed geese, African pochard, fulvous tree duck, and white-faced tree-duck were all secured on this shoot.

N.B.—From mid-December onwards the chocolate heads and white necks of the adult drake pintail could be picked out as the birds passed in the air.

DECEMBER 20TH.

(South of Todanyang the unusually heavy rains had formed pools about one mile from the lake. They were very open water and were enjoyed by the European duck, a few African pochard and the Egyptian geese, but no fulvous or white-faced tree-duck were ever there. Both these latter species seemed to prefer inundated areas in thick grass and *not* open water.)

On this day these pools yielded Egyptian geese, shoveler, garganey teal, European teal (three), and a single European wigeon drake coming into full plumage—the dark green speculum well developed. This bird seemed to be a lone straggler—no more were shot or seen during the winter.

DECEMBER 22ND TO 26TH.

Spent at Ferguson's Bay (some 65 miles south of Abyssinian border). Geese and duck in large numbers were present. (Flying with Capt. Bingley on Christmas evening I obtained to my own gun one pintail, two garganey teal, two European teal, nine white-faced tree-duck, five fulvous tree-duck, one Egyptian goose, and one knob-billed goose — unfortunately losing about nine other duck in reedy water.)

Snipe and shoveler were also obtained at Ferguson's Bay and a few African pochard were seen.

DECEMBER 31ST.

An Egyptian goose was shot with eggs (just ready for laying) inside her. These geese were mostly in packs but a few in pairs.

1942.

JANUARY 10TH.

On this day one (and probably two) gadwall was obtained south of Todanyang and some six miles south of the Abyssinian border.

This prize fell to Capt. Roy Bingley.

We were shooting in two parties and it was not until next morning that I saw Bingley, who informed me that this bird was one of a party of four out of which he obtained a right and left. When I went through the bag that evening I naturally picked out the drake gadwall, but am afraid that I probably missed the duck gadwall sorting, as I was, by the light of a hurricane lantern.

I have shot many gadwall in India and there is not the slightest doubt about this particular drake—though the gadwall duck probably obtained is, of course, problematical.

I append a rough description of the plumage of this drake gadwall, in case its "feather-state" is of interest.

Crown—dark.

Gape, ear-coverts—brown/white spotted grey.

Neck-mantle—barred grey and white.

Back—light-brown changing to barred.

Rump—plain, darker brown.

Central tail-feather—dull-grey.

Upper-tail-coverts—black.

Primaries—grey/brown.

Secondaries—grey/black to white.

N.B.—No trace of the small chesnut feathers on the wing.

Primary-wing-coverts—grey darkening to black.

Under-wing-coverts—pure-white.

Breast—white.

Flanks—barred light-grey.

Shoulders—dove-grey.

Under-tail-coverts—black.

Abdomen—very pale barred grey.

Legs and feet—dull-yellow with blackish-grey webs.

Lower mandible—dusky-yellow.

Upper mandible—black.

The bird in very good condition and normal gadwall size.

N.B.—I have never seen yellow-billed duck, pink-billed teal, or white-backed duck on Lake Rudolf.

OCCASIONAL NOTES.

NOTE ON A GADWALL COLLECTED AT KISUMU. Among a series of bird skins which have recently been presented to the Coryndon Museum by Mr. R. T. Lambert is a female gadwall (*Anas strepera*) collected at Kisumu on 19th February, 1940.

So far as I am aware this is the first skin of this species to become available for study in Kenya, and it is doubly interesting in view of the record of this species from the Kenya-Abyssinian border reported in this issue of the *Journal* by Col. Lynn-Allen.

H.C.

NOTE ON THE FOOD OF THE PURPLE ROLLER (*CORACIURA CAUDATA CAUDATA*). The purple roller (*Coraciura caudata caudata*) has been observed eating various grasshoppers, locusts, and large caterpillars. However, it is of interest to note that it has been observed on several occasions to devour the large green (blue and red-winged) grasshopper (*Phymateus viridipes* Stal.) which is usually avoided by other birds on account of the noxious substance it vomits when handled. The roller has been observed to feed a fully-fledged young one on these insects. In each instance a large insect is beaten against a bough or stone before being devoured.

F. L. VANDERPLANK,
Old Shinyanga.

BLACK LEOPARDS. Since our troops have restored Abyssinia to its rightful owners, an ever-increasing number of black leopard skins are arriving in Kenya from that country and are in great demand for making fur-coats, capes, etc., for ladies' wear. The greater proportion of these skins are of the usual type, i.e., dark sooty-brown with slightly darker spots, and rosettes showing up in shadow form. In one of these which I examined, the hind feet were white, but in a peculiar manner. The white was confined mostly to the hair growing on the sole of the foot between the pads, extending upwards just far enough to enclose the claws. Unfortunately the front paws of this specimen had been cut off. One would have liked to see these.

A more striking form of black leopard comes also from Abyssinia. In this variety the ground colour is a medium neutral grey showing like tracery between the closely-set glossy jet-black spots. This pattern is confined to the flanks and legs.

A broad line from the head down the back and including the tail shows a dense fur of jet glossy-black.

This description, however, does not, strictly speaking, apply to them all. The shade of the ground colour varies, and in some individuals the spots on the back are isolated like on the flanks while in others the tail rings, though sometimes shadowy, are clearly defined.

I have had the opportunity of measuring many of these Abyssinian leopards and find that both varieties have compared very closely with the Kenya up-country leopard averaging 7 feet to 7 feet 6 inches in length. My measurements cannot, however, be regarded as accurate as all the skins were pulled out and pegged.

I am informed that Java—like Abyssinia—abounds in black leopards, but the Javan animal is much smaller.

M.A.B.

REPORT ON THE CORYNDON MUSEUM FOR THE PERIOD JULY 1ST TO DECEMBER 31ST, 1941.

The second-half of 1941 has seen a considerable increase in exhibits in the Museum.

The bird exhibit has principally been increased in respect of the birds of prey in which section twenty new birds have been mounted and placed on view. These twenty birds include the following eagles: a juvenile crowned eagle, a juvenile and an adult martial eagle, a fish eagle, an Ayres eagle, and the rare western steppe eagle.

An exhibit of birds' eggs has also been placed on view and has proved to be a very popular exhibit.

The exhibit of marine and fresh-water fishes has also been further augmented, and there has been placed on view a series of models and charts illustrating the evolution of fish.

An exhibition of special interest to farmers illustrating the life-cycle of certain internal parasites in domestic animals has been kindly provided by the Veterinary Department.

In the Prehistory Section, which was completely rearranged and augmented in the first-half of the year, a new exhibit has now been added showing fossil remains of some of the extinct animals that were contemporary with stone-age man.

In the Insect Section, a new exhibit showing the commoner butterflies to be found in and around Nairobi has been arranged.

A number of lizards, snakes, and frogs have been added to the reptilian show-case, while in the case of the mammals the most interesting additions are two different giant shrews.

ACCESSIONS.

During the six months under review a considerable amount of material has been added to the Museum collections in almost all branches, this being in part the result of donations by the public and in part the result of collecting by the Museum staff.

The details of accessions during the year 1941 are shown in the table that accompanies this report.

RESEARCH.

The research-side of the Museum's activities has been somewhat hampered by the fact that the Assistant Curator has been with the Forces throughout the year and that the Botanist has been suffering from ill-health while the Honorary Curator has only been able to devote his evenings and week-ends to the Museum owing to war-time duties.

Mr. Turner, the assistant to the Honorary Curator, has been fully-occupied with preparing and mounting specimens and similar work.

In spite of all these difficulties research work has not been wholly neglected.

The Botanist has continued with his research on the Euphorbias and Stapelias and he has also found time to do some very valuable work on local dye-plants. This work is of particular importance in war-time and a comprehensive exhibit showing the principal local plants that can be used for making dyes, together with samples of those dyes and of materials dyed with them will be placed on view shortly.

The Honorary Curator has made a study of the collection of fossil pig remains which the Museum possesses and has prepared a paper for publication describing several new species and one new genus as well as giving new information about several little-known pigs.

A paper on a fossil human skull from Naivasha is also in preparation.

Mrs. Leakey has been engaged in preparing her collections from Nakuru for publication.

CONVERSAZIONE.

A very successful conversazione was held in October, in conjunction with the Natural History Society. It is hoped to make this an annual function.

VISITORS TO THE MUSEUM.

Apart from members of the Society and school-children, the number of people who visited the Museum during the second-half of the year was 6,694, bringing the total of paying visitors for the year to 12,834, which, with the 1,926 school-children and 326 members brings the grandtotal to 15,122. The door receipts amounted to £318/7/3.

ACCESSIONS TO THE MUSEUM DURING 1941 (DONATIONS ONLY).

Birds	...	...	...	...	878 specimens
Insects	...	...	...	...	9,314 specimens
Mammals	...	...	...	...	52 specimens
Reptiles	...	...	...	...	44 specimens
Fishes	...	...	...	...	73 specimens
Molluscs	...	...	...	...	12 specimens
Plants	...	...	...	...	798 specimens
Geology	...	...	...	...	10 specimens
Fossils	...	...	...	...	1,532 specimens
Archaeology	...	...	...	...	6,912 specimens
Ethnology	...	...	...	...	10 specimens
Books	...	...	...	...	6 books

(Sd.) L. S. B. LEAKEY,
Honorary Curator.

REPORT OF THE BOTANICAL SECTION FOR 1941.

Although the work in the Botanical Section was handicapped by the Botanist's absence for close on three months on account of ill-health, considerable progress can be reported for the year 1941.

HERBARIUM.

The study-collection was increased by 866 numbers, identified and verified by Kew and Amani; of these were new to the collection: 1 order, 34 genera, 220 species, the remainder being duplicate specimens from new localities.

The incoming material during the year consisted of 798 specimens, 390 of which were collected by the Botanist. The botanical excursions of the Natural History Society yielded 150 specimens.

SPECIAL SYSTEMATIC WORK.

The work on East African stapeliads has been greatly furthered, and the Botanical Section is indebted for their collaboration to Capt. A. T. A. Ritchie, Mr. and Mrs. Copley, Mr. MacArthur, Capt. E. F. Peck, Dr. Strangway Dixon, and others.

Four new species of stapeliads and two *Ceropegias* were described, and their publication in the *American Cactus Journal* has been arranged. Several other species still await description.

The survey of *Euphorbiaceae* has also been further developed, and a considerable number of species added during the year.

PUBLICATIONS.

Two continuations of a general survey of East African Succulents were contributed during the year 1941.

GARDEN.

A new succulent garden was laid out along the southern flank of the Museum building.

EXHIBITS.

An outstanding addition to the Botanical Room are the seventy-odd water-colour paintings of Kenya trees and shrubs by Mrs. Joy Bally, which are on loan.

Other additions are: an exhibit showing the manifold uses of the coconut; the trunk, and photographs of the nettle tree, *Obetia pinnatifida*; a root-stock of *Lannea alata*, showing the cotton-like bark, called "floatite."

CONVERSAZIONE, 1941.

On the occasion of the conversazione, these exhibits were shown, together with an exhibit of Kenya succulents, consisting of a miniature landscape with a painted background, in which twenty-four live succulents were shown.

A further exhibit demonstrated native dye-plants and samples of dyed material.

GENERAL WORK.

The native dyes exhibit having aroused general interest among the public, research work has been done on the subject with some success.

Twelve useful dye-plants have been found so far, and quite a good range of colours and shades has been obtained. This work is not yet concluded. In the way of general work the Botanical Section has provided the background for the projected group of scavengers, a reproduction of the Lone Tree area.

(Sd.) PETER R. O. BALLY,
Botanist.

THE THIRTY-FIRST ANNUAL REPORT OF THE EAST
AFRICA AND UGANDA NATURAL HISTORY SOCIETY
FOR THE YEAR 1941.

1. OFFICERS.

The following members of the Society constituted the Executive Committee for the year in question:—

President and Chairman: R. Daubney, Esq.

Vice-President: A. J. Allen-Turner, Esq.

Honorary Treasurer: Miss K. Attwood.

Honorary Secretary: Hugh Copley, Esq.

Members of Executive Committee: Mrs. R. Ward; Sir Charles Belcher; R. C. A. Cavendish, Esq.; A. F. J. Gedye, Esq.; R. Hudson, Esq.; and Dr. L. S. B. Leakey.

Mr. Gedye was on active service all the year. Mr. Klein was elected to replace Mr. R. C. A. Cavendish, but was in Mombasa, and therefore, unable to attend more than one meeting.

2. OBITUARY.

It is with considerable regret that I have to report the death of three prominent members of the Society during the last eighteen months:—

Major Hugh Ward, who died in August, 1940, served for many years on the Executive Committee of the Society, and contributed notably to the collections of birds and insects. He also presented valuable books to the Library. Hugh Ward was interested in all nature, but especially he loved birds. He will be greatly missed by the Committee and all those who knew him, for a kindlier man never lived.

Mr. Blaney Percival was a foundation member of the Society, and he did a great deal towards building up the early collections. He served on some of the earliest Executive Committees, helping to steer the Society through the troubles of its early years. He was one of the finest field naturalists we have ever had in Kenya, and he will long be remembered with affection by the older members.

By the death of Mr. R. C. A. Cavendish (a member of the Executive Committee) the Society has lost a valued friend and supporter. He was especially interested in the monthly Sunday out-door excursions, which he frequently attended; better still, he influenced others to follow his example. He will be greatly missed.

3. MEMBERSHIP AND SUBSCRIPTIONS.

The total present membership of the Society is 233. This number includes only Life Members and those members whose subscriptions are not more than one year in arrear. Twenty-six new members joined during the year, and eleven have resigned or have been deleted from the list of members.

For the information of members we are publishing this year a list of names and addresses. It is hoped that the list will enable members to make contacts with others who live in the same districts.

4. FINANCE.

The Financial Statement for the year will be laid before the meeting by the Honorary Treasurer, together with a stock-sheet showing the journals and reprints on hand at the end of the year. In compiling the stock-sheet all journals have been valued at the uniform price of Shs. 5/- and all reprints at Sh. 1/- each, but to counteract undue optimism, I would point out that many of the reprints are bad sellers. Because of the war, our stocks of recent numbers of the journal are higher than usual. But there is every reason to believe that when the war is over the surplus numbers will be absorbed as the exchange of periodicals with Europe is resumed. Equally, of course, our own library is not receiving publications from enemy and enemy-occupied countries.

5. THE LIBRARY AND JOURNAL PUBLICATIONS.

Mr. Gedye, who for some time had acted as Honorary Librarian, has been absent on military service during the year. The Honorary Secretary, therefore, took over the library, but found the work too much for what little spare time he had. However, something just had to be done, and Mrs. Copley has made a start to get all the publications in sequence preparatory to proper file-indexing.

Mr. Hudson was Honorary Editor of the *Journal* throughout the year. It was decided that, as far as possible, an attempt should be made to include in each number of the *Journal* one article that could be reprinted as a hand-book on some subject of public interest. A uniform style for such reprints is being adopted and they are being sold at a fixed price of Shs. 3/-. The first brochure, on the Freshwater Fishes of Kenya, was issued during the year, and a second, on the Scavenger Birds, is almost ready for publication. These will be followed by others in due course, and copies will be obtainable at the Museum and at the bookshops in Nairobi.

It is hoped that as many members as possible will send in short notes dealing with any of the different subjects covered by the term "natural history," for the *Journal* should be of

interest to all. There will be room for publication of the results of original scientific work and the "exchange value" of the *Journal* should not, therefore, be affected.

Members should understand that the conditions for the production of the *Journal* will not become easier, and there may come a time when it will be impossible to produce the *Journal*, or at any rate to include illustrations.

Members must also recognise that the Society has to stand on its own feet, and accordingly can only publish each year the *Journals* for which it is able to pay. If more people can be induced to join the Society at the now greatly reduced subscription of *Shs. 20/- per annum*, the Society will be able to spend more on publications.

6. BROADCASTING TO SCHOOLS.

At the invitation of the Executive Committee, the Director of Education attended the October meeting and discussed how the Society could assist in educating children in Natural History by means of broadcast talks. Three wireless talks were arranged for the last quarter of 1941, and a small Sub-Committee was formed to arrange a programme for the school-term January to April, 1942.

The three talks given in 1941 were by Capt. Ritchie on Animals, Mr. Hugh Copley on Fishes, and Dr. Leakey on Birds.

The Sub-Committee has drafted a full programme of wireless talks for the first term in 1942, and these have been approved by the Director of Education.

7. THE CONVERSAZIONE.

In October, the Society and the Museum Trustees pooled their resources and held a most successful conversazione in the Museum. A full account of this function will be given in the next issue of the *Journal*.

8. NATURAL HISTORY EXCURSIONS.

For various reasons, the Natural History excursions have not been well-supported. From March, monthly visits have been made to Karura Forest, and representative collections of botanical material and of butterflies have been obtained. Work on the botanical material from the Stoney Athi locality is now well-advanced, and it is hoped to have a paper ready for publication in the near future.

9. ARCHAEOLOGICAL OUTINGS.

During 1941, the outings of the Archaeological Group were continued until May, when it became impossible for Dr. and Mrs. Leakey to continue with them. The whole of the collection has been catalogued and will be studied in due course and published in the *Journal*.

10. LECTURES.

It was not possible to arrange a series of public lectures, but Dr. Leakey gave an illustrated lecture on "Rock Paintings," which was much appreciated.

11. THE MUSEUM.

Relations between the Society and the Museum's Board of Trustees were cordial throughout the year, and our thanks are due to the Board, which has allowed the Society to hold all its meetings in the Museum. Members of the Society have continued to donate specimens to the Museum, and have received valuable assistance from the Museum staff in the determination of material.

12. CONCLUSION.

In conclusion, the Society has survived a year that has been difficult because many of its members have been scattered over a large part of Africa, and those that are still at home have had many extra calls on their time. New activities have been initiated, and the "health" of the Society is good. Keeness must be maintained, and the Executive Committee will welcome any new ideas that may occur to members as to ways in which the work, and the *Journal*, of the Society may be made of wider interest. As the activities of the Society depend to a great extent on finance, and as more members mean larger funds at our disposal, it is in increasing the membership that I would especially invite the assistance of you all.

(Sd.) HUGH COPLEY,
Honorary Secretary.

EAST AFRICA AND UGANDA NATURAL HISTORY SOCIETY

STATEMENT OF FINANCIAL POSITION. YEAR ENDED 31-12-41.

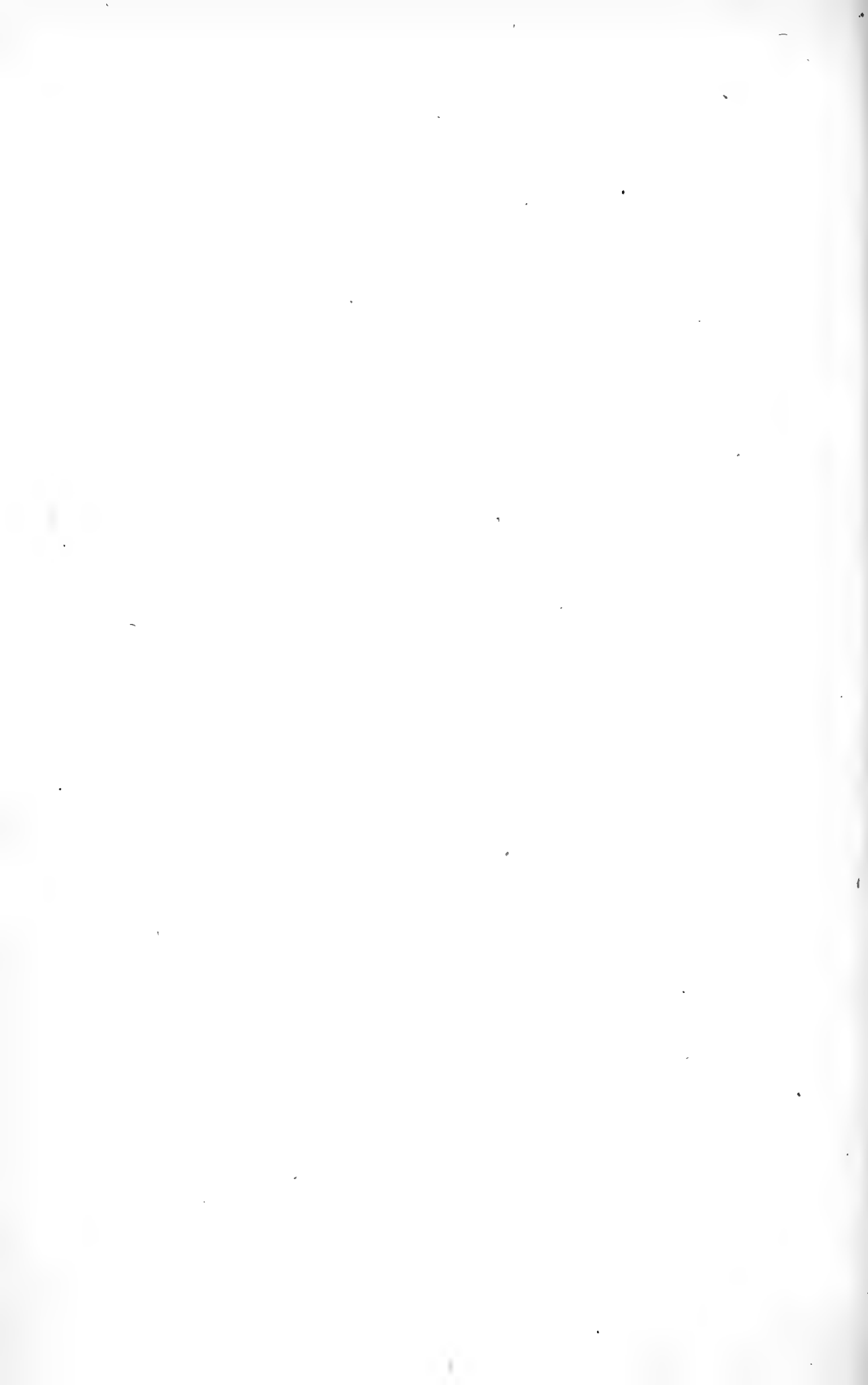
	Shs. cts.	Shs. cts.
To Balance brought forward ...	3,917 77	1,000 00
" Post Office Savings Bank ...	235 13	117 00
" Anthropological Fund—		
Donation Account ...	1,000 00	7,017 75
Subscriptions, 1941 ...	4,536 20	338 90
Museum Trustees ...	2,000 00	646 02
Conversazione ...	185 00	
Sales of Journals and Reprints ...	921 00	
Miscellaneous Donations ...	24 00	
Total Shs. 12,819 10	12,819 10	12,819 10

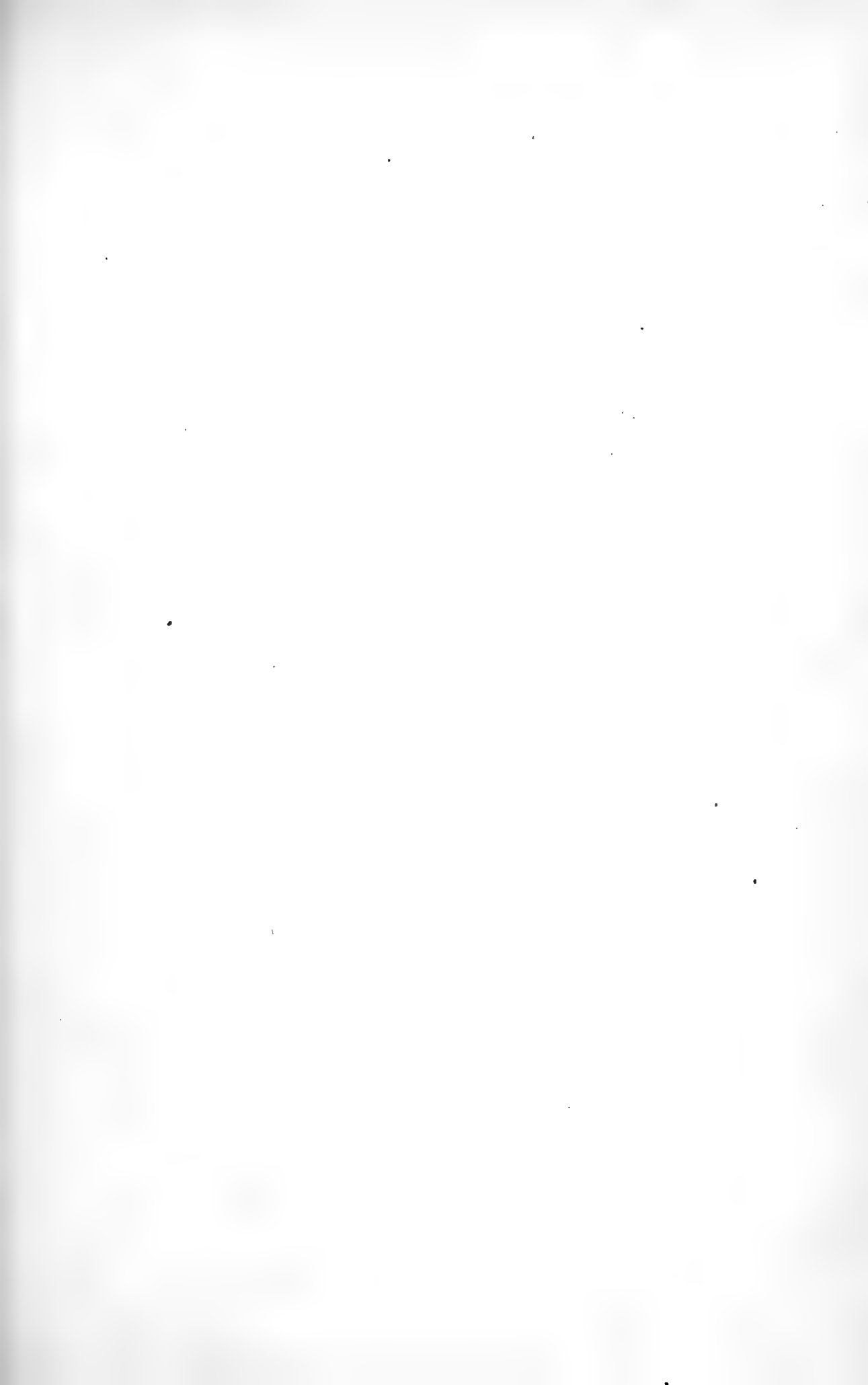
COMPARATIVE STATEMENT. 1940-1941.

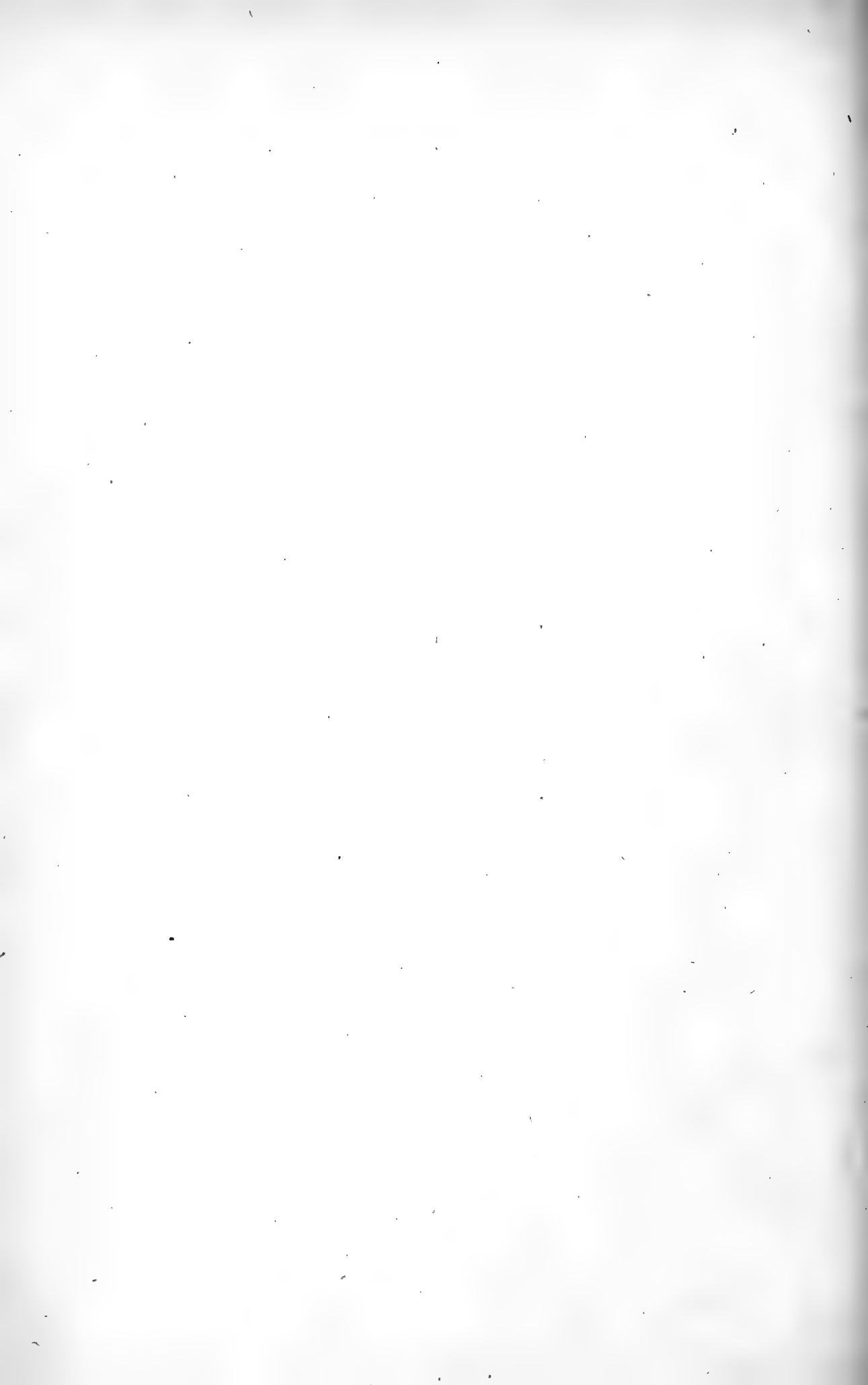
	1940.		1941.	
	Shs. cts.	Shs. cts.	Shs. cts.	Shs. cts.
To Balance at 1st January ...	5,220 13	5,152 90	1,000 00	1,000 00
" Museum Trustees ...	2,000 00	2,000 00	322 63	117 00
" Subscriptions ...	4,035 00	4,536 20		
" Sales of Journals, etc. ...	251 50	921 00	4,444 60	7,017 75
" Donations ...	21 00	24 00	134 20	338 90
" Conversazione ...	—	185 00	430 50	646 02
Total Shs. 11,527 63 12,819 10	11,527 63	12,819 10	11,527 63	12,819 10

(Sd.) HUGH COPLEY,
Honorary Secretary

(Sd.) K. ATTWOOD,
Honorary Treasurer.







East Africa Natural History Society.

PUBLICATIONS OF THE SOCIETY

Copies of most of the back-numbers of the *Journal* can be supplied at prices varying from Shs. 2/- to Shs. 20/- per copy. Members of the Society are entitled to 20% discount. Reprints of many of the articles that have appeared in the *Journal* are also available and a list may be obtained from the Honorary Secretary.

The following separates may be obtained paged in sequence and suitable for binding into volumes. These works are fully illustrated and are sold at Shs. 5/- per part.

THE BIRDS OF KENYA AND UGANDA (van Someren).

Vol. I. Parts 1—9 (Parts 3 and 8 are out of print).

Vol. II. Parts 1—5.

THE BUTTERFLIES OF KENYA AND UGANDA (van Someren).

Vol. I. Parts 1—10 and Supplement.

Vol. II. Parts 1 and 2.

The following reprints have been issued as brochures with attractive paper covers at a uniform price of Shs. 3/- per copy,

A SHORT ACCOUNT OF THE FRESH WATER FISHES OF KENYA

by HUGH COPLEY,

A FIELD GUIDE TO THE SCAVENGING BIRDS OF KENYA

by M. E. W. NORTH, M.B.O.U.,

and

EAST AFRICAN SUCCULENTS (PART IV. *Stapeliae*)

by P. R. O. BALLY,

All correspondence in connexion with the publications of the Society should be addressed to the

HONORARY SECRETARY,

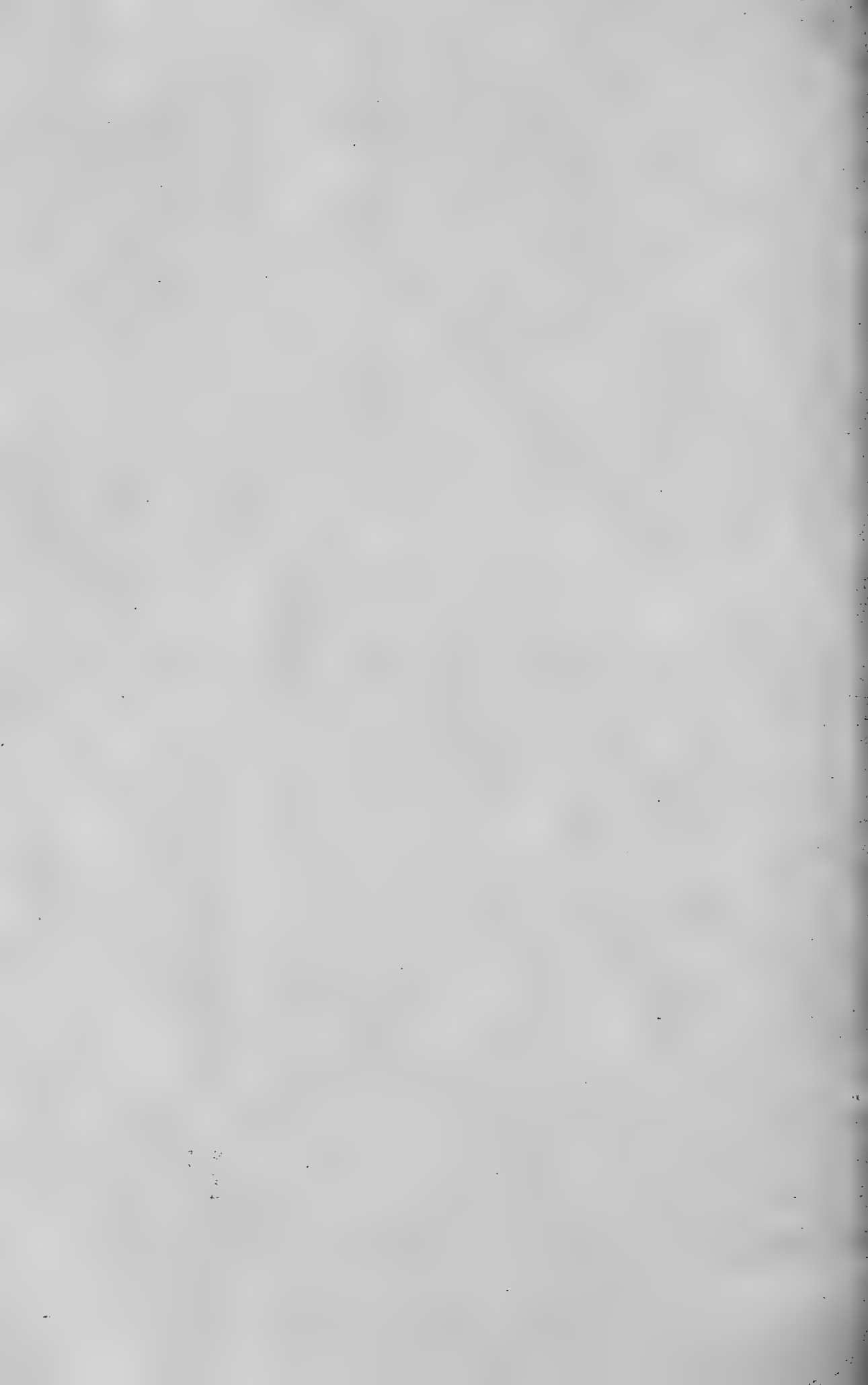
East Africa Natural History Society,

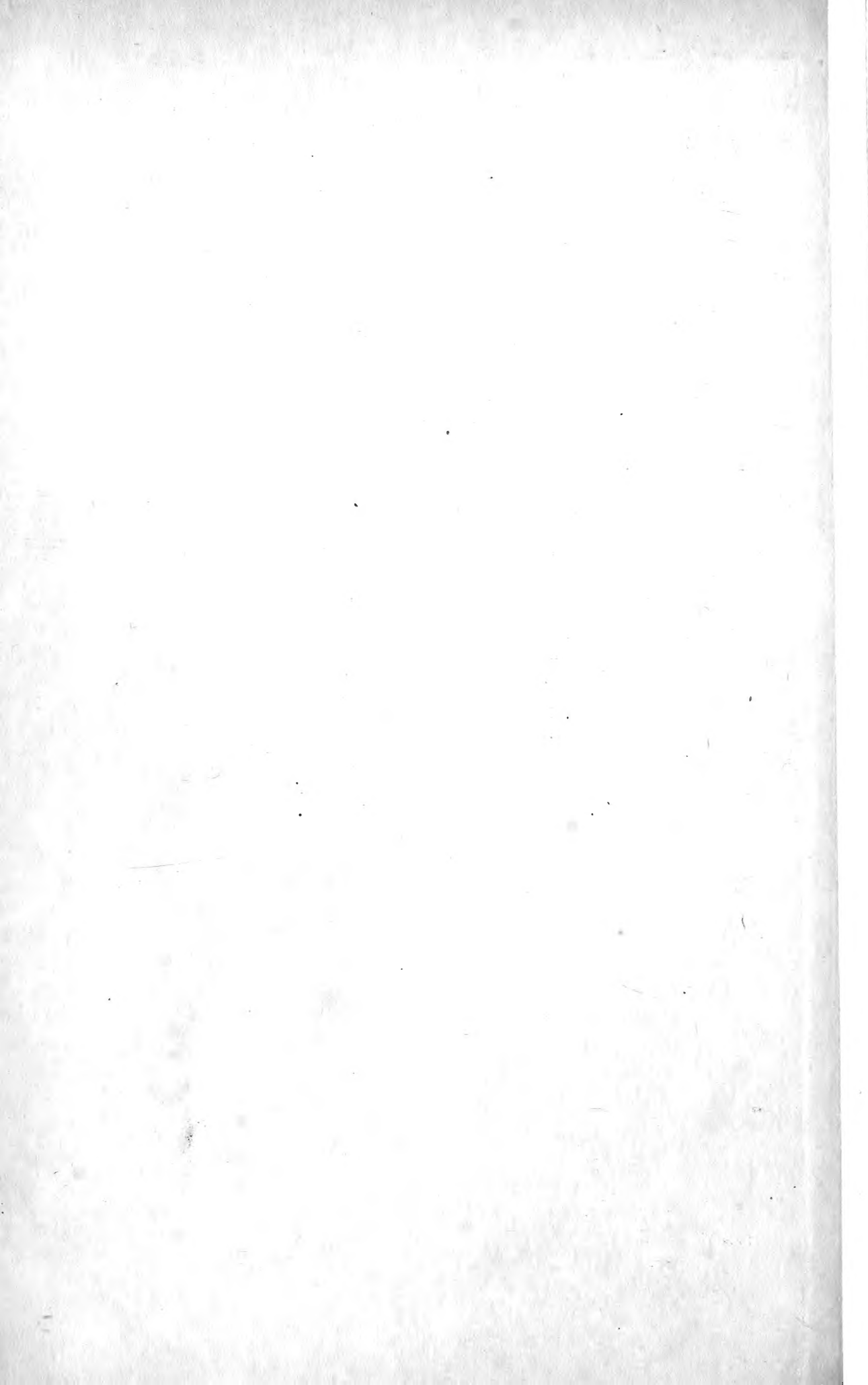
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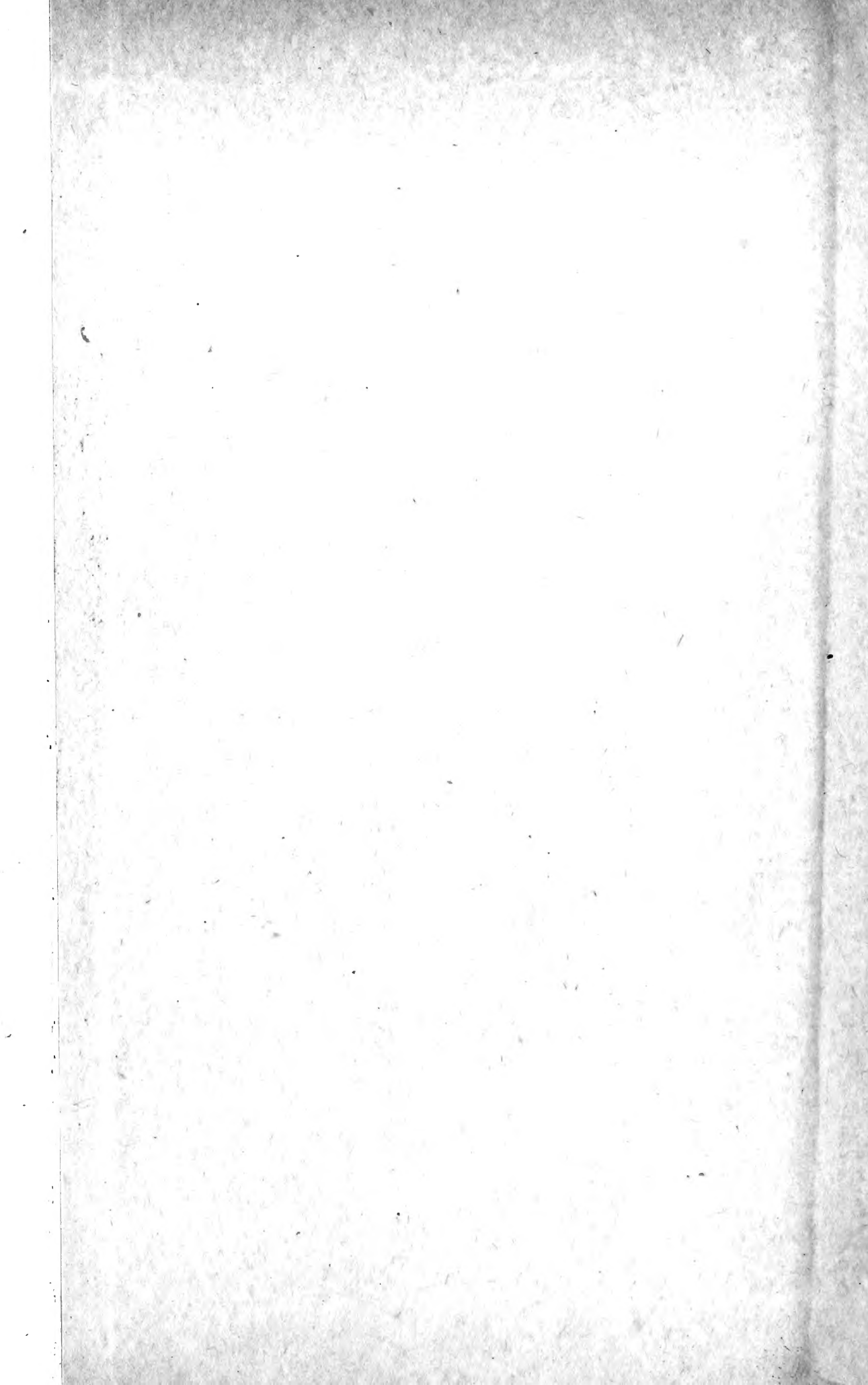
NAIROBI.

and (except when returning proofs) not to the Editor.

The Honorary Secretary will be glad to receive copies of articles for the consideration of the Journal Sub-Committee with a view to publication.







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