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# SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOL. 61

"EVERY MAN IS A VALUABLE MEMBER OF SOCIETY WHO, BY HIS OBSERVATIONS, RESEARCHES, AND EXPERIMENTS, PROCURES KNOWLEDGE FOR MEN"—SMITHSON

(PUBLICATION 2265)

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CHARLES D. WALCOTT,
*Secretary of the Smithsonian Institution.*

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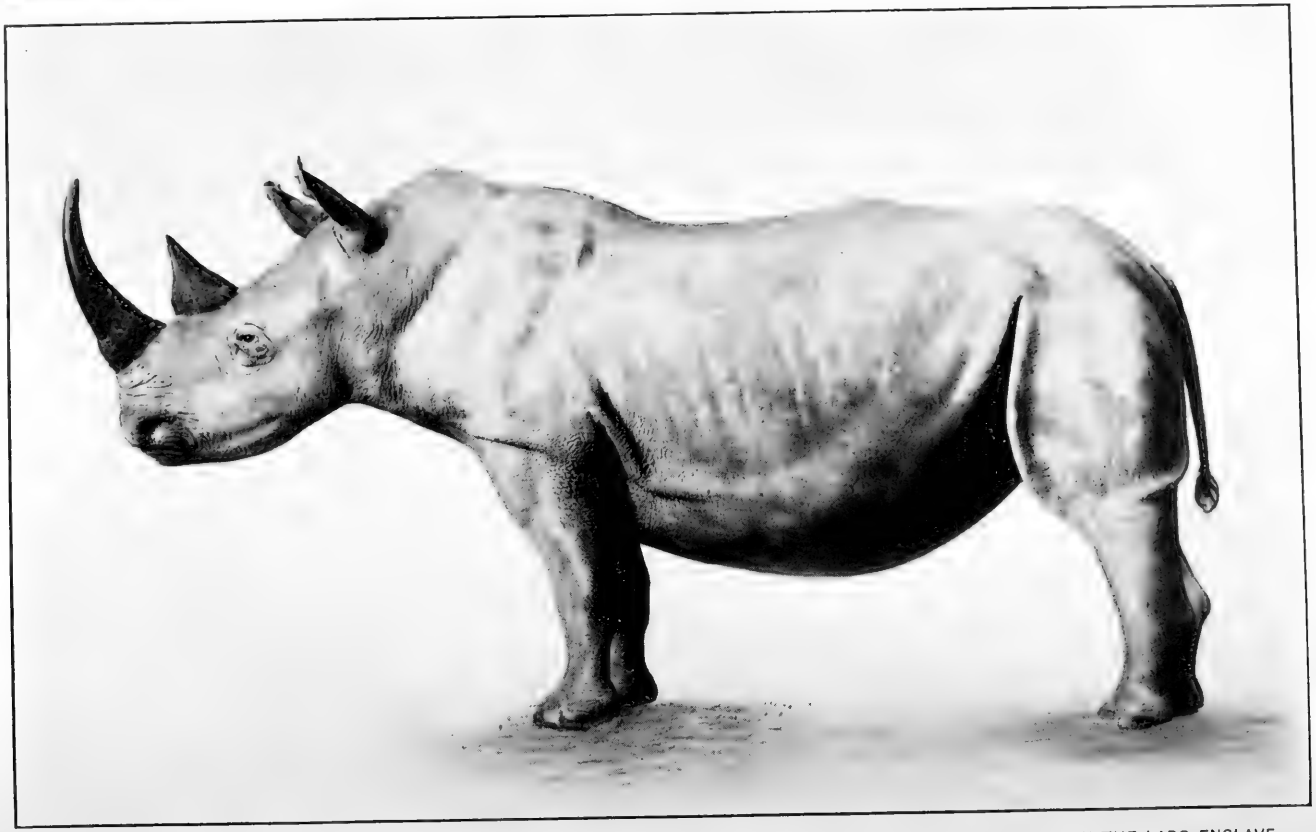

MOUNTED MALE NILE WHITE RHINOCEROS IN THE U. S. NATIONAL MUSEUM SHOT BY COL. THEODORE ROOSEVELT IN THE LADO ENCLAVE

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 61, NUMBER 1

# THE WHITE RHINOCEROS

With Thirty-one Plates

BY

EDMUND HELLER
Naturalist, Smithsonian African Expedition

(Publication 2180)

CITY OF WASHINGTON
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# THE WHITE RHINOCEROS

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## PREFACE

The white rhinoceros is so imperfectly known that it has been thought advisable to publish, in advance of the complete report of the expedition, the results obtained from the study of the specimens of this species collected in the Sudan by the Smithsonian African Expedition, under the direction of Colonel Roosevelt.[1] In order to make this material available to zoölogists generally, a series of photographs of the skull of each specimen collected has been added to the paper. This has been found necessary not only to illustrate the text, but in order to fill one of the gaps in the literature pertaining to African mammalogy. Up to the present time no photograph of a perfect skull of this rhinoceros has appeared in print. There have been a few figures published, but none showing structural details well. The present publication will do much to remedy this want, and will also, it is hoped, serve to put the species on a more logical systematic basis. In the present paper considerable emphasis has been placed on the really great structural differences which exist between the white rhinoceros and the black, with which it has hitherto been generically confounded under the name *Diceros*.

The chief zoölogical value of the present series is due to the various ages which they represent. They range from a fœtal specimen to old adults, and show fairly well the changes undergone in form and structure from youth to old age. It has been possible with this large series of skulls to determine the changes of form and structure in the skull which are due to age and sex. One of the results of this study has shown the characters of shorter and broader nasal boss assigned by Lydekker to the Nile race to be inconstant and of no systematic value. The discovery, however, of a substantial difference in dorsal outline has led to the retention of the Nile race.

[1] This paper is the eighteenth dealing with the results of the Smithsonian African Expedition.

Of the thousands of white rhinoceroses killed in South Africa less than a dozen skulls are to-day preserved in museums. Thus the series of skulls of the Nile race illustrated in this paper is greater in number than all the recorded specimens of the typical race from south of the Zambesi now preserved in natural history museums. With very few exceptions every specimen of white rhinoceros preserved in European and American museums has been examined and measured by the writer. The total amount of material studied has thus been quite as extensive as the existing collections would permit. By far the greater part of this material consists of skulls, 34 of which have been available. Nine of these represent the South African race, *Ceratotherium simum simum,* and 25 the Nile race, *Ceratotherium simum cottoni.* In addition to this material a mounted skeleton in the British Museum, and another in the Muséum d'Histoire Naturelle de Paris, of the South African race, have been examined, as well as one of the Nile race in the Congo Museum at Brussels. The mounted specimens examined consist of three males of *Ceratotherium simum simum:* one in the British Museum, another in the Rothschild Museum at Tring, and a third in the Leyden Museum. The Nile race is represented by a group of three in the National Museum, an adult male and female and a calf, shot by Colonel Roosevelt in the Lado, which have been available for study. The recorded specimens of the typical or southern race, not examined by the writer are the three in the museums of South Africa and one at Liverpool.

For the privilege of studying the material in the British Museum the writer is indebted to Mr. Oldfield Thomas, who has extended every assistance with the collection of mammals which is under his charge. Major P. H. G. Powell-Cotton has generously put his large series of white rhinoceros specimens from the Lado Enclave at the writer's disposal, and has also assisted him with notes and details of his shooting experiences in connection with the securing of the specimens. The writer is indebted most of all to Colonel Roosevelt, to whom it is a special pleasure to acknowledge his gratitude. His untiring efforts in the field in procuring the specimens and his unfailing assistance in furthering zoölogical results during his African journey have been of the utmost assistance to the writer.

## THE HUNT FOR THE WHITE RHINOCEROS

One of the most valuable contributions to zoölogy made by the Smithsonian African Expedition, under the direction of Col. Theodore Roosevelt, is the collection of square-lipped rhinoceroses from

the Lado Enclave. Special arrangements were made by Colonel Roosevelt for obtaining these specimens, in fact, the whole interest in the Nile trip centered in the quest of these rare ungulates.

The preparations for the rhinoceros hunt were made at the port of Butiaba, on the northeast shore of the Albert Nyanza. Boats were employed for the journey as far as Nimule, the lower limit of navigation on that part of the Nile known as the Bahr-el-Jebel. The fleet which was to carry us down the river to the haunts of the rhinoceros consisted of a small steam launch, the *Kenia,* a large open sloop-rigged boat, the *James Martin,* a smaller sail boat, the *Kisingiri,* and two row boats. A comparatively few men were needed to assist in the rhinoceros hunt as our movements were to be limited to the immediate vicinity of the Nile. The few men needed for transport and the preparation of the skins sailed with the fleet in the smaller boats, but the great bulk of the safari porters were sent overland along the east bank of the river to Nimule to await our arrival there.

At 10 o'clock on the morning of January 7 our preparations for embarkation were complete, and we steamed out of the protection of the long sandspit of Butiaba into the teeth of a strong head wind. The little launch *Kenia* towed all of the boats at the beginning of the voyage through the rough sea which had been kicked up by the wind. The wind dropped somewhat after we had been out a few hours and swung around to our stern, giving us a fair breeze. Sail was then hoisted on the *James Martin* and connection with the launch severed. Henceforward the boats made independent progress on the lake and down the broad waters of the sluggish Nile.

During the slow progress of the early part of the voyage we had ample opportunity to observe the landscape beyond the distant lake shore. The Albert Nyanza lies in a deep, gigantic rift valley at an elevation of approximately 2,200 feet above sea level. The whole eastern shore is a rugged precipitous wall of mountains which rises directly from the water's edge. Beyond, the hills rise tier upon tier to the crests of the mountains forming the Congo-Nile watershed. The summits of the Congo ranges appeared very lofty and dim on the distant horizon, but their height is not great, not exceeding 5,000 feet above the surface of the lake. The country nearest to us showed a scattered growth of thorn trees and bushes, with a few dark patches of dense forest on the lowland bordering the lake shore. The snow-capped peaks of Ruwenzori, the fabled mountains of the moon of the early geographers, were not visible at this distance. We were now

some 130 miles northeast of this lofty mountain mass and floating on waters which had their chief source on its slopes. The northeast shore of the lake which we were skirting is a low, level stretch of swamp and sand in marked contrast to the rugged character of the rest of the shore line.

Late in the afternoon we picked up the *Kisingiri,* one of the fleet of small sailboats which had set out in advance of the other boats. Darkness had already fallen when we entered the broad mouth of the Nile. We stopped at 10 p. m. at Koba, a station on the Uganda shore, a short way below the lake. Here we collected some additional supplies for the journey. We steamed throughout the whole night down the Nile and arrived at Wadelai at noon. The river journey as far as Wadelai lay through a broad, sluggish lake-like expanse of water, bordered on the east shore by extensive papyrus swamps and on the west by low hills supporting a scattered growth of thorn trees and grass. No native villages were to be seen, but an occasional canoe guided by a native fisherman was seen on the borders of the papyrus-fringed channel. The giant forms of candelabra euphorbias were occasionally seen on the west bank looming up above the scrub of acacias. We stopped at the abandoned station of Wadelai to pick up Grogan who had been engaged by Colonel Roosevelt to act as guide in the quest for white rhinoceroses. Near the station we found a native village inhabited by a few naked Acholi who had much the appearance of Kavirondos in their style of personal decoration—or rather absence of it. The district had recently been decimated by the ravages of the sleeping sickness and was nearly uninhabited at the time of our visit.

Early in the afternoon the fleet left Wadelai, the various boats making independent progress down stream. Below the station both banks of the river were a wide maze of papyrus swamps through which the water made innumerable channels. The Nile along this portion of its course reaches its greatest width, averaging quite three miles, but no idea of the immense breadth can be gained from a boat, owing to the channels being walled in by dense beds of papyrus. The animal life on the Nile was of a constant quality and quantity, the river here being depressingly uniform and monotonous. The heads of occasional hippopotamuses were seen in the channel, but crocodiles were quite absent, owing, no doubt, to the lack of sand banks or bars for resting places. Snake birds or anhingas, lily trotters, giant ajax herons, the white-headed fish eagle, and a large kingfisher were seen everywhere and were quite as constant in distribution as the fringing

papyrus. During the afternoon the sight of a troop of a dozen baboons peering at us from the crest of a small hill made a welcome break in the voyage. These great ground monkeys displayed a curious habit of climbing up the trees so as to get a better view of us.

At four in the afternoon we stopped at a large native village to get firewood for the launch, and also to allow the porters time to cook their food. There were two villages here, both containing some fifteen houses and surrounded by a stout boma or stockade of thorn trees. Two small openings, less than three feet in height, placed at opposite sides of the hedge were their only entrances. Near the entrance to the principal village a newly constructed fish-trap was seen. This was a large elliptical wicker basket with a depressel funnel-shaped entrance which projected into the basket in much the same manner as the entrance to our own lobster-pots and fish-traps. Traps of this description were seen submerged along the shore, their position being marked by a row of stakes which served as wings to lead the fish into the trap. Quite a quantity of evil-smelling dried fish, which formed one of the staple foods, was seen in the village. Matama, or millet, and beans were also seen stored in the elevated village graineries. Goats were the only domestic cattle seen there. Sheep and cattle were apparently not able to resist the tsetse fly diseases so prevalent near the Nile. A few sorrel colored Egyptian dogs belonging to the village watched our movements with much interest, but did not have courage enough to assert their authority as guardians.

We left this place at sundown and continued our course down the river. At nine in the evening we dropped anchor in Rhino Bay, and settled ourselves as best we could for the night amongst the chop boxes and bales in the boats. The dawn found us enveloped in a light river fog. When the fog lifted we discovered ourselves in a snug little harbor with gently sloping shores and open broadly to the river which flowed less than a hundred yards away. The immediate vicinity of the bay had a pleasing park-like appearance. Groves of large acacia trees were clustered about the higher ground above it. Nearer the shore were a few large trees with dense green foliage, which gave real shade. These were a species of *Kigelia*, which bore a long, pendulous, sausage-like fruit. The country was everywhere covered by a rank growth of long, course grass, which at this season was dry. No palms were visible from our boats, but an occasional candelabra euphorbia gave the landscape an African characteristic touch.

A permanent camp was established on this spot, the precise geographical position of which is latitude 2° 55′ north, on the west bank of the Nile, fifteen miles north of the station of Wadelai. This was Rhino Camp, and in its immediate vicinity the entire collection of rhinoceroses was made. At this point the west bank rises as a low clay bluff some ten or fifteen feet above the river's surface. At the upper end of the bluff a small bay gave a snug anchorage to our boats, and upon its gently sloping shores the camp was pitched. The river here has an elevation of 2,000 feet, being at this point some 200 feet lower than the Albert Nyanza.

The country inland stretched away in low billows, dry, and covered everywhere by a rank growth of tall dry grass interspersed with a few small acacia and *Combretum* trees. Solitary higlig trees, *Balanites ægyptica,* and *Euphorbia Candelabrum* stood out conspicuously at long intervals in the landscape. A long distance south of camp two tall borassus palms loomed up growing side by side. These pioneers from the south were the only palms in the landscape. Bordering the Nile were a few of the peculiar *Kigelia* trees, their large sausage-like fruits giving them a grotesque appearance.

One of the startling peculiarities of this region is the lack of any fringing forest on the banks of the Nile where there is a permanent supply of moisture favorable to tree growth. The scanty tree vegetation of the veldt region reaches the river's bank unchanged, giving the effect of a river newly born and cutting its way through the grass and bush plain. The vast areas of feathery papyrus which, in most places, stretched away in the distance as a fringing border on the banks of the Nile relieved this newness, but the swamps were nowhere bordered by forests. Much of the Nile at this point has the appearance of a vast papyrus swamp with open stretches of ponds and a labyrinth of stream channels connecting them. All day we were busy unloading the boats and arranging camp. Our first night at Rhino Camp was a novel experience. We were lulled to sleep by the hoarse bellowing of hippopotamuses in the bay calling across the water to one another.

Early on the day after striking camp, January 10, Colonel Roosevelt, Kermit and Grogan left to search for the huge beasts which were the object of our quest. Cunninghame and the writer, with a band of skinners, trailed after the party at some little distance so as to avoid frightening the game. The country was overgrown by a growth of rank grass which was at this time of year dry and tough. It stood over six feet high and prevented us from seeing the hunters

whom we were following. Hippopotamus and rhinoceros paths radiated in all directions through the country, and we were soon led astray and found ourselves unable to trace the Colonel and his band. We then resorted to climbing trees and gazing about the landscape in an endeavor to locate our chief and his party, but the grass was so high and dense that they could not be seen. We blundered about for several hours in the tall grass and finally stumbled upon a female rhinoceros and her half-grown calf. She regarded us for a few seconds and then dashed away. About two o'clock in the afternoon we heard shooting, the shots being the deep boom of the powerful cordite guns. We felt sure that white rhinoceroses had been found by the Colonel, and that some of them had fallen to the shots we had heard. There was no other game, we knew, which could have drawn the Colonel's fire. We were delighted with the prospect of success so early, but lamented our hard luck at having lost the party and the excitement of the chase. We returned to camp as best we could in our lone condition and awaited news from the shooting party. Soon a messenger appeared with the news of the shooting of two rhinoceroses by the Colonel. We at once gathered the skinners and some porters together, taking their tents and mine, and food for two days, as it would be necessary to spend at least that time in paring down the hides thin enough to make their weight such that they could be transported to camp by the porters.

When we arrived at the spot where the rhinoceroses lay we found the Colonel intensely delighted with his success. About noon a herd of four rhinoceroses had been discovered resting in some tall grass. No undoubted male could be seen in the herd, the animal shot, an adult female, being the largest visible. All the others bolted, one being wounded by Kermit, but as it left no blood spoor it was supposed, at the time, to have escaped. A week later it was found by Kermit surrounded by great numbers of vultures who were feeding on its decayed body. The skull and horns, however, were in perfect condition and were preserved. The calf of the first female remained behind with the body of its parent and was collected. It proved a very valuable specimen in illustrating juvenile characters in the bones of the skull and the teeth. The female was found upon examination to still have her last milk molars in use and was really an immature animal, although already the parent of a half-grown calf. The dead female did not impress us as an animal of extraordinary size among rhinoceroses. She had about the same bodily size as the black species, but the head was extremely long with the eyes situated equidistant from

the tip of the snout and the base of the ears. The squared snout and mouth, the immense base of the front horn and the prominent fleshy hump on the shoulders were distinctive characters which were evident at a glance. The coloration was apparently as dark as that of the black species. Later, however, by actual comparison of skins, the color was found to be distinctly lighter. The contents of the stomach of this individual were carefully examined to determine the food habits. Only grass was found; the identifiable substances being bits of stems of the common veldt grass.

After measuring the beast carefully as it lay, the skin was removed in a single piece in the usual manner. A median ventral cut was made the full length of the body and four others extended from this at right angles, one down the inside of each leg. The skin came off easily from the body, the muscular attachment being rather slight. Within two hours the skin was off the body with the exception of the head, which required more careful skinning. The skin was thinnest on the inside of the limbs and on the abdomen, and thickest on the back. In weight it must certainly have equalled a ton. The fifteen men failed to lift it clear, being able only to drag it slowly over smooth ground. The stiffness of the hide was remarkable, and was comparable to a sheet of thin steel. It lay in great coils after being removed and could not be folded. The only way in which we could handle the refractory affair was by rolling it up in a giant roll ten feet long and two feet in diameter, and covering it with salt.

Camp was then arranged for the night on the spot. One tent was erected over the skins of the female and the calf, another for the skinners, and a third for me. They were all placed within a few feet of the skins and carcass in order to protect these specimens from the attacks of hyenas or other predatory animals at night. No men were available for guard duty during the night, as all were tired out by their labors on the skins. Our slumbers were not disturbed, the kill apparently being too fresh to attract carnivorous animals from any great distance.

Next day the work of paring down the great hides was begun. A dozen men were set to work with fleshing knives on the large skin, cutting flakes of hide off the inside surface. In performing this work they stood on the hide and whittled out large chunks of the skin. After the surface had been gone over in this way, about half of its thickness had been removed and it could then be handled more easily. The grain or resisting qualities of the skin had been broken and it could now be folded up quite tightly. It had required the entire first

1. THE SAUSAGE TREE KIGELIA ÆTHIOPICA. A COMMON TREE AT RHINO CAMP

2. NATIVE VILLAGE AT WADELAI. ACHOLI TRIBE

1. NATIVE FISH-TRAP MADE BY ACHOLI NEGROES NEAR WADELAI

2. A GIANT CANDELABRA EUPHORBIA NEAR CHIEF SURURU'S VILLAGE

day to complete this preliminary paring. The skin was then rolled in salt and folded for the night. While the skinning was in progress a few of the porters were busy fleshing out the skeletons of the two rhinoceroses. During the day great numbers of vultures and marabout storks came to the carcass, but they were not permitted to offer their services. They contented themselves, however, by draping the neighboring thorn trees with their persons and waiting for our departure.

Our experience of the previous night had given us every assurance of the lack of carnivorous animals in the immediate vicinity. The entire force, consisting of eight skinners and myself, accordingly turned in without even thinking of taking precautions against the loss of our specimens by carnivores. We had camped practically upon the rhinoceros bodies, but beyond the protective value of our presence nothing had been done to guard the camp. At about two o'clock in the morning we were suddenly awakened by the growling of lions. Three lions had come into our midst and were quarreling among themselves over the carcasses which lay not more than fifteen feet away and almost directly between the two tents. The lions were absorbed in their quarrel over the meat and paid very little heed to us, but the night was so dark that they could not be seen. The unprotected skinners left their tent and sneaked silently over to mine. A lantern was soon lighted, and the rifles and the reflecting acetylene headlight arranged. When the powerful rays of the headlight were thrown upon the lions they bolted instantly without allowing an opportunity for a shot. They remained, however, at a safe distance of about one hundred yards or so, growling occasionally. Finally, all noise ceased. The skinners attempted to return to their tent, but a few warning growls sent them back to me. After they had eased their minds by much excited conversation they went to sleep where they were, under the fly of the tent, and we were not again disturbed until four in the morning. At this hour the lions returned and serenaded us in a last attempt to get possession of the rhinoceros meat. At daylight they withdrew leaving the field to us and the vultures.

During the morning both skins were pared down thin enough to allow the salt to penetrate through the dermis and preserve the thin epidermal layer containing the pigment and the few hairs possessed by the rhinoceros. When this work was completed the larger skin was rolled up tightly into a barrel-shaped bundle two feet in diameter and three feet in length. In this shape it was lashed to a stout pole and carried to the permanent camp on the shoulders of four negroes.

The weight of the skin was now about three hundred pounds. The smaller skin of the calf, after it had been pared, was less than half the size and weight of the adult and offered no especial difficulty in transportation.

During our absence from the permanent camp the neighboring veldt had been fired by Grogan to rid the district of the tall grass which so confined the sight of the rhinoceros hunters that very little game could be found. There was considerable dispute among the guides as to the effect of such a conflagration on the rhinoceroses. The burning of the grass proved, however, to be a wise measure. The game did not leave the district, but continued here, feeding in the isolated patches of grass which had escaped the fire. The burnt country was covered by a soft film of black ash which facilitated tracking wonderfully, adding further joy to the hearts of the hunters.

The day after returning to camp we were free to engage in the preparation of further rhinoceros skins and early in the morning Colonel Roosevelt set out in quest of more of these uncouth monsters, taking the skinners and the writer with him. After travelling a few hours fresh tracks were found on the burnt ground. The spoor which indicated three animals was followed through a maze of other tracks and finally, about ten o'clock, the animals were found in some country thinly interspersed by bushes. They were a family consisting of a bull, a cow and half-grown calf. The bull was wounded by Kermit and killed by his father, as it bolted toward the shooting party in a dazed condition. The calf, bewildered, came back to the dead bull at the moment we were preparing to measure the beast. By shouting and handclapping the gun-bearers frightened it away. The height at the shoulders of the bull was only five feet and three inches, a height often attained by the black species. The contents of the stomach of this specimen was solely grass.

The afternoon was spent skinning the specimen. When the tents arrived they were pitched near the carcass and everything was arranged for the night. During the night a few hyenas were heard near by, but they did not venture into camp. The distant roaring of lions was heard at intervals, the animals evidently being a mile or more away. These lions were the only ones in the district. They showed extreme caution owing to their fright the night before, and did not again venture near any of our camps during their nocturnal wanderings.

The next day, the 15th, the Colonel shot two more rhinoceroses. The first one was secured by spooring over the burnt country, but

1. A POOL ON THE VELDT NEAR RHINO CAMP BORDERED BY GREEN-BARKED ACACIA TREES, ACACIA VERUGERA, AND YELLOW POND LILIES

2. THE NILE AT RHINO CAMP SHOWING VAST PAPYRUS SWAMPS AND ABSENCE OF DEFINITE SHORE-LINE

1. PAPYRUS SWAMPS BORDERING THE NILE AT WADELAI

2. VELDT AT RHINO CAMP AFTER BURNING THE GRASS. SHOWING BODY OF A FALLEN RHINOCEROS AMID CHARACTERISTIC TREE GROWTH. CENTER, GREEN-BARKED ACACIA, ACACIA VERUGERA; FOREGROUND, LONCHOCARPUS LAXIFLORUS TREES

only the head was preserved. The second was discovered by a native, who brought the news to the shooting party soon after the first was shot. This specimen was a large male with a small horn, and was shot by the Colonel after it was photographed by Kermit. A runner was sent at once to camp to inform me. I had spent the morning in camp inspecting the skins already collected. The skinners, our tents, and an outfit were soon assembled and we started back with the guide. On the way we met the Colonel and Kermit returning. They had spent the day in the burnt country and showed every evidence of their contact with the black ash which lay as a pall everywhere. The ash had painted Caucasian and negro alike, and at a little distance they were distinguishable from their black followers chiefly by the difference in wearing apparel. We arrived at the kill in time to remove the skin and prepare camp for the night. Before turning in, a few large steel traps were set near by baited with pieces of rhinoceros meat. During the night we heard a leopard growl several times, but were quite unaware that the noise came from a trapped animal. Upon awakening in the morning we discovered a large male leopard moving over the veldt, about half a mile away, dragging one of the traps. Upon examination he proved to be caught by a single toe of his right fore-foot, the trap having a secure grip behind the ball. We gave chase, and when we arrived within 50 yards, he faced about growling, and then I shot him.

The entire day was spent paring down the rhinoceros hide, and late in the afternoon we returned to the main camp with the skin and the skeleton. On the way back we found the greater part of the skeleton of a white rhinoceros lying on the veldt, bleached, and in almost perfect condition. The skull was collected. Many other such weathered skulls were found later, and those in good preservation collected. Most of these specimens showed weathering of two years or less, and evidently represented rhinoceroses which had fallen victims to the rifles of the elephant poachers. The preservation of such skulls is due largely to their great size and density, which prevents such bone crushing carnivores as hyenas from breaking them up for food. The skulls of elephants, hippopotamuses and rhinoceroses alone seem to be large enough to withstand the attacks of hyenas, or rather so large that hyenas find it unprofitable to attempt to crush them.

A few days later the Colonel and Kermit went out on a photographic quest for rhinoceroses. They discovered a female with a nearly full-grown calf, but the light was so unfavorable that photo-

graphs could not be obtained. Finally the female became irritated and charged Kermit, who shot her. Upon dissection, it was found that she contained a large fœtus to which she would soon have given birth. The embryo, which already had hard hoofs, differed externally in no way other than in size from its parent. The condition of this specimen was a valuable clue to the rapid breeding of rhinoceroses. The position held by the large calf, which still accompanied its parent, was about to be filled by a new offspring. From the evidence obtained from the first female shot, and that obtained from this specimen, it is quite evident that in the Lado Enclave rhinoceroses begin to breed while still immature, and that the succession of calves is as rapid as the period of gestation will allow. With the skinners I spent the afternoon skinning the specimen and preparing camp on the spot. During the night we were not visited by a single carnivorous animal. One of the startling peculiarities of this region is its lack of carion-feeding carnivores. We could in no way account for this, for game was really abundant here.

Kermit and Grogan, two days later, were more successful with their photographic efforts. Kermit obtained some wonderful photographs of a female and a half-grown calf. This female had a long front horn which projected forward to such an extent that in feeding the tip rested on the ground. This is a peculiarity possessed only by some females. The front horn normally is curved backward as in the black species. Owing to the short distance at which it was necessary to take the photographs, this female became so irritated that she charged the camera and Kermit found it necessary to shoot her. The unskinned head was brought into camp for preservation. The front horn measured 29½ inches in length and exceeded by five inches the longest one obtained previously.

Enough rhinoceroses had now been collected. The succeeding days were devoted to elephant and buffalo hunting in the vicinity of Chief Sururu's village. The village was situated some 10 miles west of the Nile in scattered bush country near a small stream. Some 50 members of the Aluru tribe lived here within the walls of a stout thorn boma or hedge. They were an agricultural people who raised maize, sweet potatoes, and millet. In returning from the vicinity of this village on the 29th, the Colonel met an exceptionally long-horned rhinoceros which he killed. Upon examination the horn was found to be 25 inches long, the second longest in the collection. This completed the collection of rhinoceroses. We now had six complete specimens consisting of the entire skins and skeletons; three heads,

1. HALF-GROWN NURSING CALF PHOTOGRAPHED ON THE VELDT AT RHINO CAMP. COUNTRY SHOWING UNBURNED OR NATURAL CONDITION; TALL GRASS, ACACIA AND COMBRETUM BUSHES

2. HEAD OF IMMATURE MALE SHOT BY KERMIT ROOSEVELT. CAT. NO. 164589 U. S. NATIONAL MUSEUM

1. COW AND CALF PHOTOGRAPHED ON BURNED VELDT BY KERMIT ROOSEVELT

2. HEAD OF ADULT FEMALE. CAT. NO. 164587, U. S. NATIONAL MUSEUM

that is, head-skin and skull; one single skull, and four weathered skulls picked up on the veldt. This gave us a total of 14 specimens, 12 of them being adult in size, one a nursing calf and the other a fœtus.

## DESCRIPTION OF SPECIES

### Genus CERATOTHERIUM

1867. *Ceratotherium* GRAY, Proc. Zoöl. Soc., London; type *Rinoceros simus.*

Species *C. simum,* the type and only known species.

*Generic characters.*—No functional incisors or canines; skull dolichocephalic, the lambdoidal crests of the occipitals greatly produced and extending posteriorly far beyond the condyles; parietal and occipital plane of skull very little deflected upward from the general dorsal outline; post-glenoid and post-tympanic processes separated so as to leave the auditory meatus open; teeth, milk molars $\frac{1\text{-}2\text{-}3\text{-}4}{1\text{-}2\text{-}3\text{-}4}$, premolars $\frac{2\text{-}3\text{-}4}{2\text{-}3\text{-}4}$, molars $\frac{1\text{-}2\text{-}3}{1\text{-}2\text{-}3} = \frac{7}{7}$, hysodont, formed into complex folds, the surfaces soon becoming worn down level and showing three enclosed fossettes of enamel which are filled with cement as in *Equus;* mandible truncate at symphysis with the ascending ramus not sharply deflected from the level of the dental portion of the bone. External characters are the square mouth, blunt nose and fleshy hump on the nape of the neck, and the absence of dermal folds on the body.

In *Diceros* the skull is much shortened, the occipital portion showing no projection beyond the condyles, but showing decisive differences in the elevation of its parietal and occipital regions above the general outline of the skull. The simplified brachyodont teeth show in their structure a primitive condition. Another difference is the presence of the first premolar as a functional tooth in both jaws. Besides these great differences, *Diceros* shows a prominent massive process at the basisphenoid and basioccipital suture, more slender parooccipital and post-glenoid processes and longer middle pterygoid fossa and shorter anterior palatine fossa. The mandible differs in its pointed or obtuse symphysis and in its sharply angulated ascending ramus and shorter coronoid process.

Compared to *Coelodonta,* the type of which is the recently extinct woolly rhinoceros, the chief differences are the greater development of the internasal septum which is fully ossified and fills up the space between the nasals, maxillæ and premaxillæ; the greater projection of

the rostral portion beyond the molars, and the great downward curvature of the narrow nasals. The tooth foldings are fully as complicated, the teeth having besides the three fossettes occasionally another accessory one on the inner border of the third upper premolar. The dental formula is the same as in *Ceratotherium,* but the teeth are much narrower and smaller generally and do not show evidence of much cement in their composition. Another important skull difference is the union of the post-glenoid and post-tympanic processes to form a closed meatus. A further difference is found in the occipital condyles which are widely separated at their bases.

Thomas has proposed that *C. simus* be included in this genus because of the similarity in shape of skull and dental structure. The great differences in the nasal region and the auditory meatus, however, are of too much weight to permit such grouping.

The only living Asiatic rhinoceros which is related to the African species is the two-horned Sumatra species, *Dicerorhinus sumatrensis.* The skull of *Dicerorhinus* differs chiefly in the presence of functional canines, but these show a strong tendency to reduction, the central lower ones being absent and the lateral ones showing a tendency to atrophy. The cheek teeth are much less specialized, being brachyodont without complicated enamel folds. The skull is scarcely dolichocephalic, showing much less occipital projection than *Ceratotherium.* In the structure of the auditory meatus and in the general shape of the skull this genus approaches closely *Ceratotherium.* Its chief differences are the presence of a pair of upper incisors and lower canines, the lower incisors being absent. The shape of the nasals, which are slender and pointed, however, is of less systematic significance.

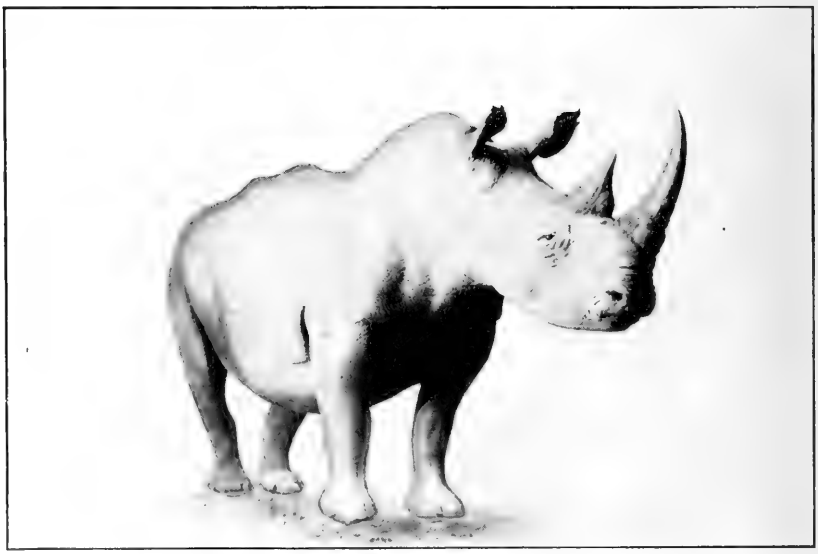
The genus *Rhinoceros,* of which the great Indian one-horned species, *Rhinoceros unicornis,* is the type, differs more widely in skull characters than *Dicerorhinus.* In this genus the front teeth show much less reduction, the lower canines especially being of large size, and the middle upper incisors are present though of little functional importance. The skull is brachycephalic, the occipital projections not extending beyond the condyles, and in general shape it is much more like that of *Diceros.* The general shape and expansion of the nasal bones is also much more like the condition we find in *Diceros* and *Ceratotherium.* The closed auditory meatus is one of the chief characters which separates it from the other living genera.

The trunk skeletal differences between *Ceratotherium* and *Diceros* are really wide, and serve only to accentuate the generic distinctness

1. HEAD OF THE LONGEST HORNED SPECIMEN, A MATURE FEMALE; FRONT HORN 29½ INCHES IN LENGTH

2. A FEMALE SPECIMEN WHERE IT FELL ON THE BURNED VELDT

1. MALE RHINOCEROS WHERE IT FELL ON THE BURNED VELDT



2. MOUNTED MALE NILE WHITE RHINOCEROS IN THE U. S. NATIONAL MUSEUM, SHOT BY COL. THEODORE ROOSEVELT IN THE LADO ENCLAVE

of the two African species. *Ceratotherium* has 22 thoracico-lumbar vertebræ, one less than the number found in *Diceros*. It is rare to find any variation in number of thoracico-lumbar vertebræ between allied genera, usually discrepancies of this sort are due to the anterior lumbar vertebræ becoming rib-bearing, reducing the number of lumbar, but leaving the whole number of thoracico-lumbar vertebræ the same. The other two genera of rhinoceroses examined, *Rhinoceros* and *Dicerorhinus,* show 22 or 23 thoracico-lumbar vertebræ, which would indicate that a difference of this sort is not of a very fundamental character. *Diceros,* however, stands alone in the possession of one more thoracico vertebra than any other living species of rhinoceros. The number of rib-bearing vertebræ in *Ceratotherium* is 18, two less than in *Diceros* and one less than in *Rhinoceros* or *Dicerorhinus*. The caudal vertebræ are apparently less in number in *Ceratotherium,* but the material examined is not reliable, some of the specimens obviously lacking one or more vertebræ, while others seem to exhibit substitution of parts. The tail of the British Museum specimen shows 16 vertebræ, but one or more anterior ones are obviously wanting. The Paris specimen, however, which has 20 vertebræ in the tail is made up near the tip of very irregular bones, which do not show the exact fitting and gradation of a perfect series. Of the four perfectly tailed specimens of *Diceros* which have been examined at the British Museum three show 22 vertebræ. In the Paris specimen the tail is wanting. From the data supplied by these specimens there is little doubt that *Diceros* has some several caudal vertebræ more than *Ceratotherium*. Both species, however, will be found to exhibit some individual variation in the number of caudals due to actual differences in numbers as well as to anchyloses with the sacrum in age. The number of sacral vertebræ is quite variable, the amount of anchyloses in this region depending upon age chiefly, and concerning itself with the caudal vertebræ.

There are some differences in the shape and size of the third trochanter of the femur in the two living African rhinoceroses. In *Ceratotherium* this process is usually shorter and forms a smaller notch with the great trochanter above it. The upwardly directed angle of the third trochanter is less produced, or shorter, and the entire process is smaller than in *Diceros;* but in *Diceros* these trochanter processes are never united to form a closed foramen as occurs in aged specimens of *Rhinoceros unicornis.*

VERTEBRAL FORMULA OF THE LIVING SPECIES OF RHINOCERATIDÆ.

| Species | Locality | Museum | Sex and age | Vertebræ | | | |
|---|---|---|---|---|---|---|---|
| | | | | Thoracic rib-bearing | Lumbar | Sacral | Caudal |
| Ceratotherium s. simum. | Mashonaland Africa. | British .. | ♂ad. | 18 | 4 | 3 | [2]16 |
| Do | South Africa | Paris | ♀ad. | 18 | 4 | 5 | [1]20 |
| Ceratotherium simum cottoni. | Lado Enclave | Congo | ♂old | 19 | 3 | 3 | 23 |
| Diceros bicornis | Abyssinia | British .. | ad. | 20 | 3 | 5 | 22 |
| Do | do | do | ad. | 20 | 3 | 5 | 22 |
| Do | do | do | ♀ad. | 20 | 3 | 5 | 21 |
| Do | do | do | ad. | 20 | 3 | 5 | 22 |
| Do | South Africa | Paris | ad. | 20 | 3 | 4 | Want'g |
| Dicerorhinus sumatrensis. | Malacca | British .. | ♂aged | 19 | 3 | 4 | 26 |
| Rhinoceros unicornis. | India | Paris | ♂ad. | 19 | 3 | 6 | [3]16 |
| Do | do | British .. | aged | 19 | 4 | 6 | 22 |
| Do | do | do | aged | 19 | 4 | 6 | [3]17 |
| Rhinoceros sondaicus. | Java | do | ad. | 19 | 3 | 5 | 22 |

[1] Bones irregular, showing substitution and duplication.
[2] Lacking at least one of the anterior vertebræ.
[3] Several apical vertebræ wanting.

## DERIVATION

In attempting to determine the closest fossil allies of the square-nosed rhinoceros we are at the very outset balked by the bewildering combination of characters displayed by the fossil species. The combinations of skull characters assumed by the late Tertiary and Pleistocene species do not seem to point to any definite lines of evolution, and moreover, are so diverse as to be of generic importance, practically forcing the recognition of a large number of monotypic genera. Osborn [1] in his monograph on the genera attempted to infuse order in the family *Rhinoceratidæ* by dividing the species into six groups, using skull and horn characters rather than dental. He has expressed his dismay at the result in these words: "If this or some similar phylogenetic hypothesis can be established it will not elucidate the origin which remains an enigma, but it will at once simplify the whole problem of the succession, development, migration, and taxonomy of this baffling group." The absence of any obvious clues to the evolution of the various groups point conclusively to the fragmentary character of the paleontological record. The fundamental diversity of most of the genera must be due largely to the great age of the groups which they represent. The fossil forms range geographically through America, Europe, Asia, and Africa. Geologically, they occur from the Oligocene to the present. The very oldest genera

[1] Bull. Am. Mus. Nat. Hist., 1900.

occurred contemporaneously in America and Europe. The early forms were four-toed, hornless species, which retained functional lower canines as well as incisors. In America there is no evidence of rhinoceroses later than the Lower Pliocene, where we find *Teleoceros,* a three-toed genus with small dermal nasal horns like some of the living forms. The Pliocene and Pleistocene of Europe, Asia, and Africa has supplied many species. The most recently extinct species is the woolly rhinoceros, *Coelodonta antiquitatis,* which was a northern animal contemporaneous with the mammoth and man. An entire carcass of this recent species has been found preserved in the ice of Siberia. The five living species of *Rhinoceratidæ* are to-day confined to Africa south of the Sahara, Eastern India, the Malay Peninsula, and the Islands of Sumatra, Java, and Borneo.

The characters which have been found of generic importance in the recent and living species are: the absence or presence of functional incisors and canines; the extent of the projection of the occipital portion of the skull beyond the condyles; the union or separation of the post-glenoid and post-tympanic processes forming an open or a closed auditory meatus; and the complication of the enamel folds in the cheek teeth and their development in relative size of crowns into brachyodont or hysodont teeth. The number of dermal horns on the snout is of less importance. These have been found to show some individual variation in the African species varying from one to three in number in the same species. The front horn, however, is nearly always the better developed and is never wanting. The characters of the cheek teeth though to some extent based on the nature of the food of the species, are nevertheless of much value in showing fundamental relationships.

*Ceratotherium* does not appear to be closely related to any fossil species. Its nearest ally is doubtless *Diceros,* although the living Sumatran rhinoceros, *Dicerorhinus sumatrensis,* is not separated any more widely structurally and shares with it the character of the open auditory meatus, and the dolichocephalic skull, both characters of much weight. The lack of functional incisors is one of the differences in dentition between *Dicerorhinus* and *Ceratotherium,* but the disappearance of these teeth in *Ceratotherium* has taken place recently. The chief dental difference with these genera, however, is the complicated enamel foldings of the cheek teeth into cement-filled enamel fossettes.

The other African genus, *Diceros,* shares with *Ceratotherium* the character of the meatus and the lack of functional incisors and canines,

but differs widely in the brachycephalic skull and brachyodont cheek teeth. The open character of the meatus, which is characteristic of the oldest genera, as well as the three living genera just mentioned, is not found in any of the more recent fossil genera. These three living genera are all two-horned forms.

Most recent authors have associated *Ceratotherium simum* closely with *Coelodonta antiquitatis,* the woolly rhinoceros of northern Europe and Asia. This course, however, does not seem justifiable, considering the great differences in the rostral portion of the skulls. In the woolly rhinoceros the whole anterior portion of the nasals, premaxillæ and maxillæ is united into a solid mass by the thickened osseous development of the mesethmoid. The vomer also shows a tendency to become very thick and heavy. The resemblances are mainly the dolichocephalic character of the skull and the structure of the cheek teeth.

Compared to *Diceros, Ceratotherium* shows much more specialization. The occipital projection of the skull is immensely greater, in fact, it is the extreme reached by rhinoceroses, while *Diceros* is quite at the other extreme in this regard, at least among recent species. The cheek teeth show the same extreme specialization over those of *Diceros* and are at least as specialized, as in any other known genus; but dental differences of this sort are not of much phylogenetic importance, for some of the oldest forms exhibit much specialization of this sort. In a measure, *Ceratotherium* shows more primitive skull characters than fossil species, like *Coelodonta antiquitatis,* where there is a great ossification of the internasals and a union of this bone with the maxillæ, intermaxillæ and nasals into a solid rostrum. The open auditory meatus is another primitive character which *Ceratotherium* has retained. *Coelodonta* shows somewhat less occipital projection and apparently less development of the cement layer in the cheek teeth. In *Ceratotherium* the cement forms a thick layer and enters largely into the structure of the teeth.

There are no fossil forms known which show a really close affinity to *Ceratotherium.* The genus may have been evolved in the Continent which is still its home. If this has been the case we should not expect to find any close allies in the later fossil forms of Europe and Asia, unless migration has taken place. Notwithstanding the great differences in shape of skull and tooth structure separating this genus and *Diceros,* there may be considerable geographical justification for the combination of these two forms into a single genus as proposed by

Thomas.[1] At all events no obvious close relationship with any foreign fossil genera has been well established yet. Osborn does not regard as improbable the derivation from a recent common ancestor species showing as great structural differences as the two under consideration. To produce such skull and dental differences as these two living African rhinoceroses now exhibit would require a long period of time, however. It is absolutely certain that they have been distinct generic types through a great length of time. Leaving out of consideration the great differences found in the occipital portion of the skulls of these two genera we have in the structure of the cheek teeth really vast differences. The differences between the teeth of *Ceratotherium* with their cement-filled fossettes of enamel and the open W-shaped cusps of *Diceros* are greater in degree than those found in the whole range of the ruminants. Such structural differences are comparable to those found between the Equidæ and Bovidæ.

## CERATOTHERIUM SIMUM COTTONI

NILE SQUARE MOUTHED RHINOCEROS

(Natives names; Aluru, *Kenga*)

1900. *Diceros simus,* THOMAS, OLDFIELD: The white rhinoceros on the Upper Nile. Nature, Vol. 62, London, 1900, p. 599. (Lado specimen collected by Gibbons.)

1901. *Rhinoceros simus,* HOLLAND, W. J.: The Carnegie Museum. Pop. Sci. Monthly. Vol. 59, No. 1, New York, 1901, p. 14, text figure.

1903. *Rhinoceros simus,* SCLATER, P. L.: [Exhibited the front horn of a rhinoceros lately obtained on the White Nile and made the following remarks.] Proc. Zoöl. Soc. London, 1903, Vol. 2, p. 194. (One horn collected by Hawker.)

1904. *Rhinoceros simus,* GIBBONS, A. H.: Africa from South to North, through Marotseland. London, 1904, Vol. 2, p. 221. (Describes shooting specimen in Lado Enclave.)

1908. *Rhinoceros simus cottoni,* LYDEKKER, R.: The white rhinoceros. Field Vol. III, London, 1908, p. 319; Game Animals of Africa, p. 38. TROUESSART, E. L.: Le rhinoceros blanc, retrouvé en Soudan est la Licorne des anciens. C. R. Acad. Sci., Vol. 147, Paris, p. 1352.

1909. *Rhinoceros simus cottoni,* TROUESSART, E. L.: Le rhinoceros blanc du Soudan (*Rhinoceros simus cottoni*). Proc. Zoöl. Soc. London, 1903, p. 198, fig. 3.

1910. *Diceros simus cottoni,* ROOSEVELT, T.: African Game Trails, New York, 1910, 474.

1910. *Rhinoceros simus cottoni,* BERGER, A.: Die von mir auf meiner Expedition in den Jahren, 1908/09 in Englisch Ost-Afrika und der Lado Enclave gesammelten Säugetiere, Sitz. Gesellsch. Naturf. Freunde, Berlin, 1910, No. 8, pp. 344, 346; In Afrikas Wildkammern als Forscher und Jäger, Berlin, 1910, p. 430.

[1] Proc. Zoöl. Soc., 1901, p. 157.

*Literature.*—Gibbons, A. H. (1904), Africa from south to north, Vol. 2, p. 221; Powell-Cotton, P. H. G. (1907), Geographical Journal, Vol. 30, London, pp. 371, 381; Churchill, W. S. (1908), My African journey, London, p. 186; Stigand, C. H. (1909), The game of British East Africa, London, pp. 167, 280; Dickinson, F. A. (1910), Lake Victoria to Khartoum with rifle and camera, London, and New York, pp. 91, 274; Roosevelt, T. (1910), African game trails, New York, pp. 394-437, and Scribner's Magazine, Vol. 48, No. 3, New York, p. 257; Berger, A. (1910), In Afrikas Wildkammern als Forscher und Jäger, Berlin, 1910, pp. 358-398.

The square-mouthed or white rhinoceros is a long-headed, tall-bodied animal with a flattened or truncate nose and a wide, square mouth. The excessively long head distinguishes this species at once from all other living forms. The ears are much longer and the feet larger than in the black rhinoceros. One of the peculiarities of this species is the prominent, rounded, fleshy hump upon the nape of the neck just forward of the withers. This hump is purely a muscular structure, and receives no support from the dorsal processes of the cervical vertebræ. One of the most obvious external differences of this rhinoceros is the lack of heavy body folds in its skin. The only evident folds are; a transverse one over the elbow joint, which completely encircles the external surface of the limb, a short transverse one on the nape immediately behind the ears, and a longer but less well marked fold on the throat. The elbow fold is the most distinct fold of the three, and is well marked in any body position. It is as distinct a fold in calves as in adults. The neck folds depend somewhat on the position of the head, the nape fold disappearing almost completely when the head is lowered to the level of the feet. The throat fold is affected similarly when the head is raised to the level of the back. The sides of the body are smooth, being without the rib-like folds so characteristic of the black rhinoceros. A further dermal character concerns the front edge of the thigh which is greatly compressed and stands out along the body as a thin, flattened ridge of hide. This latter character and the three short body folds described, are found in all the living species of rhinoceroses. Compared to the enormous body folds of the Indian rhinoceros, however, the present species appears to be quite devoid of folds.

In size this species exceeds but slightly, if at all, the great Indian single-horned species, and but little the black African species. Measurements of the length and height of the Indian species given by Lydekker[1] are scarcely inferior to authentic dimensions of the largest South African specimens. Measurements of mounted skele-

[1] Great and Small Game of India, Burma and Tibet.

tons of both species show the Indian one to be but little smaller in size. The black rhinoceros of East Africa stands several inches lower and measures less in height of head and body. This inferiority in length, however, is due largely to the much shorter head. The superiority in size of the white rhinoceros over the other living species, however, is not at all well established. In size the sexes are very similar; the male exceeding the female but little.

The species is normally two-horned, the front horn greatly exceeding the rear one in size. The front horn is situated on a prominent bony boss at the tip of the nasal bones and is immediately followed by the rear horn, which is much compressed laterally and placed on the suture between the nasal and frontal bones. The front horn is squared in front where it partakes of the shape of the snout, and is normally curved backward as in the black rhinoceros. The usual length of this horn is 2 feet, although occasional specimens attain a length of 5 feet. The record horn for the South African race is 62½ inches. Such enlarged horns are attained only by the females in which they sometimes project forward in advance of the snout. The rear horn is usually low, sharply conical and considerably compressed. It seldom exceeds more than a few inches in height, and is occasionally wanting. The rear horn never approaches the front one in size as in the keitloa variety of the black rhinoceros, in which the two horns are quite equal. The rear horn is so small that it is obviously disappearing, the species showing a marked tendency to become single-horned, though actual single-horned specimens are rare.

## COLORATION

The skins of white rhinoceroses cannot under the most lenient consideration be classed as white. They are, however, distinctly lighter than those of the black species, and may on this account be allowed to retain their popular designation of white. The blackness of the mounted specimens in the British Museum is due to the black pigment put on by the taxidermists, and such specimens consequently do not represent the natural color of the animal. Their true color is smoke gray of Ridgway,[1] a color conspicuously lighter than the dark clove-brown of their geographical ally, *Diceros bicornis*. The four adult skins in the collection show some variation, the color ranging from smoke-gray to broccoli-brown. The two male skins are lighter than the female skins, but the color differences are not consistent, the

[1] Ridgway, Robert T.: Color standards and color nomenclature, Washington, 1913.

two female skins varying more in color from each other than they do from the male skins. Number 164635, male, is light smoke-grey in color and is the lighter skin. It is quite similar in color to the colored figure of the white rhinoceros in Andrew Smith's Illustrations of the Zoölogy of South Africa, 1849. The skin of the other male, number 164589, is also light smoke gray of Ridgway. Number 164592 is the darker female, the color being light broccoli-brown. Apparently the young soon attain the same shade of color as the adults, for the calf, number 164588, has already attained adult coloration, and is actually somewhat darker than the lighter male.

The only parts of the body which show a growth of hair are the terminal margins of the ears and the apical one-fourth of the tail. The hair of the ears is quite soft and is an inch or so in length. The hair covering of the tail is stiff and bristly, and confined to a streak along both edges of the flattened tip. In the two male skins the hair covering these parts is glossy black and quite profuse, but in the female skins the covering is much thinner and decidedly brownish in color. The young at birth are no more hairy than the adults, possessing only the ear and tail fringes of coarse hair.

## SKULL CHARACTERS

The bones of the skull exhibit a really wide range of variation due to age and sex. The individual variation is much less in the series which is too small to exhibit much of this character. In the series of twelve skulls only four show any wear on the last molars which would justify their consideration as old adults. The last molars do not become functional until the animal has reached middle life. All of the milk molars are in use in two of the skulls, though worn down to very short crowns. Four others are practically of the same age as regards the condition of the last molar which is just erupting through the bone. The next two have this tooth in place, but no wear has yet taken place. The oldest of the series are the four skulls with the last molar showing wear. The series thus gives us four stages based on the condition of the teeth; the first, showing a full set of milk molars; the next, with the four milk molars still in use; and the last molar just breaking through the gums; the third stage, in which the last molar has moved up in place; and, the final one, in which the whole permanent series show wear.

In referring these various ages to the three classes usually used for fully grown animals, a certain amount of confusion is unavoidable. All those individuals showing any trace of milk dentition have been

classed as immature, but only those, however, which have all their milk molars in use are actually immature. This state of affairs is brought about in *Ceratotherium,* owing to the retention of part of its milk dentition long after it has begun to breed and has virtually become an adult animal. Immaturity, as here used, simply means milk dentition, either complete or partial, without any reference to the breeding age or size of the specimen. In the great majority of hoofed animals the milk dentition corresponds with actual immaturity, and the term is employed here on the same dental basis to conform to such usage. The adults are those individuals which have shed all their milk molars, and have their permanent premolars in use, but having the last molar just erupting. They are animals which have attained middle life. Those showing wear on the last molar are classed as old.

The variation due to age concerns itself largely with the occipital prolongation, the union of the premaxillæ, the deflection or dip and the rugosity of the nasals at the expanded tip, and the development of the processes springing from the floor of the cranium. All of these characters are intensified in age together with a general development in massiveness and accentuation of the sexual characters found in the skull. In the nursing young the skull shows no occipital prolongation beyond the condyles, being at this age practically like *Diceros* in this regard. They are quite similar in general shape to the skulls of *Diceros* of the same age, but are distinctly narrower and dolichocephalic with less concavity to the dorsal outline. Soon after leaving this age there is a gradual prolongation which continues well on to maturity before reaching its maximum development where the extreme dolichocephalic condition is reached.

The premaxillæ consist of two very small bones, an inch or two long, projecting beyond the heavy maxillary bones, but not uniting with one another for some time after the animal has become adult. They are widely separated at birth and remain thus until most of the milk premolars have disappeared. They usually unite along only a part of their width. In only one skull are they united broadly to form a solid beak-like symphysis.

The nasal bones near their tips are smooth and raised into a prominent boss from which there is a sharp descent to their extreme tip. As age proceeds this boss expands in width and becomes lower, the angle made by the anterior and posterior surfaces of the boss being much greater in old age. Accompanying this greater development of the tips of the nasals is a marked increase in the rugosity which is needed for the support of the enlarged front nasal horn. The age

effect on the nasal boss is chiefly that of expansion with very little increase in length. This is well shown by the relationship of the width to the length in the various ages. In the nursing calf the length greatly exceeds the width; in the immature, with milk dentition still in use, these two dimensions are about equal; while in the old the width greatly exceeds the length. There is also a general increase in the size and massiveness of the paroccipital and post-glenoid processes as age advances. In adults these processes show considerable elongation and attenuation at their tips together with some increase in rugosity. The post-orbital breadth or constriction of the skull attains its size early and remains fixed, thus becoming in age proportionally much less. The crests and processes are the parts which finally give the skull its greatest size, and these are the portions which change most with age. The greatly developed lambdoidal crests show a gradual increase in breadth across the occipitals as age advances.

An invariable feature of this species is the single infra-orbital foramina. No exceptions in this character have been detected in any skulls. In *Diceros* we find every degree of variation in number from one to three openings between individual skulls and between the two sides of the same skull. The same variation exists to a less degree in *Hippopotamus* and *Elephas*.

The skull also shows a very considerable amount of sexual variation, which renders it comparatively simple to determine the sex of an individual by attention to such characters. The nasal expansion is the most marked character of this sort. In the adult male this expansion is constantly 20 mm. or more greater than in the female skulls, while the length of the nasal projection beyond the maxillæ is correspondingly greater and ranges from 15 mm. to 25 mm. greater. The greater width of the nasal expansion in the male is directly in accord with the much more massive front horn of the male. The general massiveness of the skull is considerably greater in the male where it is especially marked by the greater length. The male skulls exceed female skulls from 40 mm. to 50 mm. in length, and also average considerably greater in breadth. Accompanying this increased size, is greater bulk to the bones forming the zygomatic arch, the depth of the zygomatic processes of the squamosal being much greater in the male skulls. The coronoid process of the mandible is somewhat shorter in female skulls, and the mandible itself shows considerably greater length in the male. The teeth, however, exhibit no differences in size or shape in the two sexes.

The individual variation seems to be greatest along the lines of generic differences. One of the most variable characters of this sort is the amount of separation between the post-glenoid and post-tympanic processes. This varies independent of age or sex from 2 mm. to 10 mm., and shows an average variation on the two sides of the individual skulls of 50 per cent. The wide variation in the character of the separation throws much doubt upon its generic value. The vomer in one specimen, number 164589, shows a marked departure in thickness, or width, over the normal, thin knife-like shape of the bone. There is also shown a small amount of individual variation in the extent of the lambdoidal prolongation of the occipitals and in the amount of union between the extremities of the premaxillæ, but the great bulk of the variation in these bones is due to age. The width of the parietal flat area shows great individual variation with a relatively slight increase due to age. We find the same individual variation occurring in the bush-pig, *Potamochœrus,* where this feature of the skull is much better marked.

The mandible shows much individual variation in the depth of the ramus at the angle, but this feature, however, averages greatest in the males. Length of symphysis also shows much individual variation.

There are four milk molars on each side in both the upper and lower series. The first milk molar, both in the upper and the lower jaw, is not replaced by a permanent tooth, but is gradually crowded forward and lost soon after the permanent series is well established. The loss of this tooth occurs some time before the shedding of the last milk molar, but a pit in front of the second premolar, representing the alveolus of the tooth, remains a long time afterward.

The milk molars are succeeded by the permanent premolars from before backwards with the exception of the first, which is never replaced. The first milk molar to be replaced by a premolar is the second. Soon afterward the third is replaced, but the fourth persists much longer and is not usually replaced until the last molar is beginning to appear. Contrary to the usual rule in ungulates, the milk molars show slightly less size and complexity than the permanent series which replaces them. The anterior teeth of the milk series are approximately only half the size of the permanent ones. At the time of their eruption their crowns are marked by sharp unworn ridges of enamel with two deep valleys extending into them from the inner border. Soon by the union of the two accessory crests, the crests from the ectoloph and the crotchet from the metaloph, an island of enamel, the medifossette is cut off from the anterior valley and isolated in the

dentine of the tooth. Later the posterior valley lying between the ectoloph and metaloph is cut off by the union of its posterior walls to form the postfossette. Finally, by the union of the projecting ends of the metaloph and the protoloph, another island is cut off. This is the prefossette, the most anterior in position but the last to be formed. By this union the last fossette has been formed and the tooth now has a square crown with three central islands of enamel. No antecrotchet is formed, at least no ridge is given off from the median border of the protoloph, the union with the metaloph taking place at the extreme tip of the protoloph. This condition takes place fairly early and remains throughout most of the life of the tooth, the fossettes not disappearing until the crown is worn nearly down to the roots. The permanent premolars and the molars develop their folds precisely as the milk molars, but have in addition to the enamel and dentine a

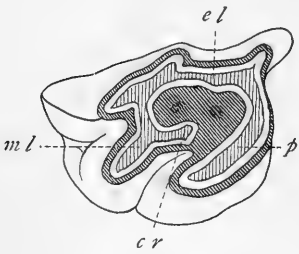



Fig. 1.

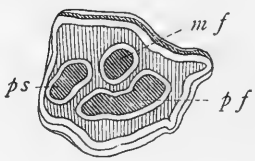



Fig. 2.

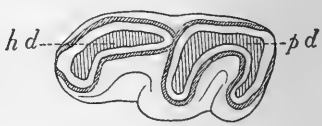



Fig. 3.

Fig. 1.—Second upper molar of *Ceratotherium simum cottoni.*

Fig. 2.—Second upper premolar of *Ceratotherium simum cottoni,* illustrating position of lophs and fossettes and composition of cheek teeth; both ½ natural size.

*Cr,* crotchet; *el,* ectoloph; *mf,* medifosette; *ml,* metaloph; *pf,* prefosette; *pl,* protoloph; *ps,* postfossette; cement layer = diagonal ruling; dentine = vertical ruling; enamel = white.

Fig. 3.—First lower molar of *Ceratotherium simum cottoni,* illustrating position of lophs and composition of mandibular cheek teeth; ½ natural size.

*Hd,* hypolophid; *pd,* protolophid. Cement layer = diagonal ruling; dentine = vertical ruling; enamel = white.

heavy outer coating of cement. This layer is usually so thick that when carried into the center of the crown by the formation of the fossettes it completely fills these cavities. This abundance of cement in the teeth is similar to the condition found in the *Equidæ,* and is one of the marked distinguishing characters of this genus of *Rhinocerotidæ.*

As the molars are erupted the premolars are pushed forward, the eruption of each molar taking place opposite the termination of the

bony palate. The new teeth are much longer than wide with irregular anterior and posterior borders. As they are pushed forward the pressure shortens and widens them so that finally when the last molar has assumed its position many of the teeth have become much wider than long, and have had their anterior and posterior faces leveled to a straight border. The tooth row is longest at the time the last molar has moved up into position and shows a slight amount of wear anteriorly. From this time on the wear on the premolars reduces the length so that there is a gradual reduction in the length of the series as age advances.

It has not been found practicable to determine size differences in individual teeth in different individuals, or for that matter, of the two races here considered. The great changes taking place in the size of the individual teeth due to wear make exact correlation impossible. The first upper molar is the most suitable for such a comparison, owing to its early eruption and long life. When first erupted this tooth is much longer than wide, but as it wears down and is pushed forward by the succeeding molars it gradually becomes shorter until in age, when the last molar is in place, it is much wider than long. The same changes take place but to a less degree in the second molar. The third is more constant, but as it is only erupted in middle age it is found in but a small proportion of skulls. This last molar may be considered virtually a " wisdom " tooth. Curiously enough, no rhinoceros skull has been found in which the last molar shows any extensive wear such as would indicate extreme old age. In *Elephas* and *Hippopotamus* this condition of extreme wear is occasionally found and apparently indicates that these animals sometimes outlive their teeth and die of starvation. It is, however, doubtful if such a fate ever overtakes a rhinoceros.

In the mandible there are likewise four milk molars, but the first is not replaced in the permanent series. The first is much more delayed than in the upper series. It does not erupt until the three milk molars which follow it have undergone a considerable amount of wear. This is well shown in the mandible of a half-grown calf, number 164588. The tooth, however, is lost early, disappearing about the time the last molar begins to break through the maxillary bone. The first milk molar has a simple narrow crest with very little of the crescent development seen in the posterior teeth. The milk molars show a simple crown formation composed of two crests, the protolophid and metalophid, with their valleys directed inward. The ends of the protolophid unite early to form the pre-fossette. Later the tip

of the metalophid joins the posterior end of the protolophid enclosing another fossette, which condition lasts until the tooth is greatly worn.

The permanent premolars and molars differ only in size from the milk molars. They are much larger, but show no more complexity of structure with the exception of the greater development of the cement layer. In the permanent teeth this layer usually fills the cavities of the fossettes. In old age, when the last molar shows wear, the other permanent teeth usually show a very worn condition with a single central island of enamel, the post-fossette.

There is remarkably little individual variation in the folds or crests of the teeth. Most of the differences which occur between the corresponding teeth of the two sides are due to differences of wear or age. One specimen, number 164594, shows the crotchet of the left fourth upper premolar cut off and isolated as a fossette, but this condition is temporary, a little more wear only being required to unite the crotchet as normally. Both the second upper molars of this same specimen show the metaloph isolated as a fossette by a shallow valley at its junction with the ectoloph. As in the case of the premolar, a little more wear would reduce this peculiarity to a normal condition.

There is no evidence of either incisors or canines in the youngest skull, number 164588, that of a half-grown calf. Skulls of the same age as the latter of *Diceros* show upper incisors, but of a very rudimentary character. In the mandible these young skulls show alveoli of incisors which had been recently absorbed. *Ceratotherium,* it would appear, is a more specialized genus than any of the other living rhinoceroses as regards its teeth.

## EXPLANATION OF TABLE OF SKULL MEASUREMENTS

All of the skulls listed, with the exception of the South African Museum specimen, have been examined and measured by the writer.

1. A. M.—American Museum of N. Y. Skull with horns still attached, but lacking a mandible, and with the zygomatic arches and condylar region cut away. Collected in South Africa by a missionary in the early part of the last century. Specimen now in the Department of Paleontology. Figured in plates.
2. B. M.—British Museum. Skull from South Africa belonging to the mounted skeleton in the Department of Paleontology in the British Museum. Figured in plates.
3. H. M.—Hamburg Museum. Specimen from South Africa lacking a definite locality. Associated with a much older mandible than its own tooth row would indicate belonged to it.
4. C. M.—Congo Museum. Lado Enclave specimen. Now a mounted specimen in the Congo Museum, Brussels. Shot by Major Powell-Cotton.

) BY AGE UNDER T

| Museu | (5) P.-C. | (5) P.-C. | (5) P.-C. | 2 |
|---|---|---|---|---|
| Localit | (32) Kevi | (40) Kevi | (20) Fariola | S |
| Sex .. | ♀ im. | ♀ im. | ♂ im. | ♂ |
| Age .. | Milk M. | Milk M. | Milk M. | v |
| Occipit | 670 | 740 | 725 | |
| Condyl | ... | ... | ... | |
| Zygom | 315 | 315 | 350 | |
| Lachry | ... | ... | ... | |
| Breadt | ... | ... | ... | |
| Breadt | ... | ... | ... | |
| Breadt | ... | ... | ... | |
| Depth | 40 | 41 | 57 | |
| Depth | 55 | 63 | 58 | |
| Foram | ... | ... | ... | |
| Width | 122 | 136 | 136 | |
| Length | 140 | 156 | 153 | |
| Angle | ... | ... | ... | |
| Separa pani | ... | ... | ... | |
| Length | ... | ... | ... | |
| Mandi | 522 | 555 | 565 | |
| Width | 86 | 89 | 98 | |
| Length | 115 | 136 | 133 | |
| Width | 147 | 152 | 168 | |
| Length | ... | ... | ... | |

SKULL MEASUREMENTS OF CERATOTHERIUM SIMUM SIMUM AND C. S. COTTONI ARRANGED BY AGE UNDER THE SEXES

| | COTTONI | | | | | | | | | | | | | | | | | | | | | | | SIMUS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Museum number | 164598 | 164596 | 164593 | 164635 | 164589 | 164592 | 164597 | 164595 | 164594 | 164587 | 164599 | 164590 | 164588 | (13) Type | (5) P.-C. | (5) P.-C. | (4) C. M. | (5) P.-C. | (5) P.-C. | (5) P.-C. | (5) P.-C. | (5) P.-C. | (5) P.-C. | (10) 2154 | (11) 11.5.13.1 | (12) 51.12.23 | (2) Skel.B.M. | (3) H. M. | (9) S. M. | (12) 52.12.9.1 | (6) P. M. | (1) A. M. | (8) S.A.M. |
| Locality | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | (7) R. C. | Kiro | (112) Lenaisia | (110) Lenaisia | L. E. | (37) Kevi | (123) R. C. | (18) Fariola | (32) Kevi | (40) Kevi | (20) Fariola | S. Af. | S. Af. | S. Af. | S. Af. | S. Af. | S. Af. | S. Af. | S. Af. | S. Af. | S. Af. |
| Sex | ♂ old | ♂ ad. | ♂ ad. | ♂ im. | ♂ im. | ♀ old | ♀ old | ♀ old | ♀ ad. | ♀ im. | ♀ im. | ♀ im. | ♀ yg. | ♂ im. | ♂ ad. | ♂ ad. | ♂ old | ♀ old | ♀ ad. | ♀ ad. | ♀ im. | ♀ im. | ♂ im. | ♂ old | ♂ old | ♂ ad. | ♂ ad. | ♂ ad. | ♂ im. | ♀ ad. | ♀ ad. | ♀ old | ♂ |
| Age | M³ worn | M³ unw'rn | M³ unw'rn | Milk M. | Milk M. | M³ worn | M³ worn | M³ worn | M³ unw'rn | Milk M. | Milk M, | Milk M. | nurs-ing | Milk M. | M³ unworn | M³ unworn | M³ worn | M³ worn | M³ unw'rn | M³ unworn | Milk M. | Milk M. | Milk M. | M³ worn | M³ worn | M³ unworn | M³ unworn | M³ unw'rn | M³ not up | M³ worn | M³ worn | M³ worn | |
| Occipital—nasal length | 838 | 820 | 825 | 800 | 730 | 780 | 775 | 755 | 780 | 770 | 762 | 695 | 437 | 770 | 820 | 795 | 770 | 760 | 770 | 700 | 670 | 740 | 725 | 870 | 800 | 827 | 800 | 830 | ... | 767 | 735 | 760 | 775 |
| Condylo—basal length | 740 | 740 | 750 | 685 | 690 | 710 | 725 | 695 | 710 | ... | ... | 690 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 750 | ... | 712 | ... | ... | 710 | 690 | ... | ... | 685 |
| Zygomatic breadth | 384 | 343 | 327 | 357 | 325 | 317 | 349 | 321 | 330 | 325 | 338 | 323 | 225 | 345 | 357 | 325 | 340 | 344 | 325 | 342 | 315 | 315 | 350 | 373 | 362 | 334 | 370 | 355 | 355 | 336 | 295 | 295 | 340 |
| Lachrymal breadth | 325 | 285 | 282 | 280 | 238 | 282 | 292 | 264 | 265 | ... | 263 | 264 | 155 | ... | ... | ... | 290 | ... | ... | ... | ... | ... | ... | 350 | 317 | 281 | ... | 302 | ... | 317 | ... | 262 | ... |
| Breadth post-orbital constriction | 117 | 120 | 118 | 116 | 108 | 108 | 112 | 105 | 113 | ... | 112 | 105 | 95 | ... | ... | ... | 118 | ... | ... | ... | ... | ... | ... | ... | 120 | 110 | ... | 118 | ... | 113 | ... | 118 | ... |
| Breadth parietal flat area | 76 | 51 | 63 | 60 | 31 | 53 | 71 | 48 | 44 | ... | 45 | 48 | none | ... | ... | ... | 52 | ... | ... | ... | ... | ... | ... | 80 | 101 | ... | ... | 58 | ... | ... | ... | 20 | ... |
| Breadth at lambdoidal crests | 245 | 228 | 222 | 218 | 200 | 207 | 212 | 194 | 202 | ... | 224 | 194 | 120 | ... | ... | ... | 185 | ... | ... | ... | ... | ... | ... | ... | 258 | 230 | ... | 230 | ... | 217 | ... | 208 | ... |
| Depth dorsal concavity | 45 | 50 | 43 | 45 | 51 | 50 | 46 | 43 | 34 | ... | 54 | 57 | 46 | ... | 49 | 42 | 48 | 44 | 33 | 46 | 40 | 41 | 57 | ... | ... | ... | ... | 65 | 65 | ... | ... | 105? | ... |
| Depth zygomatic arch | 82 | 66 | 76 | 70 | 60 | 65 | 72 | 61 | 66 | 65 | 64 | 62 | 38 | 65 | 73 | 75 | 70 | 80 | 68 | 75 | 55 | 63 | 58 | ... | 80 | 70 | 72 | ... | ... | ... | 70 | ... | ... |
| Foramen magnum to lambdoidal crest | 175 | 165 | 170 | 180 | 160 | 150 | 175 | 148 | 160 | ... | 165 | 148 | 108 | ... | ... | ... | 160 | ... | ... | ... | ... | ... | ... | ... | 190 | ... | ... | 180 | ... | ... | ... | ... | ... |
| Width nasal boss | 203 | 183 | 203 | 183 | 136 | 173 | 164 | 147 | 171 | 145 | 152 | 122 | 76 | 190 | 200 | 185 | 170 | 155 | 146 | 162 | 122 | 136 | 136 | 208 | 190 | 184 | 190 | ... | ... | 158 | 165 | 166 | ... |
| Length nasal boss | 183 | 171 | 171 | 171 | 162 | 141 | 148 | 163 | 141 | 165 | 156 | 155 | 95 | 155 | 173 | 157 | 155 | 160 | 150 | 140 | 140 | 156 | 153 | 190 | 170 | 185 | 170 | ... | ... | ... | 160 | 180 | ... |
| Angle nasal boss | 124° | 115° | 115° | 114° | 104° | 120° | 120° | 122° | 118° | 117° | 110° | 95° | 98° | . . | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Separation of post-glenoid and post tympanic processes—right side | 5 | 6 | 7 | 2 | 5 | 4 | 8 | 9 | 7 | 6 | 4 | 5 | 3 | 6 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 6 | ... | 5 | ... | ... | ... | 9 | ... | ... |
| Length maxillary tooth row | 253 | 280 | 272 | ... | ... | 266 | 265 | 267 | 280 | ... | ... | ... | ... | ... | ... | 260 | 260 | 280 | 280 | ... | ... | ... | ... | 275 | 300 | 302 | 305 | 278 | ... | 285 | 270 | 284 | ... |
| Mandibular condylo-basal length | ... | 601 | 593 | 567 | 570 | 580 | 581 | 558 | 588 | 580 | 570 | 572 | 375 | 555 | 610 | 590 | 565 | ... | 555 | 563 | 522 | 555 | 565 | 635 | 600 | 575 | 610 | 577 | 610 | 580 | 550 | ... | ... |
| Width at symphysis | 108 | 106 | 98 | 97 | 98 | 91 | 96 | 105 | 95 | 105 | 96 | 92 | 61 | 102 | 105 | 96 | ... | 99 | 93 | 161 | 86 | 89 | 98 | 125 | 117 | 112 | 120 | 120 | 120 | 111 | 100 | ... | ... |
| Length of symphysis | 148 | 141 | 146 | 138 | 124 | 134 | 140 | 136 | 144 | 138 | 136 | 136 | 76 | 140 | 129 | 134 | 150 | 147 | 138 | 128 | 115 | 136 | 133 | 155 | 140 | 131 | 150 | ... | 140 | 142 | 133 | ... | ... |
| Width of ramus at angular | 172 | 156 | 156 | 157 | 169 | 147 | 165 | 147 | 163 | 160 | 162 | 170 | 117 | 145 | 163 | 155 | 150 | ... | 146 | 148 | 147 | 152 | 168 | 185 | 170 | ... | 170 | 133 | 170 | ... | 150 | ... | ... |
| Length mandibular tooth row | 258 | 271 | 260 | ... | ... | 250 | 257 | 248 | 276 | ... | ... | ... | ... | ... | 258 | 250 | 250 | 280 | 276 | ... | ... | ... | ... | 265 | 273 | 266 | 285 | 260 | ... | 268 | 268 | ... | ... |

5. P. C.—Specimens from Major Powell-Cotton's collection from localities in the Lado Enclave.
6. P. M.—Paris Museum. Specimen from South Africa. A mounted skeleton.
7. R. C.—Rhino Camp, Lado Enclave specimens shot either by Col. Roosevelt or Kermit Roosevelt, and now preserved in the United States National Museum.
8. S. A. M.—South African Museum. Skull from measurements given by Sclater in S. Af. Mams. I, p. 300.
9. S. M.—Selous' Museum specimen. Collected by F. C. Selous in Southern Rhodesia, between Matabeleland and Mashonaland. Nasal boss cut off.
10. 2154.—Museum of the Royal College of Surgeons, London. Specimen shot by R. Gordon Cumming in South Africa.
11. 11.5.13.1.—British Museum. Specimen from Zululand.
12. 51.12.23.1.—British Museum. South Africa. No exact locality.
    52.12.9.1.—British Museum. Recorded. Figured in plates.
13. Type of *cottoni* in British Museum. Shot by Powell-Cotton in the Lado Enclave.

## THE EQUATORIAL OR NILE RACE

The square-mouthed rhinoceroses living in the Lado Enclave were separated subspecifically from those of South Africa by Lydekker in 1908 under the name *Rhinoceros simus cottoni*. The material upon which the describer based his conclusions consisted of three skulls in the collection of the British Museum. One of these was the skull of a male from the Lado, and the other two were a male and female skull from South Africa. The Lado skull, which is the type of the new race, was obtained by Major Powell-Cotton some distance north of the station of Kiro, almost precisely on the northern boundary of the Lado Enclave. It is number 53 of his collection, but has now become by donation the property of the British Museum.. The differences detected between these skulls were a greater width of the terminal boss of the nasal bones and less projection beyond the maxillary in the Lado skull. It was also suggested that very probably the northern form possessed shorter horns. A study of the present series of skulls from the Lado has shown the nasal boss to be subject to much variation due to sex and also to some individual variation. The width of the nasal expansion is always considerably greater in the male. This is directly in accord with the enlarged base of the horn in this sex which receives its support from the nasal boss. The projection of the nasals beyond the maxillary bridge is also greater in the male, but there is greater individual variation in this dimension than in the width. Both of these dimensions in adults vary much, some exceed-

ing the measurements of these bones in the adult South African skulls, while others are less. A detailed study of the skull and dental characters shown by the series of fourteen Lado skulls of the Smithsonian African Collection, has been made to determine the variations due to age, sex and the individual. With these variations in mind a careful comparison has been made between this material and the nine adult skulls from South Africa preserved in European museums, together with measurements and photographs of the three skulls from South Africa in the British Museum. The only valid difference in skulls detected between the material from these two widely separated localities is a greater depth to the dorsal concavity in the South African specimens. This greater depth is due to the higher projection of the lambdoidal crests of the occipitals above the fronto-parietal plane of the cranium. A similar projection of the occipital crests occurs in both *Coelodonta* and *Diceros,* but to a much greater degree, being so marked as to be of generic importance. *Ceratotherium* has the flattest dorsal profile of the living rhinoceroses. In the Nile race the flatness reaches its extremity and gives this race the extreme of specialization. There is little doubt but that the ancestral stock of *Ceratotherium* possessed the high occipital crests of the *Rhinocerotidæ* generally, and that flatness shows specialization. The difference of depth of the dorsal concavity, however, is only an average and not an absolute character. In the adults from Lado it is 50 mm. or less, while in the South African it is at least 60 mm., usually 65 mm. In the immature Lado specimens it is much greater than in the adults, those with milk dentition still in use showing depths ranging from 50 mm. to 57 mm. The teeth of the South African specimens also show greater size, the tooth row of adults averaging about 300 mm., while in the Lado race their average is only 270 mm.

The type skull of *Ceratotherium simum cottoni* has been examined and carefully measured by the writer. It is that of an immature male showing the last milk molar worn down to its roots and about to be shed, and the last molar not yet erupted. The age of this skull is practically that of number 164635, U. S. National Museum. It shows decided peculiarities, however, and cannot be matched by any other Lado skull. The nasal boss is extremely wide for so immature a male and is equal to that of a fully adult animal. The nasal projection is, however, short and normal for the age it represents. We have a great number of individual variations to deal with in this species. It is only by comparing minutely a large number of skulls that any real skull characters may be discovered. The nine South African skulls

examined and measured do not show any important differences from Lado skulls of the same age, with the exception of the greater elevation of the occipital portion of the skull. This is a really important difference, the index to which is the depth of the dorsal concavity or dorsal profile of the skull.

The differences in size of horns mentioned by Lydekker may exist, but the basis for comparison is yet very unsatisfactory. The few horns known from South Africa are exceptionally long ones. They have been selected from many hundreds and fail to show what the average was. Some of the few individuals which were last shot in South Africa are now in the museums of South Africa and England. It is a matter of much significance in this connection to find that these specimens show horns of no greater size than those recently secured in the Lado. The largest horned specimen in the Smithsonian African Collection is that of a female shot by Kermit Roosevelt. This horn measures 29½ inches in length and exhibits the peculiar forward pitch which is not infrequently shown by specimens from South Africa. The pitch forward in this case is extreme, the point coming in contact with the ground in feeding, so that the point is worn flat on its outer face. No other Lado horn showing this peculiarity of curvature has been seen. The longest horn in Major Powell-Cotton's collection is 36 inches in length, and in shape curves backwards in the normal way. This is also from a female specimen and is the longest one which has been examined. Horns measuring 40 inches, however, have been reported by traders in the district.

The flesh measurements of the specimens secured in the Lado by the Smithsonian African Expedition fall somewhat short in standing height and in length of head and body from those given by hunters of the white rhinoceros of the South. One of the commonest statements in the literature pertaining to the white rhinoceros is the comparison of its size as being greater than that of any other terrestrial mammal except the elephant. This is due to the exaggerated idea of its size given by sportsmen and is not based on the examination of specimens by such writers. The following table of measurements of skeletons shows conclusively how closely similar the Indian and the white rhinoceroses are in size. The flesh measurements of South African specimens given by Harris and by Coryndon greatly exceed the dimensions of any mounted specimens from that region. Harris gave the standing height attained by large bulls at the withers as from 6 feet 6 inches to 6 feet 8 inches. Coryndon records the heights of two bulls shot by him

TABLE OF FLESH MEASUREMENTS OF LADO ENCLAVE SPECIMENS AND MEASUREMENTS OF MOUNTED SPECIMENS FROM SOUTH AFRICA OF C. SIMUM, AND MEASUREMENTS OF MOUNTED SKELETONS OF C. SIMUM AND R. UNICORNIS.

| U. S. National Museum No. | Sex | Length of head and body | Length of tail | Standing height at shoulder | Length of front horn | Diameter of base of front horn | Locality | Nature of specimen | Collector |
|---|---|---|---|---|---|---|---|---|---|
| | | *Ft. in.* | *Ft. in.* | *Ft. in.* | *Inches* | *Inches* | | | |
| 164635 | ♂ im. | 11 9 | 2 5 | 5 8 | $24\frac{1}{4}$ | $7\frac{7}{8}$ | Lado Enclave | Skin and skeleton | T. Roosevelt. |
| 164593 | ♂ old | .. .. | .. .. | .. .. | $23\frac{1}{4}$ | $7\frac{3}{4}$ | do | Skull and horns | K. Roosevelt. |
| 164589 | ♂ im. | 11 5 | 2 6 | 5 3 | $14\frac{3}{4}$ | $6\frac{7}{8}$ | do | Skin and skeleton | K. Roosevelt. |
| 164587 | ♀ im. | 12 3 | 2 3 | 4 $11\frac{1}{2}$ | $23\frac{1}{4}$ | $6\frac{7}{8}$ | do | do | T. Roosevelt. |
| 164592 | ♀ old | 11 1 | 2 4 | 5 3 | $23\frac{3}{4}$ | 7 | do | do | K. Roosevelt. |
| 164590 | ♀ im. | 10 2 | 2 4 | 5 2 | $13\frac{1}{4}$ | 6 | do | Head only | T. Roosevelt. |
| 164594 | ♀ ad. | .. .. | .. .. | .. .. | $29\frac{1}{2}$ | $6\frac{3}{4}$ | do | do | K. Roosevelt. |
| 164595 | ♀ old | .. .. | .. .. | .. .. | 25 | .. | do | do | T. Roosevelt. |
| Brit. Mus. | ♂ ad. | 10 11 | 2 6 | 5 10[4] | $20\frac{3}{4}$ | .. | Matabeleland | Mounted[3] | R.T.Coryndon. |
| South Africa | ♂ ad. | 13 1 | 2 2 | 6 $1\frac{1}{2}$ | 35 | .. | Mashonaland | do[3] | |
| Tring.[5] | ♂ ad. | 12 1 | 2 10 | 6 $2^4$ | $22\frac{1}{2}$ | .. | do | do[3] | R.T.Coryndon. |
| Leyden | ♂ ad. | 11 7 | 2 $7\frac{1}{8}$ | 4 $10\frac{1}{4}$ | $18\frac{1}{2}$ | .. | South Africa | do[3] | |
| Brit. Mus.[1] | ♂ ad. | 10 $2\frac{1}{8}$ | 1 $11\frac{5}{8}$ | 5 9 | .. | .. | Mashonaland | Skeleton | R.T.Coryndon. |
| Paris Mus. | ♀ ad. | 9 $6\frac{1}{8}$ | 2 .. | 5 $1\frac{1}{4}$ | .. | .. | South Africa | do | E. Verreaux. |
| Congo Mus. | ♂ old | 9 $7\frac{1}{2}$ | 2 $5\frac{1}{2}$ | 5 $5\frac{1}{4}$ | .. | .. | Lado, Nile | do | Powell-Cotton. |
| Paris Mus.[2] | ♂ ad. | 9 $10\frac{1}{8}$ | 1 $10^5$ | 5 5 | .. | .. | India | do | |
| Brit. Mus.[2] | ad. | 9 3 | 5 6 | 5 6 | .. | .. | do | do | |
| Brit. Mus.[2] | ad. | 9 10 | 5 5 | 5 5 | .. | .. | do | do | |

[1] Skeleton of mounted specimen.
[2] *Rhinoceros unicornis.*
[3] Measurements from the mounted specimen.
[4] Coryndon's flesh measurements for these heights are 6 ft. 6 ins. and 6 ft. 9 ins., respectively.
[5] Ward (1896) Horn Measurements, p. 289.

SPECIMENS SECURED AT RHINO CAMP, LADO ENCLAVE. WITH FLESH MEASUREMENTS IN MILLIMETERS.

| U. S. Nat. Mus. No. | Field No. | Sex | Head and body | Tail vertebræ | Hind foot | Ear from notch | Height at shoulders | Depth behind shoulders | Girth behind shoulders | Nature of Specimen | Remarks | Date | Collector |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 164587[1] | 582 | ♀ im. | 3500 | 685 | .... | 260 | 1500 | .... | 2700 | Skin and skeleton | ..... | 1910 Jan. 10 | T. Roosevelt. |
| 164588[1] | 583 | ♀ calf | .... | .... | .... | 197 | .... | .... | .... | .....do..... | Parent No. 164587 | " 10 | T. Roosevelt. |
| 164589 | 586 | ♂ im. | 3460 | 760 | 475 | 280 | 1600 | 1000 | 2650 | .....do..... | ..... | " 13 | K. Roosevelt. |
| 164635[1] | 595 | ♂ im. | 3560 | 735 | .... | .... | 1728 | .... | 2930 | .....do..... | ..... | " 15 | T. Roosevelt. |
| 164590 | 597 | ♀ im. | 3080 | 710 | .... | .... | 1575 | .... | 2424 | Head only..... | ..... | " 15 | T. Roosevelt. |
| 164592 | 605 | ♀ old | 3330 | 710 | 460 | 260 | 1600 | 940 | 3000 | Skin and skeleton | ..... | " 19 | K. Roosevelt. |
| 164789 | 606 | ♂ fœtus | 910 | 208 | 180 | 86 | 460 | .... | .... | .....do..... | Parent No. 164582 | " 19 | K. Roosevelt. |
| 164593 | 607 | ♂ ad. | .... | .... | .... | .... | .... | .... | .... | Skull only ..... | ..... | " 20 | K. Roosevelt |
| 164594 | 612 | ♀ ad. | .... | .... | .... | 250 | .... | .... | .... | Head only..... | ..... | " 21 | K. Roosevelt. |
| 164595[2] | 619 | ♀ old | .... | .... | .... | .... | .... | .... | .... | .....do..... | ..... | " 29 | T. Roosevelt. |
| 164596 | 1305 | ♂ ad. | .... | .... | .... | .... | .... | .... | .... | Skull, weathered. | Picked up ..... | " 15 | E. Heller. |
| 164597 | 1306 | ♀ old | .... | .... | .... | .... | .... | .... | .... | .....do..... | .....do..... | " 15 | E. Heller. |
| 164598 | 1316 | ♂ old | .... | .... | .... | .... | .... | .... | .... | .....do..... | .....do..... | " 28 | T. Roosevelt. |
| 164599 | 1317 | ♀ im. | .... | .... | .... | .... | .... | .... | .... | .....do..... | .....do..... | " 28 | E. Heller. |

[1] Skins and horns mounted in group on exhibition in U. S. National Museum.
[2] Head, skin and horns now in the National Collection of Heads and Horns, New York Zoölogical Society.

in Mashonaland as 6 feet 6 inches and 6 feet 9 inches, respectively. One of these bulls is now mounted in the British Museum and the other is in the Tring Museum. The British Museum specimen shows a height of 5 feet 10 inches, and the Tring specimen 6 feet 1½ inches. The great discrepancies between the flesh measurements and the specimens as mounted are no doubt due to errors made by the sportsmen in the field. Such exaggerations may be due to measuring over the curve of the shoulder, or else forward to the top of the prominent hump on the neck. At all events the mounted specimens should show at least as great height as the specimens in life, and the possibilities are that they actually exceed the flesh dimensions somewhat. The most reliable data in regard to exact size is to be obtained from mounted skeletons. The largest of the three skeletons measured shows a height of 5 feet and 9 inches, the other two are several inches lower. The tanned skins of the specimens secured in equatorial Africa, and now in the National Museum, show measurements slightly exceeding those taken in the flesh. It is very doubtful if the square-nosed rhinoceroses ever exceed a standing height at the withers of 6 feet. The flesh measurements of the Lado specimens agree fairly well with the dimensions of the known mounted specimens. This agreement is in accord with the relative size of the skulls from these respective northern and southern localities, which are practically equal. It is significant in this connection to find that the largest skull in the Lado series exceeds somewhat in bulk and zygomatic width any other known specimen, thus exceeding any known skull from South Africa. The longest skull measured, however, is a South African specimen preserved in the Museum of the Royal College of Surgeons at London.

## GENERAL HISTORY

Much confusion has until recently existed in regard to the validity of records of the occurrence of the square-lipped rhinoceros in equatorial Africa. The first real evidence of its occurrence to the north of the Zambesi River was the skull procured in 1900 by Major Gibbons in the Lado Enclave. Upon the receipt of this proof, naturalists were inclined to give credence to the earlier reports of this species' occurrence by Speke, Grant, Von Höhnel, Gregory, and others. The distribution of the large mammals in the regions through which these pioneer explorers travelled is now fairly well known, and there is little doubt but that all their records referred to the black rhino. Dr. Trouessart, of the Muséum d'Histoire Naturelle de Paris, has

in a recent paper[1] carried the knowledge of the occurrence of the white rhinoceros of the Upper Nile, back to the ancients, and has fastened upon this species the identity of the unicorn mentioned by these early historians. The author has apparently been led astray by the assumption that the females of the square-lipped species carry normally a single, long, slender horn, and that all the early accounts of single horned rhinoceroses in Abyssinian and Sudan territory refer to this species. As a matter of fact there is no record of a single horned specimen of white rhinoceros from Sudan territory.[2] All the known specimens are two horned, the front horn usually being comparatively short and stubby and showing only slightly greater development than in the black rhinoceros. Notwithstanding the conspicuous structural differences found in the heads, particularly the shape of the snout, which these two species exhibit, travelers have often failed to distinguish them. This confusion is no doubt due to the close similarity in bodily size, color and horn development. The great bodily bulk of these animals has prevented sportsmen from preserving such parts as the skulls which show the systematic characters.

Strangely enough the black rhinoceros is not found associated in the Lado Enclave with the square-lipped species, but occurs abundantly on the opposite or east bank of the river, and also to the west about Lake Tchad and the Niger watershed. The black rhinoceros, however, is a widespread species, its range covering most of the country from the Cape north to Abyssinia, Somaliland and the Nile Valley. Further west it is widely spread in the Lake Tchad and Nigerian region. In range it covers Africa generally, being wanting only in the Congo Basin. The ancient accounts of African rhinoceroses refer to this widespread species, which has long been well known to the Arabs. Although the species is almost invariably two horned, occasional variations of one and three horned specimens are met with.

In length of front horn, specimens of the white rhinoceros range from a few inches to 62 inches; seldom, however, exceeding 30 inches. At the extreme base in front the horn has a square or straight base which follows the outline of the snout, while in the black species this basal part of the horn is rounded. A further distinguishing peculi-

[1] Le rhinoceros blanc du Soudan (*Rhinoceros simus cottoni*), Trouessart, E. L. Proc. Zoöl. Soc. London, 1909, p. 198-200.

[2] There are only a few records of single horned specimens among the hundreds of *C. simum* shot in South Africa.

arity of the long horns of some females of the white species, is the straight or forward pitch, which is often carried to such an extreme that in feeding the tip of the horn rests on the ground and is worn smooth on its outer face by contact with the soil.

Captain Speke is apparently the first explorer to record the square-lipped rhinoceros from north of the Zambesi, but his records were based on mistaken identity and refer to the black species. He speaks in his journal [1] of the killing of both white and black rhinoceroses in Karague, a province of German East Africa lying immediately west of the Victoria Nyanza. The figures of the heads of the white rhinoceros which he has published with his text are, however, clearly the pointed lipped black form. Grant [2] in his account of the species of game observed on the journey quotes Speke on the square-lipped rhinoceros, and then follows with a description of the differences between it and the black species, laying great stress on the enlarged front horn of this species, but also mentioning the lip differences. It is apparent that these explorers, although being aware of the lip differences, confounded the two species by using horn differences for their classification, thus applying the name of white rhinoceros to all the specimens of the black species which carried long anterior horns.

More recent explorers [3] who have travelled through Karague have found rhinoceroses very abundant in this district, but they have found them to be the common black species.

## GEOGRAPHICAL RANGE

The square-nosed rhinoceros is found at the present time in a wild state only in the Lado Enclave and the Bahr-el-Ghazal province of equatorial Africa. In the south there are a few (some ten individuals) strictly preserved on an estate in Zuzuland where they live under fairly normal conditions. These are the survivors in South Africa of the immense numbers of this species which once inhabited the country lying between the Orange and the Zambesi rivers.

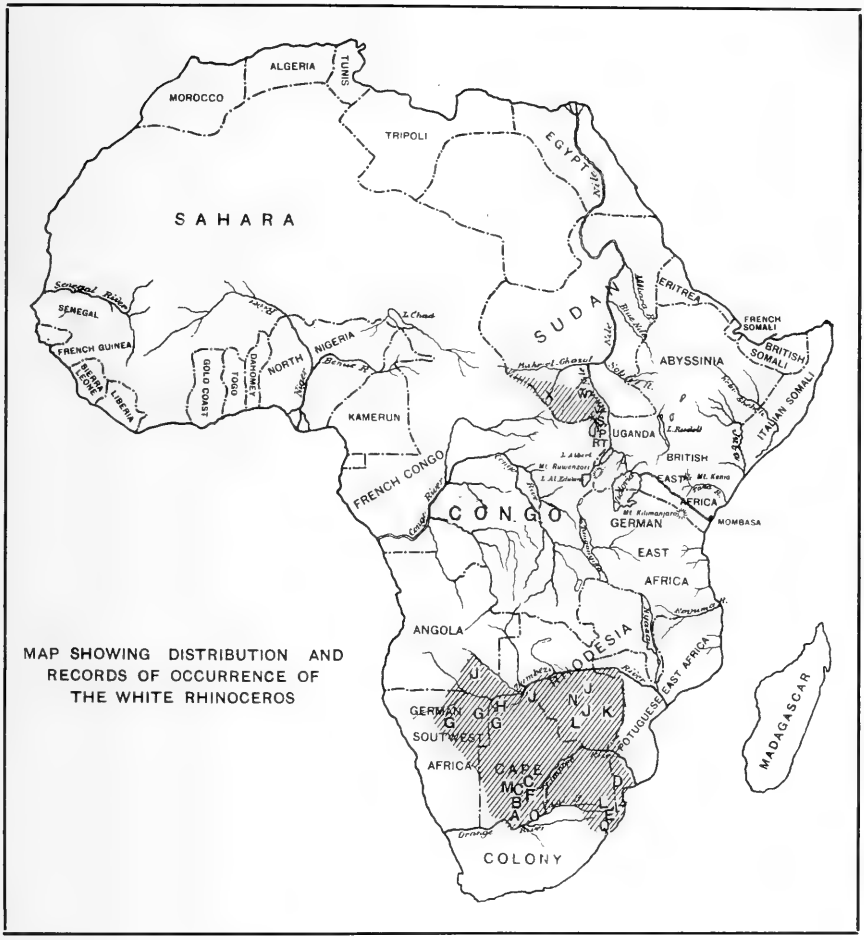
In the Lado Enclave they are confined to the immediate vicinity of

[1] John Hanning Speke, Journal of the discovery of the source of the Nile, Edinburg and London, 1863, pp. 197, 229.

[2] J. A. Grant, Summary of Observations on the geography, climate and natural history of the Lake Region of Equatorial Africa, made by the Speke and Grant Expedition, 1860-1863, Journ. Roy. Geogr. Soc., Vol. 42, London, 1872, p. 328.

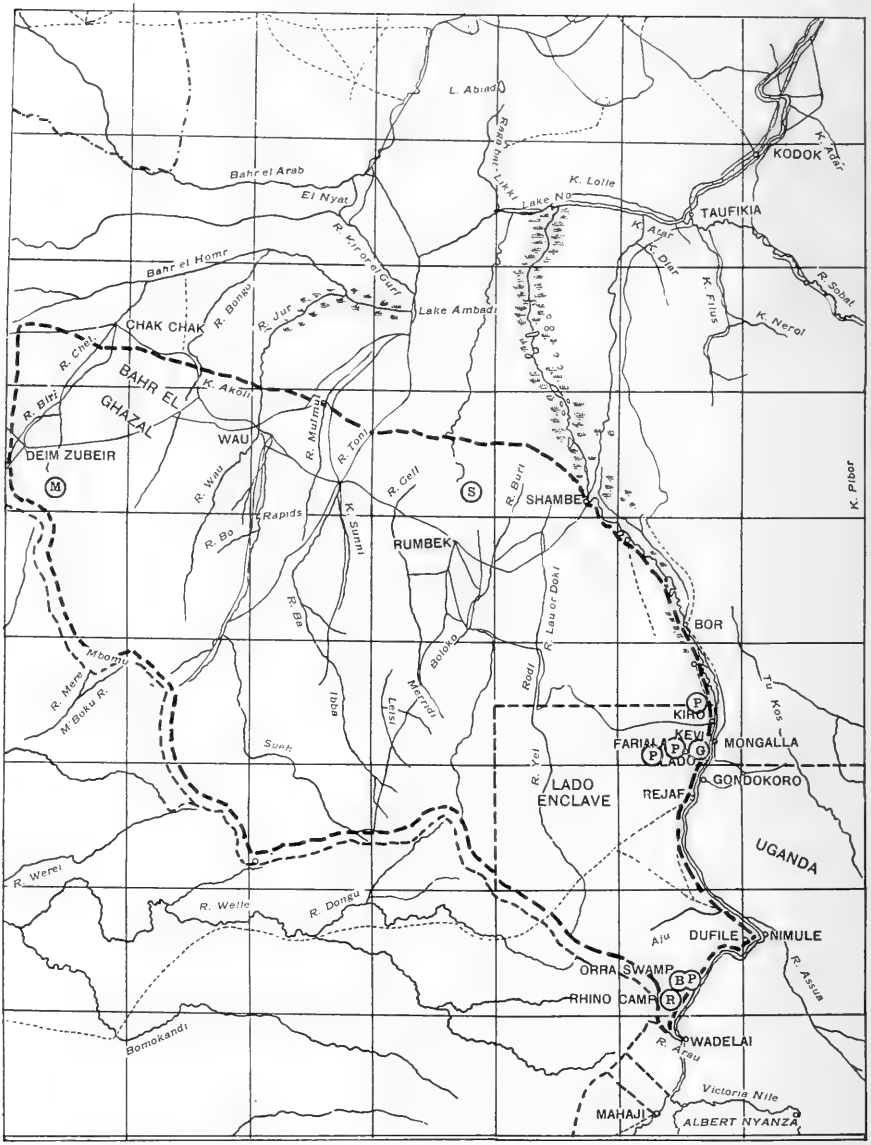
[3] Delme Radcliffe, Proc. Zoöl. Soc. London, 1905, part I, p. 185.

[3] Scott-Elliot, a naturalist in mid Africa, 1896, p. 248.




Shaded portions of map indicate general area of distribution. Letters indicate actual records as follows:

A—Burchell, 1817: Bechuanaland; exact locality of the type uncertain.
B—Campbell, 1822: Kuruman (Machow).
C—Harris, 1838: Marico and Limpopo rivers.
D—Peters, 1842: Lorenzo-Marques.
E—De la Gorgue, 1847: Zululand.
F—Cumming, 1850: Marico and Limpopo rivers; Kurichane.
G—Andersson, 1856: Walfish Bay; southwest of Lake Ngami.
H—Livingstone, 1857: Lake Ngami.
I—Baldwin, 1863: Amatongoland and Marico.
J—Selous, 1881, 1893, 1894, 1899; Upper Chobe River; Mashonaland.
K—Nicolls and Eglington, 1892: Northeast Mashonaland; Sabi River.
L—Bryden, 1893, 1897: Mashonaland and Zululand.
M—Oswell, 1895; Molopo River and Mabotsè Station.
N—Coryndon, 1894: Mashonaland.
O—Sclater. 1900: Kimberley (recent fossil remains).
P—Thomas, 1900: Lado Enclave, Lado Station.
Q—Newton, 1903: Zululand.
R—Lydekker, 1908: Lado Enclave.
S—Churchill, 1908: Lado Enclave, Rhino Camp.
T—Roosevelt, 1910: Lado Enclave, Rhino Camp.
U—Berger, 1910: Lado Enclave, Orra Swamp.
V—Powell-Cotton, 1907: Kiro and Rhino Camp.
W—Selous, 1910: West of Shambe.
X—Mahon, 190 : Dar Fertit District.




MAP OF LADO ENCLAVE SHOWING DISTRIBUTION OF WHITE RHINOCEROS

Dotted line ..... indicates general area of distribution. Actual records:

B—Berger: Orra Swamp.
C—Churchill: Rhino Camp.
G—Gibbons: Lado Station.
M—Mahon: Dar Fertit District.
P—Powell-Cotton: Kiro; Kevi; Fariala; Lenasi; Rhino Camp.
R—Roosevelt: Rhino Camp; Sururu's Village.
S—Selous: West of Shambe.

the western bank. Specimens have been shot in the Enclave in two districts, one a few miles below Wadelai and the other near the station of Lado. Very little is yet known of their distribution westward. The farthest point inland where they were met by Colonel Roosevelt was two days' march to the west of Chief Sururu's village, which is approximately 12 miles west of Rhino Camp. In this vicinity nine were seen by Colonel Roosevelt in one day's journey to the northwest of the village. A few days later Kermit Roosevelt encountered 10 in the same general neighborhood. They were found only in this particular locality and appeared to be locally distributed. Stigand mentions finding them three days' journey inland from the Nile, but mentions no definite locality. Major Powell-Cotton has informed me that the River Arau, opposite Wadelai, is the extreme southern limit of the range of the white rhinoceros, and that the species extends somewhat farther north than Kiro, and no doubt also northwest into the Bahr-el Ghazal province. General Mahon has recently secured a specimen in the Dar Fertit country at the head of the Bahr-el Ghazal drainage. This locality extends the distribution several hundred miles west of the Nile. In 1904 Major Powell-Cotton made a journey from Kiro south along the entire extent of the west bank of the Nile to the north short of the Albert Nyanza. White rhinoceros were only met with by this explorer near Kiro, Kevi, and Fariala, which localities are all in the vicinity of Mount Lado, and at two other stations, Lenaisi and Rhino Camp, in the vicinity of Wadelai. An exploration along the Kaya River and onto the plateau of Kajo-kaji, as well as a journey south along the west bank of the Nile, failed to produce evidence of rhinoceroses in this part of the Lado. During his visit the country was found to be so absolutely devoid of water that no exploration of the district lying a few days west of the Nile could be attempted, and Major Powell-Cotton's efforts had to be confined to the proximity of the west bank. The known distribution of the white rhinoceros covers the two widely separated localities of Lado Station and Rhino Camp, which are some 120 miles apart, and the more distant Dar Fertit country. If the distribution of this species is continuous between the two Lado localities the animal must occur at a considerable distance west of the Nile near the headwaters of the small tributary streams where the water supply may be permanent. White rhinoceroses require water daily and if any occurred near the west bank evidence of their presence would not have been wanting during Major Powell-Cotton's journey in the dry season when the lack of water on the veldt would have forced them to come to the Nile.

Rowland Ward has recorded in his "Records of big game" (London, 1910) a specimen of white rhinoceros obtained by Gen. B. T. Mahon in the Egyptian Sudan. Upon further inquiry Rowland Ward has informed me that this specimen was obtained in the Dar Fertit country at the headwaters of the Bahr-el-Ghazal. This district lies some 300 miles northwest of Lado Station and doubtless represents another isolated locality where the species exists. The Sudan specimen accredited by Rowland Ward to the late Prince Paul Demidoff, in all probability also came from the Dar Fertit country, but no exact data concerning the specimen is available. The late Boyd-Alexander, however, who explored the Yei River country lying between Dar Fertit and Lado does not mention the occurrence of rhinoceroses in his account of the district. There is little doubt but that the species is quite local in distribution, and to this very circumstance its long escape from discovery is to be attributed. Mr. F. C. Selous, during his recent journey for giant eland in the Sudan, discovered further evidence of the occurrence of the white rhinoceros north of the Lado Enclave. While at Shambe on the Nile he was shown the head of a specimen of white rhinoceros killed recently by an English sportsman, about a day's journey west of the station. This record carries the distribution 150 miles north of Kiro, the previously known northernmost locality. During the past year Mr. Gilbert Blaine made a shooting journey through the Bahr-el-Ghazal province from Wau to Dem Zobeir. No rhinoceroses were met with in this journey, although the spoor was occasionally seen. No specific identification of the footprints was made, although it is here essential, as the black species may also inhabit the region. He obtained good evidence, however, at Bor on the Nile of the shooting of a white rhinoceros some distance west of that station by a Sudan officer. Further exploration of this little known region will without doubt show them to be distributed well inland as far at least as the bases of the ranges marking the Congo-Nile watershed. Their haunts are the grassy veldt which in this region is widespread, the forested region being confined to the mountain summits.

In South Africa they covered a wide range of country, practically all of the territory between the upper Orange River and the Zambesi. The southern limits were fixed by the Vaal River, the chief affluent of the Orange. There are no reliable records of this species south of the Vaal, but the bushmen there have tales of its occurrence, and there is also the evidence of a recent skull found imbedded in one of the river deposits in this section of South Africa.[1] On the east coast it

[1] W. L. Sclater, Mammals of South Africa, London, 1900. Vol. I, p. 302.

ranged from Zululand north to the mouth of the Limpopo and then northward to the Zambesi above its junction with the Shire. Here in its northern range the species occurred abundantly right up to the south bank of the Zambesi. Westward it extended well over through the Lake Ngami country to Damaraland. The species was confined in its distribution to the grassy veldt country, seldom straying into the mountainous districts or high plateaus.

The distribution of this species is almost everywhere bounded by rivers both in the north of Africa and in the south. The distribution of the black rhinoceros shows the same sort of geographical barriers, though only locally. In the region west of the Victoria Nyanza this latter species is very abundant on the south side of the Kagera River, but is not known to occur on the north side of the river. The distribution of rhinoceroses illustrates well what a strong aversion the great beasts have to crossing large streams. This aversion must be due to their fear of drowning, for they are quite immune from attack by aquatic animals.

The range of the white rhinoceros shows a remarkable case of discontinuous distribution. The distance separating the northern locality, Lado, from the southern, Zambesi River, is 1100 miles approximately. There is no evidence, geological or otherwise, to show when this intermediate territory lost its square-nosed rhinoceroses or how this separation has come about. It has doubtless taken place fairly recently for there has not yet elapsed sufficient time for the development of specific differences in the individuals inhabiting these widely separated localities. Under the stimulus of the great climatic differences of the equatorial Lado and the temperate conditions of South Africa, it is to be expected that differences would soon manifest themselves. All the living species of rhinoceroses are, however, old fixed types which change very slowly. This is well shown by the close agreement of the few fossil remains of this group from the Pliocene or Pleistocene of South Africa with the same structures in the existing species.[1] Among the existing Asiatic species we find even more remarkable cases of discontinuous distribution. The Sumatran rhinoceros, *Dicerorhinus sumatrensis,* is known to inhabit the Asiatic mainland besides the islands of Sumatra and Borneo; while the Javan rhinoceros, *Rhinoceros sondiacus,* shares the mainland regions with the Sumatran and in addition occurs on the island of Java.

[1] Third Rep. Geol. Surv. Natal and Zululand, 1907, p. 257; pl. 17, 3 figs. *Opsiceros simplicidens,* Scott, Pleistocene. Teeth indistinguishable in shape or size from *Diceros bicornis.*

## HABITS

In disposition the white rhinoceros is mild and inoffensive. Indeed its record for good behavior is quite immaculate. There are very few recorded instances of authentic charges. One of these is the well known assault made upon Oswell's horse by an enraged female. This charge resulted fatally for the horse, whose death was due chiefly to its slowness in moving out of the path of the advancing rhinoceros. The rhinoceros in this case deliberately walked up to the standing horse, thrust its horn into the animal's side and disemboweled it. Many hundreds of white rhinoceroses have been wounded and killed in South Africa without offering to inflict any injury upon their pursuers. This docility of disposition is in strange contrast to the pugnaciousness and bad temper often displayed by the black species. White rhinoceroses are, as a rule, found associated in small family parties consisting of an old male and female, and their recent offspring, usually a nursing calf, and another fully grown one.

The sense of smell is used by the white rhinoceros as the chief means for the detection and location of other animals and objects generally. It is the most highly developed sense, and apparently the only one employed to really identify things, sight and hearing being used only as a means to warn or arouse the animal, in order that it may maneuver so as to get the scent of the objects whose presence has thus been made known. Enemies are winded under favorable conditions at least as far as 400 or 500 yards. Their sight, however, is really feeble, the eyes seldom receiving impressions of stationary objcts beyond 30 yards. Slowly moving objects are often not detected at 50 yards, but where the motion is more rapid the sight is affected at least as far as 100 or 200 yards. White rhinoceroses do not have the pugnacious habit of charging up wind at an enemy, as is often done by the black. Such action has been accounted for on the basis of the weak vision, the rhinoceros merely coming up to within range of its eyesight. Vision, however, is never used as the determining sense in such cases, smell alone having this function. When irritated by the presence of an enemy the white rhinoceros moves about nervously, twists its tail into a knot, cocks its ears at various angles and gazes about in its bewilderment with head erect. As soon as the position of the annoyance is located the animal either bolts at a fast gallop or trots away more leisurely in the opposite direction. Sound is perceptible at least as far as sight and is a sense of considerable keenness so far as plains standards are concerned. Normally they give no evidence of a voice. It is only occasionally when mortally wounded that they give

vent to a series of squealing grunts similar to those made by the black species under like circumstances.

Grass forms the sole food of the square-lipped species. The stomachs of the specimens shot were examined for food substance, and found to contain only the stalks and blades of the coarse veldt grass which at that season was quite dry and hard. The enlarged squared lips and blunt snout fit this species admirably for grazing.

The dung of this species found in the Lado, lay scattered along the paths or in the bush country frequented by the rhinoceroses. There was no evidence here of its deposition at definite spots until a large amount was assembled, as is the habit of the black species in equatorial Africa. In Mashonaland, Coryndon states that this species deposits its dung in heaps until a large accumulation is formed, but that no scraping occurs as is the habit of *Diceros*. About these dunging places of the black species there are usually to be seen broad furrows in the soil made by the scraping of the hind feet after deposition, but no evidence of such a habit was observed in the haunts of the white species.

The hot hours of the day are spent by the white rhinoceroses sleeping in the shade of the scattered clumps of trees or bushes which dot the grassy veldt. They seem to rest indifferently, either lying down or standing up with lowered head. When at rest they stand with their noses almost touching the ground, their heads being elevated to a horizontal position only when alarmed. The drooping position of the head is also maintained when the animal is running at full speed. The grazing is done chiefly during the cool hours of dusk or dawn and at night. Grass fires disturb them very little; at least, they exhibit no annoyance. Large areas of the grassy veldt were burned during our stay at Rhino Camp and these burned areas were at once travelled over by the rhinoceros.

Gordon Cumming found the speed of the white rhinoceros of South Africa to be much less than that of the black. He had no difficulty in running the former down with a horse. The two species he found at times closely associated and drinking at the same water-hole. In the Nile district, however, the two species have not been found in the same territory.

The female specimens of rhinoceroses secured in the Lado add materially to our scanty knowledge of the breeding habits of the species. Rhinoceroses have generally been considered very slow breeders, but it is obvious from the evidence gathered in the Lado that in this region the adult female is seldom found without a calf. The

only female, number 164590, found without a calf was a quite young individual in which the milk molars were only partially worn. She had apparently not yet reached the breeding age. The next oldest specimen, number 164587, in which the fourth milk molars were still in use, was accompanied by a large calf. This specimen had doubtless very recently become sexually mature. An old adult female, number 164592, which showed considerable wear on her last molars, was accompanied by a large calf which appeared to be somewhat less than three years old. Upon dissection this female was found to contain a large fœtus with fully formed hoofs, to which she would have soon given birth. The fœtus, which had a length of 3½ feet, was so far advanced that we were able to skin the specimen in the regular way and preserve both the skin and skeleton in a dried state. It is evident that at least in this female no great time would elapse between the weening of one calf and the birth of another. The two other specimens of mature females shot were accompanied by large calves. Seven females shot by Major Powell-Cotton, add further evidence of the rapid breeding of the Lado rhinoceroses. Four of these females were accompanied by calves and one of the others contained a large fœtus. Two of these parents were still quite immature, not having yet shed any of their milk molars. There is no definite breeding season, the young being produced at any time of year. The calves collected were of divers ages, and the condition of fœtal specimens showed similarly wide variation in ages.

## HABITS, AND SHOOTING OF LADO SPECIMENS.

No mere technical description of the specimens of white rhinoceroses secured by Colonel Roosevelt in the Lado Enclave, would be complete without the graphic account of their habits and the shooting of them, from his "African Game Trails."

"The morning after making camp we started on a rhinoceros hunt. At this time in this neighborhood the rhinoceros seemed to spend the heat of the day in sleep, and to feed in the morning and evening, and perhaps throughout the night; and to drink in the evening and morning, usually at some bay or inlet of the river. In the morning they walked away from the water for an hour or two, until they came to a place which suited them for the day's sleep. Unlike the ordinary rhinoceros, the square-mouthed rhinoceros feeds exclusively on grass. Its dung is very different; we only occasionally saw it deposited in heaps, according to the custom of its more common cousin. The big, sluggish beast seems fond of nosing the ant-hills of red earth, both

with its horn and with its square muzzle; it may be that it licks them for some saline substance. It is apparently of less solitary nature than the prehensile-lipped rhino, frequently going in parties of four or five or half a dozen individuals.

"We did not get an early start. Hour after hour we plodded on, under the burning sun, through the tall, tangled grass, which was often higher than our heads. Continually we crossed the trails of elephant and more rarely of rhinoceros, but the hard, sunbaked earth and stiff, tinder-dry long grass made it a matter of extreme difficulty to tell if a trail was fresh, or to follow it. Finally, Kermit and his gun-bearer, Kassitura, discovered some unquestionably fresh footprints which those of us who were in front had passed over. Immediately we took the trail, Kongoni and Kassitura acting as trackers, while Kermit and I followed at their heels. Once or twice the two trackers were puzzled, but they were never entirely at fault; and after half an hour Kassitura suddenly pointed toward a thorn tree about sixty yards off. Mounting a low ant-hill I saw rather dimly through the long grass a big gray bulk, near the foot of the tree; it was a rhinoceros lying asleep on its side, looking like an enormous pig. It heard something and raised itself on its forelegs, in a sitting posture, the big ears thrown forward. I fired for the chest, and the heavy Holland bullet knocked it clean off its feet. Squealing loudly it rose again, but it was clearly done for, and it never got ten yards from where it had been lying.

"At the shot four other rhinos rose. One bolted to the right, two others ran to the left. Firing through the grass Kermit wounded a bull and followed it for a long distance, but could not overtake it; ten days later, however, he found the carcass, and saved the skull and horns. Meanwhile I killed a calf, which was needed for the museum; the rhino I had already shot was a full-grown cow, doubtless the calf's mother. As the rhino rose I was struck by their likeness to the picture of the white rhino in Cornwallis Harris's folio of the big game of South Africa seventy years ago. They were totally different in look from the common rhino, seeming to stand higher and to be shorter in proportion to their height, while the hump and the huge, ungainly square-mouthed head added to the dissimilarity. The common rhino is in color a very dark slate gray; these were a rather lighter slate gray; but this was probably a mere individual peculiarity, for the best observers say that they are of the same hue. The muzzle is broad and square, and the upper lip without a vestige of the curved, prehensile development which makes the upper lip of a common

rhino look like the hook of a turtle's beak. The stomachs contained nothing but grass. It is a grazing, not a browsing animal.

"There were some white egrets—not, as is usually the case with both rhinos and elephants, the cow heron, but the slender, black-legged, yellow-toed egret—on the rhinos, and the bodies and heads of both the cow and calf looked as though they had been splashed with streaks of whitewash. One of the egrets returned after the shooting and perched on the dead body of the calf.

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"It was Kermit's turn for the next rhino; and by good luck it was a bull, giving us a complete group of bull, cow, and calf for the National Museum. We got it as we had gotten our first two. Marching through like country—burnt, this time—we came across the tracks of three rhino, two big and one small, and followed them through the black ashes. It was an intricate and difficult piece of tracking, for the trail wound hither and thither and was criss-crossed by others; but Kongoni and Kassitura gradually untangled the maze, found where the beasts had drunk at a small pool that morning, and then led us to where they were lying asleep under some thorn-trees. It was about eleven o'clock. As the bull rose Kermit gave him a fatal shot with his beloved Winchester. He galloped full speed toward us, not charging, but in a mad panic of terror and bewilderment; and with a bullet from the Holland I brought him down in his tracks only a few yards away. The cow went off at a gallop. The calf, a big creature, half grown, hung about for some time, and came up quite close, but was finally frightened away by shouting and hand-clapping. Some cow-herons were round these rhino; and the head and body of the bull looked as if it had been splashed with whitewash.

"It was an old bull, with a short, stubby, worn-down horn. It was probably no heavier than a big, ordinary rhino bull such as we had shot on the Sotik, and its horns were no larger, and the front and rear ones were of the same proportions relatively to each other. But the misshapen head was much larger, and the height seemed greater because of the curious hump. This fleshy hump is not over the high dorsal vertebræ, but just forward of them, on the neck itself, and has no connection with the spinal column. The square-mouthed rhinoceros of South Africa is always described as being very much bigger than the common prehensile-lipped African rhinoceros, and as carrying much longer horns. But the square-mouthed rhinos we saw and killed in the Lado did not differ from the common kind in size and horn development as much as we had been led to expect; although on

an average they were undoubtedly larger, and with bigger horns, yet there was in both respects overlapping, the bigger prehensile-lipped rhinos equalling or surpassing the smaller individuals of the other kind. The huge, square-muzzled head, and the hump, gave the Lado rhino an utterly different look, however, and its habits are also in some important respects different. Our gun-bearers were all East Africans, who had never before been in the Lado. They had been very sceptical when told that the rhinos were different from those they knew, remarking that 'all rhinos were the same'; and the first sight of the spoor merely confirmed them in their belief; but they at once recognized the dung as being different; and when the first animal was down they examined it eagerly and proclaimed it as a rhinoceros with a hump, like their own native cattle, and with the mouth of a hippopotamus.

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"A couple hours later, as we followed an elephant path, we came to where it was crossed by the spoor of two rhino. Our gun-bearers took up the trail, over the burnt ground, while Kermit and I followed immediately behind them. The trail wound about, and was not always easy to disentangle, but after a mile or two we saw the beasts. They were standing among bushes and patches of rank, unburned grass; it was ten o'clock, and they were evidently preparing to lie down for the day. As they stood they kept twitching their big ears; both rhino and elephant are perpetually annoyed, as are most game, by biting flies, large and small. We got up very close, Kermit with his camera and I with the heavy rifle. Too little is known of these northern square-mouthed rhino for us to be sure that they were not lingering slowly toward extinction; and, lest this should be the case, we were not willing to kill any merely for trophies; while, on the other hand, we deemed it really important to get good groups for the National Museum in Washington and the American Museum in New York, and a head for the National Collection of Heads and Horns which was started by Mr. Hornaday, the director of the Bronx Zoological Park. The rhinos saw us before either Kermit or Loring could get a good picture. As they wheeled I fired hastily into the chest of one, but not quite in the middle, and away they dashed—for they do not seem as truculent as the common rhino. We followed them. After an hour the trails separated; Cunninghame went on one, but failed to overtake the animal, and we did not see him until we reached camp late that afternoon.

"Meanwhile our own gun-bearers followed the bloody spoor of

the rhino I had hit, Kermit and I close behind, and Loring with us. The rhino had gone straight off at a gallop, and the trail offered little difficulty, so we walked fast. A couple of hours passed. The sun was now high and heat intense as we walked over the burned ground. The scattered trees bore such scanty foliage as to cast hardly any shade. The rhino galloped strongly and without faltering; but there was a good deal of blood on the trail. At last, after we had gone seven or eight miles, Kiboko the skinner, who was acting as my gun-bearer, pointed toward a small thorn tree; and beside it I saw the rhino standing with drooping head. It had been fatally hit, and if undisturbed would probably never have moved from where it was standing; and we finished it off forthwith. It was a cow, and before dying it ran round and round in a circle, in the manner of the common rhino.

" . . . . Meanwhile Kermit and I, with our gun-bearers, went off with a 'shenzi,' a wild native who had just come in with the news that he knew where another rhino was lying a few miles away. While bound thither we passed numbers of oribi, and went close to a herd of waterbuck which stared at us with stupid tameness; a single hartebeest was with them. When we reached the spot there was the rhino, sure enough, under a little tree, sleeping on his belly, his legs doubled up, and his head flat on the ground. Unfortunately the grass was long, so that it was almost impossible to photograph him. However, Kermit tried to get his picture from an ant-hill fifty yards distant, and then, Kermit, with his camera and I with my rifle, we walked up to within about twenty yards. At this point we halted, and on the instant the rhino jumped to his feet with surprising agility and trotted a few yards out from under the tree. It was a huge bull, with a fair horn; much the biggest bull we had yet seen; and with head up and action high, the sun glinting on his slate hide and bringing out his enormous bulk, he was indeed a fine sight. I waited a moment for Kermit to snap him. Unfortunately the waving grass spoiled the picture. Then I fired right and left into his body behind the shoulders, and down he went. In color he seemed of exactly the same shade as the common rhino, but he was taller and heavier, being 6 feet high. He carried a stout horn, a little over 2 feet long; the girth at the base was very great.

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" We wished for another cow rhino, so as to have a bull and a cow both for the National Museum at Washington, and for the American Museum in New York; and Kermit was to shoot this. Accordingly

he and I started off early one morning with Grogan—a man of about twenty-five, a good hunter and a capital fellow, with whom by this time we were great friends. It was much like our other hunts. We tramped through high grass across a big, swampy plain or broad valley between low rises of ground, until, on the opposite side, we struck a by-this-time familiar landmark, two tall borassus palms, the only ones for some miles around. Here we turned into a broad elephant and rhinoceros path, worn deep and smooth by the generations of huge feet that had trampled it; for it led from the dry inland to a favorite drinking place on the Nile. Along this we walked until Kassitura made out the trail of two rhino crossing it at right angles. They were evidently feeding and seeking a noonday resting place; in this country the square-mouthed rhinoceros live on the grassy flats, sparsely covered with small thorn trees, and only go into the high reeds on their way to drink. With Kassitura and Kongoni in the lead we followed the fresh trail for a mile or so, until we saw our quarry The stupid beasts had smelt us, but were trotting to and fro in a state of indecision and excitement, tails twisting and ears cocked, uncertain what to do. At first we thought they were a bull and a small cow; but they proved to be a big cow with good horns, and a calf which was nearly full grown. The wind and sun were both exactly wrong, so Kermit could not take any photos; and accordingly he shot the cow behind the shoulder. Away both animals went, Kermit tearing along behind, while Grogan and I followed. After a sharp run of a mile and a half Kermit overtook them, and brought down the cow. The younger one then trotted threateningly toward him. He let it get within ten yards, trying to scare it; as it kept coming on, and could of course easily kill him, he then fired into its face, to one side, so as to avoid inflicting a serious injury, and, turning, off it went at a gallop. When I came up the cow had raised itself on its forelegs, and he was taking its picture. It had been wallowing, and its whole body was covered with dry caked mud. It was exactly the color of the common rhino, but a little larger than any cow of the latter we had killed.

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"At last Kermit succeeded in getting some good white rhino pictures. He was out with his gun-bearers and Grogan. They had hunted steadily for nearly two days without seeing a rhino; then Kermit made out a big cow with a calf lying under a large tree, on a bare plain of short grass. Accompanied by Grogan, and by a gun-bearer carrying his rifle, while he himself carried his 'naturalist's graphlex' camera, he got up to within fifty or sixty yards of the dull-

witted beasts, and spent an hour cautiously manœuvering and taking photos. He got several photos of the cow and calf lying under the tree. Then something, probably the click of the camera rendered them uneasy and they stood up. Soon the calf lay down again, while the cow continued standing on the other side of the tree, her head held down, the muzzle almost touching the ground, according to the custom of this species. After taking one or two more pictures Kermit edged in, so as to get better ones. Gradually the cow grew alarmed. She raised her head, as these animals always do when interested or excited, twisted her tail into a tight knot, and walked out from under the tree, followed by the calf; she and the calf stood stern to stern for a few seconds, and Kermit took another photo. By this time the cow had become both puzzled and irritated. Even with her dim eyes she could make out the men and the camera, and once or twice she threatened a charge, but thought better of it. Then she began to move off; but suddenly wheeled and charged, this time bent on mischief. She came on at a slashing trot, gradually increasing her pace, the huge, square lips shaking from side to side. Hoping that she would turn Kermit shouted loudly and waited before firing until she was only ten yards off. Then with the Winchester, he put a bullet in between her neck and shoulder, a mortal wound. She halted and half wheeled, and Grogan gave her right and left, Kermit putting in a couple of additional bullets as she went off. A couple of hundred yards away she fell, rose again, staggered, fell again, and died. The calf, which was old enough to shift for itself, refused to leave the body, although Kermit and Grogan pelted it with sticks and clods. Finally a shot through the flesh of the buttocks sent it off in frantic haste. Kermit had only killed the cow because it was absolutely necessary in order to avoid an accident, and he was sorry for the necessity; but I was not, for it was a very fine specimen, with the front horn thirty-one inches long; being longer than any other we had gotten. The second horn was compressed laterally, exactly as with many black rhinos (although it is sometimes stated that this does not occur in the case of the white rhino). We preserved the head-skin and skull for the National Museum.

"The flesh of this rhino, especially the hump, proved excellent. It is a singular thing that scientific writers seem almost to have overlooked, and never lay any stress upon, the existence of this neck hump. It is on the neck, forward of the long dorsal vertebra, and is very conspicuous in the living animal; and I am inclined to think that some inches of the exceptional height measurements attributed to

South African white rhinos may be due to measuring to the top of this hump. I am also puzzled by what seems to be the great inferiority in horn development of these square-mouthed rhinos of the Lado to the square-mouthed or white rhinos of South Africa (and, by the way, I may mention that on the whole these Lado rhinos certainly looked lighter colored, when we came across them standing in the open. than did their prehensile-lipped East African brethren). We saw between thirty and forty square-mouthed rhinos in the Lado, and Kermit's cow had much the longest horn of any of them; and while they averaged much better horns than the black rhinos we had seen in East Africa, between one and two hundred in number, there were any number of exceptions on both sides. There are recorded measurements of white rhino horns from South Africa double as long as our longest from the Lado. Now this is, scientifically, a fact of some importance, but it is of no consequence whatever when compared with the question as to what, if any, the difference is between the average horns; and this last fact is very difficult to ascertain, largely because of the foolish obsession for 'record' heads which seems to completely absorb so many hunters who write. What we need at the moment is more information about the average South African heads. There are to be found among most kinds of hornbearing animals individuals with horns of wholly exceptional size, just as among all nations there are individuals of wholly exceptional height. But a comparison of these wholly exceptional horns, although it has a certain value, is, scientifically, much like a comparison of the giants of different nations. A good head is of course better than a poor one; and a special effort to secure an exceptional head is sportsmanlike and proper. But to let the desire for 'record' heads, to the exclusion of all else, become a craze, is absurd. The making of such a collection is in itself not only proper but meritorious; all I object to is the loss of all sense of proportion in connection therewith. It is just as with philately, or heraldry, or collecting the signatures of famous men. The study of stamps, or of coats of arms, or the collecting of autographs, is an entirely legitimate amusement, and may be more than a mere amusement; it is only when the student or collector allows himself utterly to misestimate the importance of his pursuit that it becomes ridiculous.

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" . . . . Of rhinoceros, all square-mouthed, we saw nine, none carrying horns which made them worth shooting. The first one I saw was in long grass. My attention was attracted by a row of white objects moving at some speed through the top of the grass. It took

a second look before I made out that they were cow herons perched on the back of a rhino. This proved to be a bull, which joined a cow and a calf. None had decent horns, and we plodded on. Soon we came to the trial of two others, and after a couple of miles' tracking Kongoni pointed to two gray bulks lying down under a tree. I walked cautiously to within thirty yards. They heard something, and up rose the two pig-like blinking creatures, who gradually became aware of my presence, and retreated a few steps at a time, dull curiosity continually overcoming an uneasiness which never grew into fear. Tossing their stumpy-horned heads, and twistnig their tails into tight knots, they ambled briskly from side to side, and were ten minutes in getting to a distance of a hundred yards. Then our shenzi guide mentioned that there were other rhinos close by, and we walked off to inspect them. In three hundred yards we came on them, a cow and a well-grown calf. Sixty yards from them was an ant-hill with little trees on it. From this we looked at them until some sound or other must have made them uneasy, for up they got. The young one seemed to have rather keener suspicions, although no more sense, than its mother, and after a while grew so restless that it persuaded the cow to go off with it. But the still air gave no hint of our whereabouts, and they walked straight toward us. I did not wish to have to shoot one, and so when they were within thirty yards we raised a shout and away they cantered, heads tossing and tails twisting.

"Three hours later we saw another cow and calf. By this time it was half-past three in the afternoon and the two animals had risen from their noonday rest and were grazing busily, the great clumsy heads sweeping the ground. Watching them forty yards off it was some time before the cow raised her head high enough for me to see that her horns were not good. Then they became suspicious, and the cow stood motionless for several minutes, her head held low. We moved quietly back, and at last they either dimly saw us, or heard us, and stood looking toward us, their big ears cocked forward. At this moment we stumbled on a rhino skull, bleached, but in such good preservation that we knew Heller would like it; and we loaded it on the porters that had followed us. All the time we were thus engaged the two rhinos, only a hundred yards off, were intently gazing in our direction, with foolish and bewildered solemnity; and there we left them, survivors from a long vanished world, standing alone in the parched desolation of the wilderness.

"On another day Kermit saw ten rhino, none with more than

ordinary horns. Five of them were in one party, and were much agitated by the approach of the men; they ran to and fro, their tails twisted into the usual pig-like curl, and from sheer nervous stupidity bade fair at one time to force the hunters to fire in self-defence. Finally, however, they all ran off. In the case of a couple of others a curious incident happened. When alarmed they failed to make out where the danger lay, and after running away a short distance they returned to a bush nearby to look about. One remained standing, but the other deliberately sat down upon its haunches like a dog, staring ahead, Kermit meanwhile being busy with his camera. Two or three times I saw rhino, when aroused from sleep, thus sit up on their haunches and look around before rising on all four legs; but this was the only time that any of us saw a rhino which was already standing assume such a position. No other kind of heavy game has this habit; and indeed, so far as I know, only one other hoofed animal, the white goat of the northern Rocky Mountains. In the case of the white goat, however, the attitude is far more often assumed, and in more extreme form; it is one of the characteristic traits of the queer goat-antelope, so many of whose ways and looks are peculiar to itself alone.

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"Next morning Kermit and I with the bulk of the safari walked back to our main camp, on the Nile. . . . . Each of us struck off across the country by himself, with his gun-bearers. After walking five or six miles I saw a big rhino three-quarters of a mile off. At this point the country was flat, the acacias very thinly scattered, and the grass completely burnt off, the green young blades sprouting; and there was no difficulty in making out, at the distance we did, the vast gray bulk of the rhino as it stood inertly under a tree. Drawing nearer we saw that it had a good horn, although not as good as Kermit's beast; and approaching quietly to within forty yards I shot the beast."

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Description of *Ceratotherium oswelli;* with figure of horns; species based on the horns, no skull known or mentioned.

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Occurrence of white rhinoceros in Amatongoland and Marico in 1856-7.

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Mentions white rhinoceros seen in Karague; figure of head, p. 229. Figure clearly that of black rhinoceros and showing characteristic pointed upper lip; description refers to the black species, no other being known in the district.

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Note on the approaching extinction of the white rhinoceros.

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Account of shooting of specimen of *Rhinoceros simus* which is now preserved in the South African Museum.

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Description and past and present distribution of white rhinoceros; text figure of head in South African Museum, shot by Selous in Mashonaland, p. 492.

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Description of white rhinoceros and measurements of the horns; figure of skull and horns, p. 288.

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Text figure of skull, p. 227.

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Text figure of mounted specimen of *R. simus*, p. 14.

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Description of horns of *R. Simus* obtained by Hawker from Belgian officials at Lado; two figures of front horns, p. 194.

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Description of the collecting of a specimen of *R. simus* at Lado. Now on exhibition in the Carnegie Museum at Pittsburgh.

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Original description of *R. simus cottoni.*

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Description of *R. simus,* with notes on habits and distribution by Selous, pp. 39-46; description of *R. simus cottoni,* p. 38.

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Description of habits and shooting of specimens of white rhinoceros in the Lado Enclave; figure, p. 400; photographs of living animals, pp. 414, 420, 422, 428.

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## PLATE 12

(About 1/8 natural size)

Illustrating generic characters

FIG. 1. *Rhinoceros unicornis,* immature; milk molars in use; permanent incisors just erupting; from the menagerie of Barnum and Bailey; sex and origin unknown. No. 16251, U. S. National Museum.

Dorsal outline deeply concave; incisors in both jaws; post-glenoid and post-tympanic processes united.

FIG. 2. *Diceros bicornis,* male, old; Loita Plains, Southern Guaso Njoro District, British East Africa; shot by Col. Theodore Roosevelt, June 18, 1909. No. 162830, U. S. National Museum.

Occipital crests produced above dorsal plane of skull but not beyond the condyles; post-glenoid and post-tympanic processes separated.

FIG. 3. *Ceratotherium simum cottoni,* female, old; from Rhino Camp, Lado Enclave; weathered skull. No. 164597, U. S. National Museum.

Nasals and premaxillæ widely separated; dorsal profile of skull showing very slight deflection of the occipital crests, but the latter greatly produced backward beyond condyles; post-glenoid and post-tympanic processes separated.

FIG. 4. *Coelodonta antiquitatis,* adult; from the Pleistocene of the Tunguska River, Siberia. No. 6053, U. S. National Museum.

Mesethmoid greatly developed and united with the nasals; nasals and premaxillæ united at their tips into a solid rostrum; occipital crests inflected upward above dorsal plane of skull; post-glenoid and post-tympanic processes united.

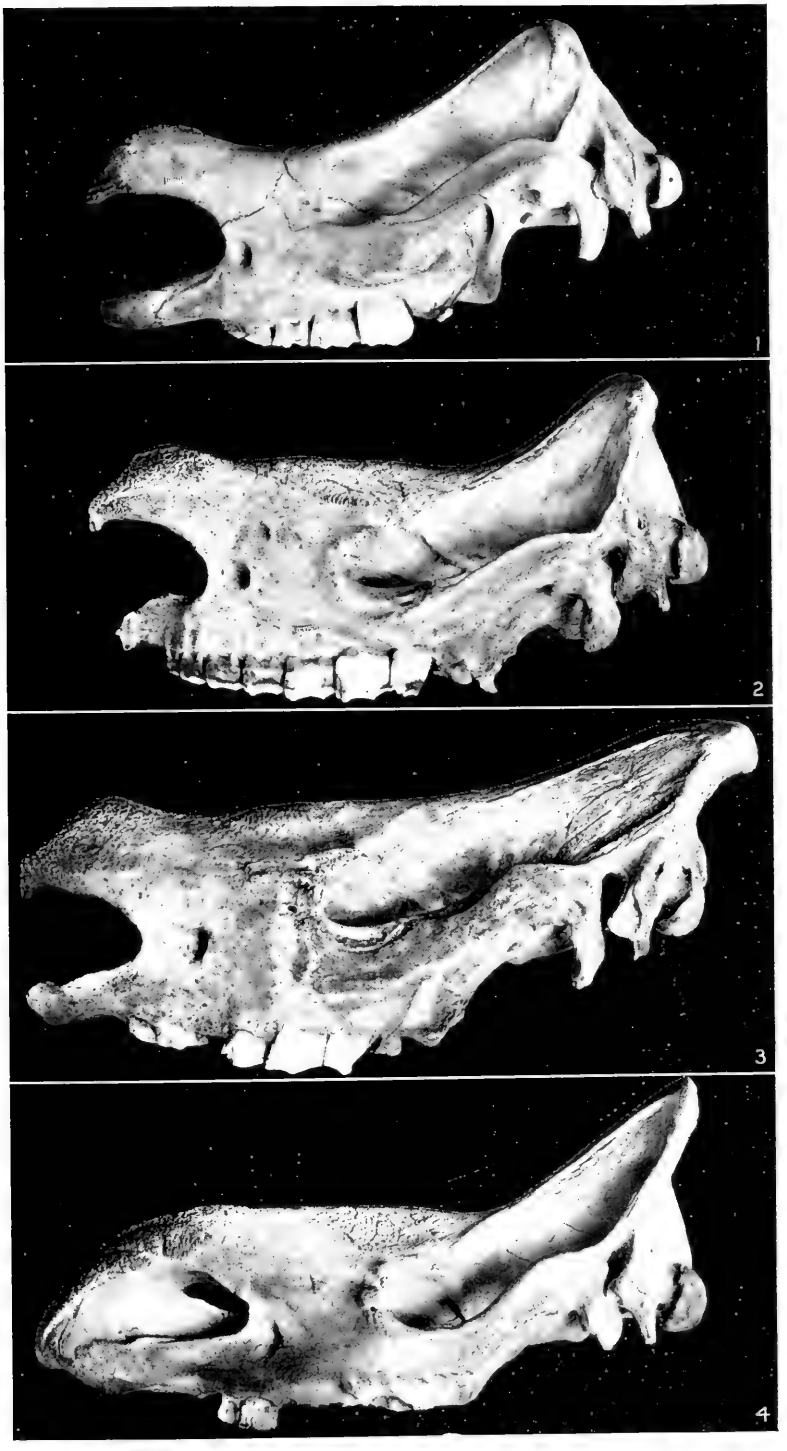



FIG. 1.—RHINOCEROS UNICORNIS, IMMATURE
FIG. 2.—DICEROS BICORNIS, MALE, AGED
FIG. 3.—CERATOTHERIUM SIMUM COTTONI, FEMALE, AGED
FIG. 4.—COELODONTA ANTIQUITATIS, ADULT

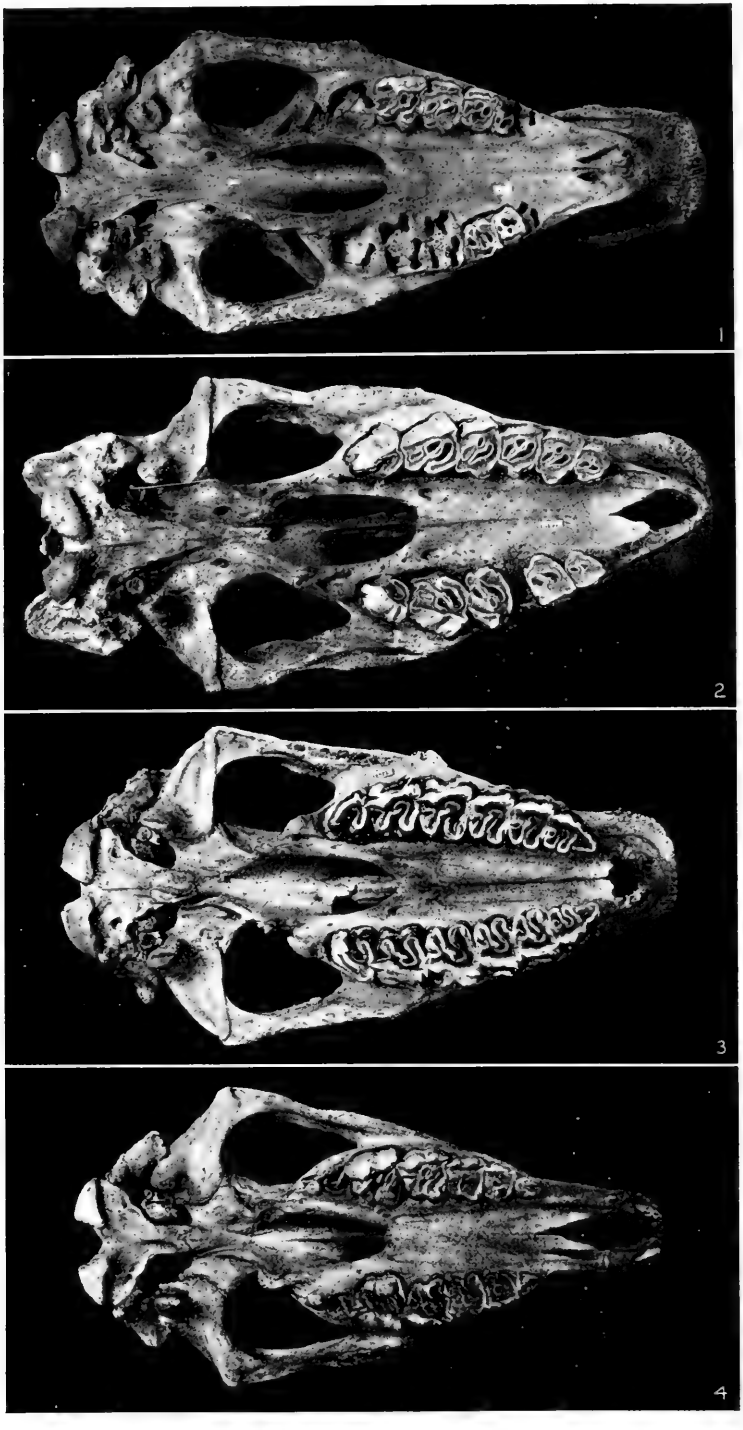



FIG. 1.—COELODONTA ANTIQUITATIS; ADULT
FIG. 2.—CERATOTHERIUM SIMUM COTTONI; FEMALE, AGED
FIG. 3.—DICEROS BICORNIS; MALE, AGED
FIG. 4.—RHINOCEROS UNICORNIS; IMMATURE

## PLATE 13

(About ⅛ natural size)

Illustrating generic characters

FIG. 1. *Coelodonta antiquitatis,* adult; from the Pleistocene of the Tunguska River, Siberia. No. 6053, U. S. National Museum.

Tips of premaxillæ and nasals broadly united into a solid bridge; teeth with central fossettes of enamel filled by cement; vomer thickened.

FIG. 2. *Ceratotherium simum cottoni,* female, old; from Rhino Camp, Lado Enclave; weathered skull. No. 164597, U. S. National Museum.

Teeth with central fossettes of enamel and cement; three upper premolars; vomer thin and knife like; occipital crest produced beyond condyles.

FIG. 3. *Diceros bicornis,* male, old; Loita Plains, Southern Guaso Nyiro District, British East Africa; shot by Col. Theodore Roosevelt, June 18, 1909. No. 162930, U. S. National Museum.

Teeth without fossettes, the folds remaining open; four upper premolars; sphenoidal process of basi-occipital large.

FIG. 4. *Rhinoceros unicornis,* immature; the milk molars in use; only the first molar erupted; permanent incisors just erupting; from the menagerie of Barnum and Bailey; sex and origin unknown;. No. 16251, U. S. National Museum.

Teeth with one or two central fossettes, but without the cement layer present; functional incisors present.

## PLATE 14

(About ⅛ natural size)

FIG. 1. *Coelodonta antiquitatis,* adult; from the Pleistocene of the Tunguska River, Siberia. No. 6053, U. S. National Museum.

Nasal boss elongate, supporting a compressed frontal horn; lambdoidal crests truncate.

FIG. 2. *Ceratotherium simum cotioni,* female, old; from Rhino Camp, Lado Enclave; weathered skull. No. 164597, U. S. National Museum.

Front edge of nasal boss truncate; lambdoidal crests deeply emarginate.

FIG. 3. *Diceros bicornis,* male, old; Loita Plains, Southern Guaso Nyiro, British East Africa; shot by Col. Theodore Roosevelt, June 18, 1909. No. 162930, U. S. National Museum.

Brachiocephalic; lambdoidal crests not projecting beyond condyles; front edge of nasal boss rounded.

FIG. 4. *Rhinoceros unicornis,* immature, milk molars in use; from the menagerie of Barnum and Bailey; sex and origin unknown. No. 16251, U. S. National Museum.

Brachiocephalic; lambdoidal crests not projecting beyond condyles; nasal boss slender, terminating in an obtuse angle.

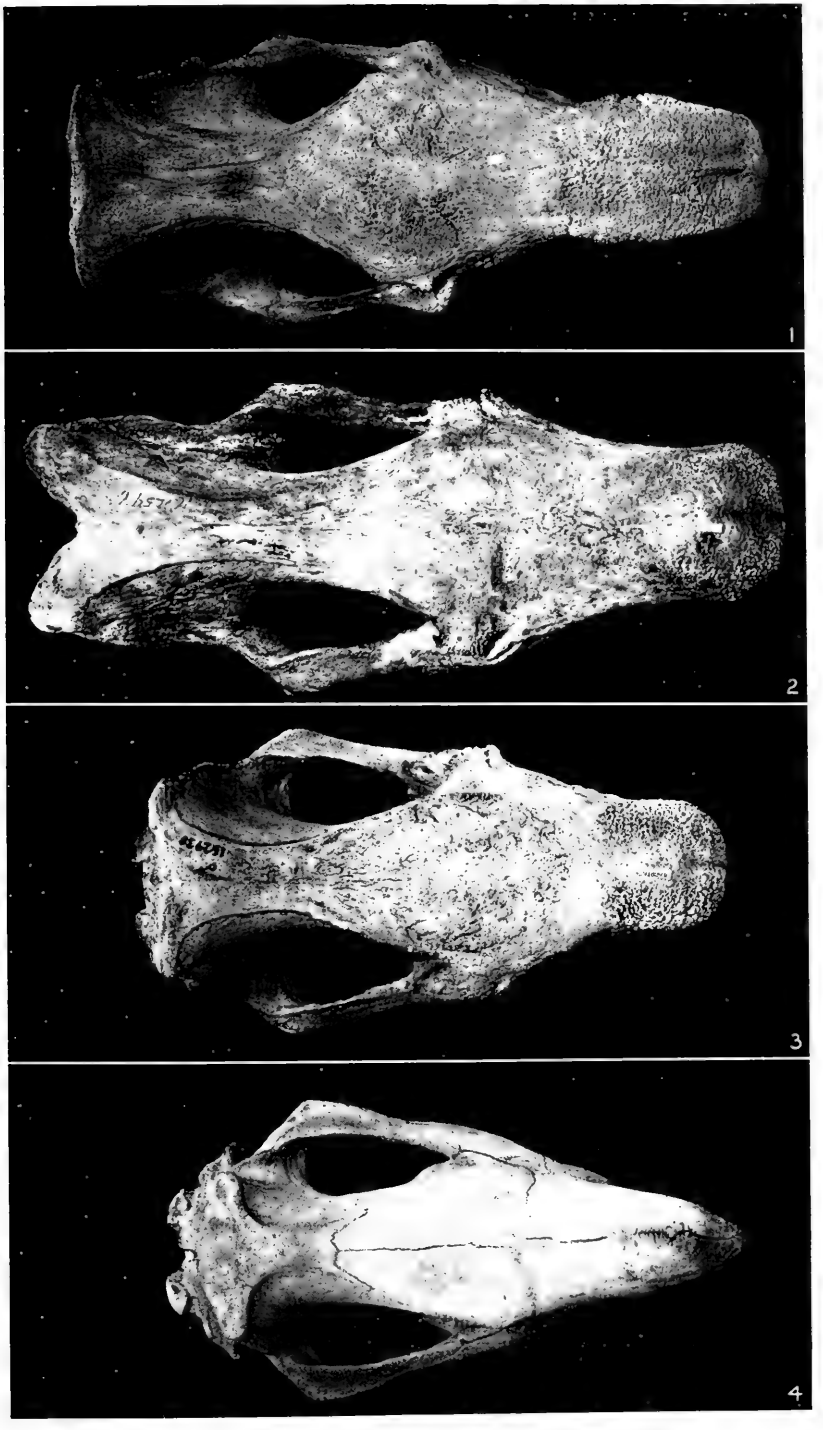



FIG. 1.—COELODONTA ANTIQUITATIS; ADULT
FIG. 2.—CERATOTHERIUM SIMUM COTTONI; FEMALE, AGED
FIG. 3.—DICEROS BICORNIS; MALE, AGED
FIG. 4.—RHINOCEROS UNICORNIS; IMMATURE

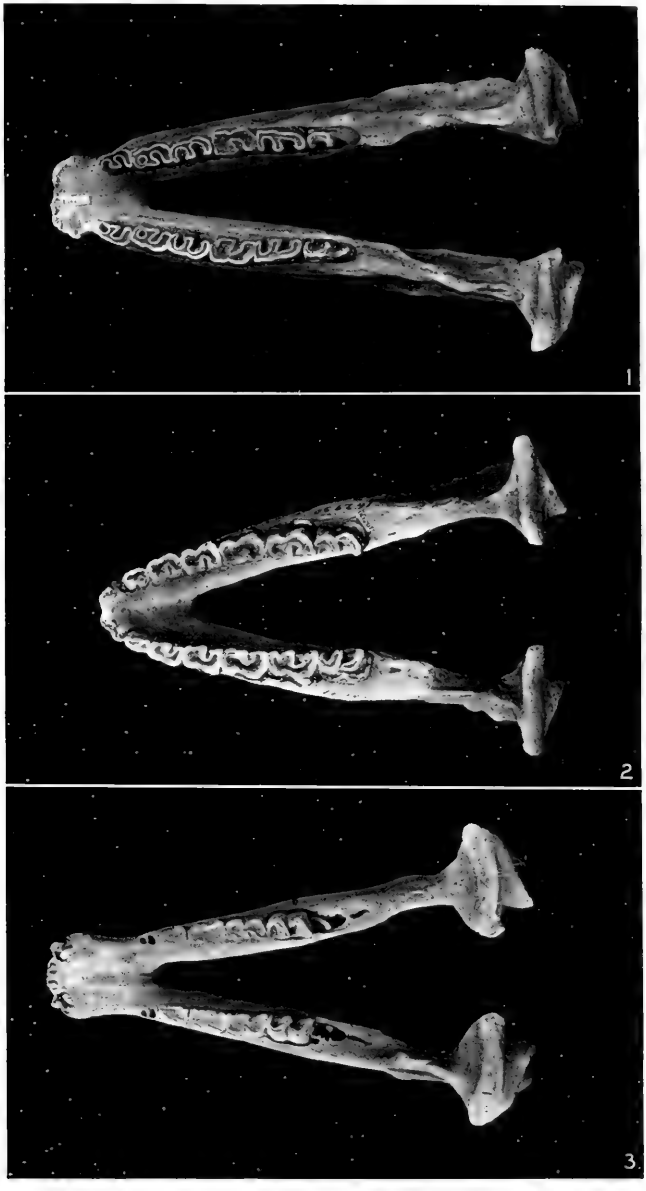



FIG. 1.—CERATOTHERIUM SIMUM COTTONI; FEMALE, AGED
FIG. 2.—DICEROS BICORNIS; MALE, AGED
FIG. 3.—RHINOCEROS UNICORNIS; IMMATURE

## PLATE 15

(About 1/8 natural size)

Illustrating generic characters

FIG. 1. *Ceratotherium simum cottoni,* female, old; from Rhino Camp, Lado Enclave; weathered skull. No. 164597, U. S. National Museum.

Symphysis broad and truncate along front edge, and extending well beyond tooth row; teeth occasionally showing fossettes of enamel.

FIG 2 *Diceros bicornis,* male, old; Loita Plains, Southern Guaso Nyiro, British East Africa; shot by Col. Theodore Roosevelt, June 18, 1909. No. 162930, U. S. National Museum.

Symphysis short and rounded, not produced much beyond tooth row.

FIG. 3. *Rhinoceros unicornis,* immature; milk molars in use; from the menagerie of Barnum and Bailey; sex and origin unknown. No. 16251, U. S. National Museum.

Symphysis bearing two pair of incisors, the outer developed into formidable tusks; diastema long (permanent outer incisors just erupting, the milk still in position in figure).

PLATE 16

(About 1/8 natural size)

Illustrating generic characters

FIG. 1. *Ceratotherium simum cottoni,* female, old; from Rhino Camp, Lado Enclave; weathered skull. No. 164597, U. S. National Museum.

Anterior edge of ascending ramus slanting backward uniformly, in line with the coronoid process; coronoid process long and slender; symphysis deep.

FIG. 2. *Diceros bicornis,* male, old; Loita Plains, Southern Guaso Nyiro, British East Africa; shot by Col. Theodore Roosevelt, June 18, 1909. No. 162930, U. S. National Museum.

Outer edge of coronoid process produced forward giving the ascending ramus a concave anterior border; coronoid process short; symphysis shallow.

FIG. 3. *Rhinoceros unicornis,* immature; milk molars in use; from the menagerie of Barnum and Bailey; sex and origin unknown. No. 16251, U. S. National Museum.

Outer edge of ascending ramus vertical; coronoid process short; symphysis shallow and elongate, bearing large outer incisors at its anterior angle.

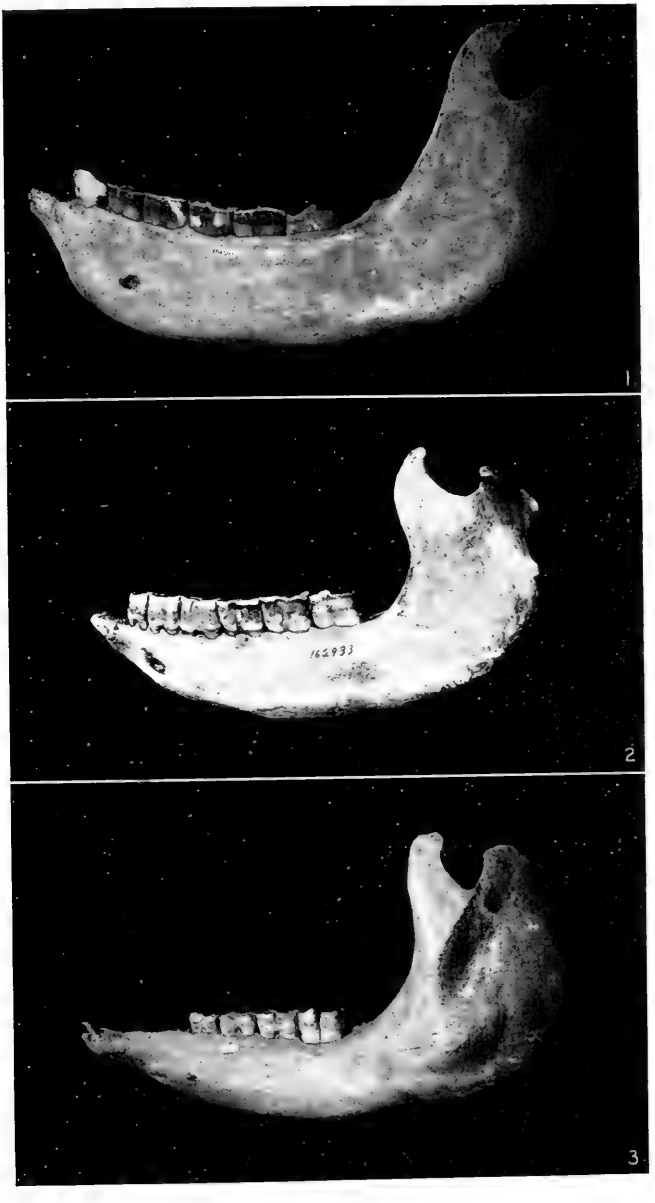



FIG. 1.—CERATOTHERIUM SIMUM COTTONI; FEMALE, AGED
FIG. 2.—DICEROS BICORNIS; MALE, AGED
FIG. 3.—RHINOCEROS UNICORNIS; IMMATURE

FIGS. 1, 2 & 3.—CERATOTHERIUM SIMUM SIMUM
FIG. 4.—CERATOTHERIUM SIMUM COTTONI

## PLATE 17

(Figs. 1, 2, 3 about 1/9 natural size)

(Fig. 4 about 1/8 natural size)

Illustrating subspecific character of greater dorsal elevation of lambdoidal crests in *simum* than in *cottoni*.

Figures of skulls of *simum* are not reliable in relative comparisons of parts not in the same plane as they were made with a short focus lens.

FIG. 1. *Ceratotherium simum simum*, male, adult; from South Africa; collected by Stephens; exact locality not known. No. 51.12.23.1., British Museum.

FIG. 2. *Ceratotherium simum simum*, male, adult; from South Africa; exact locality not known; specimen from a mounted skeleton on exhibition in the gallery of paleontology in the British Museum.

FIG. 3. *Ceratotherium simum simum*, female, adult; from South Africa; collected by Brandt; exact locality not known. No. 52.12.9.1., British Museum.

FIG. 4. *Ceratotherium simum cottoni*, female, old; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 19, 1910. No. 164592, U. S. National Museum.

## PLATE 18

(About ⅛ natural size)

Illustrating subspecific character of greater dorsal elevation of lambdoidal crests in *simum* than in *cottoni*, and its variation due to age in the latter race.

FIG. 1. *Ceratotherium simum simum*, female, old; from South Africa; exact locality not known; specimen in the department of paleontology at the American Museum of Natural History.

Horn attached to boss so that exact depth of dorsal concavity is not obtainable, the marked deflection upward of the lambdoidal crests shows it to be much greater than in *cottoni*.

FIG. 2. *Ceratotherium simum cottoni*, male, immature; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 13, 1910. No. 164589, U. S. National Museum.

This skull has greater depth to the dorsal concavity than any other, which character is due chiefly to its extreme immaturity.

FIG. 3. *Ceratotherium simum cottoni*, female, adult; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 21, 1910. No. 164594, U. S. National Museum.

This skull exhibits the least amount of depth to the dorsal concavity.

FIG. 1.—CERATOTHERIUM SIMUM SIMUM; FEMALE, AGED
FIG. 2.—CERATOTHERIUM SIMUM COTTONI; MALE, IMMATURE
FIG. 3.—CERATOTHERIUM SIMUM COTTONI; FEMALE, ADULT

FIGS. 1, 2, 3 & 4.—CERATOTHERIUM SIMUM COTTONI, MALE; ARRANGED ACCORDING TO AGE, OLDEST AT THE TOP

## PLATE 19

(About ⅛ natural size)

Illustrating age differences in male skulls. Skulls arranged by age, the oldest at the top.

FIG. 1. *Ceratotherium simum cottoni,* male, old; from Rhino Camp, Lado Enclave; weathered skull. No. 164598, U. S. National Museum.

FIG. 2. *Ceratotherium simum cottoni,* male, adult; from Rhino Camp, Lado Enclave; weathered skull. No. 164596, U. S. National Museum.

FIG. 3. *Ceratotherium simum cottoni,* male, adult; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 10, 1910. No. 164593, U. S. National Museum.

FIG. 4. *Ceratotherium simum cottoni,* male, immature; last milk molars about to be shed; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 15, 1910. No. 164635, U. S. National Museum.

## PLATE 20

(About ⅛ natural size)

Illustrating age differences in female skulls. Skulls arranged by age, the youngest at the bottom.

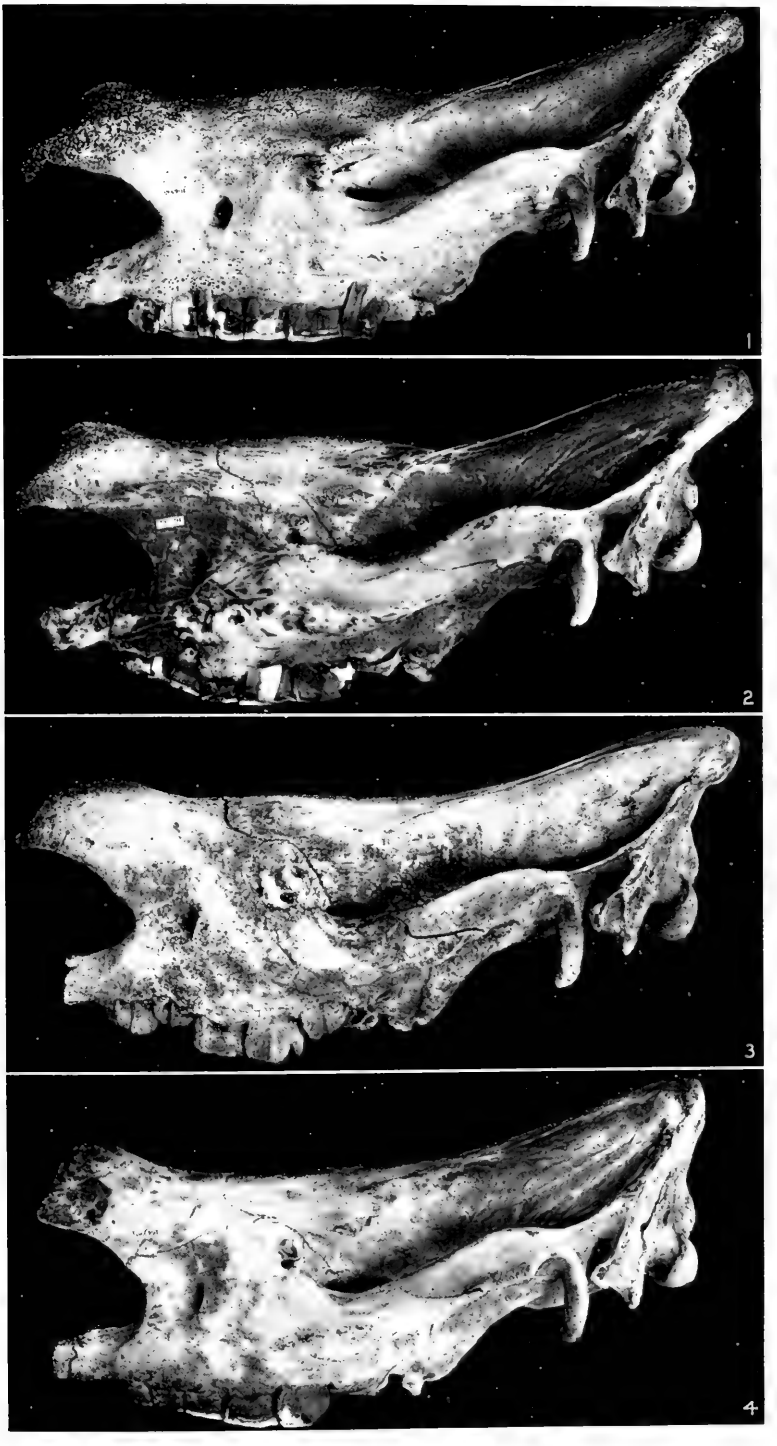
Angle of nasal boss increases with age, due to the production forward of the anterior border. Depth of the dorsal concavity grows less as age advances.

FIG. 1. *Ceratotherium simum cottoni,* female, old; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 29, 1910. No. 164595, U. S. National Museum.

FIG. 2. *Ceratotherium simum cottoni,* female, immature; last molar not yet erupted; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 10, 1910. No. 164587, U. S. National Museum.

FIG. 3. *Ceratotherium simum cottoni,* female, immature; last milk molars about to be shed; weathered skull; from Rhino Camp, Lado Enclave. No. 164599, U. S. National Museum.

FIG. 4. *Ceratotherium simum cottoni,* female, immature; milk molars in use; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 15, 1910. No. 164590, U. S. National Museum.




FIGS. 1, 2, 3 & 4.—CERATOTHERIUM SIMUM COTTONI, FEMALE; ARRANGED ACCORDING TO AGE, THE OLDEST AT THE TOP

FIG. 1.—CERATOTHERIUM SIMUM COTTONI
FIGS. 2, 3 & 4.—CERATOTHERIUM SIMUM SIMUM

## PLATE 21

(Fig. 1 about 1/8 natural size)

(Figs. 2, 3 and 4 about 1/9 natural size)

Illustrating subspecific character in *simum* of larger teeth than *cottoni*.

Skulls of *simum* photographed with short focus lens and not strictly comparable with those of *cottoni*, which were taken by a lens having great depth of focus. This distortion is well shown in *simum* by the carrying forward of the premaxillæ as far as the tip of the nasals.

FIG. 1. *Ceratotherium simum cottoni*, female, old; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 19, 1910. No. 164592, U. S. National Museum.

FIG. 2. *Ceratotherium simum simum*, female, adult; from South Africa; collected by Brandt; exact locality not known. No. 52.12.9.1., British Museum.

FIG. 3. *Ceratotherium simum simum*, male, adult; from South Africa; collected by Stephens; exact locality not known. No. 51.12.23.1., British Museum.

FIG. 4. *Ceratotherium simum simum*, male, adult; from South Africa; exact locality not known; specimen from a mounted skeleton on exhibition in the gallery of paleontology in the British Museum.

## PLATE 22

(About 1/8 natural size)

Illustrating sexual differences in skulls

Nasal boss much larger and zygomatic breadth much greater in males.

FIG. 1. *Ceratotherium simum cottoni,* male, old; from Rhino Camp, Lado Enclave; weathered skull. No. 164598, U. S. National Museum.

FIG. 2. *Ceratotherium simum cottoni,* male, adult; from Rhino Camp, Lado Enclave; weathered skull. No. 164596, U. S. National Museum.

FIG. 3. *Ceratotherium simum cottoni,* female, old; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 29, 1910. No. 164595, U. S. National Museum.

FIG. 4. *Ceratotherium simum simum,* female, old; from South Africa; exact locality not known; specimen in the department of paleontology of the American Museum of Natural History.

This specimen shows much larger teeth than any of the female skulls of *cottoni.*

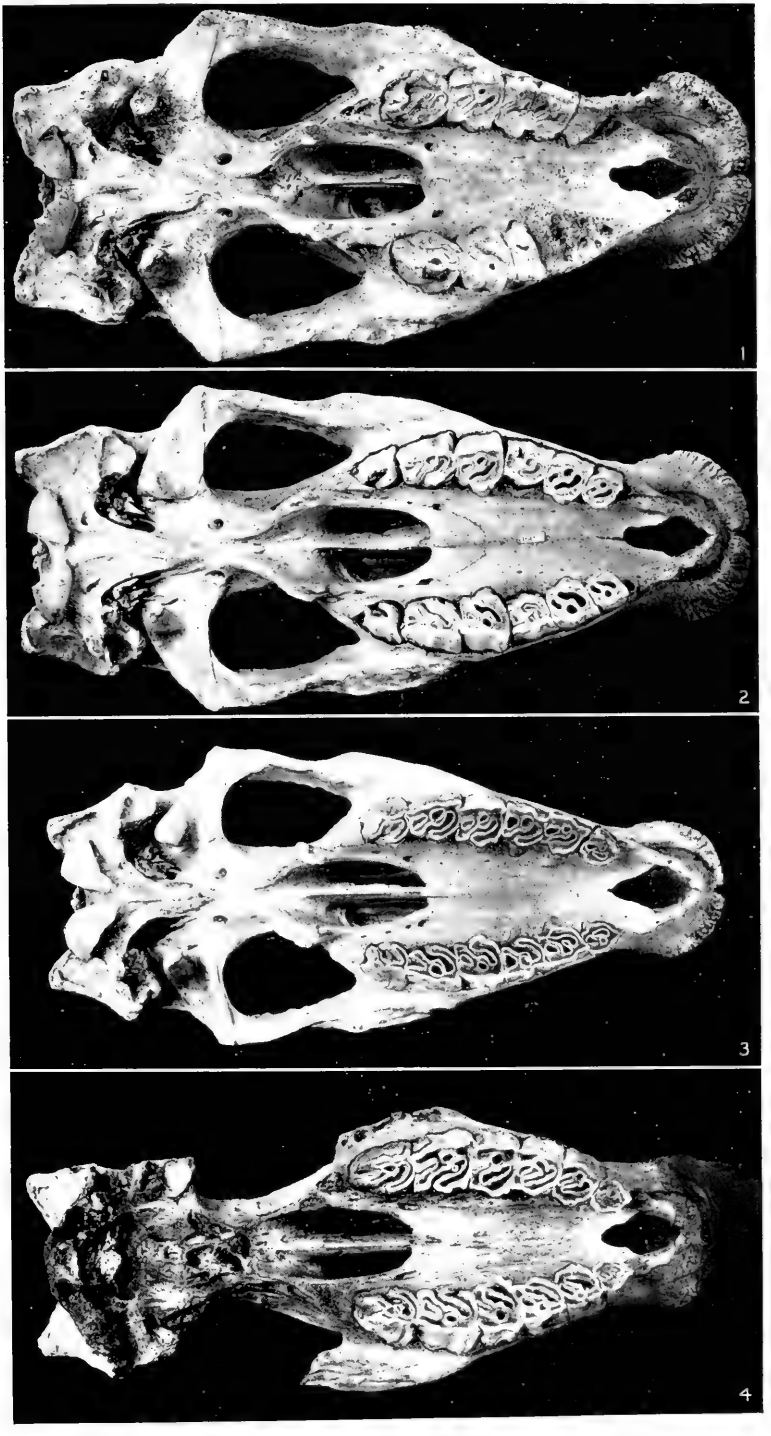
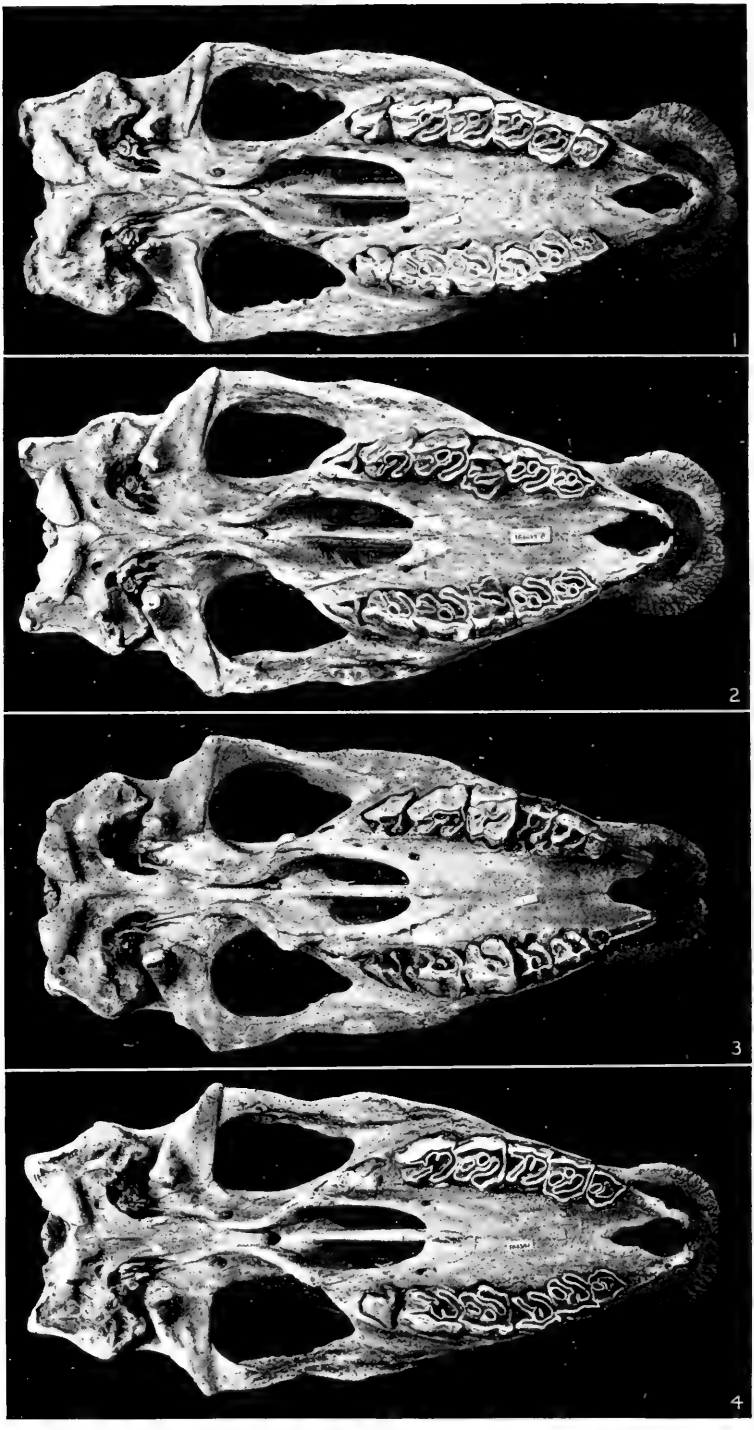



FIG. 1.—CERATOTHERIUM SIMUM COTTONI; MALE, AGED
FIG. 2.—CERATOTHERIUM SIMUM COTTONI; MALE, ADULT
FIG. 3.—CERATOTHERIUM SIMUM COTTONI; FEMALE, AGED
FIG. 4.—CERATOTHERIUM SIMUM SIMUM; FEMALE, AGED




FIGS. 1 & 2.—CERATOTHERIUM SIMUM COTTONI; MALE
FIGS. 3 & 4.—CERATOTHERIUM SIMUM COTTONI; FEMALE
SHOWING AGE AND SEXUAL DIFFERENCES IN DEVELOPMENT OF THE NASAL BOSS

## PLATE 23

(About 1/8 natural size)

Illustrating age differences in nasal boss development between both sexes and also individual variation in zygomatic breadth.

FIG. 1. *Ceratotherium simum cottoni,* male, adult; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 20, 1910. No. 164593, U. S. National Museum.

FIG. 2. *Ceratotherium simum cottoni,* male, immature; last milk molars still in use; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 15, 1910. No. 164635, U. S. National Museum.

FIG. 3. *Ceratotherium simum cottoni,* female, immature; last milk molars still in use, but premolars not yet in tooth line; from Rhino Camp, Lado Enclave; weathered skull. No. 164599, U. S. National Museum.

FIG. 4. *Ceratotherium simum cottoni,* female, adult; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 21, 1910. No. 164594, U. S. National Museum.

## PLATE 24

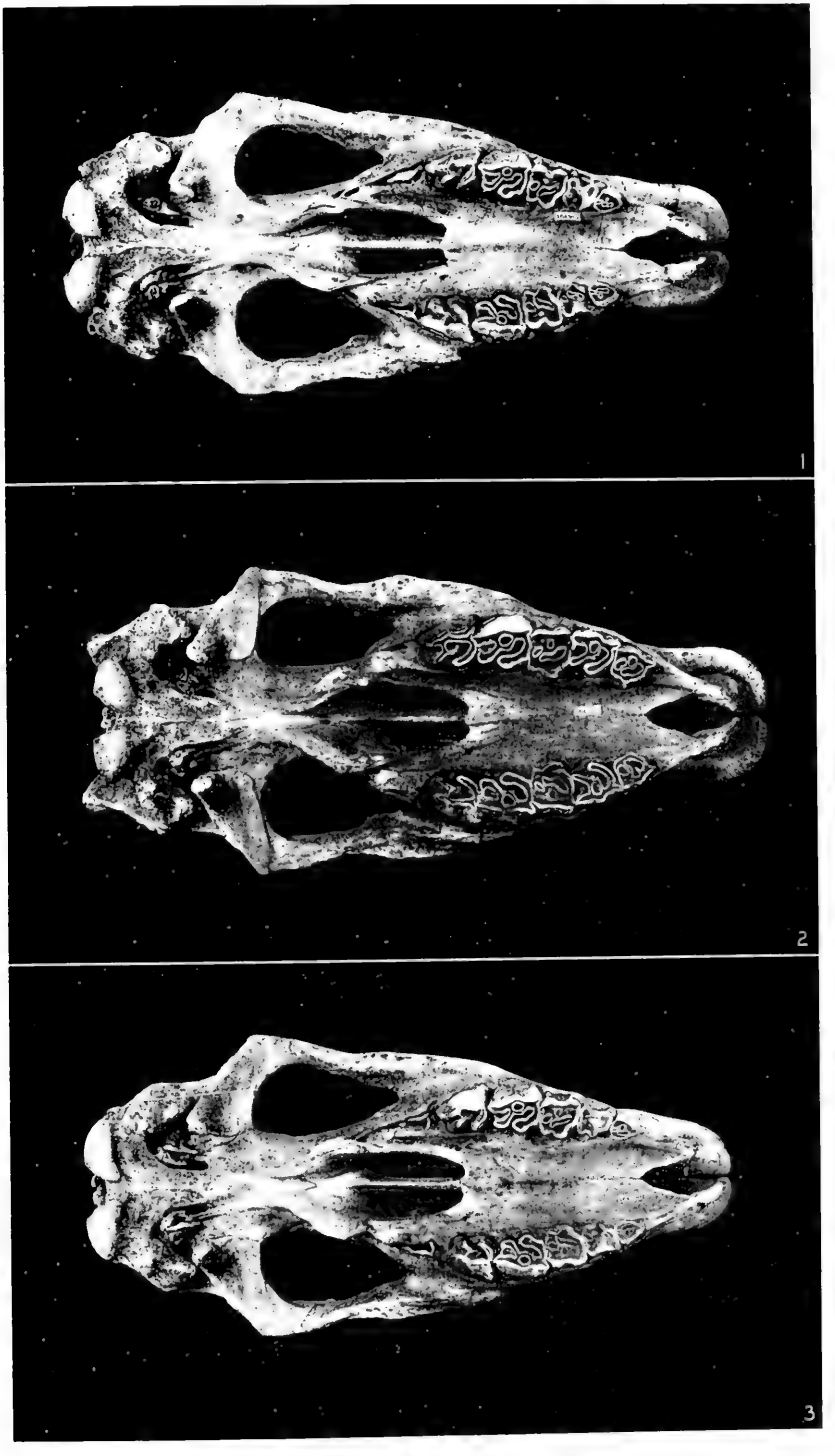
(About ⅛ natural size)

Illustrating milk dentition

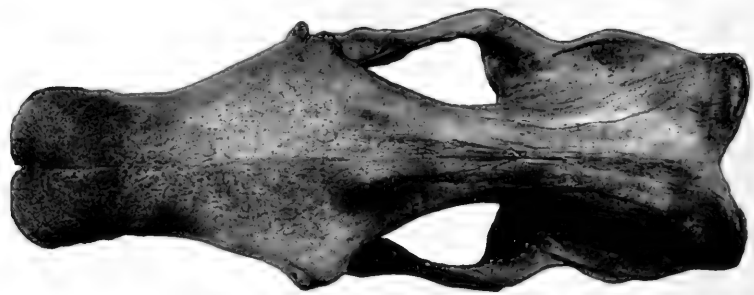
FIG. 1. *Ceratotherium simum cottoni,* male, immature; four milk molars in use, second about to be shed, but the first persisting and not replaced; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 13, 1910. No. 164589, U. S. National Museum.

FIG. 2. *Ceratotherium simum cottoni,* female, immature; last milk molar only in use; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 10, 1910. No. 164587, U. S. National Museum.

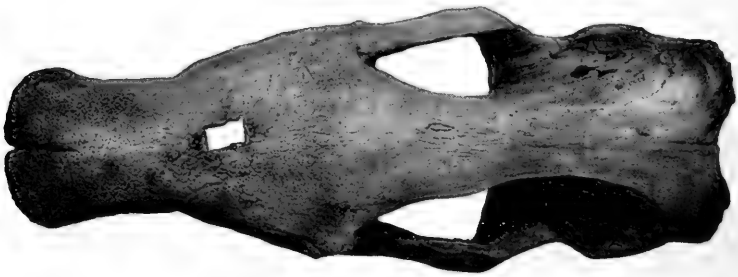
FIG. 3. *Ceratotherium simum cottoni,* female, immature; four milk molars in use, second about to be shed, but the first persistent and not replaced by a premolar; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 15, 1910. No. 164590, U. S. National Museum.



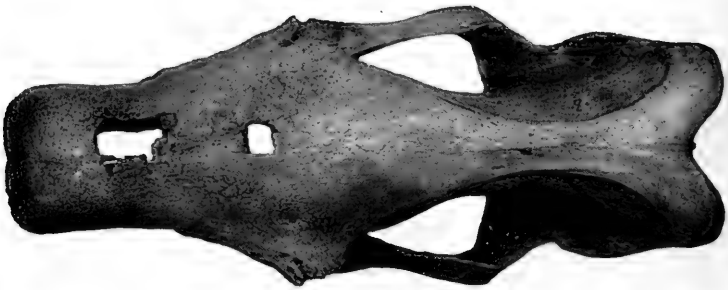

FIGS. 1, 2 & 3.—CERATOTHERIUM SIMUM COTTONI; SHOWING MILK DENTITION



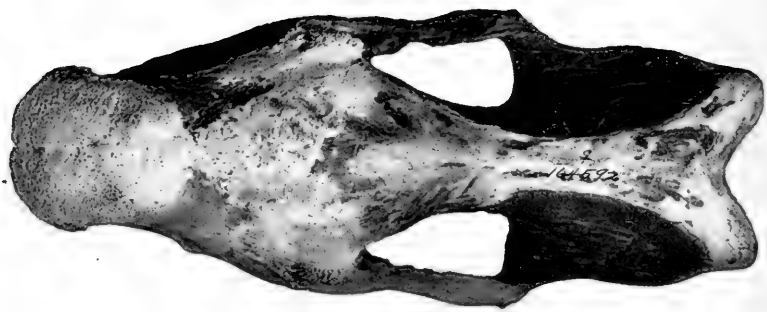
1



2



3



4

FIGS. 1, 2 & 3.—CERATOTHERIUM SIMUM SIMUM
FIG. 4.—CERATOTHERIUM SIMUM COTTONI

## PLATE 25

(Figs. 1, 2, 3 about 1/8 natural size)

(Fig. 4 about 1/7 natural size)

Illustrating similarity in dorsal aspect of skulls of *simum* and *cottoni*.

The figures of skulls of *simus* are not reliable in relative comparison of parts not in the same plane as they were taken with a short focus lens. Lachrymal breadth too great in comparison to the zygomatic breadth.

FIG. 1. *Ceratotherium simum simum,* male, adult; from South Africa; exact locality unknown; specimen from a mounted skeleton on exhibition in the gallery of paleontology at the British Museum.

FIG. 2. *Ceratotherium simum simum,* male, adult; from South Africa; collected by Stephens; exact locality unknown. No. 51.12.23.1., British Museum.

FIG. 3. *Ceratotherium simum simum,* female, adult; from South Africa; collected by Brandt; exact locality unknown. No. 52.12.9.1., British Museum.

FIG. 4. *Ceratotherium simum cottoni,* female, old; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 19, 1910. No. 164592, U. S. National Museum.

## PLATE 26

(About 1/10 natural size)

Illustrating age differences in nasal boss and lachrymal breadth in male skulls. Skulls arranged by age, the oldest at the top.

FIG. 1. *Ceratotherium simum cottoni,* male, old; from Rhino Camp, Lado Enclave; weathered skull. No. 164598, U. S. National Museum.

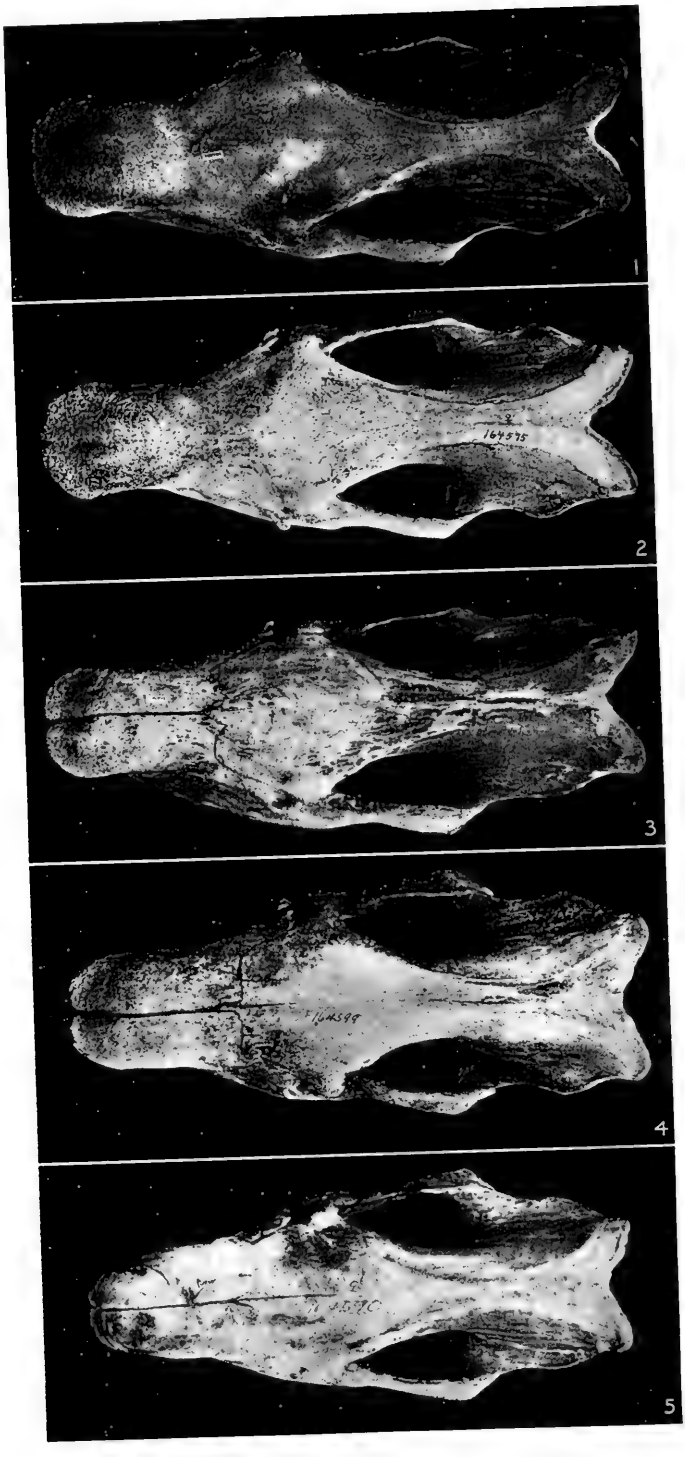
FIG. 2. *Ceratotherium simum cottoni,* male, adult; from Rhino Camp, Lado Enclave; weathered skull. No. 164596, U. S. National Museum.

FIG. 3. *Ceratotherium simum cottoni,* male, adult; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 20, 1910. No. 164593, U. S. National Museum.

FIG. 4. *Ceratotherium simum cottoni,* male, immature; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 15, 1910. No. 164635, U. S. National Museum.

FIG. 5. *Ceratotherium simum cottoni,* male, immature; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 13, 1910. No. 164599, U. S. National Museum.

FIGS. 1, 2, 3, 4 & 5.—CERATOTHERIUM SIMUM COTTONI, MALE; ARRANGED ACCORDING TO AGE, OLDEST AT THE TOP




FIGS. 1, 2, 3, 4 & 5.—CERATOTHERIUM SIMUM COTTONI, FEMALE; ARRANGED ACCORDING TO AGE, OLDEST AT THE TOP

## PLATE 27

(About 1/10 natural size)

Illustrating age differences in nasal boss, lachrymal breadth and persistence of sutures in female skulls.

Skulls arranged by age, the oldest at the top.

FIG. 1. *Ceratotherium simum cottoni,* female, adult; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 21, 1910. No. 164594. U. S. National Museum.

FIG. 2. *Ceratotherium simum cottoni,* female, old; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 29, 1910. No. 164595, U. S. National Museum.

FIG. 3. *Ceratotherium simum cottoni,* female, immature; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 10, 1910. No. 164587, U. S. National Museum.

FIG. 4. *Ceratotherium simum cottoni,* female, immature; from Rhino Camp, Lado Enclave; weathered skull. No. 164599, U. S. National Museum.

FIG. 5. *Ceratotherium simum cottoni,* female, immature; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 15, 1910. No. 164590, U. S. National Museum.

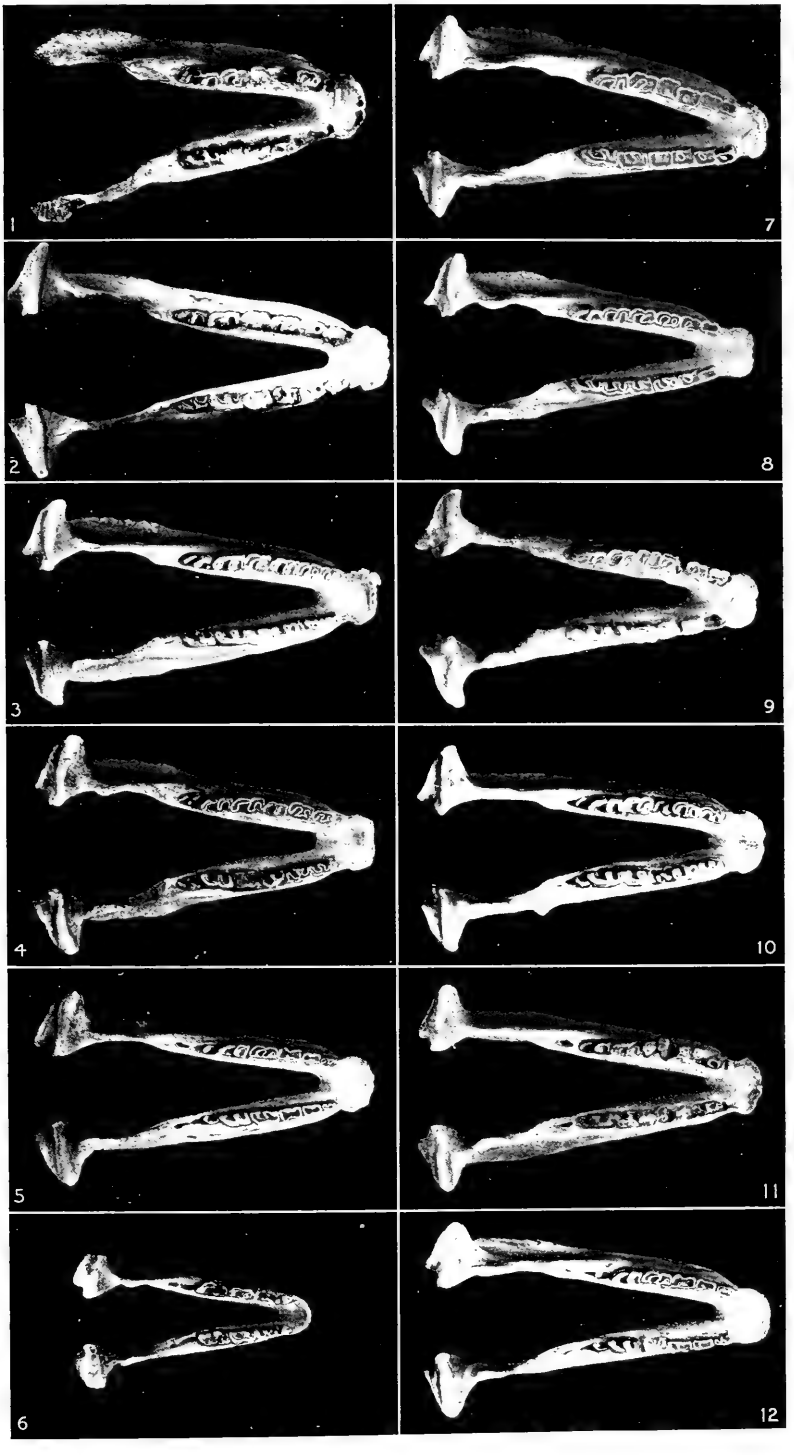
## PLATE 28

(About 1/13 natural size)

Illustrating form and tooth wear in mandibles of *Ceratotherium simum cottoni,* from Rhino Camp, Lado Enclave.

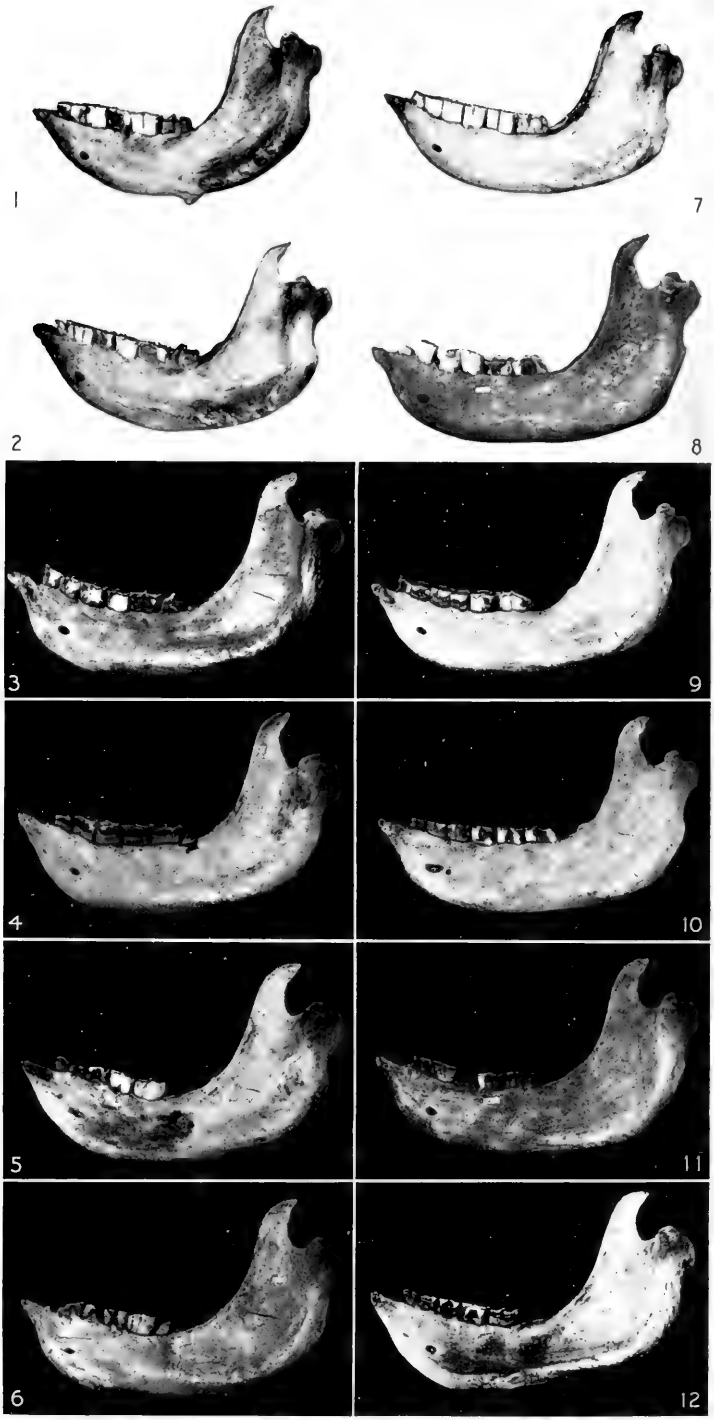
Arranged by age under the sexes; oldest at the top.

FIG. 1. Male, old; weathered. No. 164598, U. S. National Museum.
FIG. 2. Male, adult; weathered. No. 164596, U. S. National Museum.
FIG. 3. Male, adult; shot by Kermit Roosevelt, January 20, 1910. No. 164593, U. S. National Museum.
FIG. 4. Male, immature; shot by Col. Theodore Roosevelt, January 15, 1910. No. 164635, U. S. National Museum.
FIG. 5. Male, immature; shot by Kermit Roosevelt, January 13, 1910. No. 164589, U. S. National Museum.
FIG. 6. Male, young; shot by Col. Theodore Roosevelt, January 10, 1910. No. 164588, U. S. National Museum.
FIG. 7. Female, old; shot by Kermit Roosevelt, January 19, 1910. No. 164592, U. S. National Museum.
FIG. 8. Female, old; shot by Col. Theodore Roosevelt, January 29, 1910. No. 164595, U. S. National Museum.
FIG. 9. Female, old; weathered. No. 164597, U. S. National Museum.
FIG. 10. Female, immature; shot by Col. Theodore Roosevelt, January 10, 1910. No. 164587, U. S. National Museum.
FIG. 11. Female, immature; weathered. No. 164599, U. S. National Museum.
FIG. 12. Female, immature; shot by Col. Theodore Roosevelt, January 13, 1910. No. 164590, U. S. National Museum.




MALE FEMALE

CERATOTHERIUM SIMUM COTTONI; ARRANGED ACCORDING TO AGE, THE OLDEST AT THE TOP




MALE FEMALE

FIGS. 1, 2 & 7.—CERATOTHERIUM SIMUM SIMUM
FIGS. 3-6 & 8-12.—CERATOTHERIUM SIMUM COTTONI

ARRANGED ACCORDING TO AGE, THE OLDEST AT THE TOP

## PLATE 29

(About 1/13 natural size)

Illustrating form in mandibles arranged by age under the sexes

*Ceratotherium simum simum* from South Africa

FIG. 1. Male, adult. No. 51.12.23.1., British Museum.
FIG. 2. Male, adult. Skeleton in gallery of paleontology at British Museum.
FIG. 7. Female, old. No. 52.12.9.1., British Museum.

*Ceratotherium simum cottoni* from Rhino Camp, Lado Enclave

FIG. 3. Male, adult; shot by Kermit Roosevelt, January 20, 1910. No. 164593, U. S. National Museum.
FIG. 4. Male, adult; shot by Col. Theodore Roosevelt, January 15, 1910. No. 164635, U. S. National Museum.
FIG. 5. Male, immature; shot by Kermit Roosevelt, January 13, 1910. No. 164589, U. S. National Museum.
FIG. 6. Female, immature; weathered. No. 164599, U. S. National Museum.
FIG. 8. Female, old; weathered. No. 164597, U. S. National Museum.
FIG. 9. Female, old; shot by Kermit Roosevelt, January 19, 1910. No. 164592, U. S. National Museum.
FIG. 10. Female, old; shot by Col. Theodore Roosevelt, January 29, 1910. No. 164595, U. S. National Museum.
FIG. 11. Female, immature; shot by Col. Theodore Roosevelt, January, 10, 1910. No. 164587, U. S. National Museum.
FIG. 12. Female, immature; shot by Col. Theodore Roosevelt, January 13, 1910. No. 164590, U. S. National Museum.

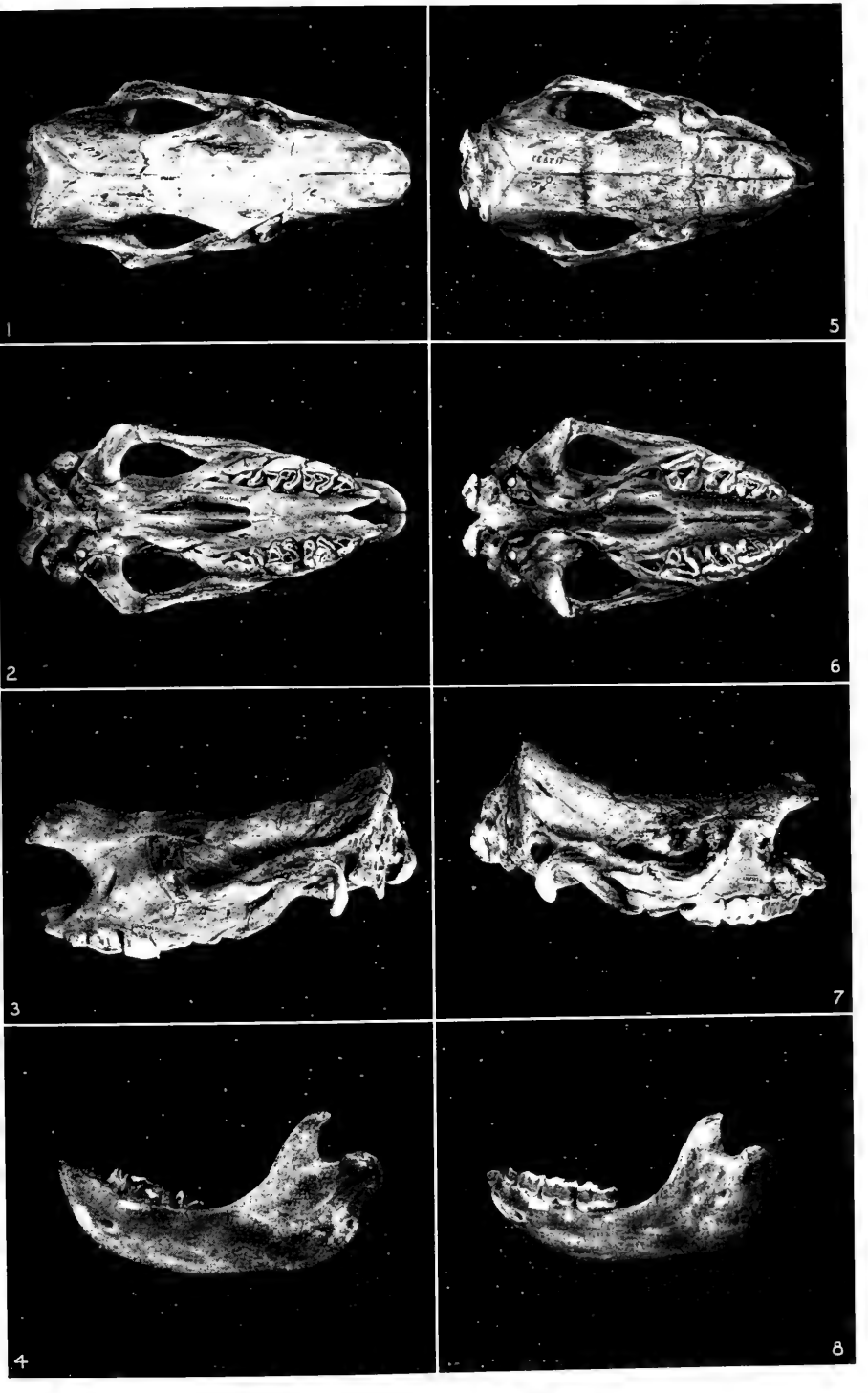
PLATE 30

(About ⅛ natural size)

Illustrating similarity in skulls of nursing young of *Ceratotherium* and *Diceros*.

FIGS. 1, 2, 3, 4. *Ceratotherium simum cottoni*, nursing; parent number 164587; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 10, 1910. No. 164588, U. S. National Museum.

FIGS. 5, 6, 7, 8. *Diceros bicornis*, nursing; parent number 162931; from Loita Plains, British East Africa; shot by Col. Theodore Roosevelt, June 20, 1909. No. 162932, U. S. National Museum.




CERATOTHERIUM S. COTTONI DICEROS BICORNIS

CALVES A FEW MONTHS IN AGE

FIG. 1.—CERATOTHERIUM SIMUM SIMUM; FEMALE, AGED
FIGS. 2 & 3.—CERATOTHERIUM SIMUM COTTONI; FEMALE, ADULT
FIGS. 4 & 5.—CERATOTHERIUM SIMUM COTTONI; MALE, ADULT
SHOWING SEXUAL DIFFERENCES IN SIZE OF BASE OF FRONTAL HORN

## PLATE 31

(Fig. 1 about 1/15 natural size)

(Figs. 2, 3, 4 and 5 1/11 natural size)

Illustrating sexual differences in horns.

Base of male horns greater in circumference than those of females, regardless of relative length.

FIG. 1. *Ceratotherium simum simum,* female, old; from South Africa; exact locality not known; specimen in the department of paleontology at the American Museum of National History.

Type of abnormal projecting horn found only in some females; horn projecting forward at greatest possible angle, the tip when feeding coming in contact with the ground and showing a flat, worn surface on its outer face.

FIG. 2. *Ceratotherium simum cottoni,* female, adult; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 21, 1910. No. 164594, U. S. National Museum.

The longest horned specimen secured by the expedition and the only one having the forward pitch and wear on outer surface of tip as in fig. 1; length 29½ inches.

FIG. 3. *Ceratotherium simum cottoni,* female, immature; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 10, 1910. No. 164587, U. S. National Museum.

FIG. 4. *Ceratotherium simum cottoni,* male, immature; from Rhino Camp, Lado Enclave; shot by Col. Theodore Roosevelt, January 15, 1910. No. 164635, U. S. National Museum.

Longest male horn secured by the expedition; length 24½ inches.

FIG. 5. *Ceratotherium simum cottoni,* male, adult; from Rhino Camp, Lado Enclave; shot by Kermit Roosevelt, January 20, 1910. No. 164593, U. S. National Museum.

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# DESCRIPTION OF THE SKULL OF AN EXTINCT HORSE, FOUND IN CENTRAL ALASKA

(With Two Plates)

BY

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Research Associate of the Carnegie Institution of Washington

(Publication 2181)

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# DESCRIPTION OF THE SKULL OF AN EXTINCT HORSE, FOUND IN CENTRAL ALASKA

By OLIVER P. HAY

RESEARCH ASSOCIATE OF THE CARNEGIE INSTITUTION OF WASHINGTON

(With Two Plates)

On January 25, 1913, there arrived at the U. S. National Museum the fossil skull of a horse which had been sent from the interior of Alaska. Hitherto our knowledge of Alaskan horses has depended on very scanty remains, such as single teeth, or a very few associated teeth, and a few bones, or fragments of them. These scanty remains had, however, been found at a considerable number of places; and, meager as they were, they showed that at some time in the past horses had been widely distributed in that apparently inhospitable region. A map is here presented (fig. 1) which shows the localities, where, as far as the writer knows, evidences of fossil horses have been found in Alaska and Yukon territories. Doubtless many remains have been discovered which have not been reported; and possibly a few announcements have escaped the notice of the writer.

The skull here described was discovered, in the course of mining operations, by Mr. C. P. Snyder, near Tofty, Alaska (fig. 1 (13)), a small mining town situated on Sullivan's Creek, about 24 miles southwest of Rampart and 7 miles northwest of Hot Springs. Rampart is on the Yukon River, about 4° east of the center of the territory. Sullivan's Creek empties into the Tanana River. The skull has been deposited for the present in the U. S. National Museum, and has been given the number 7700. In some of the cavities of the specimen is an extremely fine-grained deposit; a fact which shows that the skull had been buried in the silts, which are so abundant along the great rivers of Alaska.

The skull (pls. 1, 2) lacks the lower jaws, also the greater part of both nasals, the ascending processes of the premaxillæ, and the upper borders of the maxillæ over the premolar teeth. Otherwise it is in fine condition. The bone is stained brown; and, while thoroughly mineralized, retains its original structure. Nearly all the sutures are yet open. The teeth, too, are in fine condition and in the most favorable stage for study. The animal appears to have been

about 6 years old. Inasmuch as the upper canines are well developed, it was quite certainly a male.

After having made a careful study of the skull, taken many measurements and made careful comparisons with the accessible materials, the writer concludes that the animal probably belonged to the

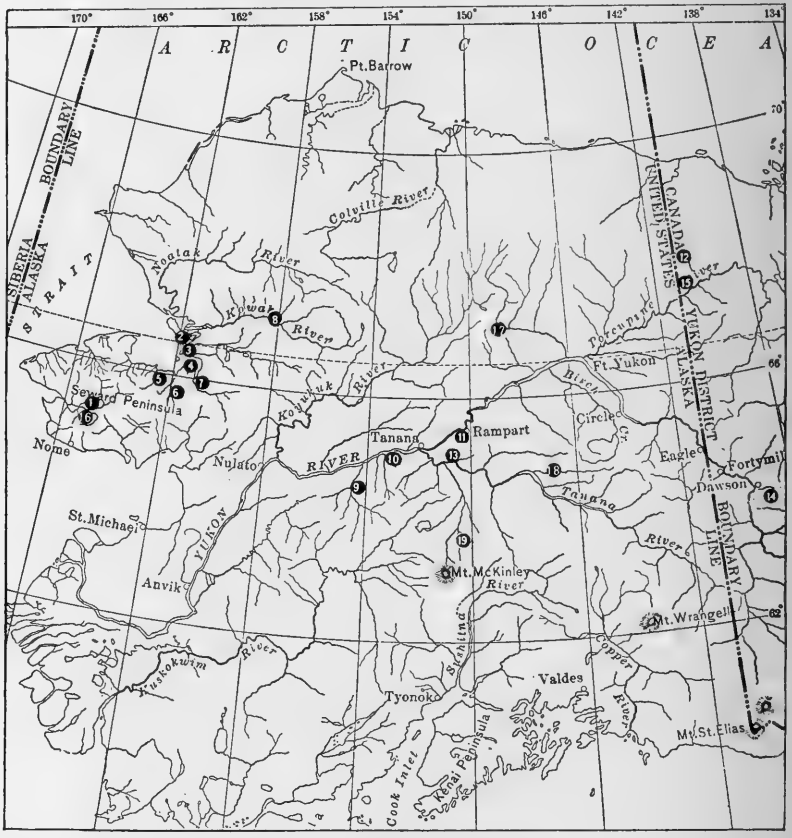



FIG. 1.—Map showing localities in Alaska where remains of fossil horses have been found.

species which he described recently (Proc. U. S. Nat. Mus., Vol. 44, pp. 569-593, pls. 69-73, and text figures) under the name *Equus niobrarensis*. Nevertheless, there appear to be certain differences which, although apparently not of specific value, make it proper to signalize this horse as a distinct form. It may be named and characterized as follows:

**EQUUS NIOBRARENSIS ALASKÆ, new subspecies**

Skull somewhat smaller than in the typical form; premaxillæ relatively wider, and differing in outline; region about articulation of the lower jaw and zygomatic arch modified.

The differences between this form and that found in Nebraska will appear in greater detail as the description proceeds. It is especially to be noted that the Alaskan horse is considerably smaller than the other. The type of *Equus niobrarensis* was found at Hay Springs, in northwestern Nebraska; but other members of the species have been recognized in teeth from western Texas, eastern Nebraska, and western Iowa. A lower molar, found at Wathena, Kansas, is referred to the same species. The deposits at Hay Springs are known as the Sheridan, or Equus, beds. The teeth from Iowa occur in the Aftonian, as do probably those from eastern Kansas and western Nebraska.

The following measurements have been taken from the skull and the teeth; and these are accompanied by the corresponding measurements of the type *Equus niobrarensis,* No. 4999, U. S. National Museum:

MEASUREMENTS OF SKULL AND TEETH OF *E. niobrarensis.*

| | No. 7700 mm. | No. 4999 mm. |
|---|---|---|
| 1. From middle of incisive border to rear of occipital condyles | 518 | 556 |
| 2. From middle of incisive border to front of foramen magnum | 498 | 530 |
| 3. From middle of incisive border to rear of hard palate | 268 | 290 |
| 4. From middle of incisive border to rear of occipital crest | 540 | 582 |
| 5. From middle of incisive border to line joining fronts of pm.$^2$ | 129 | 137 |
| 6. From middle of incisive border to line joining the rear of the orbits | 368 | 400 |
| 7. From middle of occipital crest to line joining the rear of the orbits | 174 | 181 |
| 8. Length of the orbit | 65 | 84 |
| 9. Distance between i.$^3$ and pm.$^2$ | 93 | 105 |
| 10. Width across post-tympanic processes | 117 | 119 |
| 11. Width across glenoid fossæ | 195 | 217 |
| 12. Width at rear of orbits | 220 | 240 |
| 13. Width at front of orbits | 158 | 158 |
| 14. Width on maxillary ridge at maxillo-malar suture | 182 | 187 |
| 15. Width of palate at m.$^3$ | 72 | 70 |
| 16. Width of palate at pm.$^2$, least | 50 | 50 |
| 17. Width of palate at diastema, least | 54 | 45 |
| 18. Width from outside to outside of m.$^3$ | 124 | 123 |
| 19. Width from outside to outside of pm.$^4$ | 128 | 125 |
| 20. Width from outside to outside of canines | 68 | — |

| | | |
|---|---|---|
| 21. Width from outside to outside of outer incisors | 77 | 78 |
| Length of premolar-molar series of teeth | 170 | 179 |
| Length of premolar series | 95 | 98 |
| Length of molar series | 77 | 81 |
| $Pm.^2$, height | 60 | 75 |
| length | 39 | 38 |
| width | 26.5 | 27 |
| protocone | 9.5 | 10 |
| $Pm.^3$, height | 68 | 75 |
| length | 30 | 30 |
| width | 28 | 28 |
| protocone | 12 | 13.5 |
| $Pm.^4$, height | 68 | 85 |
| length | 28.5 | 29 |
| width | 28.5 | 27 |
| protocone | 15 | 14 |
| $M.^1$, height | — | 80 |
| length | 25.5 | 27 |
| width | 27.5 | 28 |
| protocone | 12 | 13 |
| $M.^2$, height | — | 80 |
| length | 26 | 27 |
| width | 26 | 25 |
| protocone | 12 | 14 |
| $M.^3$, height | — | 75 |
| length | 26.5 | 26 |
| width | 24.5 | 23 |
| protocone | 13 | 14 |
| Canine, length, fore and aft | 12 | — |
| width | 9 | — |
| $I.^1$, greater diameter | 18 | 19 |
| shorter diameter | 10.5 | 13 |
| $I.^2$, greater diameter | 22 | 20 |
| shorter diameter | 11 | 12 |
| $I.^3$, greater diameter along worn surface | 24 | 21 |
| shorter diameter | 10 | 11 |

It seems proper to make some remarks regarding certain of these measurements. The orbit of the type of *Equus niobrarensis* appears to be much larger than that of the Alaskan specimen; but this is probably due to some distortion in the type. To the same is probably to be attributed the apparent narrowness of the skull of the type at the fronts of the orbits; likewise, the narrowness of the palate; while it is probable that the width at the rear of the orbit is somewhat exaggerated. The relatively somewhat greater width at the glenoid fossæ is hardly due to distortion.

The measurement numbered 2 is that called by Osborn (Mem. Amer. Mus. Nat. Hist., n. s., Vol. 1, p. 85) the basilar length; that

numbered 4, the vertex length; that numbered 6, the facial length; that numbered 7, the cranial length; that with the numeral 12, the frontal width. From these measurements we may obtain certain indices, viz., the cephalic index (measurement $12 \times 100 \div$ measurement 2); the facio-cephalic index (measurement $6 \times 100 \div$ measurement 2); and the cranio-cephalic index (measurement $7 \times 100 \div$ measurement 2). These operations performed give us the following results. For comparison, there are included the same indices determined from the skull of a large Percheron gelding, No. 174960, U. S. N. M.; from the skull of an Arabian horse, No. 172454, U. S. N. M.; from four skulls of Grevy's zebra (*Equus grevyi*); from four skulls of Grant's zebra (*Equus burchelli granti*); and from three skulls of *Equus przevalskyi*.

These details are added for the purpose of contributing to the determination of the value of the various indices which have been employed in determining the races and species of horses. All the skulls employed in these estimates belong to the U. S. National Museum, except those of *Equus przevalskyi*. These are in the American Museum of Natural History, where the author has been kindly permitted to study them. The zebras were collected by the Smithsonian African Expedition of 1909, most of them by Mr. Edmund Heller.

INDICES OF SKULLS OF HORSES AND ZEBRAS

| Indices | *E. niobrarensis* | | *E. caballus* | | *E. grevyi* | | | |
|---|---|---|---|---|---|---|---|---|
| | Type | E. n. alaskæ | 174960 | Arab | 163228 | 163227 | 163331 | 163238 |
| Cephalic index | 45.2 | 44.2 | 40 | 43 | 39 | 40 | 38.3 | 37.2 |
| Facio-cephalic index | 75.4 | 73.9 | 75.3 | 75 | 75.7 | 76.1 | 77.6 | 76.8 |
| Cranio-cephalic index | 34.3 | 35 | 36.6 | 35.5 | 35.1 | 35.1 | 35.6 | 35.1 |
| Palato-cranial angle, in degrees | 14.5 | 11 | 19.5 | 15.3 | 18 | 29 | 22.5 | 21 |

| Indices | *E. burchelli granti* | | | | *E. przevalskyi* | | |
|---|---|---|---|---|---|---|---|
| | 161930 | 161932 | 162962 | 162955 | 136 | 32686 | 71 |
| Cephalic index | 40.9 | 40.2 | 41 | 40 | 43.1 | 43 | 43.2 |
| Facio-cephalic index | 74.2 | 75.6 | 76.3 | 74.3 | 76.9 | 77 | 76.2 |
| Cranio-cephalic index | 36 | 36.4 | 36.8 | 39.1 | 36.2 | 36 | 33.7 |
| Palato-cranial angle, in degrees | 6.5 | 20 | 18.5 | 17 | 19 | 15.5 | 17.5 |

As regards the cephalic index, it will be observed that, especially among the skulls of Grevy's zebra, there is a good deal of variation. It has been regarded as an animal possessing a very long, narrow skull; while Grant's zebra, to the eye, seems to have a rather broad

skull. Yet one of the four skulls of Grevy's zebra has the same relative breadth as one of Grant's zebra. When, however, the average of the four skulls of each species is taken, that of the skulls of Grevy's zebra equals 38.6, that of the skulls of the other zebra 40.5. It is, therefore, pretty certain that measurements made on a large number of skulls of the two species will show, as regards breadth, a decided specific difference. Nevertheless, individuals will be found which trespass the limits.

It will be noted that the relative breadth of the skull of the Przevalsky horse is much higher than that of either of the zebras, equaling that of the Arabian horse here measured. The specimens of *Equus niobrarensis* stand above all the others. On looking through the figures representing the facio-cephalic index, it seems to be hopeless by this means to distinguish species. The average for *Equus grevyi* amounts to 76.5; that of Grant's zebra, 75.1; that of Przevalsky's horse, 76.7. These figures seem, however, to exclude the possibility that the Alaskan skull belonged to *Equus przevalskyi*.

One of the skulls of the Przevalsky horse has a very low cranio-cephalic angle, and this reduces much the average for this species. The skull was that of a horse much younger than the other two, and this may have something to do with its shortness behind the orbits. The average for Grevy's zebra is 35.5; for Grant's, 37.1; for the Przevalsky horse, 35.3. All the four skulls of *E. grevyi* have this index less than any of those of Grant's zebra.

An examination of the figures representing the palato-cranial angle shows that there is, in some cases, great variation among members of the same species. Among the three individuals of *Equus przevalskyi* the range of variation is not wide, although there is much difference in age. The specimen numbered 32686 is regarded by Mr. Chubb, of the American Museum of Natural History, who has given much attention to the osteology of horses, as having had the age of thirteen years; number 136, twelve years; and number 71, four and one-half years. The differences do not, therefore, appear to be due to age, the youngest horse standing between the other two. In the case of the skulls of *Equus grevyi* there is a range of 11°. The youngest, No. 163227, yet retains the milk-teeth, but has the second upper molar through the bone. It has the highest angle, 29°. The next in age, No. 163238, had the last molar just beginning to wear and the third incisors not yet cut; its angle is 21°. The other two animals were of practically the same age, with all the permanent teeth in use and with the incisors yet cupped. The angles are, as seen, respectively, 18° and 22.5°.

The greatest range in the size of the palato-cranial angle is seen in the four skulls of Grant's zebra; and the greatest difference is seen to exist between No. 161930 and No. 161932. These two animals were mature, but not aged, of nearly the same age, both males, and both secured on the same farm in British East Africa. One has an angle of 6.5°; the other an angle of 20°. It will be observed that this angle is relatively small in the type of *Equus niobrarensis* and in the skull from Alaska; but other skulls of the species might furnish quite different results.

The gelding and the Arabian agree in having the occiput-vertex angle equal to 77.5°; the type of *Equus niobrarensis* and the Alaskan skull agree in having it equal to 73.5°.

The grinding teeth of the Alaskan specimen (pl. 1, fig. 2) resemble greatly those of the type of *Equus niobrarensis*. The table above given shows that those of the two skulls differ little in size. The outer styles are equally prominent in the teeth of both. In both skulls the protocone of the last premolar is longer than the protocones of the molars. In the two hinder premolars of both skulls, the post-protoconal valley is broad, has a deep re-entering loop in front, and sends a long branch to the center of the grinding surface. In both skulls these peculiarities of this valley are not so prominent in the molars as in the premolars, and slightly less so in the molars of the Alaskan skull than in the molars of the type. As regards the enamel surrounding the cement lakes, there appear to be no important differences. In the type skull the hinder border of the hinder lake in the first and second molars has a rather deep notch, while in the Alaskan skull this is absent or extremely small.

The incisors of the Alaskan skull (pl. 1, fig. 3) are in a slightly more advanced stage of wear than are those of the type skull. All have deep cups, that of the second incisor being 30 mm. deep. This incisor, evidently, had the hinder wall notched, as shown by a sharp groove in the rear of the tooth. The third incisor is worn down just to the bottom of the notch.

The width of the posterior nares, in front of the hamular processes, is 46 mm. In the type of *Equus niobrarensis* the width is 46 mm.; in the Arabian horse, 50 mm.; in the gelding, 60 mm. In the Alaskan skull the width across the occipital condyles is 80 mm.; in the type of *Equus niobrarensis,* 84 mm.; in the Arabian horse, 90 mm.; in the gelding, 99 mm.

The Alaskan skull differs from all the others here mentioned in the condition of the sagittal crest (pl. 2, fig. 1). The ridges which run

backward from the orbits do not coalesce on the parietals, but are separated by a space of about 8 mm. A ridge which runs forward from the occipital crest passes between these and finally disappears on the general surface. However, in examining a number of skulls of Grant's zebra, the cranium of which usually has a well-developed crest, two are found with the post-orbital ridges separated to the rear of the skull, but not so widely as in the Alaskan horse. One of these two zebra skulls belonged to a young animal, the other to one with the incisors well worn down.

It is observed also that the hinder border of the palate extends forward to nearly the middle of the second molars; while in the type of *Equus niobrarensis* it reaches only to the hinder end of this molar.

The premaxillæ in the Alaskan skull have the same absolute width at the incisors that these bones have in the type skull. The outline of the two jaws in this region are somewhat different, as seen from above.

The zygomatic arch, where narrowest, is 29 mm. wide in the Alaskan skull; while in that from Nebraska this arch is absolutely and relatively much wider, 37 mm. Its upper border above and behind the glenoid fossa is much thicker and more obtuse than in the type skull. The width of the occipital crest, at the suture between the superoccipital and the parietals, is equal to 68 mm. in the Alaskan skull; in the Nebraskan, 74 mm.; and the form is different in the two; especially does the occipital crest in the Nebraska skull project more backward.

The face of the type of *Equus niobrarensis* is more elevated than that of the Alaskan skull, the midline being at a height of 123 mm. above the rear of the palate, while in the Alaskan skull the height is 111 mm. This is 5 mm. more than is required by the greater length of the skull; but slight distortion of the skull as restored, or individual variation in either of the skulls, may easily account for the difference.

There are some distinct differences found in the glenoid fossæ of the two skulls here compared. In the type of *Equus niobrarensis* the articulatory surface has an extent, from side to side, of 63 mm.; in the Alaskan skull this is only 51 mm. In the Nebraskan skull this surface is so concave from side to side that a straight line from its extremities is, at one point, 8 mm. from the surface. In the case of the Alaskan skull such a line is nowhere more than 4 mm. from the surface. In the case of a considerable number of zebra and horse skulls examined, this region shows much constancy in form.

It has been suggested to the writer that the skull here described might belong to *Equus przevalskyi*. The thought readily suggests itself that this horse of eastern Asia might have crossed, with many other species of mammals, into America at a time when Bering Strait was temporarily abolished and that later it became extinct in this country. However, the Alaskan horse differs in many ways from *Equus przevalskyi*. The teeth are of practically the same size in the two forms, but the enamel of the Asian species has a still less complicated arrangement. The upper incisors are narrower and are curved more strongly downward. It is the writer's opinion that the horses and the bisons, probably also the mammoths and many other species, found in Alaska, became extinct about the middle of the glacial epoch.

They probably flourished during the Aftonian and the Sangamon stages.

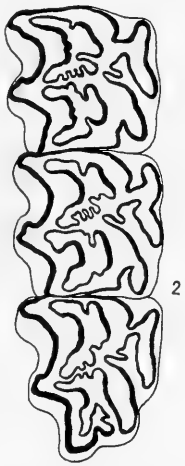



Fig. 2. Three upper molars of right side, No. 2313, U. S. Nat. Mus. x $\frac{3}{4}$

In the U. S. National Museum are various teeth and fragments of jaws from Alaska. One lot of these (Cat. No. 2313, U. S. National Museum) consists of a part of the right maxilla, with the three molars (fig. 2). It was collected on Quartz Creek, in the Seward peninsula, by A. H. Jose, and presented to the U. S. Geological Survey. The locality is indicated on the map here presented (fig. 1) by the numeral (1). For an account of this locality see Mr. A. T. Collier, in Professional Paper, No. 2, U. S. Geological Survey, page 27. These teeth, also, the writer refers to *Equus niobrarensis alaskæ*, but they present some differences. The following are the dimensions:

MEASUREMENTS

| | |
|---|---|
| Molar series, length | 58 |
| $M.^1$, height | 24 |
| length | 26 |
| width | 26.5 |
| protocone | 13 |
| $M.^2$, height | 51 |
| length | 25 |
| width | 25 |
| protocone | 15 |
| $M.^3$, height | 58 |
| length | 28 |
| width | 24 |
| protocone | 15 |

It will be seen that these teeth are slightly smaller than those of both the type of *Equus niobrarensis* and those of the Alaskan skull from Tofty. Likewise the protocones are longer, equaling the length of that of the fourth premolar of the Tofty skull. These teeth have, too, a greater complication of the enamel which bounds the opposed faces of the two cement lakes. That on the hinder face of the front lake is especially folded, forming five loops. However, it is only a little more complicated than that of the lakes of the first molar of the Tofty skull.

The numeral (2) on the map here shown marks Hotham Inlet, latitude 162° West, where, close to the Arctic Circle, Mr. L. S. Quackenbush (Bull. Amer. Mus. Nat. Hist., Vol. 26, p. 121, pl. 18) found, in very barren deposits, the metatarsal bone of a horse. This specimen, as well as others found by Mr. Quackenbush, are in the American Museum of Natural History, New York.

Various specifically unidentifiable remains of fossil horses have been found around Eschscholtz Bay. The earliest mentioned were discovered by Captain Beechey and his companions in 1827 at Elephant Point. The parts then found were an astragalus, a metacarpal, and a metatarsal. They were mentioned and figured by Buckland in the second volume of the Narrative of the Voyage of the Blossom, p. 597, pl. 3, figs. 13-15.

The same region was visited by the ship "Herald," in 1848; and some bones of horses, together with those of various other extinct animals, were found. These were described by Sir John Richardson in the Zoölogy of the Voyage of the Herald, pp. 17-20. Of the horse he described a sacrum, a right os innominatum, a part of a right ischium, a radius and part of the attached ulna, a whole tibia and parts of four others, two astragali, and a part of a metatarsal. To these were applied simply the name, *Equus fossilis*. All these specimens are in the British Museum of Natural History (Lydekker, Cat. Foss. Mammalia, Brit. Mus., pt. 3). None of these seem to have been figured.

In the summer of 1907 Mr. L. S. Quackenbush explored the region around Eschscholtz Bay in the interests of the American Museum of Natural History, New York. His report was published in the bulletin of that museum, Vol. 26, 1909. On the north shore of the bay, eastward of Chloris Peninsula, he found some remains of an undetermined species of horse. In the same locality he found Elephas, Bison, Ovibos, Rangifer, Canis, and Castor (op. cit., p. 106). This locality is marked by the numeral (3) in the map here shown.

On the south side of Eschscholtz Bay, from Elephant Point eastward, Quackenbush (op. cit., p. 94, *seq.*) collected various remains of Equus, foot bones, a cervical vertebra, some loose teeth and a fragment of a lower jaw, with the premolars. The grinding faces of these teeth are shown in fig. 3. The teeth were well worn down. The height of the jaw at the front of the last molar is 90 mm.; at the front of pm.$_4$, 78 mm.; at the front of pm.$_2$, 45 mm. These measurements indicate a horse with a more slender jaw than that found in the type of *Equus niobrarensis*. This is to be expected on account of the evidently greater age of the animal; but in the type the width at the front of pm.$_2$ is 67 mm., in place of 45 mm., in the fragment here described. The following are the measurements of these teeth:

Pm.$_2$, height 10 mm., length 33 mm., width 13.5 mm.
Pm.$_3$, height —— length 26 mm., width 15 mm.
Pm.$_4$, height 35 mm., length 26 mm., width 15.5 mm.

These teeth appear to belong to *Equus niobrarensis alaskæ*, although the arrangement of the enamel is somewhat less complicated than in the horse from Nebraska.

Fig. 3. Three lower premolars, No. 14337, Amer. Mus. Nat. Hist. × ⅔

The same explorer found indications of the horse along Buckland River (fig. 1 (7)), together with Elephas, Bison, Rangifer, Ovibos, Alce, Ursus, Canis. Mr. Quackenbush visited also the region south of Spafarief Bay, along the basin of the Keewalik River (fig. 1 (6)) and the Kugruk River (fig. 1 (5)). From both regions he reported Equus remains. Along Candle Creek, a branch of the Keewalik, he found an upper premolar, probably the third or the fourth. The height is 81 mm.; the length, 29 mm.; the width, 26 mm.; the length of the protocone, 14.5 mm. It is curved so as to be concave on the inner and the hinder faces. It is referred provisionally to *Equus niobrarensis alaskæ*.

In the U. S. National Museum are two horse teeth, which were collected somewhere in the region about Kotzebue Sound, or probably Eschscholtz Bay, and presented by the Board of Education of the Department of the Interior. One is a second upper left premolar, with a length of 40 mm. and a width of 26 mm. on the grinding surface. There is nothing to distinguish it from the same tooth of *Equus caballus*, although it is not probable that it belonged to that species. The other tooth, a lower left molar or premolar, differs from that of the domestic horse, and resembles that of *Equus niobrarensis*.

Mr. C. W. Gilmore, who led an expedition into Alaska in 1907, reported (Smithsonian Misc. Coll., Quarterly Issue, Vol. 2, p. 31) that fossil horse remains, a single bone or two, now in the U. S. National Museum, were found on the Kowak, or Kobuk, River (fig. 1 (8)). He also ascended the Nowitna River, a southern affluent of the Yukon, a distance of about 180 miles and found, on the sand bars, remains of horse, mammoth, extinct bison, etc. (fig. 1 (9)). Mr. Gilmore further reported the finding of Equus remains along the Palisades on the Yukon (fig. 1 (10)). These

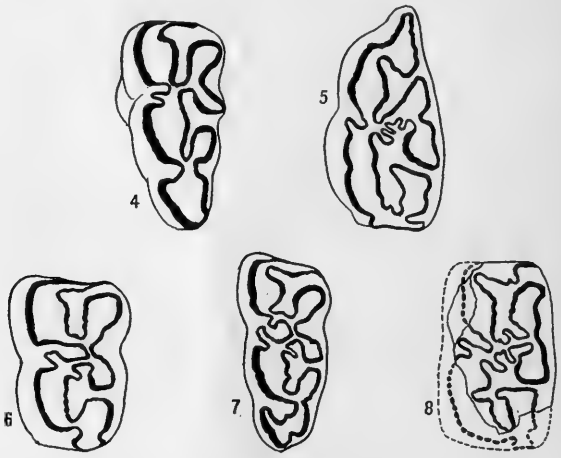



FIG. 4.—Left last lower molar, No. 866, U. S. Nat. Mus. × ¾.
FIG. 5.—Left lower second premolar, No. 2645, U. S. Nat. Mus. × ¾.
FIG. 6.—Left lower tooth, probably first molar, No. 2645, U. S. Nat. Mus. × ¾.
FIG. 7.—Left lower third molar, No. 2645, U. S. Nat. Mus. × ¾.
FIG. 8.—Left lower tooth, premolar or molar, No. 2645, U. S. Nat. Mus. × ¾.

Palisades begin about 35 miles below Tanana. The materials secured by Mr. Gilmore included no teeth and are specifically indeterminable.

In the U. S. National Museum is a part of the left side of the lower jaw of a horse and in it is found the last molar. The catalogue number is 866. In an older catalogue the information is given, under the number 6563, that this jaw was collected in the region of Rampart (fig. 1 (11)). It was secured by Dr. William H. Dall, who tells the writer that the discoverer of the jaw was Mr. J. Lockhart, an old trapper in the employ of the Hudson Bay Company. The tooth is worn down to a height of about 45 mm. The length of the grinding surface (fig. 4) is 37 mm.; the width in front is 16 mm. This is greater by about 3 mm. than the width of the same tooth in the type of *Equus niobrarensis;* but that tooth may not have yet reached its full width. No other differences of importance are observed.

The catalogue number, 2645, in the U. S. National Museum, belongs to a lot of four lower teeth, which were collected by Mr. A. G. Maddren for the museum in 1904, on the Old Crow River, in Yukon Territory, not far from the boundary line between this territory and Alaska (fig. 1 (12)).

It seems probable that three of these teeth belonged to one individual, the fourth to another and much younger one. The three are represented by figs. 5-7, the fourth tooth by fig. 8. One of the three (fig. 5) is the second premolar, another (fig. 7) the third molar, the other (fig. 6) probably the first molar; and all belonged to the left side of the lower jaw. The following are the dimensions of these teeth:

Measurements

| | | |
|---|---|---|
| $Pm._2$, | height | 53 |
| | length | 38 |
| | width | 17.5 |
| $M._1$, | height | 56 |
| | length | 30 |
| | width | 17 |
| $M._3$, | height | 65 |
| | length | 33.5 |
| | width | 14 |

On comparing the figure of $pm._2$ (fig. 5) with that of the same tooth of the type of *Equus niobrarensis* (Proc. U. S. Nat. Mus., Vol. 44, p. 579, fig. 20) it will be seen that the Alaskan tooth is broader and has somewhat more complicated enamel. The supposed first molar (fig. 6) differs from that of the type of *Equus niobrarensis* in having slightly more complicated enamel bands, but especially in having the valley which enters the tooth from the outside pushed between the two longitudinal valleys and nearly to the enamel of the opposite side. In about the same way the last molar (fig. 7) differs from that of the Niobrara horse. It does not appear probable that these teeth belonged to *Equus niobrarensis alaskæ*.

The fourth tooth (fig. 8) evidently belonged to a younger horse, having been worn down very little. It is considerably damaged, but the essentials of its structure can be made out. The height of the tooth is 82 mm.; the length is about 34 mm.; the width, 11 mm. The drawing will show the extreme complication of the enamel. It is probable that it is the tooth of a third Alaskan species.

During the summer of 1912 Mr. Copely Amory, Jr., made a small collection of fossil mammal bones on the Old Crow River, about fifty miles above its mouth. Among the animals represented are the mammoth, bison, a camel, and one or more horses. The horse

remains consist of a tooth, a part of a femur, parts of two tibia, two astragali, three proximal, and two second phalanges. The tooth presents all the characters of an upper left premolar of *Equus niobrarensis alaskæ*. The grinding surface is 28 mm. long and 28 mm. wide. The protocone is unusually long, 16 mm.

Mr. L. S. Quackenbush (op. cit., p. 91) states that he collected a fragmentary pelvis of a horse on the tailings of a mine, at Fox Gulch, not far from Dawson, Canada (fig. 1 (14)). The fossil bones occur here in a muck, which overlies a bed of gravel. They are sometimes found partly imbedded in the gravel.

Lydekker (Cat. Foss. Mamm., Brit. Mus., pt. 3, pp. 78, 86, 87) records the presence, in the British Museum of Natural History, of part of the right ramus of the lower jaw of a young horse, a part of a metatarsal, and a first phalange. These had been collected many years ago by Rev. R. McDonald, on the Porcupine River, Canada. The locality is not more exactly indicated; but it was probably not far from New Rampart House (fig. 1 (15)).

On a map, which forms a part of his paper already referred to several times, Mr. Quackenbush indicated (pl. 25) the localities in Alaska and Yukon where up to that time horse remains had been discovered. Four of these localities remain to be noted here. The first of these (fig. 1 (16)) is in the Seward Peninsula, on the Pilgrim River, south of the Kuzitrin River. To Mr. Quackenbush there was presented, by a civil engineer, Mr. A. Gibson, in whose statements he had full confidence, a tooth of a horse, which had been found on the river mentioned, and which is now in the American Museum of Natural History.

The three following localities were reported by the well-known collector, Mr. Charles Sheldon, to Prof. Henry F. Osborn, and communicated by him to Mr. Quackenbush. At some point on the Chandler River (fig. 1 (17)), at about latitude 67° north and about longitude 149° west, Mr. Sheldon found a terminal phalanx of a horse; and this he presented to the American Museum of Natural History. From some point along the Chena River (fig. 1 (18)), east of Fairbanks, somewhat south of latitude 65° north and not far from longitude 147° west, Mr. Sheldon reported the skull of a fossil horse. Where this skull now is the present writer does not know. Likewise, evidences of the existence of a fossil horse were found by Mr. Sheldon somewhat north of Mount McKinley. This was apparently not far north of latitude 63° north and somewhat west of longitude 150° west (fig. 1 (19)).

Mr. Quackenbush kindly informs the writer that a trader gave him a fossil horse tooth, which had been picked up on the ocean side of an island at the mouth of Schismareoff Inlet. Mr. Quackenbush regarded it as possible that the tooth had been carried there by floating ice; consequently, the locality is not recognized on the map.

At the American Museum of Natural History, New York, the writer saw three fragmentary horse teeth, which had been brought back by the Stefansson and Anderson Expedition and found about fifteen or twenty miles southwest of Point Barrow. Since, however, these teeth were discovered on the sites of Eskimo villages, it is probable that they had been taken there by human agency. For this reason this locality is not placed on the map.

One who studies the animals, living and extinct, of Alaska, is naturally led to consider those found on the other side of Bering Strait. The writer has not had the time and opportunity to enter into this subject thoroughly. He has, however, examined the descriptions and figures of fossil horses which were prepared by Tscherski (Mem. Acad., St. Petersburg, ser. 7, Vol. 40, pp. 257-380, pls. 5, 6). This author had in his possession a skull, well preserved and lacking few important parts, which had been obtained on Liakhof Island, situated in the Arctic Ocean, latitude 73° north, longitude 140° east. This is more than a degree farther north than Point Barrow, Alaska. The horse to which the skull belonged was supposed to be eight or nine years old. Tscherski figured this skull in three positions and presented a view of the grinding surfaces of the upper premolars and molars. He likewise described the skull in great detail and gave numerous measurements of its parts and of the corresponding parts of many other horses, existing and fossil. The skull had a basilar length of 502 mm., only 4 mm. more than the Alaska skull. It is, therefore, easy to make comparisons between the two. The width at the rear of the orbits is 216 mm., slightly less than in the Alaska skull; the cephalic index is, therefore, 43 instead of 44.2 mm. This difference is due to the fact that in the Liakhof Island horse the hinder part of the rim of the orbits does not project beyond the zygomatic arches, as it does in the Alaska skull. Tscherski attached considerable importance to this feature; but a study of the skulls of a number of Grant's zebras seems to show that in this respect, as in so many others, there is a good deal of variation. The facio-cephalic index in the Liakhof skull is 73.1; in the Alaska horse, 73.9. Tscherski measured carefully the postorbital bar, the height of the zygomatic arch below the orbit and behind it, and obtained indices thereof and compared them with those obtained from other horses;

but it needs only an examination of such a set of zebra skulls as have been gathered at the U. S. National Museum to convince one that there exists in probably every species of Equus great individual variations in the regions under consideration.

In the Liakhof horse the width of the skull at the articulation for the lower jaw is 14 mm. greater than in the Alaska skull. The width across the hinder ends of the nasals, taken in a straight line, is 118 mm. in the Alaska skull; in the Liakhof skull it is given as 126? The orbit in the Alaska skull is smaller than that of the other, the horizontal measurements being respectively 66 mm. and 67 mm.; the perpendicular, 55 and 61. The face of the Alaska horse appears to have less height than that of the Liakhof horse, the height measured at the rear of the last premolar, being in the former, 132; in the latter, 140 mm. The nose of the Alaska skull appears to have been, somewhat longer (from front of the premaxillæ to the front of $pm.^2$) than in the other skull, being 134 mm. as compared with 129 mm., a relatively small difference. The length of the diastema between $i.^3$ and $pm.^2$ is the same in both. Tscherski notes, in the skull discovered by him, a concavity which occupied a considerable area just above the maxillary ridge. In the Alaska skull there is a corresponding cavity somewhat larger and deeper. In some specimens of Grant's zebra this region is strongly convex; in others, it is slightly concave. It is possible, of course, that a character variable in one species will be constant in another. The face of the Liakhof skull is somewhat wider on the maxillary ridge than in the Alaska skull, being 191 mm. as compared with 182 mm. These maxillary ridges extend farther forward in the Alaska skull than in the other, reaching nearly to the middle of the hinder premolar; in the Liakhof skull, to about the middle of the first molar.

The hard palate of the skull last named ends in the midline opposite the middle of $m.^3$; in the Alaska skull it ends opposite the hinder end of the protocone of $m.^2$ The distance from the front of the foramen magnum to the hinder edge of the hard palate is almost exactly the same in the two skulls. From the front of the foramen to the edge of the vomer, at the midline, the distance is 131 mm. in the Liakhof skull; in the Alaska skull, 121 mm. From the same point of the vomer to the edge of the hard palate is 109 mm. in the Liakhof skull; in that from Alaska, 114 mm. In the last-named skull the index obtained by dividing the smaller distance multiplied by 100, by the greater is 83.2; in the former skull, 94.2. It remains to be proved that this difference is of specific value. Tscherski stated that the incisive foramina, or fissures, in the skull which he described

were extraordinarily short, 30 mm.; while in other horses examined by him the length ranged from 41 mm. to 53 mm. In the Alaska skull these slit-like openings are 29 mm. long. In a number of skulls of Grant's zebra these fissures vary greatly in length.

It remains to compare the teeth of the Liakhof skull with those of the Alaskan. They differ little in measurements. The length of the premolar-molar series in the former, measured in a straight line, is 170 mm., exactly that of the Alaskan skull. In the following table the measurements of both are given for easier comparison.

MEASUREMENTS OF TEETH

| Teeth | Liakhof horse mm. | Alaskan horse mm. |
|---|---|---|
| Pm.$^2$, length | 41 | 39 |
| width | 24 | 26.5 |
| protocone | 10 | 9.5 |
| Pm.$^3$, length | 27 | 30 |
| width | 29 | 28 |
| protocone | 13 | 12 |
| Pm.$^4$, length | 26 | 28.5 |
| width | 30.5 | 28.5 |
| protocone | 14 | 15 |
| M.$^1$, length | 24 | 25.5 |
| width | 28.5 | 27.5 |
| protocone | 13.5 | 12 |
| M.$^2$, length | 23.5 | 26 |
| width | 27.5 | 26 |
| protocone | 15 | 12 |
| M.$^3$, length | 29 | 26.5 |
| width | 25 | 24.5 |
| protocone | 16 | 13 |

It will be seen that there are no remarkable differences in the dimensions of the teeth, probably not greater than would be found in different individuals of the same species. The Liakhof skull, having belonged to an older horse, would naturally be expected to have the anterior premolar and the hinder molar longer, and the others shorter, on the grinding surface, than the younger horse. The protocones are of about the same length, except that those of the hinder molars of the Liakhof skulls are 3 mm. longer than those of the Alaskan skull.

As far as can be judged from Tscherski's figure the arrangement of the enamel around the two cement lakes of each tooth appears to be not especially different from that seen in the Alaskan skull. A considerable difference is seen, however, in the valleys which enter the interior of the tooth on the inner side. The median, or postproto-

conal, valleys of the teeth of the Liakhof skull are not so wide as those of the Alaskan skull and do not extend nearly so far toward the center of the tooth. The little bay entering the tooth behind the hinder inner pillar (hypocone) is much narrower in the Liakhof horse than in the Alaskan. Likewise the bay entering the tooth in front of the protocone is narrower, and the anterior end of the protocone extends further forward inside of it.

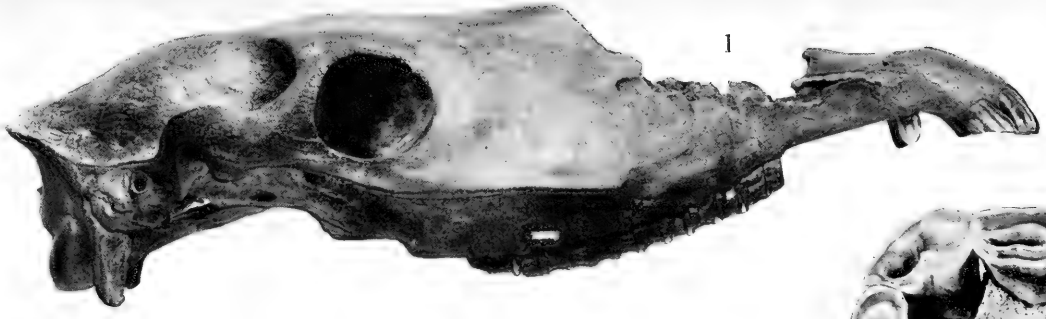
Tscherski attached much importance to the feature just mentioned, the elongation of the anterior end of the protocone, and proposed an index to express this. He measured the distance from the hinder border of the tooth to the anterior border of the protocone and divided this, multiplied by 100, by the distance from the hinder border of the tooth to the nearest point of the anterior bay. His results on the teeth of the Liakhof skull are given below, and with them the indices derived from the skull forming the type of *Equus niobrarensis,* the Alaskan skull here described, two skulls of *Equus grevyi,* and two of *Equus burchelli granti.* In each case the present writer has taken the measurements from the hinder end of the under inner pillar (hypocone).

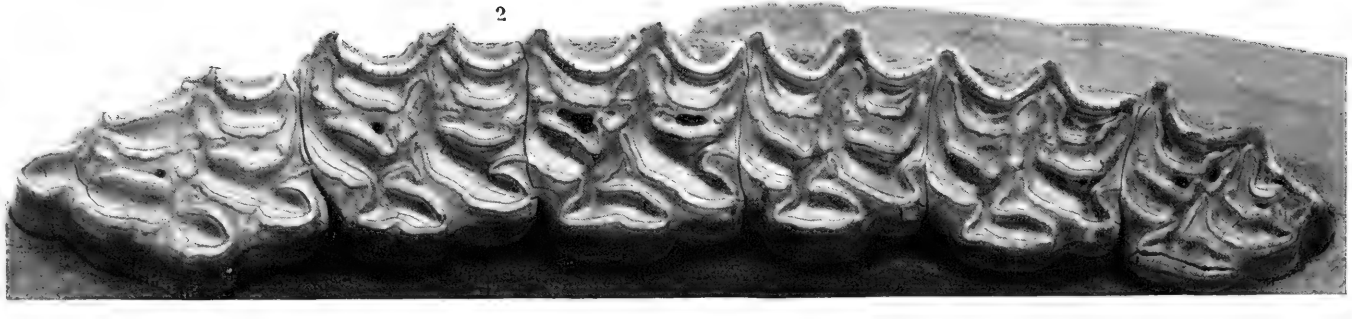
INDICES SHOWING EXTENSION FORWARD OF PROTOCONE IN *Equus.*

| Teeth | Liakhof horse | *E. niobrarensis* type | *E. niob. alaskæ* type | *E. grevyi* No. 163228 | *E. grevyi* No. 163331 | *E. bur. granti* No. 162951 | *E. bur. granti* No. 161927 |
|---|---|---|---|---|---|---|---|
| $Pm.^3$ | 127.2 | 120 | 108.3 | 115.8 | 108 | 112.5 | 106.9 |
| $Pm.^4$ | 123.6 | 119.7 | 109.9 | 115.8 | 111.6 | 123.3 | 115 |
| $M.^1$ | 119.5 | 112.5 | 106.7 | 117.6 | 117.6 | 111.2 | 106.9 |
| $M.^2$ | 127.5 | 117.8 | 111.1 | 120.9 | 113.9 | 116.1 | 106.4 |

It will be seen from this table that the indices of the Liakhof skull stand above all the others here measured. It will be observed also that there is a considerable range in the cases of the two specimens of Grevy's zebra and in the two of Grant's zebra. Inasmuch as both the depth of the anterior bay and the extension forward of the protocone may vary independently of each other, it would probably be better to compare each with the length of the grinding surface or with its width.

While it must be admitted that the Liakhof skull resembles greatly that from Alaska, the writer is not prepared to say that they belong to the same species. It must be stated here also that, while Tscherski in his work calls the Liakhof horse *Equus caballus,* he (p. 341) expresses the opinion that in case the peculiarities of the skull should be found repeated in other specimens, this might justify the specific independence of the animal.






EQUUS NIOBRARENSIS ALASKÆ

1. Side view of skull. x $\frac{1}{4}$. 2. Upper premolar and molar teeth. x 1. 3. Upper incisor teeth. x $\frac{3}{4}$.

EQUUS NIOBRARENSIS ALASKÆ x $\frac{1}{4}$.

1. View of skull from above. 2. View of skull from below.

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# REPORT ON FRESH-WATER COPEPODA FROM PANAMA, WITH DESCRIPTIONS OF NEW SPECIES

(With Five Plates)

BY

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of the U. S. Department of Agriculture

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# REPORT ON FRESH-WATER COPEPODA FROM PANAMA, WITH DESCRIPTIONS OF NEW SPECIES [1]

By C. DWIGHT MARSH

OF THE U. S. DEPARTMENT OF AGRICULTURE

(With Five Plates)

## PLANKTON COLLECTIONS OF THE SMITHSONIAN BIOLOGICAL SURVEY OF THE PANAMA CANAL ZONE

These collections were made by Meek and Hildebrand, in connection with their work on fishes in the seasons of 1911 and 1912, by Goldman in 1912, and by Marsh who was present in Panama for four weeks in 1912 for the express purpose of making such collections. Most of the collections were made within the limits of the Canal Zone. A few collections were made in eastern Colombia, some on Rio Bayana and its tributaries, some on the Chagres and Trinidad outside the Zone and some in the neighborhood of Chorrera and of old Panama.

The general character of the country is not especially favorable to the growth of plankton organisms either in variety or numbers. There are no lakes in the Canal Zone and comparatively few permanent pools.

The continental divide is close to the southern shore of the isthmus. From the summit of the divide to high tide on the Pacific side is only about six miles. The slope consequently is very steep and whatever water falls runs away almost immediately. During the season when the collections were made there was practically no rain on this slope, so that it was difficult to find any fresh water. Consequently nearly all collections on the southern slope within the limits of the Canal Zone were made either in water which had been artificially impounded, or in the standing water in the deeper parts of streams that were otherwise dry.

The northern slope extends from the divide to the Atlantic, a distance, in a straight line, of something over thirty miles. Two considerable rivers come into the Canal Zone from this slope, the Rio Chagres and the Rio Trinidad. On the lower reaches of these

[1] The present paper is the nineteenth dealing with the results of the Smithsonian Biological Survey of the Panama Canal Zone.

rivers, and this is especially true of the Trinidad, are extensive swamps. The Chagres is a swift flowing stream, sometimes torrential in character, and does not furnish a suitable environment for any extensive development of plankton organisms. The swamps form a suitable environment for plankton, but, connected together as they are, would not lead one to expect any great variety.

The Gatun Lake will eventually be a large body of water with a surface of 164 square miles and a depth of 47 feet. At the time the collections were made, the lake was very small. Especially careful collections were made in this lake and in the neighboring waters and in sufficient numbers to give a good idea of its flora and fauna.

As has been stated before there are no natural lakes in the Canal Zone. The Canal Commission, however, has built, for sanitary purposes, a series of reservoirs and these, having been in existence for a considerable period, may be considered as lakes. Following is a list of these reservoirs with the dates of their construction. These dates are stated as given by Downes (Downes, 1910, 1). The depths given are the maximum depths at the time the collections were made.

| | Built | Elevation | Depth |
|---|---|---|---|
| Cocoli | 1909 | 36 feet | 33 feet |
| Rio Grande | 1906 | 240 " | 50 " |
| Camacho | 1907 | 370 " | 45 " |
| Carabali | 1906 | 76 " | 10 " |
| Agua Clara | 1910 | 68 " | 30 " |
| Brazos Brook | 1906 | 48 " | 25 " |

While the Rio Grande is considered as constructed in 1906, it is really an old French reservoir which was built sometime between 1882 and 1889 and has had a continuous existence since that time; it covers an area of 72.77 acres.

Besides these reservoirs there is the Mindi reservoir in the neighborhood of the Brazos Brook reservoir which was to be abandoned soon after the collections were made, and, at that time, no attempt was made to keep it in sanitary condition.

There is a reservoir at Toro Point but this, when visited, was found dry. These reservoirs were made by constructing dams in places where the waters of small streams could be impounded. The beds were cleared of vegetation except in the case of the Cocoli, and after construction, the shores were kept clear of vegetation to a distance of fifty or more feet from the margin. The condition of the waters in these reservoirs has been explained in detail by Downes (Downes, 1910). The reservoirs were all "plankton-poor." This is what

would be expected from their environment which produces permanent bottom stagnation. In cold climates the bottom waters of lakes have a more or less complete stagnation in summer and in winter, the stagnation being more complete in the smaller bodies of water in which winds have no opportunity to produce bottom currents, but in spring and in fall, because of the change in temperature, there is a complete overturning of the water. No such change, of course, takes place under the constant temperature conditions of the Canal Zone, so that only the surface waters contain the oxygen which is necessary for the life of the plankton organisms. This has led to a practical difficulty in the use of the waters for sanitary purposes, and it has been found necessary in some cases to so arrange the outflow pipes from the reservoirs that the water shall always be taken from near the surface and thus avoid the foul odors of the deeper waters. While the foregoing statement is true in regard to the general condition of the waters of the reservoirs, it must not be understood as meaning literally that the oxygen always diminishes in exact ratio to the depth. Local and meteorological causes may produce some modifications of the general statement. This has been discussed by Downes who gives a series of charts of dissolved oxygen (Downes, 1910, 9 and 10). Downes also treats of the general chemical character of the waters and of their bacterial content.

The present report deals only with the copepods, and, inasmuch as the collections will be put into the hands of other specialists to treat of the other organisms, it is not pertinent to this report to say much of the character of the plankton as a whole until after the more complete examination of the collections has been made. Attention, however, may be called to the fact that the plankton of the Isthmus not only lacks great variety of species, but also with few exceptions, lacks great numbers of individuals. Diatoms were perhaps as abundant as would be expected, and in some cases the number of individuals was enormous. The filamentous algæ were present, but not especially abundant. The desmids were present in some collections in phenomenal numbers. This was noticeably true of some species of *Micrasterias* and *Closterium*. One or two of the pond collections consisted largely of *Micrasterias*. The desmids were quite numerous in the Carabali reservoir, a reservoir which according to Downes has given much trouble. Downes states that *Anabæna* occurs in this reservoir but it was not noticed at the time these collections were made.

The Protozoa and Rotifera were present in comparatively small numbers.

The Cladocera and Ostracoda, too, were not numerous. The small numbers of Cladocera presented a striking contrast to similar collections made in the United States.

## DESCRIPTION OF THE COPEPODA

### PSEUDODIAPTOMUS CULEBRENSIS, new species

The cephalothorax is oval (pl. 1, fig. 1), the first segment being about one-third its total length, and the first two together considerably exceeding one-half the total length. The segments fit closely together with no overlap so that the dividing lines between the segments are not very distinct on the lateral margins. The dorsal surface of the fifth cephalothoracic segment is thickly beset with short hairs. The angles of the last cephalothoracic segment are rounded and armed with hairs.

The first and second segments of the female abdomen (pl. 1, fig. 2), are about equal in length, and the third is about one-half the length of the second. The furcal rami are long and slender and somewhat less in length than the combined length of the second and third segments. There is a row of hairs on the left lateral margin of the third segment and the inner margins of the furcæ are ciliate.

The abdomen of the male (pl. 1, fig. 4) is long and slender, all the segments being of approximately the same width, and the three preceding the last, armed on the posterior border with a row of small spines. The furcal rami are short, somewhat exceeding in length the last abdominal segment, and ciliate on the inner margin.

The antennæ are composed of 22 segments and somewhat exceed in length the cephalothorax. The part of the male right antenna beyond the geniculating joint (pl. 1, fig. 7) is composed of two segments. The form of the swimming feet is typical of Pseudodiaptomus (pl. 1, fig. 5).

In the female fifth feet (pl. 1, fig. 3) the endopodites are wanting. The distal margin of the second basal segment is armed on one side with a row of blunt spines and has a small lateral hair at almost one-third its length. The exopodite consists of two segments and a hook articulated to the second segment. Each segment of the exopodite is armed at its outer distal angle with a long and slender spine. The second segment has, in addition, on its inner distal margin, two spines, one short, the other two-thirds as long as the spine on the outer margin and ciliated. The terminal hook is slender and acute, about equal in length to the first segment of the exopodite; except for a sharp curve at its base it is straight. It bears on the inner margin of the base a short blunt spine.

In the fifth feet of the male (pl. 1, fig. 6) the first basal segments have a row of a few long acute spines on the posterior surface. The second basal segment of the right foot is much wider at the proximal margin than at the distal, due mainly to a curved projection on the inner margin. This curved projection is armed with long acute spines. On the posterior surface a cuticular ridge runs diagonally across the segment, and this is armed over its proximal third with a row of sharp spines. There are two stout hairs about midway of its posterior surface near the outer margin; opposite these hairs there are on the outer margin a few short hairs, and the distal angles have a few hairs.

The first segment of the exopodite is as wide as long. There is an acute spine at its outer distal angle, and a stout process on the dorsal surface near the distal end; this process is about one-half as long as the segment. Upon the middle of the posterior surface is a stout hair about as long as the process, and from the middle of the interior margin projects laterally a long hair. There are a few stout spines near the inner distal angle of the segment.

The second segment of the exopodite is somewhat shorter than the second basal segment and its outer margin is very nearly the arc of a circle. The lateral spine is situated a little distad of the middle of the outer margin, is straight, about as long as the first segment of the exopodite and denticulate on the margin. The terminal hook is sickle-shaped, about as long as the rest of the exopodite, has two short hairs near its proximal end and is denticulate on the inner margin.

There is no endopodite on the right foot.

The second basal segment of the left foot is about as long as broad, and extends somewhat beyond the middle of the corresponding segment of the right foot. Its inner margin is armed with long acute spines, and it has a hair on the posterior surface near the inner distal angle. The first segment of the exopodite is longer than wide, and approximately quadrangular in outline.

The second segment of the exopodite is about equal in length to the first, is curved, the outer margin being convex and the inner concave, and is armed with three blunt spines. The endopodite is composed of a single segment and is considerably longer than the first segment of the exopodite.

In all the specimens seen the right egg sac of the female was apparently atrophied. The left sac contains about eight eggs while there is no evidence of eggs in the right sac which is much smaller. A simi-

lar condition has been recorded by Dahl in regard to *Pseudodiaptomus richardi* Mrazek. He says (Dahl, 1894, p. 11): "Interessant ist die Art dadurch, dass sie als einzige mir bekannte Calanide zwei und zwar zwei ungleichliche Eiersäcke besitzt. Der linke Sack ist immer grösser und enhalt 10-12 Eier, während man in rechten deren 4-5 findet."

Average length of female 1.22 mm. Length of male 0.883 mm.

The type specimens were collected by Messrs. Meek and Hildebrand in Rio Culebra, a branch of the Rio Chepo, in Panama, in brackish water.

The type of the genus, *Pseudodiaptomus pelagicus* was described by Herrick (Herrick, 1884) from material collected in Mississippi Sound in brackish water. Since that time ten other species have been described. Three, *P. acutus, P. gracilis* and *P. richardi,* were described by Dahl (Dahl, 1894) from material collected at the mouth of the Amazon. Two, *P. hessei* Mrazek (Mrazek, 1894) and *P. serricaudatus* Th. Scott (Scott, 1893), were in the mouth of the Congo. *P. salina* Giesbrecht (Giesbrecht, 1896) occurs in the Red Sea. *P. stuhlmanni* Poppe and Mrazek (Poppe and Mrazek, 1895) was found in the Quilimani River on the east coast of Africa. *P. lobipes* Gurney (Gurney, 1907), was found in tanks at Calcutta, *P. poppei* Stingelin (Stingelin, 1900) in the fresh waters of Celebes, and *P. forbesi* Poppe and Richard (Poppe and Richard, 1890), in Lake Sitai and river Whangpoo near Shanghai.

Thus of the eleven described species apparently four were found in fresh water, one in salt water, and the others in brackish waters.

*P. culebrensis* is the first member of the genus to be described from the west coast of America, and is very distinct in its structure from the other species. Inasmuch as the genus is practically world wide in its distribution, it seems probable that further collections will bring to light many more species.

### PSEUDODIAPTOMUS CRISTOBALENSIS, new species

The first segment of the cephalothorax exceeds one-third the total length of that part of the animal, and the first two somewhat exceed one-half the length. The last segment is terminated with a rather prominent acute spine on each side (pl. 2, fig. 5).

The abdomen of the male (pl. 2, fig. 1) is slender. The last segment is about one-half as long as the preceding. The furcal rami are about twice as long as the last abdominal segment and are ciliate on the interior margin.

The antennæ are composed of 21 segments, and about equal in length the cephalothorax. The part of the male right antenna beyond the geniculating point is composed of two segments.

In the fifth feet of the male the first basal segment of the right foot is short (pl. 2, fig. 3) as broad as long and has on its inner margin a few very short spines. In the second basal segment the length is to the breadth as four to three; it has a patch of rather short spines near its inner margin and a small lateral hair on the outer margin at about two-thirds its length. It has a row of spines in the distal margin of the anterior surface. The first segment of the exopodite is about as broad as long. The outer distal angle is prolonged into a dentate process. The inner margin is armed with two or three rows of stout spines and upon the posterior surface not far from the inner distal angle is a large spine. The second segment of the exopodite is about equal in length to the second basal segment. The outer margin is convex, while the inner is slightly concave. The distal end is about twice as broad as the proximal. The lateral spine is near the distal end, is straight, acute, and about as long as the first segment of the exopodite. Nearly opposite the lateral spine there is, on the inner margin, a short hair. The terminal hook is symmetrically curved, denticulate on the inner margin and somewhat shorter than the rest of the exopodite. It has two short spines near the proximal end. There is no endopodite on the right foot.

The second basal segment of the left foot (pl. 2, fig. 2) is not quite twice as long as broad, is quadrangular in general outline, and bears two small lateral spines a little beyond its middle. It has a row of spines on the distal margin on the anterior surface. The first segment of the exopodite is quadrangular, broader than long, and bears a stout spine at its outer distal angle. On the distal margin on the anterior surface is a row of spines. The second segment is twice as long as the first. About midway of its length it has a stout spine on the outer margin, and opposite this a small one on the inner margin. The distal margin is setose. At the inner distal angle is a stout serrate spine, and another similar spine near the inner margin at about three-fourths the length of the segment. The left endopodite is club-shaped, setose at tip, with two somewhat long setæ, and extends about one-third the length of the second segment of the exopodite. Length 0.1 mm.

The female of this species is unknown. In connection with the males two immature females were found. One certainly did not belong to this species. The other probably did, but was too immature to make a description possible.

The species is so clearly distinct from other species that it has seemed best to give the description in spite of the fact that the females are unknown.

*Pseudodiaptomus cristobalensis* was found in the collections made in the old French canal, in salt and brackish water, and has been given this specific name as it may be considered characteristic of the brackish water of the Atlantic side of the isthmus. It seems probable that further collections will bring to light at least one other species of this genus.

### DIAPTOMUS GATUNENSIS, new species

A small species. The first cephalothoracic segment is about twice as long as the second. Each of the succeeding segments is slightly shorter than the one anterior to it. The last cephalothoracic segment is armed with an acute spine on each side (pl. 1, fig. 9), and has on the posterior border of each side about three small blunt spines. The general form of the cephalothorax is a narrow oval. The dorsal surface of the fifth cephalothoracic segment near its posterior border is thickly covered with minute spines. These spines are much more numerous in the female than in the male.

The first segment of the female abdomen (pl. 2, fig. 7) slightly exceeds the rest of the abdomen including the furca. It is dilated laterally, its greatest width being to its length as about three to four. It is armed on each side with an acute spine of moderate size. The second segment is less than half the length of the third. The furcal rami are somewhat shorter than the third abdominal segment and are ciliated on the inner margin.

The antennæ reach considerably beyond the end of the furca. The right male antenna is swollen anterior to the geniculating joint; the antepenultimate segment has a hyaline lamella extending its length and projecting from its distal end in a blunt point (pl. 2, fig. 10).

The spines of the first basal segments of the female fifth feet (pl. 1, fig. 8) are large and prominent. The lateral hair of the second basal segment is of usual size.

The first segment of the exopodite is about twice as long as wide. The second segment, with the hook, is nearly as long as the first segment, and bears a rather small spine on its outer distal angle. The inner margin of the hook is finely denticulate. The third segment is distinct and bears two slender spines, the inner of which is nearly twice as long as the outer. The endopodite is composed of a single segment, is about one-half as long as the first segment of the exopodite, and has inconspicuous setæ near the tip.

The spines of the first basal segments of the male fifth feet (pl. 2, fig. 4) are acute, with a prominent mammilliform base. The second basal segment of the right foot is somewhat longer than wide; the lateral hair is situated at four-fifths of its length. The first segment of the exopodite is ordinarily wider than long, and has a short cuticular ridge near its distal margin on the caudal aspect. The second segment exceeds in length the combined length of the first segment and the second basal segment, and is about twice as long as wide. About midway of its caudal surface there are three cuticular ridges. The lateral spine is situated near the distal end of the segment, is stout and straight, finely denticulate on the margin, and is somewhat shorter than the segment. The terminal hook is falciform, with a nearly symmetrical curvature, finely denticulate on the inner margin, and about equals in length the combined length of the rest of the exopodite and the second basal segment. The endopodite is triangular in form, not exceeding in length the first segment of the exopodite, and has a few short setæ near the tip of the inner margin.

The left fifth foot of the male extends a little beyond the distal margin of the first segment of the exopodite of the right foot. The second basal segment is about four-fifths the length of the corresponding segment of the right foot, is trapezoidal in shape, its distal margin being about two-thirds as long as the proximal; the lateral hair is situated at three-fourths its length. The first segment of the exopodite is about three-fourths the length of the second basal segment. It is curved, the convexity being exterior, and bears a setose pad on its inner surface. The terminal segment is nearly as wide as long, is armed at the end with two small papilliform processes, and has on the inner margin near the end a minute setose papilliform process. The endopodite is triangular, about as long as the first segment of the exopodite, and setose on the inner margin near the end.

Length of female 1.48 mm. Length of male 1.31 mm.

This was found in great numbers in a collection made in the Black Swamp near the old line of the Panama Railroad.

It occurred also in a pond at Bohio which had been there since the time of the French excavations.

### DIAPTOMUS LEONINICOLLINUS, new species

A small species. The form and details of structure of the cephalothorax and abdomen are like *D. gatunensis*. As in that species the antennæ extend beyond the furca, and the antepenultimate segment of the right antenna of the male has a hyaline lamella of the same form (pl. 2, fig. 8).

The fifth foot of the female (pl. 2, fig. 9) is like that of *D. gatunensis* except that the endopodite is more slender and longer, being two-thirds the length of the first segment of the exopodite.

The spines of the first basal segments of the fifth feet of the male (pl. 2, fig. 6) are acute on a prominent mammilliform base. The second basal segment of the right foot is longer than wide, and has a conical projection on its caudal surface. The lateral hair is situated at four-fifths of its length. The first segment of the exopodite is twice as long as wide, its distal angles are prolonged into blunt, rounded projections, and near the inner distal angle it has on the caudal surface a curved cuticular ridge. The second segment is considerably shorter than the combined length of the first segment and the second basal segment, is approximately oval in outline, its greatest width being about two-thirds its length. The lateral spine is situated near the end of the segment, is stout and straight, finely denticulate on the margin, and less than one-half the length of the segment. The terminal hook is falciform in its general shape, but with the tip recurved, is denticulate on the inner margin, and is considerably less in length than the combined length of the rest of the exopodite and the second basal segment. The endopodite is rudimentary, being a triangular projection armed with short setæ on the inner margin.

The left fifth foot of the male is like the corresponding foot in *D. gatunensis.*

Length of female 1.581 mm. Length of male 1.362 mm.

This was found in a collection made by Meek and Hildebrand near Lion Hill, C. Z.

It will be noticed that *D. leoninicollinus* is somewhat larger than *D. gatunensis.* The principal distinctive points, however, are in the structure of the fifth feet. These differences in a genus like Diaptomus, which shows so little variation in specific characteristics, are amply sufficient for the establishment of the species.

### DIAPTOMUS MARSHI Juday

1913. *Diaptomus marshi* JUDAY, p. 804, figs. 1 and 2.

A small species. The first cephalothoracic segment (pl. 3, fig. 5) is about as long as the combined length of the three following segments. The last cephalothoracic segment is armed on each side with two rather blunt spines.

The first segment of the female abdomen (pl. 3, fig. 4) considerably exceeds in length the rest of the abdomen including the furca; it is dilated in front and bears upon each side a small blunt spine. The

second abdominal segment is very short being only about one-fourth the length of the third.

The third segment and the furcal rami are about equal in length. The furcal rami are ciliated on the inner margin. The egg sac of the female has about 16 eggs.

The antennæ reach the end of the furca. The right antenna of the male is swollen anterior to the geniculating joint; the antepenultimate segment has no special armature.

The spines of the first basal segments of the fifth feet of the female (pl. 3, fig. 1) are stout and blunt.

The lateral hair of the second basal segment is small. The first segment of the exopodite is about three times as long as wide. The second segment, with the hook is about as long as the first. The inner margin of the hook is finely denticulate. The third segment is distinct and bears two spines, the inner being about twice as long as the outer. The endopodite is composed of a single segment in the Guatemala specimens, but in the Panama material it is indistinctly two-segmented; it is about two-thirds as long as the first segment of the exopodite and bears two spines near the tip.

The spines of the first basal segments of the male fifth feet (pl. 3, fig. 2) are of fair size and stout. The second basal segment of the right foot is longer than wide, with a blunt projection on its inner margin at about one-third its length. The lateral hair is small and situated near the distal end of the segment. The first segment of the exopodite is about two-thirds as long as wide, the outer margin being considerably longer than the inner; it has an arcuate cuticular ridge on the posterior surface near the distal end of the segment and, projecting from this, a stout, blunt spine: back of this is a second cuticular prominence of varying size. The second segment is about as long as the second basal segment and has an elongated oval outline. The lateral spine is situated at about the middle of the segment, is slightly curved, and about equals in length the combined lengths of the first and second segments of the exopodite; the inner margin of the spine bears five to seven blunt teeth. These teeth are seen more distinctly in the magnified figure (pl. 3, fig. 3). This dentate lateral spine is unique, not having been noted in any other species. The terminal hook is falciform with a symmetrical curvature, and in length about equals the rest of the foot exclusive of the first basal segment. The endopodite of the right foot is triangular, equalling in length the inner margin of the second basal segment and is setose at the tip.

The left fifth foot of the male reaches the second segment of the right exopodite. The second basal segment is about three-fourths the length of the corresponding segment of the right foot, is trapezoidal in form, and bears the small lateral hair near the distal end. The first segment of the exopodite is somewhat shorter than the first basal segment, and is much narrower at its distal end. It has a setose pad on the inner surface. The terminal segment is about two-thirds as long as the first and ends in a digitiform process. About midway of its length is a stout curved spine, and there is a setose pad on its inner margin.

The endopodite is composed of one segment and about equals in length the first segment of the exopodite.

Length of female 1.35 mm. Length of male 1.1575 mm.

This was first found in Guatemala by Juday, near Puerto Barrios and Los Amates, and was described by him in Trans. Wisconsin Acad., Vol. 17, Pt. 2, pp. 803-806.

Inasmuch as it is a new species of considerable interest in connection with the fauna of Panama, it has seemed best to describe it in some detail in this place, with figures which will show the characteristic features of the species.

In Panama it occurred in the Comacho reservoir and in Rio Trinidad.

### CYCLOPS LEUCKARTI Claus

*Cyclops leuckarti* was found generally distributed in the Canal Zone, as would be expected, it being a cosmopolitan species.

It occurred in all the sanitary reservoirs and in most of the other fresh-water collections. The synonymy of this species has been discussed in a former publication (Marsh, 1910, 1081-85), and it is not necessary to enter upon that subject here. The Panama specimens agree very closely with the types found in other localities. Plate 3, fig. 6, shows the connecting membrane of the fourth feet; the two blunt spines are characteristic of this species and of *tenuis*. Judging from the figure of Schmeil (Schmeil, 1892, pl. 3, fig. 6) these spines are much more prominent in European specimens than in those from America. Plate 3, fig. 14, shows the labrum. In many of the Panama specimens it was noticed that the hyaline membrane of the sixteenth segment was minutely serrate (pl. 3, fig. 9). This was true also of some specimens collected near Havana, Cuba. This apparently has never been noted in individuals from other localities, except that it is figured, without remark, by Kokubo, 1912, from material collected in Japan.

### CYCLOPS ALBIDUS Jurine

*Cyclops albidus* was found only in the collections made in the Black Swamp.

No significance is to be attached to this restricted distribution, as the species is found the world over; it simply means that it probably does not occur in any great abundance in the Canal Zone, at least at the time of year when the collections were made.

### CYCLOPS SERRULATUS Fischer

*Cyclops serrulatus* occurred on the northern slope in the Comacho reservoir, in a pond at Bohio, in the Black Swamp, and in the Rio Trinidad and the water immediately connected with it. On the southern slope it was found at Miraflores and in stagnant water on the savannas near Panama.

### CYCLOPS PRASINUS Fischer

*Cyclops prasinus* occurred in only a few localities. It was found in the Black Swamp, a region that is to be covered by Gatun Lake, in Gatun Lake, in a stream near the Alhajuela caves, and in a pond near Bohio.

### CYCLOPS TENUIS Marsh

1910. *Cyclops tenuis* MARSH, p. 1085, pl. 75, figs. 4-9, pl. 79, fig. 5.

*Cyclops tenuis* was originally described from material collected at Calabasas, Arizona, and up to the present time has been found in no other locality. Its occurrence in the Canal Zone is therefore a matter of considerable interest. It belongs to the *leuckarti* group resembling that species in general form, armature of the fifth feet, and spinous armature of the membrane connecting the fourth feet, but differing in size, lack of armature of terminal segments of the antennæ and of crenulations on the maxillipede, and in the form of the fifth feet and of the receptaculum seminis.

It is very closely related to *C. oithonoides,* from which it distinctly differs in the fact that the antennæ are shorter and do not have a hyaline membrane on the terminal segments; the receptaculum seminis, too, is different from that in *C. oithonoides.*

The specimens from the Canal Zone correspond very closely with those from southern Arizona, but were much smaller. The average length of females from Gatun Lake was 0.683 mm., from the Trinidad River 0.66 mm., and from Agua Clara Reservoir 0.63 mm. Most of the egg-bearing females had four eggs in each sac; none have

been noticed with more than seven. There was considerable variation in the relative lengths of the terminal setæ of the furca.

Plate 3, fig. 12, shows the typical form from Calabasas in which the second seta from the outside is considerably longer than the fourth. In specimens from the savannas near Panama (pl. 3, fig. 11) the second and fourth are equal in length, while in others (pl. 3, fig. 10) from the Trinidad River, the fourth is very short. Schmeil considers the relative length of these setæ in *C. oithonoides* of specific importance, but this does not seem to be the case in *C. tenuis*. There does not seem to be anything in the relative length of the setæ that is characteristic of one slope of the isthmus as compared with the other, for specimens collected at Miraflores from the southern slope had the same relative length as those collected in the Trinidad River on the northern slope.

It will be noticed that the dorsal seta in the specimen figured from the savannas is abnormally long. This was not a uniform condition in the specimens from this locality, but was found in some individuals. There was a wide range of variation in this seta, a variation which was not distinctly correlated with local distribution.

Plate 3, fig. 7, shows the fifth foot of a specimen collected at Bohio. The inner spine of the terminal segment was not in all cases distinctly serrated. Plate 3, fig. 13, shows the connecting membrane of the fourth feet, and plate 3, fig. 8, shows the form of the receptaculum seminis.

*Cyclops tenuis* was found on the southern slope at Miraflores, Cocoli Reservoir, and on the savannas near Panama. On the northern slope it was found in a pond near Bohio, in Gatun Lake, Trinidad River, in a spring at Toro Point, and in the reservoirs on the northern slope, namely Comacho, Carabali, Mindi, and Agua Clara. It may be considered one of the most characteristic copepods of this region.

*Cyclops oithonoides* has been reported from Haiti, Richard '95, p. 1, and Paraguay, Daday, 1905, 142. Inasmuch as in neither of these cases have the details of the anatomy been given, it seems possible that the authors had *C. tenuis* rather than *C. oithonoides*.

### CYCLOPS DENTATIMANUS, new species

A slender species. The last cephalothoracic segment is armed on each side with a stout ciliated seta.

The abdomen (pl. 4, fig. 10) is slender. The first segment is enlarged at the anterior end, and equals in length the two succeeding

segments and one-half the third. The second, third, and fourth segments are about equal in length.

The furcal rami (pl. 4, fig. 6) somewhat exceed in length the last cephalothoracic segment. The lateral setæ are situated at the distal third. The longer of the terminal setæ is nearly as long as the abdomen and furca.

The first antennæ (pl. 4, fig. 8) are short and composed of twelve segments.

The inner margin of the claw of the maxillipede is armed with five prominent teeth. These are shown in plate 4, fig. 9, and more clearly in the figure of the claw (pl. 4, fig. 12). The presence of these teeth is a unique feature and the specific name is given because of this structure.

The rami of the swimming feet are two-segmented. The spinous armature of the terminal segments of the exopodites is represented by the formula, 3, 4, 4, 3. Plate 4, fig. 7, shows the fourth foot, and plate 4, fig. 5, the terminal segment of the endopodite of the first foot. The connecting membrane between the fourth feet is armed with two rows of fine spines.

The fifth feet (pl. 4, fig. 11) are one-segmented. This segment is elongated, its length being about three times its width. It is armed at the distal end with a minute spine and a seta, which is a little more than twice as long as the segment.

*Cyclops dentatimanus* was found on the savannas between Panama and Old Panama in a stagnant stream in which were large numbers of *C. æquoreus* and *C. panamensis*. In the collection a glance was sufficient to show its specific distinction from *C. panamensis* because of its larger size and short antennæ. Only a few individuals were found of this species. Two of them were mature females. As they were dissected before measurements were taken, on the assumption that a larger number would be found, the description is incomplete as far as the morphology of the cephalothorax is concerned. The species, in its general structure is almost identical with *Cyclops anceps* Richard (Richard, 1897), which was found in Brazil. The receptaculum seminis, however, is of a different form, and Richard does not mention the peculiar structure of the maxillipede, which was so noticeable in *C. dentatimanus*. It is highly improbable that such a structure would have escaped the notice of so skilled and experienced an investigator as Richard. Daday (Daday, 1902b, 443), who afterwards identified *C. anceps* in material from Chili, does not mention any unusual form of the maxillipede. Later he records

*C. anceps* from Paraguay (Daday, 1905, 133-134) and from the East Indies (Daday, 1906, 181). In regard to the Paraguay material he says (Daday, 1905, 134): "am unteren Maxillarfuss ist die sichelförmige Kralle de vorletzten Gliedes sehr kräftig, nahe zur Basis mit kurzen Zähnchen bewehrt." His figure, however, shows nothing to compare with the teeth in *C. dentatimanus,* and we may assume that he refers to the minute teeth which are found on this segment in other species of Cyclops.

### CYCLOPS PANAMENSIS, new species

A slender, graceful species. The cephalothorax is oval, its length comparing with its breadth as about 9 to 5. The length of the abdomen exclusive of the furcal rami about equals the breadth of the cephalothorax. The last cephalothoracic segment is armed on each side with a prominent seta, and the margins have minute spines.

The abdomen (pl. 4, fig. 1) is slender. The first segment is enlarged at its anterior end, and somewhat exceeds in length the two succeeding segments. The remaining segments of the abdomen equal each other in length.

The furcal rami are slender and are nearly equal to the combined length of the two preceding segments. The lateral setæ are situated at the distal third of the furcæ. Of the four terminal setæ, the outer and inner are weak and short, the inner being considerably shorter and smaller than the outer. The longest of the terminal setæ about equals in length the combined length of the last three abdominal segments and the furcæ.

The first antennæ (pl. 4, fig. 3) are composed of eleven segments and reach to about half the length of the second cephalothoracic segment. The segments have the customary armature of setæ but have no distinctive structures.

The rami of the swimming feet are two-segmented. The spinous armature of the terminal segments of the exopodites is represented by the formula 3, 4, 4, 3. The first segments of the rami are armed on the distal border by a row of minute spines. The membrane connecting the feet of the fourth pair is armed on each side with three blunt spines. Plate 4, fig. 4, shows the fourth feet.

The fifth feet (pl. 4, fig. 2) are one-segmented. This segment is short and broad, its length only slightly exceeding its width. The inner distal angle is prolonged into a fine needle-like spine; this is apparently a part of the segment, and is not separated by a joint. At

the outer distal angle it bears a stout seta which is of about the same length as the seta upon the last cephalothoracic segment.

The egg sacs contain from seven to ten eggs each.

The average length of the mature females is 0.696 mm.

Found on the savannas between Panama and Old Panama.

### CYCLOPS VARICANS Sars

The occurrence of *Cyclops varicans* in America has been discussed in a former paper (Marsh, 1910, 1101). While there was good reason to suppose that this species, of world-wide distribution, belonged also to the fauna of North America, in the absence of figures and descriptions there was still some doubt. Daday has reported it in Patagonia (1902a, p. 208) and Paraguay (1905, p. 135), while van Douwe (1912, 315) has reported it in Brazil. Only a few individuals were found in the Panama collections and these in only one locality, the Black Swamp, along the old line of the Panama Railroad. These individuals were mature, however, and corresponded in all details to the typical forms. The first antennæ are short and composed of twelve segments (pl. 5, fig. 4).

The swimming feet are two-segmented, the formula for the spines of the terminal segments being, 3, 4, 4, 3. Plate 4, fig. 13, shows the third foot.

The last cephalothoracic segment is armed on each side with a long seta. The fifth foot consists of a single long slender segment terminated with a seta (pl. 5, fig. 5).

The female carries about twelve eggs in each sac.

Plate 5, fig. 1, shows the form of the abdomen.

### CYCLOPS QUINQUEPARTITUS, new species

This interesting species occurred only in collections made in the Black Swamp along the line of the Panama Railroad. Only a few individuals were found. It was at first supposed to be *Cyclops phaleratus*. Careful examination showed that it corresponded in structure to *C. phaleratus* in all particulars except that the first antennæ are composed of only five segments.

No egg-bearing females were found, but they were apparently mature, the swimming feet being fully developed and the general appearance of the animal indicating maturity. No detailed description is necessary as it corresponds to *C. phaleratus* in all particulars except the segmentation of the first antennæ. It is somewhat smaller than *phaleratus*.

In plate 5, figs. 3, 2, and 7, are given drawings of the first and second antennæ and of the fourth swimming feet.

Van Douwe, 1912, 315, reports *Cyclops phaleratus* from Brazil, but states that the forms, although mature, had antennæ of seven segments. It seems possible that further study of South American and Central American material may result in the establishment of a group of Cyclops species closely related to *Cyclops phaleratus*.

**CYCLOPS ÆQUOREUS Fischer**

The literature and synonymy of *Cyclops æquoreus* have been given in a former paper (Marsh, 1910, 1106). The species is very widely distributed, being found as far north as Finland (Martens, 1910, 110), and as far south as Algeria (Blanchard and Richard, 1891, p. 515). It has been found in Madeira and in the Sea of Aral. Thus far there have been only two recorded localities in America. Herrick found it in waters connected with the Gulf of Mexico (Herrick and Turner, 1895, 122), in Mississippi Sound, and Mr. E. Foster has collected it in Lake Ponchartrain. Considerable interest, therefore, attaches to its occurrence in Panama. It occurred in a sluggish stream on the savannas near Panama and in an old well in Old Panama. In both cases the water was fresh, but it might have easily migrated to those locations from brackish water. Inasmuch as figures of the species as occurring in America have not been published, it has been deemed best to illustrate the typical peculiarities of the species. Plate 5, fig. 8 shows the antenna of the female, plate 5, fig. 6, the abdomen and fifth foot, and plate 5, fig. 9, the fourth swimming feet.

The formula for the spines of the terminal segment of the exopodites of the swimming feet is 3, 4, 4, 3.

## GENERAL OBSERVATIONS ON THE DISTRIBUTION OF THE COPEPODA FOUND IN PANAMA

The presence of *Cyclops albidus, Cyclops leuckarti, Cyclops serrulatus,* and *Cyclops prasinus* has no significance from the standpoint of the distribution of species. These species are cosmopolitan, and one would expect to find them in Panama. A new locality for a species has some interest, of course, but in these cases it only corroborates what we had known before of the world-wide distribution of these forms.

More interest attaches to *Cyclops varicans,* for, if this occurs in the United States, it certainly is uncommon, while apparently it is characteristic of the fauna of South America. The same may possibly be true of *Cyclops tenuis.* In the discussion of this species it is remarked that *Cyclops oithonoides* has been reported from

South America and from Haiti, and it is suggested that this may have been *C. tenuis*. In that case we should consider *C. tenuis* as a South American form with a northern limit of southern Arizona.

*Cyclops dentatimanus* and *C. panamensis* are South American in their general relationships.

*Cyclops æquoreus* is distributed widely, but has never before been reported from the west coast of America. It seems rather strange that it did not appear in the collections from the east coast, but those collections were few in number, and it is probable that further work will show that it is found there also.

The genus Pseudodiaptomus has been found in Europe, Asia, Africa, and North and South America. Both the species from the Pacific coast and that from the Atlantic coast are closely related to South American forms, that from the Atlantic coast being very close to one found in the mouth of the Amazon.

The three species of Diaptomus, too, find their nearest relatives in South America.

It is evident then, that the general character of the copepod fauna of the Canal Zone is much more closely related to the South American fauna than to that of North America. When we compare the north and south sides of the isthmus we find common to the two slopes *Cyclops leuckarti, C. tenuis,* and *C. serrulatus. C. æquoreus* we know is not peculiar to the Pacific slope. *C. albidus, C. prasinus, C. varicans, C. quinquepartitus, Diaptomus marshi, D. leoninicollinus, D. gatunensis,* and *Pseudodiaptomus cristobalensis* are found on the Atlantic side but not on the Pacific.

Peculiar to the Pacific slope are *Cyclops dentatimanus, C. panamensis,* and *Pseudodiaptomus culebrensis.* It will be noted that no species of Diaptomus are recorded from the Pacific slope. It does not follow, however, that none are present. Some immature specimens and one mature female were found, but no males, so that no diagnosis of species could be made. We certainly cannot consider *Cyclops varicans* as peculiar to the Atlantic side, for it is a South American species. In fact there is a reasonable doubt whether any of the species of Cyclops found on the northern slope are peculiar to that locality. Probably the three species of Diaptomus found on the northern side may be considered characteristic of that slope. So, probably the two new species of Cyclops found on the south side, *C. dentatimanus* and *C. panamensis* are peculiar to that slope. The species of the brackish water genus Pseudodiaptomus, too, are peculiar, that on the south shore differing from that on the north shore, but both are closely related to South American species.

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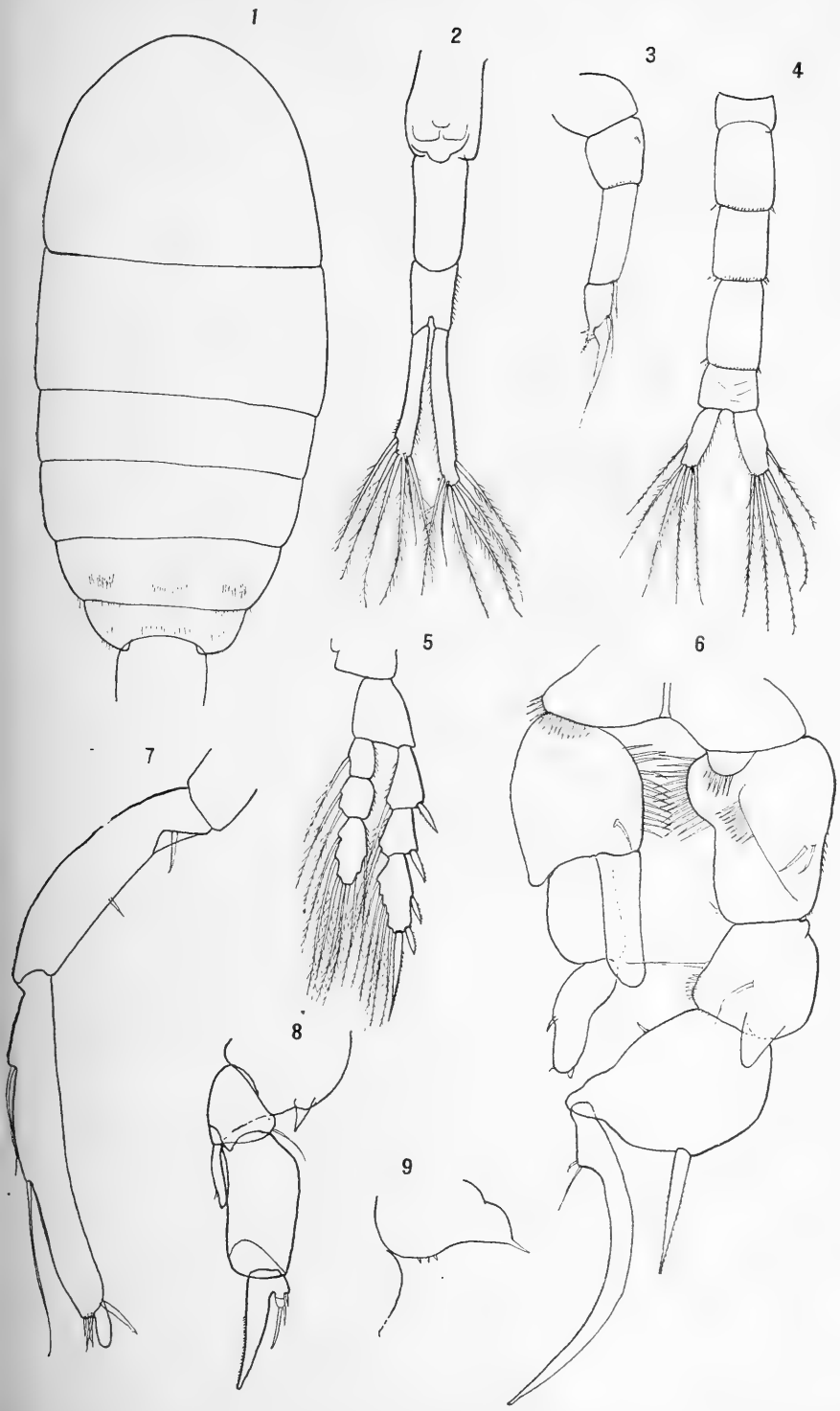
## PLATE 1.

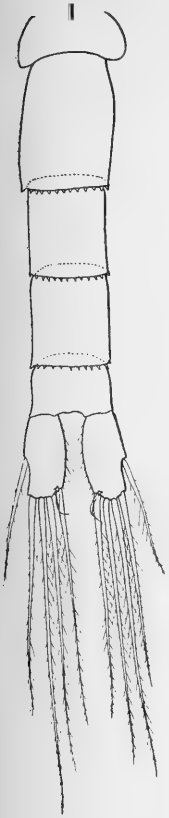
FIG. 1.—*Pseudodiaptomus culebrensis,* cephalothorax × 110.
FIG. 2.—*Pseudodiaptomus culebrensis* ventral surface of abdomen of female × 153.
FIG. 3.—*Pseudodiaptomus culebrensis,* fifth feet of female × 223.
FIG. 4.—*Pseudodiaptomus culebrensis,* abdomen of male × 153.
FIG. 5.—*Pseudodiaptomus culebrensis,* fourth foot × 223.
FIG. 6.—*Pseudodiaptomus culebrensis,* fifth feet of male × 438.
FIG. 7.—*Pseudodiaptomus culebrensis,* terminal segments of right antenna of male × 438.
FIG. 8.—*Diaptomus gatunensis,* fifth foot of female × 213.
FIG. 9.—*Diaptomus gatunensis,* one side of last cephalothoracic segment × 213.

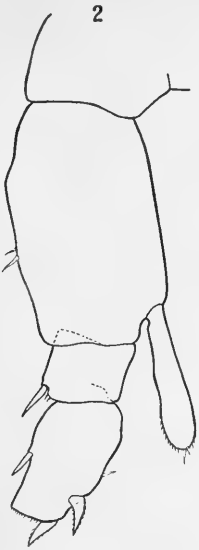


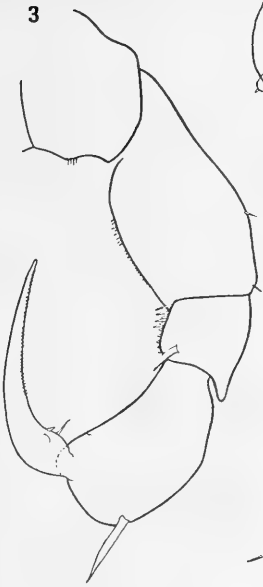

COPEPODA FROM PANAMA

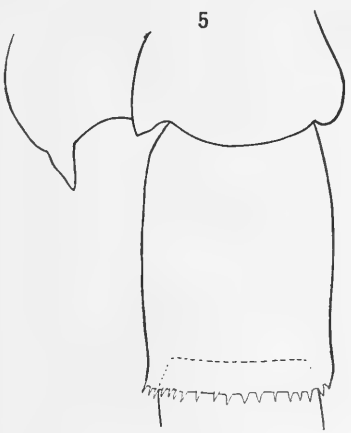
PLATE 2

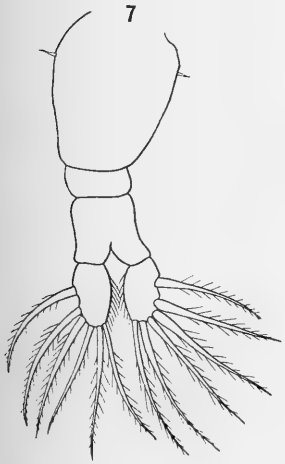
FIG. 1.—*Pseudodiaptomus cristobalensis,* abdomen of male × 223.
FIG. 2.—*Pseudodiaptomus cristobalensis,* left fifth foot of male × 438.
FIG. 3.—*Pseudodiaptomus cristobalensis,* right fifth foot of male × 438.
FIG. 4.—*Diaptomus gatunensis,* fifth feet of male × 223.
FIG. 5.—*Pseudodiaptomus cristobalensis,* one side of last cephalothoracic segment of male × 438.
FIG. 6.—*Diaptomus leoninicollinus,* fifth feet of male × 223.
FIG. 7.—*Diaptomus gatunensis,* abdomen of female × 110.
FIG. 8.—*Diaptomus leoninicollinus,* terminal segments of right antenna of male × 223.
FIG. 9.—*Diaptomus leoninicollinus,* fifth foot of female × 223.
FIG. 10.—*Diaptomus gatunensis,* terminal segments of right antenna of male × 223.

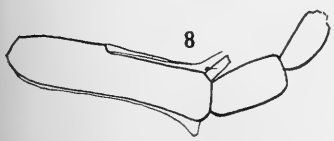




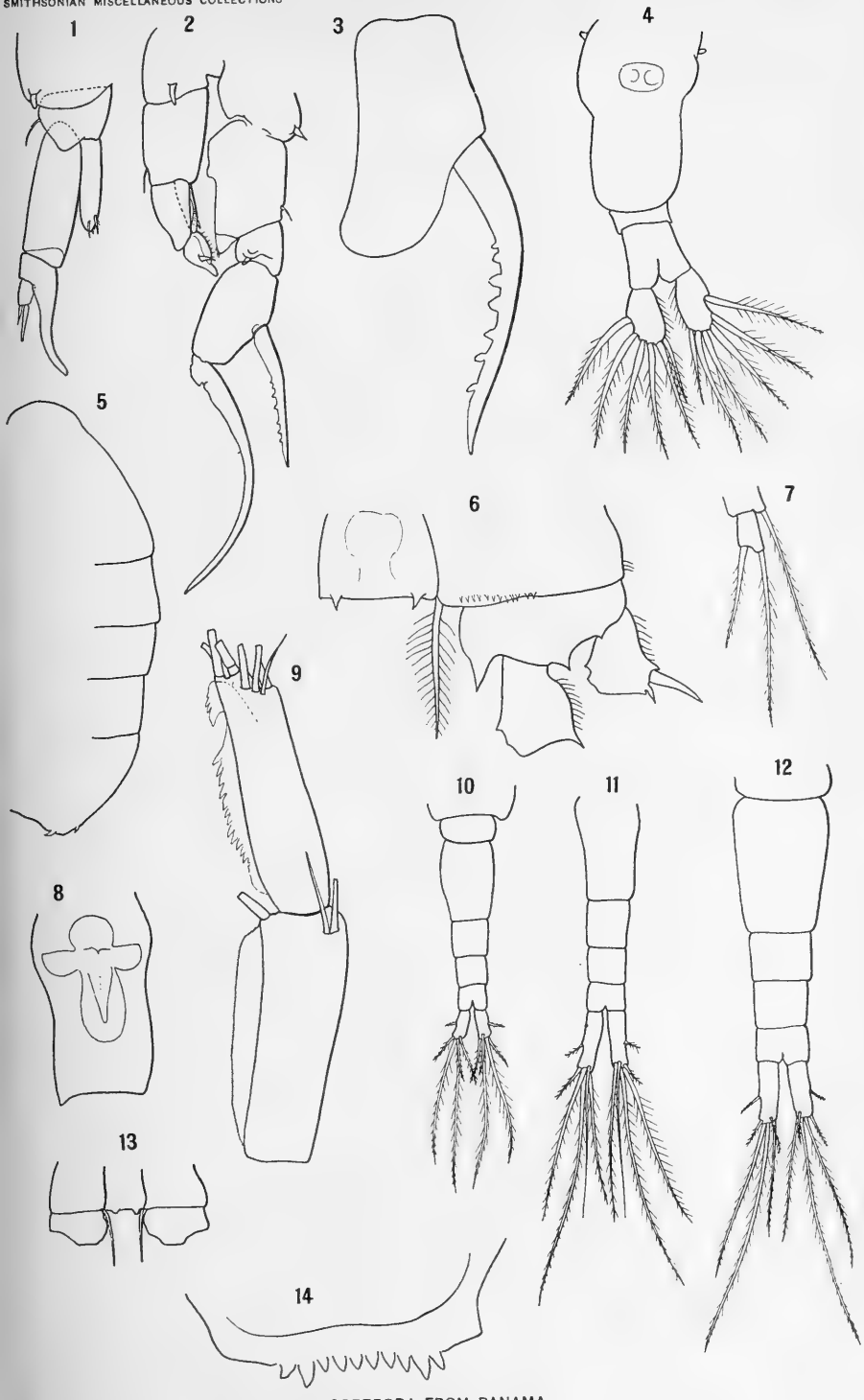


COPEPODA FROM PANAMA

## PLATE 3

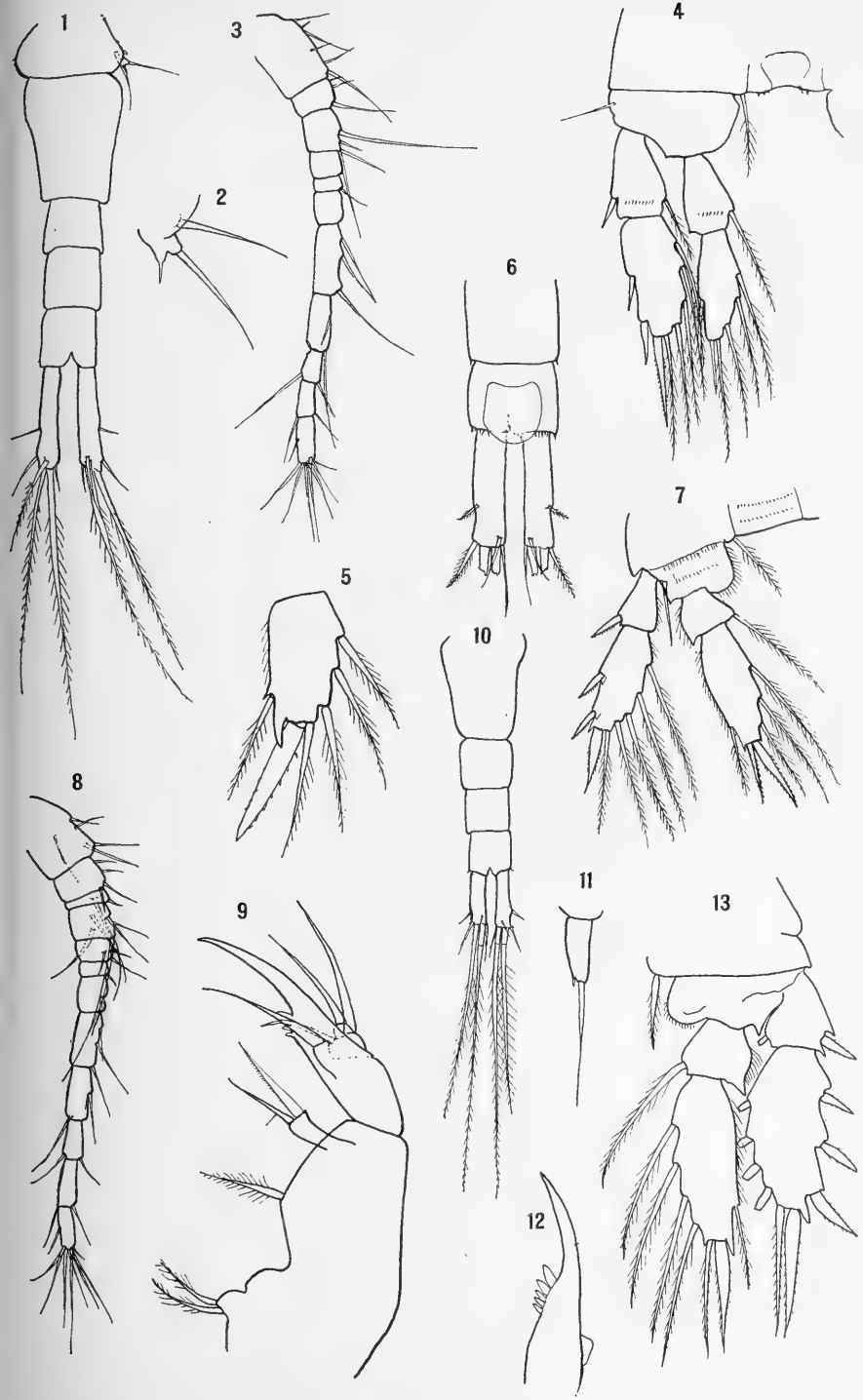
FIG. 1.—*Diaptomus marshi,* fifth foot of female × 223.
FIG. 2.—*Diaptomus marshi,* fifth feet of male × 223.
FIG. 3.—*Diaptomus marshi,* second segment of right fifth foot of male × 438.
FIG. 4.—*Diaptomus marshi,* abdomen of female × 110.
FIG. 5.—*Diaptomus marshi,* profile of cephalothorax of female × 223.
FIG. 6.—*Cyclops leuckarti,* basal segments and connecting membrane of fourth feet of female × 223.
FIG. 7.—*Cyclops tenuis,* fifth foot × 438.
FIG. 8.—*Cyclops tenuis,* receptaculum seminis × 223.
FIG. 9.—*Cyclops leuckarti,* terminal segments of antenna of female × 438.
FIG. 10.—*Cyclops tenuis,* abdomen of female from Rio Trinidad × 60.
FIG. 11.—*Cyclops tenuis,* abdomen of female from savannas near Panama × 110.
FIG. 12.—*Cyclops tenuis,* abdomen of female from Calabasas Ar.
FIG. 13.—*Cyclops tenuis,* basal segments and connecting membrane of fourth feet of female × 223.
FIG. 14.—*Cyclops leuckarti,* labrum × 438.




COPEPODA FROM PANAMA

## PLATE 4

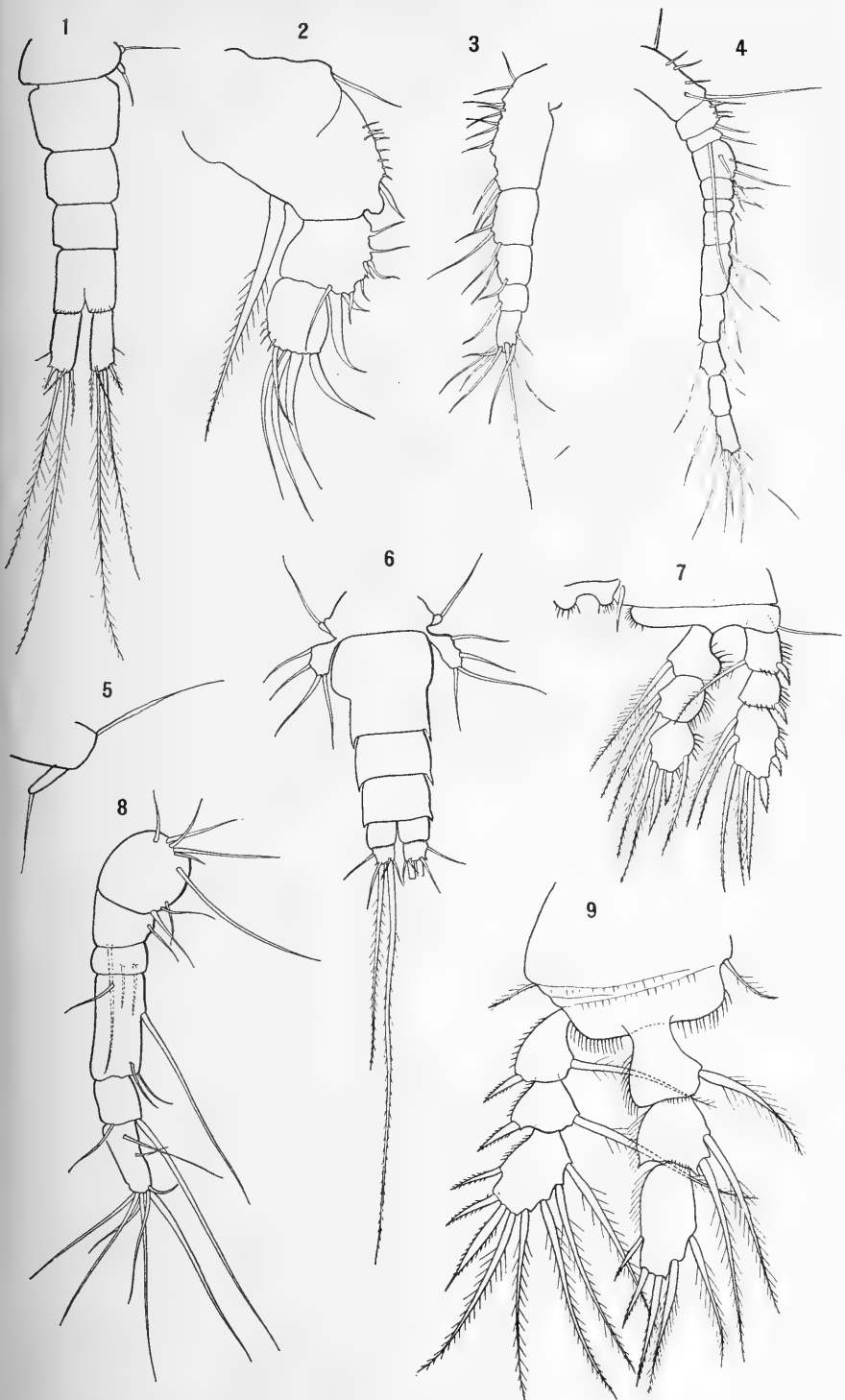
FIG. 1.—*Cyclops panamensis,* abdomen of female × 223.
FIG. 2.—*Cyclops panamensis,* fifth foot of female × 438.
FIG. 3.—*Cyclops panamensis,* first antenna of female × 223.
FIG. 4.—*Cyclops panamensis,* fourth foot of female × 438.
FIG. 5.—*Cyclops dentatimanus,* terminal segment of endopodite of first foot × 438.
FIG. 6.—*Cyclops dentatimanus,* terminal segments of abdomen and furca of female × 223.
FIG. 7.—*Cyclops dentatimanus,* fourth foot × 223.
FIG. 8.—*Cyclops dentatimanus,* first antenna of female × 223.
FIG. 9.—*Cyclops dentatimanus,* maxillipede × 438.
FIG. 10.—*Cyclops dentatimanus,* abdomen of female × 60.
FIG. 11.—*Cyclops dentatimanus,* fifth foot × 438.
FIG. 12.—*Cyclops dentatimanus,* claw of maxillipede × 438.
FIG. 13.—*Cyclops varicans,* third foot × 438.




COPEPODA FROM PANAMA

## PLATE 5

FIG. 1.—*Cyclops varicans,* abdomen of female × 223.
FIG. 2.—*Cyclops quinquepartitus,* second antenna × 438.
FIG. 3.—*Cyclops quinquepartitus,* first antenna × 223.
FIG. 4.—*Cyclops varicans,* first antenna × 223.
FIG. 5.—*Cyclops varicans,* fifth foot × 438.
FIG. 6.—*Cyclops æquoreus,* abdomen of female with fifth feet × 223.
FIG. 7.—*Cyclops quinquepartitus,* fourth foot × 223.
FIG. 8.—*Cyclops æquoreus,* first antenna of female × 438.
FIG. 9.—*Cyclops æquoreus,* fourth foot × 438.




COPEPODA FROM PANAMA

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 61, NUMBER 4

# SAFFORDIA, A NEW GENUS OF FERNS FROM PERU

(With Two Plates)

BY

WILLIAM R. MAXON

(Publication 2183)

CITY OF WASHINGTON
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The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

SAFFORDIA INDUTA Maxon
(NATURAL SIZE)

# SAFFORDIA, A NEW GENUS OF FERNS FROM PERU

By WILLIAM R. MAXON

(With Two Plates)

Among a small lot of ferns gathered in the mountains of Peru by Mr. W. E. Safford, in 1892, and presented by him to the U. S. National Museum, there are several sheets of the peculiar species here discussed. As may be seen from the accompanying illustrations the specimens have the habit and general outline of most species of Doryopteris, and at the same time the dense covering of closely imbricate scales which is characteristic of Trachypteris. Their venation, which is minutely areolate, without included veinlets, is almost exactly that of Trachypteris, yet the fronds differ materially in structure, particularly in being uniform rather than dimorphous, and otherwise indicate no immediate relationship to the species of that genus; nor were repeated efforts successful in associating the plants with any published species or group of species. Accordingly specimens were sent to Kew, to Georg Hieronymus in Berlin, to Dr. H. Christ, and to Mr. Carl Christensen, Copenhagen, for identification or for suggestions as to relationship. The replies elicited were alike in regarding this species as unpublished and as lacking any very near relatives, specifically. Further study having shown that it cannot properly be placed in any of the genera hitherto described, without unduly extending their limits, it is accordingly here recognized as the type of a new genus, a conclusion which Mr. Christensen also regards as correct.

The writer has had peculiar pleasure in dedicating this genus to its collector, whose ability and keen enthusiasm in the study of the natural sciences are hardly less notable than his researches in ethnology and his generous spirit of helpfulness to his associates.

**SAFFORDIA Maxon, new genus**

Fronds small, uniform, stiffly erect, fasciculate from a short densely paleaceous rhizome; stipes stout, firm, polished, densely paleaceous, the scales imbricate, deciduous; lamina deltoid-pentagonal, pinnately parted, the basal segments strongly basiscopic, pinnately parted; leaf tissue rigid, densely appressed-paleaceous beneath, the scales closely

imbricate; venation wholly areolate, the meshes small, mostly hexagonal, without included veinlets, arranged in many rows, successively smaller outward, not attaining the margin; sporangia borne upon and immediately beyond the outermost row of areoles in a continuous slightly intramarginal band, partially concealed by the scales; indusia wanting.

Type species, *Saffordia induta* Maxon.

**SAFFORDIA INDUTA Maxon, new species.**

Plants 15 to 25 cm. high, the fronds numerous (6 to 14), rigidly erect, closely fasciculate; rhizome ascending or erect, short, 1 to 2 cm. in diameter, densely paleaceous, the scales closely tufted, light castaneous in mass, concolorous, flaccid, linear, 5 to 8 mm. long, with long slender tortuous subflexuous tips; stipes stout, 9 to 18 cm. long, 1.7 to 2 mm. in diameter, firm, terete, purplish-brown, lustrous beneath a dense covering of appressed imbricate detergible scales, these light castaneous, lance-ovate, long-acuminate, sharply denticulate-fimbriate, variable in size, the largest ones about 7 mm. long; lamina 5 to 10 cm. long, 5 to 11 cm. broad, deltoid-pentagonal, pinnately parted to within 3 to 6 mm. of the costa, the basal pair of segments deltoid, inequilateral, coarsely and deeply lobed upon the broad proximal side, shallowly or not at all lobed upon the narrow distal side, thus strongly basiscopic; other primary segments or lobes 2 or 3 pairs below the short-caudate apex, opposite or nearly so, linear to linear-oblong, oblique, straight or upwardly subfalcate, the margins entire, strongly involute at maturity; leaf tissue thick, rigidly herbaceo-coriaceous, glabrous above but scantily and deciduously squamulose along the partially concealed slender costæ, densely appressed-paleaceous beneath, the scales closely imbricate, persistent, similar to those of the stipes, completely covering the lower surface (including the costæ), extending beyond the margin and commonly recurved as a regular narrow border upon the upper surface; venation areolate, without included veinlets, the areoles small, mostly hexagonal, arranged in 5 or 6 rows upon each side of the costæ, the costal ones elongate and parallel to the costa, the others successively smaller, shorter, and more oblique, not extending to the margin; sporangia partially concealed by scales, densely crowded in a continuous slightly intramarginal band 1.5 to 2.5 mm. broad, borne partly upon the outermost row of areoles and partly upon the adjacent veinless area, about 0.5 mm. apart from the unchanged margin; indusia wanting; spores subglobose, obscurely triplanate, light brown, discontinuously areolate, the ridges very thin, vermiculate.

Type in the U. S. National Herbarium, No. 619807, collected along the Arroyo Railway, in the mountains back of Lima, Peru, March, 1892, by W. E. Safford (No. 989).

Saffordia need be compared only with Trachypteris, Doryopteris, and Notholæna. In its paleaceous vestiture and to a lesser extent in form it resembles certain species of Notholæna, as, for example, the Mexican *N. aurantiaca* D. C. Eaton; but from this genus it is excluded by its strictly areolate venation and by the position of its sori, which are borne in a rather broad continuous band, largely upon the leaf tissue, instead of upon the tips of the veins. The margin, moreover, is involute, instead of revolute, and has neither the form nor the function of an indusium.

Doryopteris, to which Saffordia has already been likened, is a small genus of world-wide distribution, a part of whose species not only resemble it in general form but have a very similar, though coarser, areolate venation. From these, which are devoid of scales upon the lamina, Saffordia departs widely in its dense paleaceous covering, in the absence of any indusium whatever, and in its more ample soriation.

Despite obvious differences in form and habit Saffordia is probably more closely related to Trachypteris. This little known South American genus, described in 1899, is currently regarded as consisting of a single species, *T. pinnata* (Hook. f.) C. Chr., first described (in 1847) as *Hemionitis pinnata* from specimens collected by Charles Darwin upon Charles Island of the Galapagos group, and again a few years later (in 1854) by the elder Hooker (upon other material from the same islands) as *Acrostichum aureonitens,* the name under which it has since been best known. Subsequently it was referred to several other genera and was finally (in 1899) placed by Diels as a new section (Heteroglossum) of Elaphoglossum, in the tribe Acrosticheæ. In the same year André's generic name, Trachypteris, was proposed for it by Christ, who regarded it as closely allied to Elaphoglossum. Meanwhile its range had been extended by the discovery of specimens in the Andes of Ecuador; also, another species had been described from Minas Geraes, in southern Brazil, as *Acrostichum Gillianum* Baker. The latter is placed by Christ as a form of *T. pinnata,* having ternately divided instead of pinnate sporophyls. Specimens with sporophyls of somewhat intermediate form, collected in Bolivia by R. S. Williams (No. 1177), were regarded by Underwood as representing an additional species. Without a critical study of all the material it is difficult to say whether one or several species are here involved. It is sufficient for the purposes of the present paper to point out that the

various forms are at any rate of the closest interrelation, that they are similarly dimorphic, and that their sterile fronds at least are scarcely distinguishable from each other.

The sterile fronds of Trachypteris being entire, subspatulate, exstipitate, and arranged in a rotate basal tuft are thus in shape, structure, and habit very dissimilar from Saffordia, which they resemble chiefly in venation and in the similarly dense paleaceous covering of the under surface. The fertile fronds are slender and very long-stipitate, the blades varying from ternately divided to pinnatifid (with 4 to 7 segments) to fully pinnate, with 3 or 4 pairs of distant subsessile segments. The basal segments may even be lobed upon the proximal side, the lobes more or less produced (as shown in Hooker's figure and in the Bolivian specimen at hand); and it is the basiscopic form thus assumed which, together with the ultimate venation and the type of soriation, offers a suggestion as to a possible common origin of Trachypteris and Saffordia. The most notable differences between the two genera lie in the extreme dimorphism exhibited by Trachypteris—the complete restriction of vegetative and reproductive activities to separate leaves. Thus, as might be expected, only the sterile fronds are persistent, the fertile fronds shrivelling after maturity; while in Saffordia the fertile and sterile fronds are alike and are stout, rigidly erect and long-persistent, characters consequent upon the parallel expression of both vegetative and reproductive functions in the same frond. Nearly all fronds of Saffordia are fertile and all are truly vegetative.

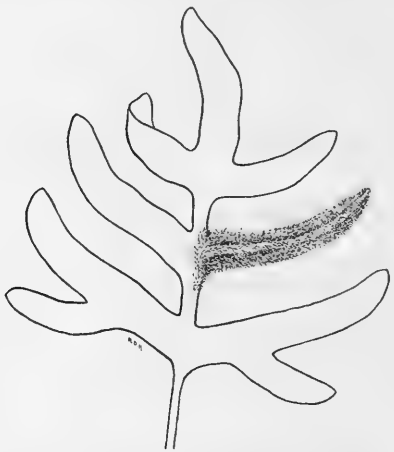


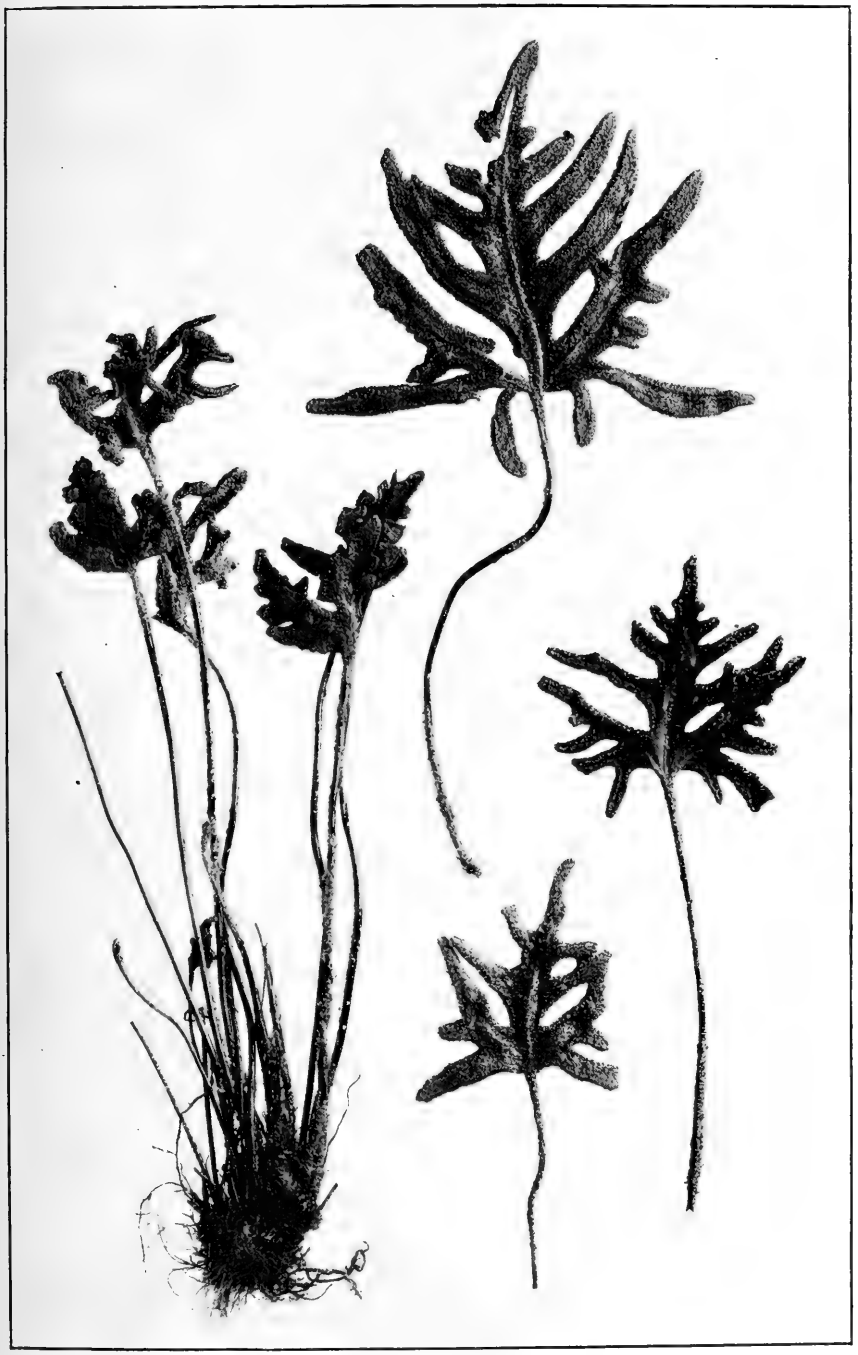
FIG. 1.—Blade of fertile frond of Trachypteris from Bolivia (*Williams* 1177), intermediate between the Brazil and Galapagos forms. Natural size.

With respect to soriation there is a strong similarity between Trachypteris and Saffordia, the difference being in extent rather than in kind. The fertile fronds of Trachypteris have the sporangia nearly covering the under surface of the segments, only the costal row of areoles commonly being devoid of them; and thus, because of the narrowness of the segments, the two broad bands of sporangia nearly

meet at maturity. The sporangia then appear to have arisen from the whole lower surface, as has erroneously been stated to be the fact. In Saffordia the sporangia occupy less space actually and relatively and, from the greater size of the fronds, appear only as a broad, slightly intramarginal band.

Saffordia thus represents a new type of fern almost exactly intermediate between Doryopteris and Trachypteris, having the habit and general structure of the former and the scaly covering and soriation characteristic of the latter genus. It is clearly a member of the Pterideæ, as is Doryopteris, and must carry with it to that tribe the genus Trachypteris, which latterly has been placed among the Acrosticheæ.

The discovery of this new genus in a region relatively so accessible is interesting not only in itself but also as suggesting the probable richness and peculiarity of a fern flora as yet little known.



SAFFORDIA INDUTA Maxon
(ABOUT ONE-HALF NATURAL SIZE)

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 61, NUMBER 5

# A NEW DINOSAUR FROM THE LANCE FORMATION OF WYOMING

BY

CHARLES W. GILMORE

(PUBLICATION 2184)

CITY OF WASHINGTON
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The Lord Baltimore Press
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# A NEW DINOSAUR FROM THE LANCE FORMATION OF WYOMING

By CHARLES W. GILMORE

ASSISTANT CURATOR OF FOSSIL REPTILES, U. S. NATIONAL MUSEUM

## INTRODUCTION

In July, 1891, Messrs. J. B. Hatcher and W. H. Utterback discovered in Wyoming an articulated skeleton of a small Orthopodous dinosaur. Until quite recently this specimen had remained in the original packing boxes and it was in the nature of a surprise upon first examination to discover that it represented an undescribed form. I therefore propose to make this animal the type of the new genus, *Thescelosaurus*. The present paper may be considered preliminary, as upon the completion of the preparatory work now in progress a more detailed account of the skeletal anatomy, and a discussion of its affinities, will be given.

### THESCELOSAURUS, new genus

In the present communication the characters of this genus are included in the description that follows of *Thescelosaurus neglectus*, the type species.

### THESCELOSAURUS NEGLECTUS, new species

*Type.*—Cat. No. 7757, U. S. N. M. This specimen consists of a nearly complete articulated skeleton, the skull and neck being the only important parts missing.

*Type-locality.*—Doegie Creek, Converse County, Wyoming.

*Paratype.*—Cat. No. 7758, U. S. N. M. A second individual consisting of a few cervical, dorsal, and caudal vertebræ, portions of both scapulæ, ribs, bones of fore and hind feet, and portions of limb bones. Collected by Mr. O. A. Peterson, 1889.

*Locality.*—Lance Creek, Converse County, Wyoming.

*Horizon.*—Both specimens from the Lance formation, Upper Cretaceous or Lower Tertiary.

*Description.*—The vertebral column is present from the anterior dorsal region to the tip of the tail. The centra of the median dorsals

measure 40 mm. in length; arches low with thin flattened spinous processes; centra broadly rounded transversely, without lateral cavities; ends of centra slightly biconcave throughout the series. Anterior and median caudals about same length as dorsals mentioned above. Median caudals have sides of centra bisected by a sharp longitudinal ridge.

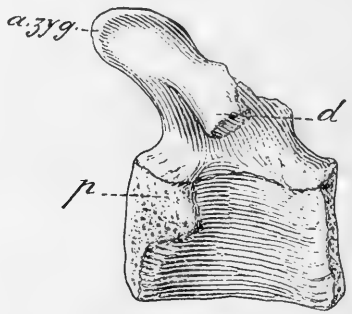
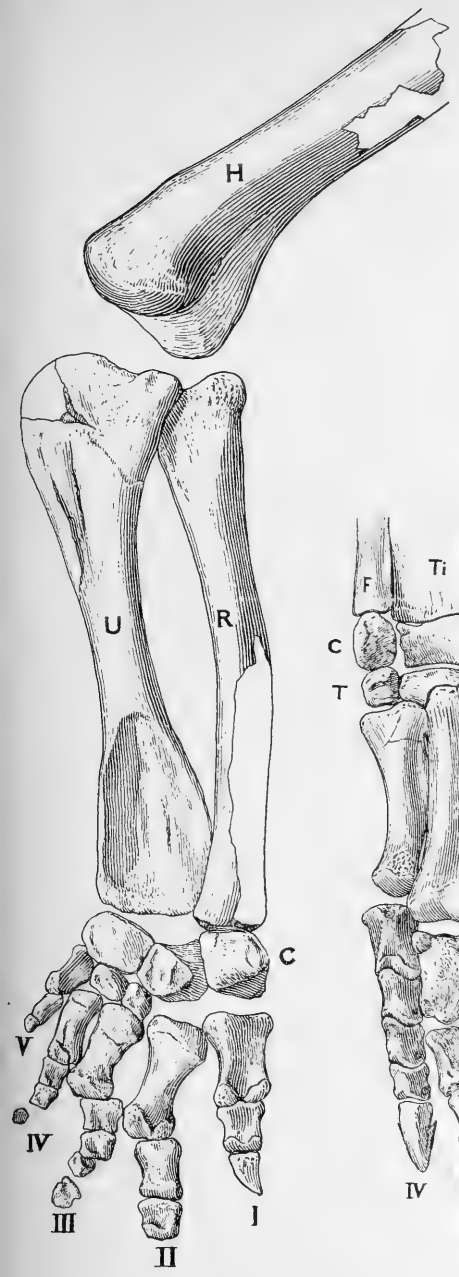



FIG. 1.—Cervical vertebra of *Thescelosaurus neglectus*. Paratype. Cat. No. 7758 U. S. N. M. about ⅔ nat. size. Viewed from left side. *a. zyg*, anterior zygapophysis; *d*, diapophysis; *p*, parapophysis.

The back of this animal is strengthened by ossified tendons extending along either side of the neural spines from the median dorsal

FIG. 2.—Left scapula of *Thescelosaurus neglectus*. Paratype. Cat. No. 7758 U. S. N. M. ½ nat. size. Viewed externally.

region nearly to the tip of the tail. A cervical pertaining to the paratype No. 7758 (see fig. 1.) shows the sides of the centra below the neuro-central suture to be pinched in, but to a less degree than in the cervicals of *Camptosaurus*. Ventrally there is a broad, flat, roughened



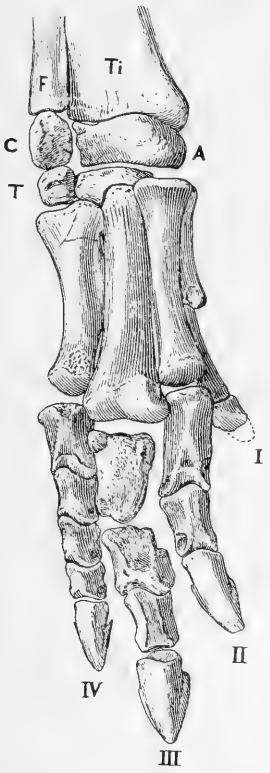



FIG. 3 FIG. 4 FIG. 5

FIG. 3.—Left fore limb of *Thescelosaurus neglectus*. Type. Cat. No. 7757 U. S. N. M. ½ nat. size. Palmar view of foot shown as found *in situ*. *C*. carpus; *H*, humerus; *R*, radius; *U*, Ulna; I, II, III, IV, and V, digits one to five.

FIG. 4.—Right hind foot of *Thescelosaurus neglectus*. Type. Cat. No. 7757 U. S. N. M. ¼ nat. size. Shown as found *in situ*. *A*, astragulus; *C*, calcaneum; *F*, distal end of fibula; *T*, distal row of tarsals; *Ti*, distal end of tibia; I, II, III, and IV, digits one to four.

FIG. 5.—Right hind leg of *Thescelosaurus neglectus*. Type. Cat. No. 7757 U. S. N. M. About ⅛ nat. size. Shown as found articulated.

surface extending the entire length of the centrum, being wider behind than in front. Cervical ribs free. Dorsal ribs of good length, T-shaped above but flattening out into a broad distal portion. Calcified sternal ribs present.

In the pectoral arch the scapula is remarkably short with widely expanded blade, much as in *Camptosaurus* (see fig. 2). The proximal portion of this bone not known. Ossified sternum present. Only the distal half of the humerus known, but the proportions between upper and lower bones of the fore limb appear much the same as in other bipedal predentate dinosaurs. Carpus ossified, though its elements have not yet been definitely determined. There are five digits in the manus, having the phalangial formula 2, 3, 4, 3, 2. The first three digits are tipped with pointed unguals, the terminals of the fourth and fifth, however, have been reduced to small rounded bony nodules; the fifth digit is borne by a small metacarpal and is comparatively feeble. Ungual digit II missing.

The pelvic arch has not been developed sufficiently to show all its features, but the presence of a rounded rod-like pubis with a long, slender postpubic process reaching the end of the ischium is observed. The ischia have flattened shafts meeting on the median line but without especial enlargement of their distal ends.

The femur is longer (355 mm.) than the tibia (300 mm.), slightly curved and with pendant trochanter on the postero-inner face of the shaft. As in *Camptosaurus* this trochanter is developed just above the middle of the shaft. The finger-like great trochanter is present on the antero-external angle of the proximal end. The head is globular and separated from the shaft by a well-defined neck. Fibula slender with distal third closely applied to the tibia.

The astragulus and calcaneum as usual form the proximal row of the tarsus. The distal row consists of two flattened bones articulating with the proximal ends of metatarsals III and IV, the inner element extending somewhat over the top of metatarsal IV, as shown in figure 4 of the articulated foot. There are four digits in the hind foot; metatarsal I being reduced; digit V is wanting. The phalangial formula is 2, 3, 4, 5, 0. All digits are terminated by pointed claw-like unguals.

Typically *Thescelosaurus neglectus* is of moderate size, having a total length of perhaps twelve feet, and standing a little over three feet at the hips. The fore-limbs are somewhat more than half as long as the hinder pair, and this disproportionate length of limb would appear to indicate an animal normally using a bipedal mode of progression.

*Relationships.*—The non-union of the pubes in front of the sacrum, the slender post-pubic processes extending parallel to the ischia, and the characteristic bird-like hind feet show *Thescelosaurus* to be a true member of the suborder Orthopoda or Predentate dinosauria. Provisionally this genus is here referred to the family *Camptosauridæ*. From *Dryosaurus, Laosaurus,* and the English *Hypsilophodon* it may at once be separated by the greater length of femur as compared with the tibia. From *Camptosaurus* it is to be distinguished by the rounded rod-like pubis as compared to the flattened blade-like pubis of that genus. Additional characters are to be found in the fore-feet, *i. e.,* an additional phalanx in digit III, and the non-coalescence of the first metacarpal with the carpus.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 61, NUMBER 6

# GREAT STONE MONUMENTS IN HISTORY AND GEOGRAPHY

BY

J. WALTER FEWKES

(PUBLICATION 2229)

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1913

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# GREAT STONE MONUMENTS IN HISTORY AND GEOGRAPHY[1]

By J. WALTER FEWKES

## INTRODUCTION

A seemingly well defined phase of human culture history, attained independently in localities widely separated geographically, has been designated the megalithic. The dominant racial feeling, religious or cultural, was expressed in this epoch by great commemorative monuments constructed of stone and called "monoliths," or, when sculptured in life forms as representations of animals, men, and gods, they are termed colossi.

The close connection, in the mind of primitive man, of culture and religion is preserved in the Latin word *cultus*, or its English derivative, culture, the stimulus for which is desire for improved condition of life in thought and act or a striving for higher ideals, so well brought out in Mr. Matthew Arnold's scholarly essay, "Sweetness and Light." The megalithic epoch expresses objectively a consciousness of power and is largely correlated with religious feeling and the cult of the dead.

This phase in racial history culminated in the later Stone Age, and in some cases lasted long after the discovery of metals, echoes of it appearing sporadically even in the highest civilization. Many races appear not to have had a megalithic epoch in their history; in others the expression was individual, not racial; some peoples had not sufficiently advanced to have attained it, while others have progressed so far beyond this condition that its very existence is at present known only by monuments; the names and the races of the builders have passed out of memory, or are unrecorded.[2]

[1] Presidential address delivered before the Anthropological Society of Washington, February 20, 1912. This address was accompanied by stereopticon views, only a few of which are here reproduced as illustrations.

[2] Since the habit of erecting megalithic structures is of independent origin and not derivative, the age of monoliths varies among different races. While the dynasty in which many of the Egyptian obelisks were erected is known from the inscriptions they bear, no one has yet satisfactorily determined the antiquity of the unworked dolmens and menhirs, nor is it known whether they were erected contemporaneously with obelisks or earlier.

The able archeologist, Dr. Daniel Wilson, was one of the first to clearly recognize this epoch, as will appear in the following quotation from his article on Archæology in the Encyclopædia Britannica:

> There appears to be a stage in the development of the human mind in its progress towards civilization when an unconscious aim at the expression of abstract power tends to beget an era of megalithic art. The huge cromlechs, monoliths, and circles still abounding in many centers of European civilization perpetuate the evidence of such a transitional stage among its prehistoric races. But it was in Egypt that an isolation, begot by the peculiar conditions of its unique physical geography, though also perhaps ascribable in part to certain ethnical characteristics of its people, permitted this megalithic art to mature into the highest perfection of which it is capable. There the rude unhewn monolith became the graceful obelisk, the cairn was transformed into the symmetrical pyramid, and the stone circles of Avebury and Stonehenge, or the megalithic labyrinths of Carnac in Brittany, developed into colonnaded avenues and temples, like those of Denderah and Edfu, or the colossal sphinx avenue of Luxor.

He refers elsewhere to it as follows:

> There seems to be an epoch in the early history of man when what may be styled the megalithic era of art develops itself under the almost endless variety of circumstances. It is one of the most characteristic features pertaining to the development of human thought in the earliest stages of constructive skill.

It is an instructive study in religious or culture history to trace the distribution of megalithic monuments characteristic of this epoch, to compare the varieties of forms they assume in different localities and consider their purpose; but the vastness of the subject limits my consideration to one aspect, monoliths and colossi, rendering it necessary to pass over a large number, perhaps the majority, of megaliths.

Why do these monuments occur in certain geographical localities and not in others, and how are they to be interpreted by the student of human geography? What is the nature of the feeling they express?

The causes which have led one race and not another to develop a megalithic habit may be sought in certain psychical conditions difficult of interpretation, but the custom appears to have originated independently and spontaneously under different physical conditions. The erection of monoliths is not due to similarity of environment so much as to identity of thought;[1] the feeling originating subjectively rather than in response to surroundings. Westropp ("Prehistoric Phases") writes:

> It is now a generally accepted canon that there are common instincts implanted by nature in all the varieties of the human race, which lead mankind

[1] A consciousness of power, always a source of personal and racial gratification, tends to express itself in huge monuments.

in certain climates and at a certain stage of civilization to do the same thing in the same way, or nearly so, even without teaching or previous communication with those who have done so before.

Mr. John Evans apparently had a similar idea and remarks:

The curious similarity observed in different parts of the world may possibly be due to some analogous development of thought and feeling rather than to any intimate connection between the races who erected them.

In much the same way Professor Westropp thus expresses himself in his work "Prehistoric Phases" (p. 122):

The weapons and instruments of stone which are found in the north of Europe, in Japan, in America, the South Sea Islands, and elsewhere, have, for the most part, such an extraordinary resemblance to one another in point of form, that one might almost suppose the whole of them to have been the production of the same maker. The reason for this is very obvious, namely, that their form is that which first and most naturally suggests itself to the human mind.

Mr. Dennis in a suggestive work,[1] speaking of those megalithic monuments called cromlechs, writes:

This form of sepulchre can hardly be indicative of any race in particular. The structure is so rude and simple that it might have suggested itself to any people and be naturally adopted in an early state of civilization. It is the very arrangement the child makes use of in building his house of cards. This simplicity accounts for the wide diffusion of such monuments over the Old World . . . . there is no necessity to seek for one particular race as the constructors of these monuments or even as the originators of the type.

The significance of megalithic monuments is correctly pointed out by Mr. Fergusson who writes:[2]

Honour to the dead and propitiation of the spirits of the departed seem to have been the two leading ideas that, both in the East and West gave rise to the erection of these hitherto mysterious structures which are found numerously scattered over the face of the Old World.

In somewhat the same vein are the words of Mr. John Stuart:

The remains of most ancient people attest that greater and more enduring labor and art have been expended on the construction of tombs for the dead than in abodes for the living.

Sir James Stimpson held somewhat the same belief:

There is no longer reason to doubt that the Egyptian pyramids are megalithic tombs of the dead.

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[1] Groge Dennis, The cities and cemeteries of Etruria. London, 1848, 3 ed., 1883.

[2] Fergusson, Rude Stone Monuments, p. 509.

A study of the megalithic epoch has its historical and its geographical sides; the historian being concerned with its appearance in time; the geographer with place. The anthropogeographer embracing both in his consideration asks the pertinent question: Why has this epoch occurred at a certain place at a certain sequence in culture history and not elsewhere at another time?

It is unnecessary to remind you that culture history is not limited to written records, and that concerted actions of races, whether recorded or not, constitute their history. Those inventions that have most profoundly influenced culture, like the discovery how to make fire, are more important in results than great battles that have brought about dynastic changes.

Monoliths, as expressions of a desire to perpetuate the memory of ancestors or to commemorate past events, are naturally found only where the race had arrived at a self consciousness of its own power. Their geographical distribution[1] over the earth's surface corresponds roughly with the awakening of that consciousness. The megalithic custom, therefore, has an independent origin among different people, and its prevalence among widely separated races by no means implies, much less proves, acculturation or contact. It is autochthonous and its origin, being mental, can be traced to what for a better name we call psychic influence.

The megalithic habit is necessarily dependent on the nature of convenient rock formations and other geological conditions.

It is self evident that except in so far as the production of megaliths is dependent on transportation of material used, the distribution of monoliths is largely geographical, correlated with that of stones suitable for their manufacture. Great plains or sandy deserts furnish scanty material for construction of monoliths, and if megaliths are used by people living in this environment the distribution of rivers and the direction of their flow, by which they were transported from a distance, must be given weight. Monumental structures are not to be expected in cold regions where the earth's surface is covered with snow or ice clad; while generally children of the deserts, they occur in forested regions, and are commonly found in those regions of the earth that show a long continued habitation by man. They are tropical and warm temperate zone structures and exotic elsewhere.

[1] Evidences of great human antiquity are commonly found in regions where megaliths occur. It takes a long time to develop this habit or phase of thought, and monumental structures are not the product of a few years.

It will be well, at the very outset, to choose a few types of megalithic monuments for study and to eliminate certain huge single stones used in construction of cyclopean walls, although they also are the same mental expressions and have a close cultural affinity with colossi and monoliths; they may be passed by but not neglected.

For convenience, monoliths may be treated under the following headings: (1) natural stones of great size placed vertically by human means but showing no sign of having been artificially shaped; (2) monoliths carved or otherwise worked artificially generally bearing elaborate inscriptions; (3) colossi or cyclopean monolithic representations of real or imaginary beings.[1] Monoliths may be still further classified, according to their purpose, as erected in commemoration of events or persons, boundary stones, or connected with ceremonials, but in no classification that has yet been devised do we find a clear cut line of demarkation between different classes. Thus large stones commemorative of events or statues of kings easily develop into objects of reverence. It is interesting to note that colossal statues of so-called gods are often commemorative of deified heroes, and it is probable that the same feeling that leads civilized man to erect statues of those he honors also accounts for the existence of monoliths among men less highly developed culturally.

Natural monoliths or huge stones, unchanged by the hand of man, have been set up by all races, occurring with equal abundance in Europe, Asia, Africa, America, and the islands of the Pacific. They are found singly, or in groups, regularly or irregularly arranged, taking the forms of rectangles, circles, and other combinations.

## OLD WORLD MEGALITHIC EPOCH

In certain regions of the earth's surface, as in France, England, the Mediterranean Islands, along the coast of northern Africa,[2] Syria, Egypt, and India, monoliths are more abundant than in regions situated in higher latitudes. They are not found very far from the historic zone of civilization. The similarity of these objects along both shores of the Mediterranean Sea and beyond the Pillars of Hercules has suggested to some students that they were erected at the

[1] The discussion is limited to monolithic colossi for obvious reasons.

[2] A. Lissauer, Archæologische und Anthropologische Studien uber die Kabylen (Zeit. f. Eth., Vol. 40, part 4, 1908. Berlin, 1908) gives figures and illustrations of dolmens, menhirs, and cromlechs from Tunis to Tangiers. A map locating the megaliths shows the distribution of different types. Translation in Smithsonian Report for 1911.

same time by the same race, but the constructors of monoliths have not necessarily a racial connection.

It is believed that the unworked monolith was used far back in human history for some religious purpose. While its erection as a commemorative object would seem to be secular and to have developed from the habit of throwing together a heap of stones to mark some event, a large stone has almost invariably acquired a religious meaning. Worship of stones is universal;[1] the Greeks early worshipped a shapeless stone, probably a meteorite, in Ephesus that was later replaced by a beautiful statue representing Diana. The Kaaba of Mecca, as is well known, antedates the Mohammedan era; the shrine of the Earth and Fire god of the Hopi Indians of Arizona is a log of petrified wood.[2]

The following interpretation of the structure of megaliths known as cromlechs has been suggested by Herr W. Pastor. They present three distinct regions: (1) a centrally placed altar; (2) one or more concentric circles[3] of stone surrounding this altar: (3) an entrance passing to the holy enclosure formed by rows of stones cutting the concentric circles at right angles.

Since monoliths from their very nature are commemorative they early became the media on which pictographs were incised, and there is an instructive connection between the origin of writing and the construction of monoliths. Man first inscribed his ideas on the face of cliffs, rocks, or boulders, and it is a significant fact that the races that have invented writing have likewise been foremost in erecting monoliths. The relation, however, is not necessarily one of cause and effect. On Easter Island, for instance, where great colossi in human form exist, we also find evidence of writing. The glyphs of the Central American stelæ are well known. The Egyptians who excelled all people in the grandeur of their megalithic monuments, have left the largest known corpus of hieroglyphic material. Irish

[1] My friend, Dr. I. M. Casanowicz, has called my attention to the fact that Cybele (Magna deum Idæa) "came from Phrygia to Rome in 204 B. C. and was solemnly installed on the Palatine under the form of a black aerolite."

[2] Very many instances of stone worship among American Indians might be mentioned; almost any strangely shaped stone is supposed to have magic powers.

[3] Professor Lockyer finds in these circles of megaliths evidences of sun worship; according to him the concentric lines of stones represent the course of the Sun god. To Mr. Arthur Evans "it seems a universal rule that the stone circle surrounds a central dolmen or stone cist containing the remains of the dead."

ograms and Scandinavian runes are well known, but no North American tribe erected a monolith or independently invented a system of writing. In the majority of cases the most perfect monoliths, like the obelisk and colossus, in the New World as well as the Old, bear hieroglyphics.[1]

We find at various places in the old and new continents monoliths arranged in alignment or rectangular or circular forms which were connected with solar or stellar ceremonies. These combinations bear various names, being known in the New World as Indian

FIG. 1.—Portion of Stonehenge, Wiltshire, England, from Lockyer.

enclosures, ball courts, or corrals; while in the Old World they are called dolmens, menhirs, and cromlechs.

Columns or pillars supporting roofs of buildings, which are so common in sacred architectural constructions, are regarded as monoliths related to those commemorative or religious forms we are considering.[2] In the same architectural category are huge stone blocks

[1] The association of writing with monoliths is one aspect of a general truth, already mentioned, that the latter almost universally occur in localities where there are evidences of a great antiquity of man.

[2] This theory would consider the columns of Greek temples as morphologically upright stones surrounding a sacred enclosure, rather than homologues of wooden piles of archaic pile dwellings, as taught by Sarasin.

used in foundations or construction of buildings or monolithic roofs of tombs. The covering of the grave of Theodoric the Great at Ravenna, Italy, is a good example of this type of monolith, as are likewise the huge stones found in buildings in Japan, at Ostia near the mouth of the Tiber, in Peru, and elsewhere.[1]

At this point in a consideration of megalithic structures may be mentioned the almost universal duality of types of buildings among human races, or the deep-seated architectural distinction between sacred edifices and habitations. This difference is primarily due to dissimilarity in origin and use. The hut or habitation has, as a general thing, no resemblance to a primitive sacred edifice, nor does the home and temple develop along the same lines. One is transient, the other permanent; one disappears in a generation or two, the other remains unchanged; one is the product of individual labor, the other of combined racial work governed by religious ideals. Consequently little or nothing is known of the houses of the builders; we know only their great temples or religious structures.

As megalithic structures are religious in use it is natural to trace their origin to the same feeling that erected rude stone monuments or monoliths to tombs of the dead, rather than habitations of the living. Temples and shrines thus belong to a series apart from secular buildings. To them we owe the development of sacred architecture which is primarily a communal expression of religious feeling in the building art. The palace-temple contains rooms for the residences of priests, but still preserves the primary distinction between a habitation and a sacred edifice.

The best known of all megalithic monuments is the famous Stonehenge, in Wiltshire, England, the purpose of which has been variously

[1] So far as size goes some of the circular disks with central holes, from Uap, one of the Caroline Islands, may be called monoliths. These stones have been figured and described by Mr. Wm. H. Furniss, 3d, who thus identifies these as stone coins: "This medium of exchange they call Fei and it consists of large, circular, stone wheels ranging in size from a foot in diameter to twelve feet, and having in the center a hole, varying in size with the diameter of the stone, wherein a pole may be inserted sufficiently strong to bear the weight and to facilitate transportation. These stone coins, if I may so call them, are not made on the island of Uap, but were originally quarried and shaped in the Pelao Islands, four hundred miles to the southward, and then brought to Uap by some venturesome navigators in canoes and on rafts, over seas by no means as pacific as the name implies." (University of Pennsylvania, Trans. Dept. Archæol. Free Museum of Science and Art, Vol. I, 1904-5, p. 53.)

interpreted by different authors. This monument consists of many monoliths and trilithons, some of which are more or less artificially worked, others natural, surrounded by rings of stone.

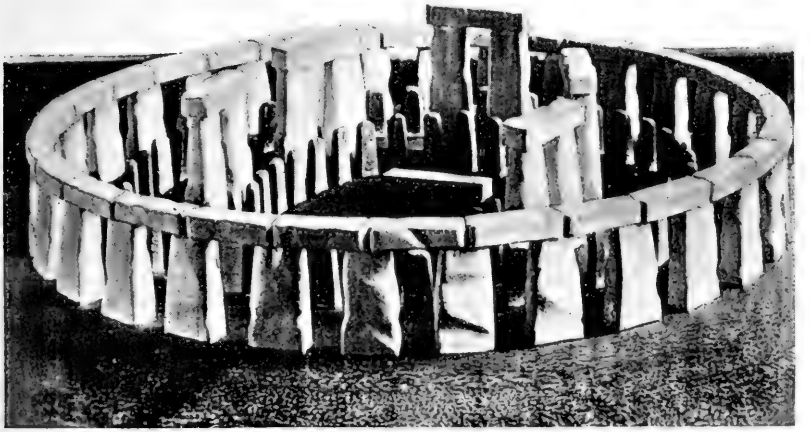

FIG. 2.—Stonehenge, Wiltshire, England (restored).

FIG. 3.—Stonehenge, Wiltshire, England, from Lubbock.

The stone circles of Avebury, measuring 1,200 feet across, were the largest and finest megalithic monuments in existence, "exceeding Stonehenge as a cathedral does a parish church." Other stone circles occur at Stanton Drew in Somersetshire, in the Orkneys and other English islands.

Simpler forms, like "Kit's Coty House," one of the best known dolmens[1] in England, are reproduced almost in duplicate in Sweden, Holland, Denmark, Portugal, France, India, on the banks of the Jordan, in the deserts of Arabia, India, Syria, Mexico, and Peru.

The evidence available shows that rude undressed stones, like menhirs, dolmens, and cromlechs, are essentially sepulchral or memorial stones, but their wide distribution over the earth's surface precludes our limiting them to any one race of men. In some parts of

FIG. 4.—Talaya, Balearic Islands, from Cartailhac.

Europe they have been ascribed to the Druids, but the presence of dolmens[2] and cromlechs in lands where Druids never lived shows that this popular belief must be somewhat modified. In their distribution around the shores of the Mediterranean, Corsica, Sardinia, and the Balearic Islands, they seem to have followed certain laws which might

[1] Particularly fine table stones called talaya, occurring in the Balearic Islands, have been described by Cartailhac, Monuments primitifs des isles Baleares, Toulouse, 1892. The latest work on these talayas is by A. Bezzenberger, Vorgeschichtliche Bauwerke der Balearen, Zeit. für Ethnol., Berlin, 1907.

[2] Their names are Gaelic, but there is nothing to show that a cromlech or dolmen was ever constructed by the Druids for an altar.

lead us to refer these monoliths to a center of distribution, situated on the shore of the eastern Mediterranean, but this law can not account for the presence of similar monoliths of the New World or in eastern Asia or southern Africa.

Some of the dolmens now above ground were formerly buried and were superficially indicated by mounds or barrows.[1] But perhaps the religious character of menhirs, cromlechs and dolmens is best indicated by those buried in mounds:

> The great Lanyon dolmen in Cornwall was uncovered about one hundred years ago by a farmer who supposed it to be a mere heap of earth which he thought might be usefully applied to farming purposes. By degrees, as the earth was carted away, the great stones began to appear and when operations were completed and all the soil had been cleared away the dolmen, much as it now exists, was disclosed containing in its interior a heap of broken urns and human bones.

The relation of megalith and mound is shown in the accompanying views (figs. 5, 6) of New Grange, Ireland, from a work on Irish antiquities by Vallancey, published near the close of the 18th century.

The geographical distribution of megalithic remains is almost parallel with that of stone buildings, which in turn are identical with caves, natural and artificial.

Mr. Baring Gould[2] describes and figures buried dolmens in south France upon which churches were constructed, the chamber of the dolmen serving as the crypt of the church, a perpetuation of the sacred character of a building used for religious purposes in prehistoric times before the introduction of Christianity. This fact is in evidence

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[1] Some of the dolmens may have always been aerial or never covered with soil forming a mound; others apparently were formerly buried, appearing on the surface as a barrow or mound.

[2] Cliff Castles and Cave Dwellings of Europe, London, 1911. According to Mr. Baring Gould (pp. 190-192) there is situated near Plouaret, in Cotes-du-Nord, a prehistoric dolmen under a tumulus on which is a chapel, the crypt of which is the subterranean chamber of the dolmen. The prehistoric monument in this example consists of two capstones of granite resting on vertical uprights. He likewise describes from Cangas-de-Ones near Oviedo, in northwest Spain, a chapel on top of a mound covering a dolmen. From the chamber of the dolmen that serves as the crypt to the church prehistoric copper and stone objects have been taken, the country people regarding the cavity of the dolmen as a saint's tomb, soil from which is regarded by them as possessing medicinal virtues. The cover or capstone of a dolmen near S. Germain-sur-Vienne is supported on pillars made in the 12th century, the original supports having been removed. It served as a cover of an altar made of stone and a chapel now destroyed was built about it—a transmission of the sacred use of the dolmen as an altar into Christian worship.

in its bearings on the former religious use of the megalithic monuments.

Windle,[1] in considering the use of monoliths, writes:

Such stones have been in other countries not merely memorials of some great deed or departed hero, but objects of worship, and the same was probably the case in this country.

Mr. Gomme, in an instructive work, "Survivals of Worship," shows how the reverence once attached to them persists in folk practices.

At the village of Holme situated on one of the moors of Dartmoor is a field of about two acres, the property of the parish and called Plog Field. In the center of this field stands a granite pillar (menhir) 6 feet or 7 feet high. On May mornings before daybreak the young men of the village used to assemble there and then proceed to the moor where they released a ram lamb, and after running it down brought it in triumph to the Plog Field, fastened it to the pillar, cut its throat and then roasted it whole.

The relation of megalithic chambers and burial tumuli is shown by a writer in the following quotation from the Edinburgh Review:

It may probably be assumed that the dolmen or cromlech was originally a stone cist in the center of a tumulus meant to contain either one or more bodies. This, afterwards, was expanded into a chamber for the accommodation of several. In the third stage it was furnished with a passage or avenue of entrance so as to be permanently accessible. In the fourth stage, the covering tumulus was dispensed with; but the last form most probably was when the cromlech was placed externally on the top of the mound as a mere ornament or simulated tomb, as we find in France and Algiers.

The evidence drawn from a study of the monoliths known as menhirs, dolmens, and cromlechs seems conclusive that they were connected with religious beliefs and always related in some way to the dead or mortuary ceremonials. In western Europe these stones have long since ceased to be used in religious rites, although survivals of former ceremonials persisting in peasant folk lore, are significant. We must look elsewhere in other lands where similar objects occur for light upon the meaning of monoliths. Asia and Africa furnish important aid in this study.

Herr Kremer in his accounts of the ancient cults of Arabia makes frequent allusions to natural stone worship, and in the village of Tarf there was worshipped a great irregular stone block identical with a

[1] B. C. A. Windle, Life in Early Britain. London, 1897. This author also writes: "The observation of Aristotle, to which Dr. Thurman calls attention, that the Iberians used to place as many obelisks around the tomb of the dead warrior as he had killed enemies perhaps gives a clue to the origin of this custom."

FIG. 5.—Lateral view, New Grange, Ireland (schematic) from Vallancey.

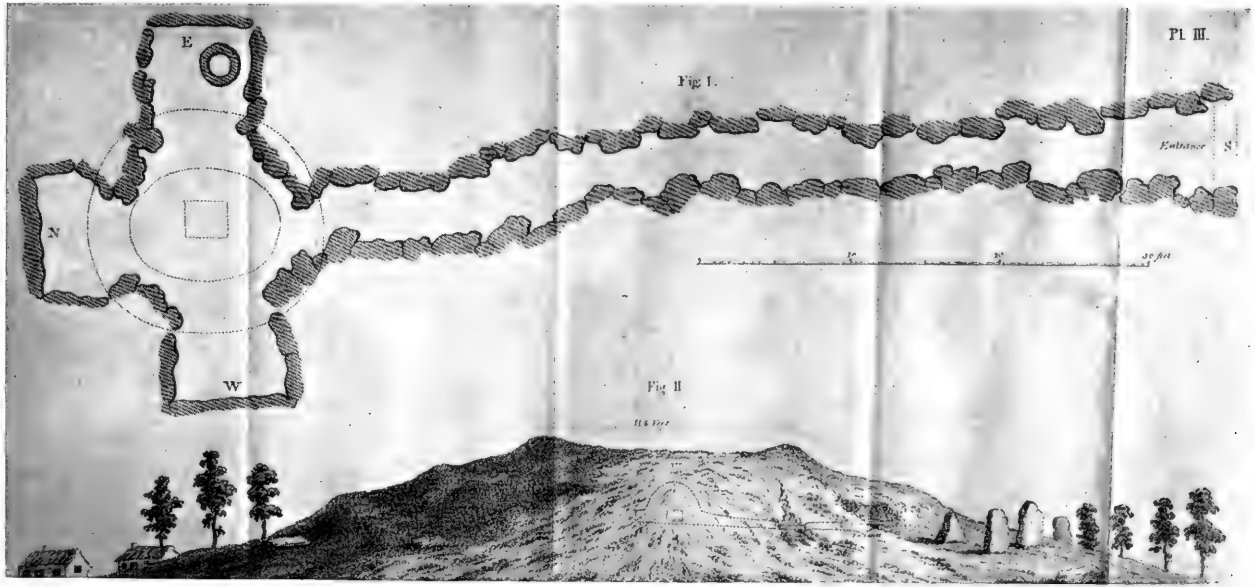


FIG. 6.—Ground plan and elevation of mound at New Grange, Ireland, from Vallancey.

goddess whom Herodotus called Urania. The Phenicians were very much given to the worship of stones called baetylia, and wherever the influence of this wide roving race of traders was exerted there these monoliths are found. They are scattered along routes of trade of this people and to a degree their distribution follows the same law as that of Greek colonization so ably pointed out by Professor Myers. Apparently the same paucity of these monuments is found on the coast of the Adriatic Sea, for the same reason that it has no Greek colonies. These baetylia are most abundant where Greek and Phenician settlements, especially the latter, are most numerous.

Certain districts of India, as the Neermul Jungle, are said to swarm with monoliths and megalithic monuments. In Berrary, alone, Dr.

FIG. 7.—Carnac, Brittany, from Hunter-Duvar et alii.

Forbes Watson counted 2,129 megalithic monuments, and menhirs, cromlechs, and dolmens have been recorded in Sorapoor and Khasia; they also occur elsewhere among the hill tribes. The Todas in the Nilghery Hills have large stone circles similar to those of England, and in the Deccan, in India, villages are said to have circles of large stones sacred to Vetac. Col. Leslie records stone circles in Ceylon, and according to Palmer there are stone circles over 100 feet across near Mt. Sinai in Arabia, where Kohen mentions three large stone circles consisting of lofty trilithons 10 feet high, standing on raised foundations. Stone monuments occur in Morocco, Algiers, Tripoli, and along the whole coast of northern Africa; Lieutenant Oliver has compared the megalithic structures found in Madagascar, among the Hovas, with those of the Channel Islands.

The upright stones of some of the East Indian dolmens in the Deccan are, according to Capt. Meadows Taylor,[1] perforated and used by the natives for various purposes one of which is to facilitate the passage of food to the manes of the dead.

Similar "holed-stones," according to Mr. W. G. Wood-Martin,[2] which "may, in most instances, be regarded as pillar-stones," are found in Ireland: they occur in Scotland, England, and France, and from thence can be traced to India. It is stated that in the last mentioned country these perforated stones are "used by devotees, as a means of attaining forgiveness of sins, or for spiritual regeneration. If the hole is large enough, the suppliant creeps through, but if it is small the hand alone is passed through."

FIG. 8.—Holed-Stone, India, from Strand Magazine.

While some of the Irish "holed-stones" are unworked monoliths perforated, belonging to pagan times and worship, the early Christian missionaries, in order "to divert the religious feeling pertaining to them into Christian channels, caused them to be cut in the shape of crosses, the hole being reduced to the size of the finger." These so-called "secondary holed-stones" are also known in Ireland as "prayer-stones" and still appeal to the imagination of the modern peasants, who suppose they possess magic powers. Irish country women resort to them to pray for children; marriages are performed near them, the betrothed pair clasp hands through them; while children by creeping through them are supposed to be cured of certain

[1] Capt. Meadows Taylor, Trans. Roy. Hist. Acad, Vol. 24, p. 329.

[2] W. G. Wood-Martin, Traces of the Elder Faiths of Ireland, 2 vols., London, 1902.

ailments. The ancient varieties sometimes take the form of stone rings which Mr. Wood-Martin labels, "enormous wedding rings." Circular "secondary holed-stones" known to have been "lying for ages in the church yard of Kirk Braddan in the Isle of Man," remain, according to Mr. Wood-Martin, "ready for use by any bewildered bridegroom who may have forgotten to bring the ring for his bride."

It is a far cry from the Manx stone rings to the stone "collars" of the aborigines of Porto Rico, but both may have been connected with rites of similar intention.[1]

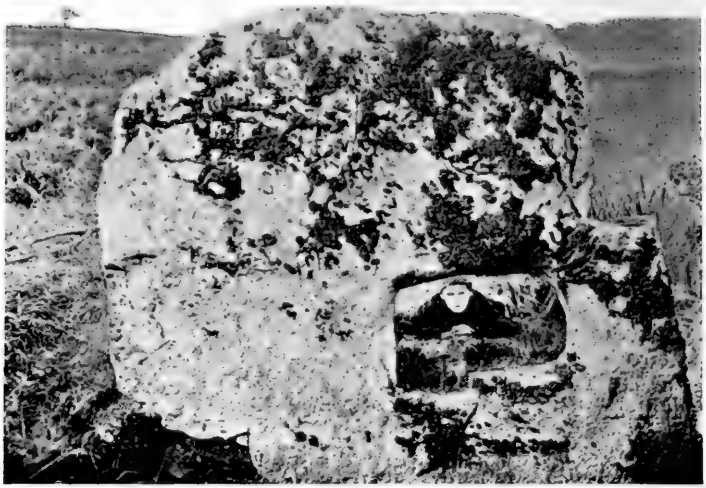

FIG. 9.—Holed-Stone, Ireland, from Wood-Martin (Welsh's Irish Views).

For obvious reasons I shall not attempt to consider the phallic side of the study of monoliths, but my presentation would be incomplete if it were not mentioned. It is self evident that the mystery of the origin of life made a profound impression on the mind of the primitive as well as on the most highly educated mind.

[1] In a short article in the American Anthropologist (Vol. 13, No. 3, 1911) Mr. Herbert Janvrin Browne interprets the Porto Rican slender stone collars as representing the female sex organ used in auto-suggestion at birth. He also identifies on them the different anatomical parts. It is not unlikely that these enigmatical objects may be connected with germination ceremonies, but how far we can go in comparing them in detail with the organ mentioned is not wholly satisfactorily determined.

Similar perforated stones, called in Germany "helfensteins," are interpreted as connected with a future life in the sepulture they enclose. Perforated slabs of rock of unknown significance occur in pueblo graves near ruins along the Little Colorado in Arizona.

Dolmens have been found in Korea, and others constructed of unhewn stones have been discovered in Kiusia and in the south part of the island Yeso. Some of these Japanese dolmens are two chambered and have stone floors and passageways.

Palgrave mentions in an account of his travels that he saw in the Kaseem, central Arabia, enormous stone boulders placed perpendicularly and he also records having observed others arranged in curves as if they once formed a part of an immense circle, differing but little from Stonehenge or other European dolmens and cromlechs.

The artificial monolith includes all single stone monuments of size worked by human hands, from a rude hewn slab set on end to a finely carved obelisk inscribed with hieroglyphs. Some of these stones are enormous in size, but how they were cut from the quarries and transported long distances are facts difficult to explain with our limited knowledge even of the Egyptians, whose every art and craft is illustrated on the walls of tombs and temples by picture writing. Many of these large stones were apparently moved without the use of machinery, yet we find this accomplished without leaving any traces of roads or highways. To indicate the magnitude of the work of transporting these great stones consider the amount of labor in transporting the monolithic pillars of the Treasury building in Washington, which are among the largest single stone blocks in the United States, and have been calculated to weigh 38 tons; some of the Egyptian obelisks weigh 300 tons, or nearly eight times as much.[1]

The columns or pillars of the Cathedral[2] of St. John the Divine in New York will be even larger than the monoliths of the Treasury building.

[1] The monument of Emperor Alexander I, standing in front of the winter palace in St. Petersburg, probably the most remarkable monument of artificial monolith in existence, is a cylindrical pillar of one solid piece of granite 78 feet high and 12 feet in diameter.

[2] Granite monoliths are being quarried at Vinal Haven, Maine, for the cathedral being built at Morningside Park, New York. Thirty-two of these columns are required to be 54 feet long and 6 feet in diameter, each weighing 160 tons, or two-thirds as much as Cleopatra's Needle in Central Park. For dressing and polishing these granite columns they are mounted in a giant lathe and revolved so as to bring their exterior surface first against cutting tools and afterward on polishing materials. This lathe is 86 feet long and weighs 135 tons, and the rough stone which it reduces to dimension, weighs at first as much as

Prof. G. P. Merrill, Curator of Geology, U. S. National Museum, has kindly sent me the following data on large stones lately quarried:

| Authority | Quarry | Destination | Size | Weight. | Kind of Stone |
|---|---|---|---|---|---|
| Stone, Dec. 1892, p. 60 | Stony Cr., Conn. | West Point, N. Y. | 41′x6′x6″ | 100 tons | Branford Red Granite |
| Stone, Mar. 1902 | Hallowell, Me. | Hall of Records, N.Y. | 36′10″x4′10″ | ..... | Granite |
| ..... | Badger Bros Quincy, Mass. | ..... | 72″ diam. | 110 tons | ..... |
| ..... | Barre, Vt. | Mausoleum Vice-Pres. G. A. Hobart | 34′ | 43 tons | Granite |
| ..... | J. J. and F. P. Treanor, Hastings-on-the-Hudson, N. Y. | Stoop, Huntington Mansion, 5th ave. and 57th st., N. Y. | 22′x15′x18″ | 24 tons | ..... |

Several of the obelisks quarried and moved by the Egyptians were double the size of any of these and weighed several times as much: The estimated height of the Lateran obelisk is 105 feet 6 inches and its weight 510 tons; Cleopatra's Needle in New York is 69 feet 6 inches high and weighs 224 tons. The obelisk still in the quarry at Syene is 95 feet long and it is estimated to weigh 770 tons, which may be a greater weight than the Egyptians could move.

The monolith has a religious significance in Arabia and is used to designate a place of prayer in some parts of Asia Minor. The present distribution of these monoliths marks the distribution of that pagan worship or abomination the Israelites repeatedly tried to root out but without success.[1] These "high places of worship" formerly found

310 tons. This lathe was designed and patented by engineers of Boston, and was constructed in Philadelphia. (*American Geologist*, Vol. 27, No. 1, January, 1901, p. 66.)

[1] Whether or not we accept the theory that the church spire and minaret is the surviving homologue of the ancient obelisks marking places of prayer, the absence of steeples in synagogues is often quoted as a protest against these indications of heathen worship.

Although the Israelites were commanded not to set up an image of stone (eben maskith) they often used stones for commemoration, as when Joshua erected 12 stones in Gilgad after crossing the Jordan.

everywhere among the Moabites, Canaanites, Edomites, and Samaritans are still to be seen in the Syrian and Arabian mountains, where they are marked with obelisks cut out of solid rock, photographs of which are shown by Libbey and Hoskins [1] in their account of the ruin of Petra.

It is instructive to note how universally ancient megaliths have come to be associated with germinative rites, which among primitive man are universal. In Brittany and elsewhere in France, Sabillot has found in the folk lore of the country people many large boulders where germinative rites are still performed. The same association exists

FIG. 10.—Platform monoliths, Zimbabwe, Africa, from Bent.

wherever monoliths occur. The obelisk or stone pillar of Begig in the Fayum is resorted to by Egyptian women who desire children, and the god of germs at Hopi is a log of petrified wood; survivals from different geographical locations which are instructive as showing the connection of these large stones with earth goddess worship.

The monoliths found in the great ruins of Mashonaland, in South Africa, recall in general forms the menhirs of Brittany, being for the most part tall, rude monoliths alternating with small round masonry towers arranged on platforms, reminding one of the stone colossi and their bases at Easter Island.

[1] William Libbey and Franklin Evans Hoskins, The Jordan Valley and Petra. New York, Putnam and Sons, 1905.

At the great ruin Zimbabwe, in South Africa, there are huge boulders about 50 feet high; immediately below the highest is a curious little plateau adorned by huge monoliths and soapstone pedestals supporting gigantic stone birds, the tallest of which stood 5 feet 4 inches in height. Several of these monoliths are decorated with life figures, one of which, 11½ feet high, is made of soapstone and adorned with geometrical patterns. In Bent's account[1] of this ruin occurs the following forcible description:

Such is the great fortress of Zimbabwe, the most mysterious and complex structure that it has ever been my fate to look upon. Vainly one tries to realize what it must have been like in the days before ruin fell upon it, with its tortuous and well-guarded approaches, its walls bristling with monoliths and

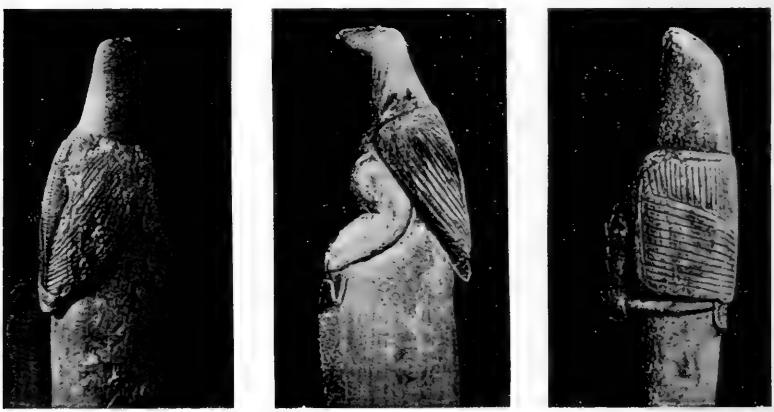

FIG. 11.—Stone birds, Zimbabwe, Africa, from Bent.

round towers, its temple decorated with tall, wierd-looking birds, its huge decorated bowls, and in the innermost recesses its busy gold-producing furnace. What was this life like? Why did the inhabitants so carefully guard themselves against attack? A thousand questions occur to one which one longs in vain to answer. The only parallel sensation that I have had was when viewing the long avenues of menhirs near Carnac, in Brittany, a sensation at once fascinating and vexatious, for one feels the utter hopelessness of knowing all one would wish on the subject. When taken alone this fortress is sufficiently a marvel; but when taken together with the large circular building below, the numerous ruins scattered around, the other ruins of a like nature at a distance, one cannot fail to recognize the vastness and power of this ancient race, their great constructive ingenuity and strategic skill.

Although we have no positive evidence that the South African obelisks are religious, the probability is that these monoliths illustrate

[1] J. Theodore Bent, The Ruined Cities of Mashonaland. London, 1892, p. 112.

the same law as similar structures found in Asia, Europe, America, and Polynesia. They are religious in nature or connected with worship and the cult of the dead.

## OBELISKS

The most finished type of monolith is the obelisk,[1] a stone structure best represented in the valley of the Nile and adjacent territory. In architectural proportions the Egyptian obelisk is a perfect monolith. Although from the early times transported by conquerors

FIG. 12.—Monolith, Zimbabwe, Africa, from Bent.

of Egypt to different localities in Europe and adopted throughout the world as a commemorative or mortuary monument, the obelisk in its present form originated in a narrow geographical area skirting the Nile, in northeastern Africa.

Hardly a civilized country can be mentioned where imitations of Egyptian obelisks are not found. Essentially Egyptian in origin the obelisk was copied by both Greeks and Romans, especially the latter,

[1] Egyptian Obelisks by Henry H. Gorringe, New York, 1882. This monograph contains an exhaustive account of all known obelisks and a special description, profusely illustrated, of the removal of Cleopatra's Needle from Alexandria to New York; also Erasmus Wilson, Cleopatra's Needle and Egyptian Obelisks, London.

and its beauty [1] has been admired from earliest times. Good examples are found in Italy, England, the United States, France, Germany, and Constantinople; it has been stated by an acute student of the subject that at present there are more obelisks above ground in Rome than there are in Egypt,[2] their native land.

The purest type of obelisk, like that of Heliopolis, is a monolith tapering from base to apex, its height being about 10 times the length of one side of the base. In true obelisks all four faces are plain surfaces equal in width, although sometimes as observed by Verninac at

FIG. 13.—Obelisk, Heliopolis, Egypt.

Karnak there is a marked entasis or convexity similar to the curves in pediments of temples. When obelisks bear hieroglyphics they are regularly arranged in three rows reading from above downwards, the oldest vertical row being always in the middle.

The original inscriptions on some obelisks have been erased and new ones added, a method adopted by some rulers to express their consummate egotism.

[1] The obelisk has the three essential qualities indispensable in architecture as pointed out centuries ago by Vitruvius. It has firmitas, utilitas, and venustas —stability, utility, beauty.

[2] The largest number of obelisks found in one place in Egypt was 10 or more, some in fragments (Ebers says 12; Fergusson 13) at San in the Delta, the Zoan of the Bible (Brugsch's Egypt).

FIG. 14.—Temple and obelisk, Karnac, Egypt, photograph from Lekejan.

The various Egyptian obelisks not only vary slightly in proportions but also in decorations: some have pictures and inscriptions, others not. There is a variety in mounting; thus, the obelisk of the Piazza del Minerva in Rome and one at Catania in Sicily are carried on the backs of stone elephants. Supporting the corners of Cleopatra's Needle now in Central Park, New York, were bronze props representing crabs, which probably belonged to a later cult and were placed under this monolith when it was first moved and set upright in Alexandria.

Egyptian obelisks, as those of Karnac (Thebes), commonly stood in pairs before the gates of the temples and were made of hard stone obtained from quarries at Syene, from which fact the word syenite has come to designate this geological formation. They commemorate the deeds of rulers whose cartouches they bear, accompanied by invocations and grandiloquent references to the mighty deeds of the builders, or subsequent rulers.

The prostrate obeliscoid column of Begilg near Crocodilopolis, in the fertile valley of Fayûm, differs in the shape of its shaft and form of the apex from the others. Its sides are unequal and bear representations of beings[1] formerly worshipped. Its top is rounded, deeply grooved across the middle, and the sides are of unequal breadth. From an inscription on the narrow sides, as translated by M. Chabas, and as interpreted by the practices of native women about its fallen fragments, one is led to regard this obelisk as somewhat different from the majority of commemorative monuments. It is still regarded in the same light as the Phenician monoliths known as baetylia that are found on both shores of the Mediterranean from Asia Minor to Spain and Morocco.

Many theories have been framed to explain how these obelisks were quarried. A large specimen still remaining in place in the quarries at Syene is attached to the rock by one side, the other three sides having been fashioned into shape. It is supposed by some authorities that the form of the obelisk was first marked out on the surface by cutting a groove, and that the rock was cracked by first building fire on it, after which the ashes were swept away and water poured into the groove—a method still used at the present day by the East Indians. Other authorities have supposed that holes were made at intervals and a series of wedges was placed in these holes

[1] The upper part is occupied by 5 vignettes representing the king Usertesen I, before 10 pairs of divinities, 5 on the right and 5 on the left.

and thus the stone was cracked off.[1] Having been quarried the obelisk was dressed and inscribed, after which it was moved to its future home. The means by which it was transported on rafts are known, but how the great weight was set on end after the obelisk had been brought to its future site is as yet not clear.

It would seem that the meaning of the Egyptian obelisks would be revealed by the inscriptions they bear on their sides. While this might be expected, unfortunately there is some lack of uniformity in the translation of those inscriptions, although all agree they contain arrays of grandiloquent titles and exalted references to attributes of the Pharaohs, indicating that they serve as memorials and were erected in commemoration[2] of rulers or events.

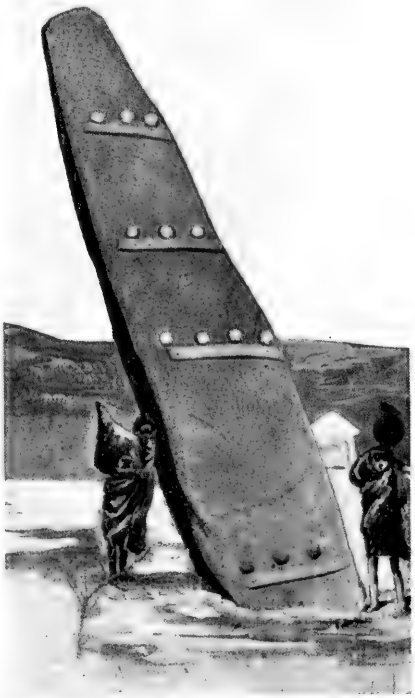

FIG. 15.—Monolith, Abyssinia, from Bent.

It is instructive for comparisons to pass to a consideration of commemorative objects like Alaskan totem-poles made of wood and those of New Zealand, where the same idea has been executed in both wood and stone. Lieutenant Meade, in an interesting work entitled "A Ride through New Zealand," describes a trilithon consisting of two perpendicular blocks of stone about 25-30 feet high supporting a horizontal one about half as long again. In the center of the latter

[1] The great Seringapatam obelisk erected by Hindoos in memory of Josiah Webbe, in 1805 was split off with iron wedges as described by Col. Wilks (Edin. Philos. Trans., Vol. 9).

[2] Pompey's Pillar, a shaft 88 feet 6 inches, according to an inscription was erected at Alexandria in Egypt in honor of the Emperor Diocletian. Its monolith measures 69 feet.

is a circular hollow or basin that the natives call the "kava bowl" of the gods or giants. The New Zealand totem-pole like that of our Northwest Coast was commonly carved in wood, but the same idea was expressed here as in other parts of Polynesia by great stones often uncut.

As we depart from the Nile, the home of the obelisk, southward into Abyssinia, we find representations of the obelisk of somewhat different forms and probably of different development. The main difference outside of the form appears to be the absence of inscriptions and a departure from the square section with equal faces.

The best Abyssinian obelisks would seem to represent sacred buildings, or sun houses consecrated to Baal, being connected with sabeism or sun-worship, a pagan cult that antedated the introduction of Christianity into Abyssinia, but which has left in that country several architectural survivals, among which may be mentioned circular churches with doorways at the cardinal points, and ceremonial rites as dances before the church altars.

It is almost impossible, indeed not necessary, to enumerate or describe all the monoliths of Abyssinia. The type is a characteristic one. Bent[1] estimates that there are 50 of these stones standing in the holy city, Aksum, alone, and Bruce says of the Aksum pillar stones:

> In one square there are 40 of these obelisks, none of which have any hieroglyphs. One large specimen is still standing, but there are two others still larger that have been broken in falling. These obelisks are constructed of one piece of granite, and on the top of that which is standing there is a decoration somewhat Greek in appearance, that is exceedingly well carved. Below this apical ornamentation there is carved on the surface of the stone a door-bolt and lock, as if to represent an entrance into a rear room. The form of the lock and bolt resemble those used in Egypt and Palestine at the present day.

One instructive fact about the Aksum obelisks is that they present all varieties of form, from the rude unhewn stone to a highly finished obelisk with polished surface. The simplest form is a monolith set on end, and an intermediate stage of the series is represented by a squared natural rock with several notches on the corners or holes cut in the angles or on the faces to indicate floors or beams. A still more complicated form has four bands and accompanying circles supposed to represent the end of rafters cut in relief, and the most highly real-

[1] J. Theodore Bent. The Sacred City of the Ethiopians, London, 1893.

istic represents the wall of a many-storied house, each having a sham door cut on the face of the obelisk, and in one instance with lock and bolt carved in relief.[1] Instead of having a pyramidion on top, as in the Egyptian obelisk, we find some of the Abyssinian obelisks tipped with a round projection with flat front and rear faces on the rim of which are still visible the holes for pegs by which a metallic disk, like those

FIG. 16.—Monolith, Abyssinia, from Bent.

used in sabeism or sun-worship, was riveted. Bent finds at their bases remains of benches or tables on which he supposes sacrifices were formerly made in further support of the theory that these obelisks were devoted to the solar cult.

The monoliths of Russia, commonly called babas, or old women, grannies, may be classified as colossi and are probably of Mongol

[1] The obelisk in this example represents, symbolically the habitation, the temple proper, or adytum, Beth-el, or House of God.

origin, being found from Mongolia to the banks of the Danube. They represent a connecting link between the statue menhirs or engraved dolmens of Aveyron, south France, the "steinfiguren" of Germany and the colossi of China, to all of which they are akin. They show that monoliths and colossi are the same in intent, and that the basal

FIG. 17.—Monolith, Aksum, Abyssinia, from Bent.

principle of both is ancestor worship or the almost universal cult of the dead.

The latest historical and comparative study of these rude statues has been published by Joseph Castagné,[1] who has figured not only the babas or "grannies" of the steppes of Russia, but also a few similar images from Mongolia. Some of the babas of Orenburg preserved in the museum of that place are of considerable size, one being

[1] Joseph Castagné, Bull. et Mem. de la Soc. d'Anthropologie, No. 45, 1910.

mentioned as 10 feet in height. These babas are almost always found associated with burial tumuli, and are interpreted by Castagné as examples of the Roman custom of carrying wax masks of the deceased, or images of the defunct, their presence being survivals of the

FIG. 18.—Babas, grannies, Siberia, from Castagné.

cultus of the dead that had a real and serious meaning to primitive man.

## COLOSSI

The highest expression of the megalithic art appears in great single stones carved into life forms known as colossi, of which the statues of Memnon are good examples. In these monoliths man attempted to

express his ideas of the greatness of his gods[1] or ancestors by the mammoth size of his idols.

We detect very clearly in the colossus the influences of geographical environment. They can be traced to a sedentary life, for a wandering people is not one that produces great sculptures. The dependence of the sculptor on available rock formation has long been recognized, for the production of a colossus of great size is impossible unless a certain kind of rock is available for that purpose. Colossi were made in the most advanced stage of the megalithic epoch and are abundant in both the old and new worlds.[2]

With exception of the sculptured menhirs, "steinfiguren," and babas, European colossi are small and inconspicuous. Monolithic colossal statues are not characteristic of ancient Greek, Etruscan, or Roman art in Europe, but occur in Asia,[3] northern Africa, Central America, and Polynesia.

We find some of the largest known colossi in Egypt where the megalithic age reached its highest development. The great sphynx at Ghizeh, the statue of Rameses II[4] and the enormous seated figures of the vocal Memnon, at Thebes, one of which is still a monolith, attest the barbaric power of the ancient Egyptians in this line of expression.

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[1] The area immediately surrounding the colossus is generally without roof, open to the sky—a characteristic feature of various forms of monoliths. The development of the enclosure where the idol stands into a temple led to a diminution in size of the colossus and a predominance of accessories. The idol being a symbol, the shrine or temple is symbolically the habitation of the god, but the main structures of the more complicated temples are elaborations of entrances and porticoes. Very diverse structures are called temples; the Yucatec sacrificial pyramid has little in common with the palace temples of Egypt and Assyria. Some of the Abyssinian obelisks have the house, as well as the disk, of the sun (Baal) upon it.

[2] In modern times we find allegorical figures, as the statute of Liberty at the entrance to New York harbor, that of Walhalla at Ratisbon, Bavaria, or the statue of Ariovistus, Germany, taking a colossal form. While the religious feeling is absent the commemorative element still survives, and is expressed in these and many other sporadic instances that might be mentioned.

[3] The terrace on which the temple (of Baalbec) stands is formed of stones of enormous magnitude; at the northwest angle are three stones, two of which are 60 feet, and the third 62 feet 9 inches in length. Hodder M. Westropp, Handbook of Archaeology, 1867.

[4] This stupendous statue now in fragments measured 22 feet 4 inches across the shoulders. Sir G. Wilkinson estimated that the whole mass entire weighed 887 tons.

The Babylonians and other ancients of the Euphrates valley were not inferior to the Egyptians in the production of enormous colossi, while the monolithic figures of Buddha scattered through India, Ceylon, Java, China, and elsewhere express the same feeling of enormous or ponderous power controlling the mind of a people dominated by a like consciousness.

In the buried cities of Ceylon there are many monoliths and colossi of Buddhas. The interior of the first temple of Dambulla contains

FIG. 19.—Great sphynx, Ghizeh, Egypt.

" the gigantic recumbent figure of Buddha, which together with the pillow and couch on which it rests, is cut out of the solid rock, and measures 47 feet in length."[1] " The reclining figure of Buddha," says Burrows in his description of Gal Vihara (rock temple) of Ceylon, " is by far the finest of the three. It measures 46 feet in length and has suffered little from the ravages of time."

The colossi of China are best illustrated by the stone figures lining the road or dromos to the tombs of the Ming dynasty, about 40 miles north of Pekin, recalling the avenue of colossal sphinxes in Egypt. These huge images take the forms of men, griffins, elephants, camels,

[1] S. M. Burrows, The Buried Cities of Ceylon. Colombo, 1905.

and turtles, 32 in number, arranged in pairs; one of the latter having an obelisk on its carapace reminds one of the elephant bearing an obelisk now in the Piazza del Minerva at Rome, and can be traced directly to Mongol influences, although in southern China where it is not as strong, giant images of Buddhas are frequently encountered.

FIG. 20.—Elephant colossus, Ming Tombs, China, photograph from F. B. Wright.

Historical monoliths like the Nestorian tablet of China set up in 781 A. D., or that erected by the Japanese in commemoration of the visit of the U. S. squadron to Japan under Commodore Perry, the Tomb of Midas and other massive rocks bearing inscriptions claim attention in our studies of the megaliths.

Boundary stones are repeatedly mentioned in Biblical writings. Both the Romans and Chinese erected stone pillars commemorative of battles, or memorials of famous emperors or generals.

The consideration of the great monoliths of the Pacific islands naturally lead us to the architectural wonders of Java, or to the great temples which arose in that island under Hindoo influences. In the

FIG. 21.—Elephant colossus, Ming Tombs, China, photograph from F. B. Wright.

silent jungles of this island stand the massive ruin of Chandi-Sewa, the "thousand temples," adorned with figures constructed of solid stone. Some of these ruins, as that of Chandi-Kali-Bening, surpass in size those in India itself and the magnitude of the great temple of Boroboda with its triple circle of towers compares favorably with the temples of Luxor and Karnac. The human labor necessary to

construct these sculptured hill temples of Java is almost incomprehensible. No other people have excelled the builders of these tremendous temples in their constructive skill and power of work.

It would be quite impossible to embrace in a few remarks any adequate account of the many colossi found in these Javanese temples, nor will a few examples, however fitly chosen, aid in your appreciation of them. I cannot in such a dilemma do better than refer you to the writings of Raffle and the magnificent plates of the temple of Boro-Bodo (Bara-Budur) published by the Minister of the colonies

FIG. 22.—Camel colossus, Ming Tombs, China, photograph from F. B. Wright.

of the Netherlands. Here we find massive megalithic architecture in all its grandeur, relieved with a profusion of detail, decorated with an artistic embellishment nowhere else duplicated in the megalithic age. These Javanese temples, as pointed out by W. H. Holmes, suggest the great prehistoric terraced sacred buildings of Central America,[1] and yet they are so characteristic of East Indian art that they

[1] A general view and ground plan of Boro-Boda (Bara-Budur), a typical example of these Javanese temples, shows a rectangular terraced structure with niches for sitting figures, like Papantla in Mexico, the whole covered by a cupola 52 feet in diameter surrounded by smaller cupolas. Like the topes or dagobas of Ceylon this building was for the enshrinement of relics rather than a temple in the Greek or Egyptian sense of the term.

stand out as a distinct architectural type. The mind of man was in both instances under the influence of an identical thought, environment furnishing different materials for the expression of that thought.

FIG. 23.—Colossus of soldier, Ming Tombs, China, photograph from F. B. Wright.

The existence of colossi on Easter Island, one of the most isolated islands of the Pacific Ocean, so far from all other monumental works of magnitude, is one of the archeological enigmas. Here and there on Pacific islands there are stones that may be called monoliths, but the images of Easter Island surpass them all in size and importance.

The latter are thus described in a report on a visit to this island in 1876 by Paymaster William J. Thomson,[1] U. S. Navy:

In order to form an estimate of the magnitude of the work performed by the image-makers, every one on the island was carefully counted, and the list shows

FIG. 24.—Brambanan temple façade, Java.

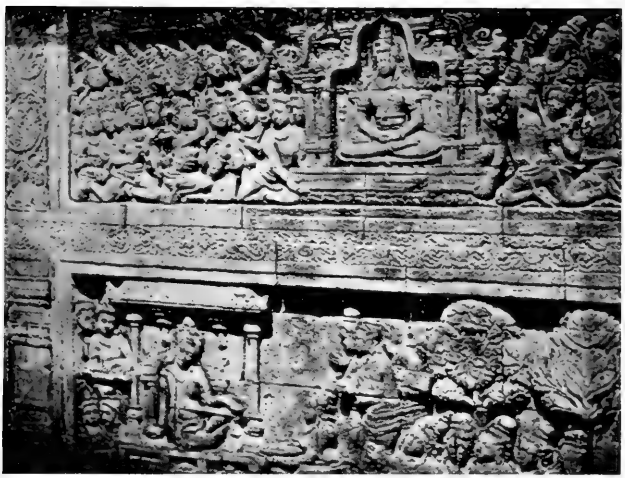

FIG. 25.—Boro-Bodo temple façade, Java.

a total of 555 images. . . . . Of this number 40 are standing inside of the crater . . . . The largest image is in one of the workshops in an unfinished state and measures 70 feet in length; the smallest was found in one of the caves and is a

[1] Te Pito Te Henua, or Easter Island, by Paymaster William J. Thomson, U. S. N., Report U. S. National Museum for 1889, p. 497.

little short of 3 feet in length. One of the largest images that has been in position lies near the platform which is ornamented, near Ovahe; it is 32 feet long and weighs 50 tons. . . . .

The images were designed as effigies of distinguished persons and intended as monuments to perpetuate their memory. They were never regarded as idols, and were not venerated or worshipped in any manner. . . . .

The work of carving the image into shape and detaching it from the rock of which it was a part, did not consume a great deal of time, but the chief difficulty was, in the absence of mechanical contrivances to launch it safely down the slope of the mountain and transport it to a distant point. It was lowered to the plain by a system of chocks and wedges, and the rest was a dead drag accomplished by main strength. A roadway was constructed over which the images

FIG. 26.—Monoliths and images (fallen) Easter Island, from Thomson.

were dragged by means of ropes made of indigenous hemp, and sea-weed and grass made excellent lubricants. The platforms were all built with sloping terraces in the rear, and up this incline a temporary road-way was constructed of a suitable height, upon which the statue could be rolled until the base was over the proper resting place. The earth was then dug away to allow the image to settle down into position, the ropes being used to steady it in the meantime. . . . .

The fact that these huge monoliths rise from platforms recalls conditions in South Africa already considered where monoliths and gigantic birds stand on similar great stone platforms.

There is abundant evidence that Mr. Thomson has correctly interpreted the Easter Island colossi as "effigies of distinguished persons . . . . intended as monuments to perpetuate their memory." Investi-

gation of the monoliths and colossi of other Polynesian islands points to the same conclusion regarding them.

Wherever we find the megalithic pillars in the Pacific we find them connected with a cult of the dead, and as we pass westward across the Pacific to the architectural wonders of Java where the stone working becomes more elaborate we find the same connection. The megalithic monuments of Polynesia have been repeatedly likened to the cromlechs and alligned stones of Stonehenge in England and Carnac in Brittany.

In the Penrhyn Islands there are small circles of stone described by Mr. Lamont that enclose an area some hundred yards square, "a sort of Stonehenge in a small way," and there are megalithic tombs in the Tonga Islands described in the Natural History of Man by Mr. Wood. The Australians likewise had stone circles with an upright stone slab in the middle.

In the Sandwich (Hawaiian) Islands we find the megaliths limited to walled enclosures like the pagan temple at Waikiki, but in Rapatiti there are massive stone forts. In the Friendly Islands, near the ancient metropolis of Tongatabu, there are 19 truncate pyramids, the stones composing which average 18 feet long by 5½ feet high and 3 feet thick weighing 20 tons each. Near these pyramids is a trilithon the uprights of which are 14 feet high, 8 feet wide and nearly 4 feet thick, weighing 15 tons, the cross-piece being somewhat smaller. They were transported over 3 miles by savages supposed to be ignorant of mechanical appliances.

In the Ladrones there are rows of stone columns, called the "houses of the ancients"; and massive walls built of basaltic prisms, 300 feet long and 35 feet high, exist in Ponape of the Caroline group.

Of the many archeological problems presented by the islands of the Pacific none are more instructive than the great heathen temple 51 feet by 39 feet in size, situated in a secluded valley in the center of Opala in Samoa. The adjacent tombs of the Tonga chiefs on these islands are marked with monoliths of enormous size.

## NEW WORLD MEGALITHIC EPOCH

Mr. E. G. Squier in a brief pamphlet, "The Primeval Monuments of Peru compared with those in other parts of the World," published in the *American Naturalist* in 1870, arrived at the far reaching truth that megalithic monuments "seem to have been the spontaneous productions of the primitive man in all parts of the world, and not neces-

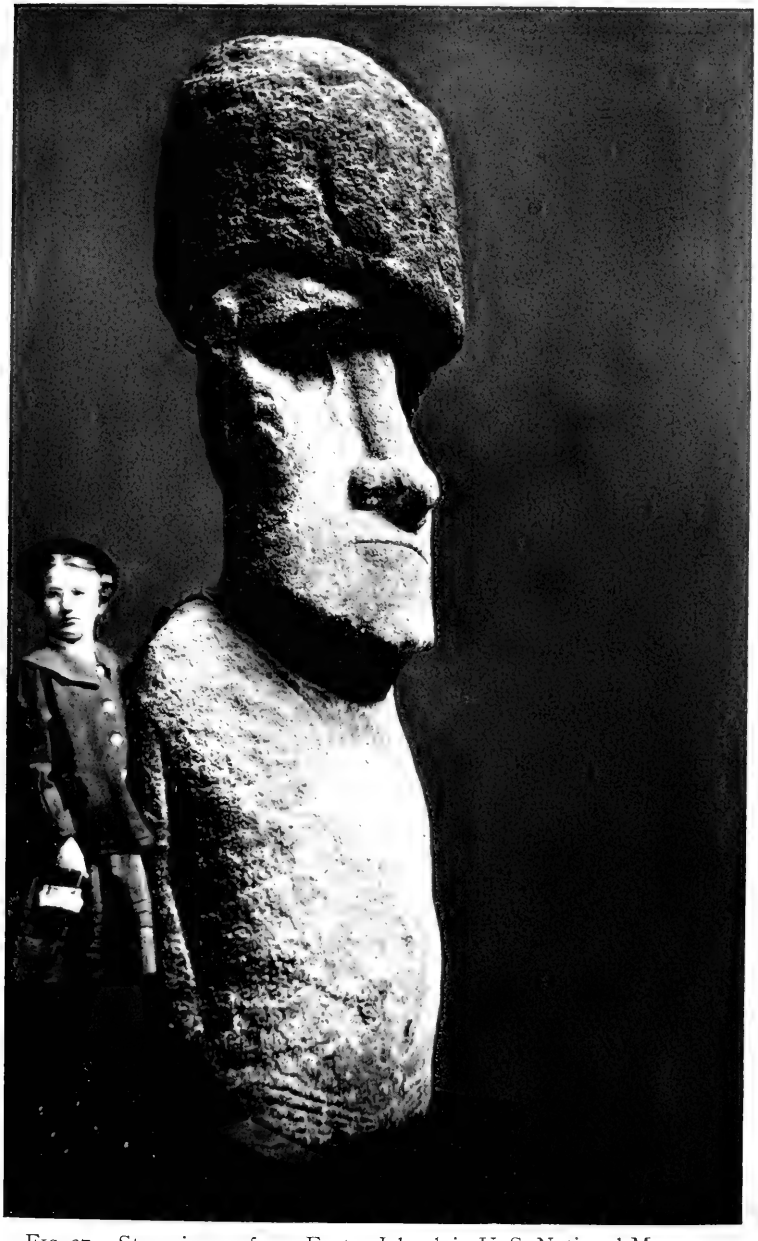

FIG. 27.—Stone image from Easter Island, in U. S. National Museum. Photograph by René Bache.

sarily nor even probably derivative." Other writers before and since him have recognized that truth, but no one had previously followed the resemblance of New and Old World megalithic structures.

Only a few of the more advanced people of America show evidences of the megalithic phase of culture, but the races dwelling on the Cordilleras of South America and those inhabiting the lowlands of

FIG. 28.—Stela F, Quirigua, Honduras, from Maudsley.

Central America were in this stage of cultural development before the discovery of America by Europeans. The best examples of megaliths occur in Peru, Colombia, Guatemala, Honduras, Mexico, and Yucatan, in all of which countries there are fine examples of both monoliths and colossi. They often bear glyphs or calendar symbols, which are characteristic of the New World as the Egyptian hieroglyphs are of the country bordering the Nile. No satisfactory evidence has yet been brought forward that phonetic writing arose independently on the American continent. The Indians of the terri-

tory of the present United States never developed a megalithic stage, although sporadic instances of natural rocks which have a religious rôle might be mentioned.[1]

Unworked monoliths or giant natural stones set upright singly or in numbers are found in both Central and South America, one of which from Argentina is as high as the head of a man on horseback.[2]

With few exceptions where we find monoliths and colossi, cyclopean walls likewise occur, evidently intended to express the same consciousness of power. This is particularly true of the Incas and pre-Incan races who handled the largest blocks of heavy stone and fitted them together with an accuracy that has astonished everyone from the time of their Spanish conquerors to the present.

We find in various parts of tropical America circles and alignments of monoliths recalling menhirs or cromlechs of the Old World, and called Indian corrals and ball courts. One of the largest and best known of these described by Schomburgk,[3] near San Juan de Maguana in Hayti, was formed of granite stones each from 30 to 50 pounds in weight and arranged in a ring measuring 2,776 feet in circumference. In the center of this dolmen was a rock over 5 feet high supposed to be an idol. Similar enclosures also with central idol found in Porto Rico were described by Dr. A. Stahl and others.[4]

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[1] Such natural monuments as the Snake Rock at Walpi or the Twin pinnacles at Tayallone, near Zuñi, or innumerable others which are mentioned in the folk-lore tales of Indians are not here considered, although like all monoliths they have a religious significance.

The stone "mountain lions" of Cochiti are sometimes rightly called colossi.

Mr. J. N. B. Hewitt has called my attention to the following from the "Histoire du Canada," by Sagard Teodot, which explains itself:

Ils m'ont monstré plusieurs puissans rochers sur le chemin de Kebec, ausquels ils croyent presider quelque esprit, & entr'autres ils me monstrerent un à quelque cent cinquante lieuës de là, qui auoit comme une teste & les deux bras esleuez en haut, & au ventre au milieu de ce grand rocher il y auoit une profonde cauerne de tres-difficile accés. Ils me vouloient persuader & faire croire à toute force auec eux, que ce rocher auiot esté autrefois homme morte comme nous, & que esleuant les bras & les mains en haut, il s'estoit metamorphosé en cette pierre, etc.

[2] See charts; Las Viejas Razas Argentinas. Felix Fuertes and Carlos Brusch. In the explanatory text occurs the following quotation that reminds one of bateys and similar structures in the West Indies: "Enciertos localidades se han encontrado piedras disquestas en circolo y paredas quisa in fin religioso."

[3] Sir Robert Schomburgk, Ethnological Researches in Santo Domingo. Report British Association, 1851.

[4] A. Stahl, Los Indios Borinqueños, Puerto Rico, 1889. J. Walter Fewkes, Aborigines of Porto Rico and Neighboring Islands, 25th Rept. Bur. Amer. Ethnology. 1907.

Peruvian and Bolivian "sun-circles," elsewhere mentioned, are structurally comparable with stone circles in Taumalipas and Vera Cruz, except that they approach the circular rather than rectangular forms.

As Egypt is the native land of the Old World obelisk and colossus, so Central America is the home of the colossi and commemorative monoliths of the New. The American counterpart of Egyptian obelisks are the so-called stelæ of Tikal, Quirigua, Ocosingo, Copan, and the ruins of the valley of the Ucimacintla, in Honduras.

FIG. 29.—Stela B, Copan, Honduras, from Maudsley.

According to Mr. C. P. Bowditch[1]:

> "Monoliths are scattered all over the northern and eastern slopes of the Cordilleras as they run through the State of Chiapas in Mexico, and through the Republic of Guatemala into Honduras . . . . and in the whole extent of the peninsula of Yucatan. . . . . The monoliths may be roughly divided into two kinds, according to their shape. One kind (called stela, plural stelæ) is tall, measuring in one case 28 feet in height, while they are not over 4 feet in width or depth. The others are low and take various forms, being square, oblong, or round as a rule, though some are carved in the shape of an uncouth animal."

Elsewhere Mr. Bowditch, regarding monoliths, calendaric or hieratic in character, quotes Landa, who states "that there were found in Mayapan seven or eight stones ten feet in length, unworked and with several rows of these (hieroglyphic) characters, and that the Mayas were accustomed to raise stones like these every 20 years." He likewise quotes Cogolludo, who says "that the Mayas counted the

[1] C. P. Bowditch, The Numeration, Calendar Systems and Astronomical Knowledge of the Mayas, Cambridge, 1910, p. 6.

ages by 20 years, which they call katun, and that they placed one worked stone on another on the walls of their temple at the end of these periods, as he himself has seen."

The stelæ of Copan and other related Central American ruins have carved upon them representations of men or women wearing sym-

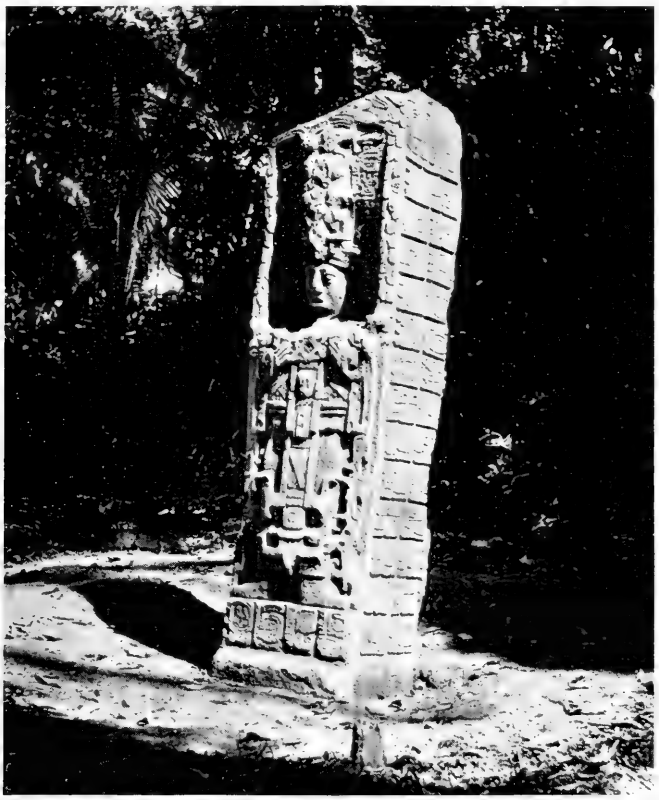

FIG. 30.—Stela C, Quirigua, Honduras, from Maudsley.

bolic ceremonial paraphernalia, and like the Egyptian statues of Rameses are not intended for divinities but represent priests wearing symbols or headdresses characteristic of gods. These American monoliths or stelæ, like Egyptian obelisks, bear vertical rows of lines of hieroglyphs; they generally stand in front of temple mounds or on ceremonial plazas, in much the same relative position as obelisks, indicating by the position, general form, and accompanying glyphs that they are both memorial and religious in character.

The great animal effigies of the Lake of Menagua in Nicaragua, described by Dr. Carl Bovallius, belong to the group of monoliths architectural rather than religious in character, being intermediate between unworked monoliths and colossi. Perhaps the best known Aztec megalithic statue is that called Huitzilopochtli, the God of War, which Mr. Payne,[1] with good reason, identifies as the Corn Snake goddess, a colossal representation of an effigy made of corn stalks used in ceremonial dances. The great stone tiger found a short time ago in excavations made in a street back of the cathedral near where the

FIG. 31.—Turtle, Quirigua, Honduras, from Maudsley.

old temple of the Aztecs once stood in Mexico City, is a colossus, and the giant serpent's head, part of the ancient wall of the temple now set in the foundation of an adjacent modern building, belongs to the same category.

Although expressions of the megalithic consciousness were less pronounced among the Totonac and Huastec people of the coast of the Gulf of Mexico than in Central America, or the valley of Mexico, statues from Xico Viejo, near Jalapa in the state, Vera Cruz, and the neighborhood of Tampico, in Taumalipas, have been figured in the speaker's account of the antiquities of eastern Mexico.[2]

[1] Edward John Payne, History of the New World called America, Vol. I, p. 470. Oxford.

[2] Twenty-fifth Annual Report Bureau of American Ethnology.

No colossi have been reported from the Gulf coast north of Tamaulipas, but the pillar stones in rude human form, like those of the Huastecs,[1] occur from Cuba to St. Vincent, West Indies, showing the presence of the monolithic feeling among the former people of the Antilles, as well as the Spanish Main.

Our studies of megaliths in America would be incomplete were we to neglect the cyclopean buildings of Peru, with monoliths so remarkable that they have excited the imagination of all travellers. Considerable literature[2] exists regarding these structures; the impression after reading descriptions of them is of great wonder at the magnitude of these buildings.

Mr. E. G. Squier[3] has figured and described one of these monuments which he aptly designates the "American Stonehenge":

> The temple seems to me to be the most ancient of all the distinctive monuments of Tiahuanaco. The stones defining it are rough and frayed by time. The walls between its rude pilasters were of uncut stones; and although it contains the most elaborate single monument among the ruins, and notwithstanding the erect stones constituting its portal are the most striking of their kind, it nevertheless has palpable signs of age, and an air of antiquity which we discover in none of its kindred monuments. Of course, its broad area was never roofed in, whatever may have been the case with smaller, interior buildings no longer traceable. We must rank it, therefore, with those vast open temples (for of its sacred purpose we can scarcely have a doubt) of which Stonehenge and Avebury, in England, are examples, and which we find in Brittany, in Denmark, in Assyria and on the steppes of Tartary.

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[1] Ed. Seler. Die Alten Ansiedelungen im Gebiete der Huaxteca. Berliner Anth. Gesells., 1888.

The "*Steinfiguren*" figured by Dr. Seler and the rectangular enclosures, *tlachco*, of the Cerro el Cangrejo near Chila, in the neighborhood of Tampico, remind me of the Porto Rican "*batey*" and rude pillar stones of the West Indies. Mr. Joyce has figured a pillar stone in the British Museum said to have come from Nevis in the West Indies, which is a statue comparable with the Huastec, but shows marked old world influences. Mr. Connell of St. Kitts has a similar pillar stone also from Nevis.

[2] Several writers refer these megalithic monuments to a pre-Incan civilization. Good authorities might be mentioned in support of the belief that the megalithic monuments of Peru belong to different cultures.

[3] *Op. cit.* Later authorities, Strübel and Uhle, and Sir Clements Markham, especially the last, have greatly enlarged our knowledge of Incan and pre-Incan megaliths. Some very large rocks at Cuzco are still rough, while the stones at Ollantaytambo are smooth. The monoliths of Abancay and the Cuzco stones are instructive megaliths.

The great monolithic gateway of Tiahuanaco, Peru, is the best known megalith of South America. In describing this structure Squier says:

We must imagine a block of stone, somewhat broken and defaced on its edges, but originally cut with precision, 13 feet 5 inches long, 7 feet 2 inches high above ground, and 18 inches thick. Through its center is cut a doorway, 4 feet 6 inches high, and 2 feet 9 inches wide. Above this doorway and as it now stands on its southeast side or front, are four lines of sculpture in low relief, like the Egyptian plain sculptures, and a central figure immediately over the doorway sculptured in high relief. On the reverse we find the doorway

FIG. 32.—Monolithic gateway, Tiahuanaco, Peru, from Stübel and Uhle.

surrounded by friezes or cornices, and above it on each side two small niches, below which, also on either side, is a single larger niche. The stone itself is a dark and exceedingly hard trachyte. It is faced with a precision that no skill can excel.

Among other examples of South American structures illustrating South American monoliths may be mentioned the sun-circles (*intihuatana*), first described by Squier, of Sillustani and the stone pillars of Hatuncolla, the latter decorated with figures of serpents, lizards, frogs, and elaborate geometrical designs. The sun-circles[1] consist of rings of well-fitted flat stones forming a platform, on the inner edge

[1] The best description of these known to me is found in Bandelier's "The Aboriginal Ruins at Sillustani, Peru" (American Anthropologist, Vol. 7, No. 1, 1905). There are a number of sun-circles, less carefully built, on the height called Kajopi, above the village of Huata in Bolivia, according to this authority.

of which are erect uncut stones arranged in ring shape, while in the enclosure thus formed are other upright stones that also show no sign of tools. These sun-circles reminded Squier of megalithic monuments of England and northern Europe, and in certain particulars they recall to my mind the batey[1] or ball courts of the West Indies, Mexico, and Central America.

In the limited time available only a few of many megalithic structures in Peru can be instanced, the list might be much enlarged by

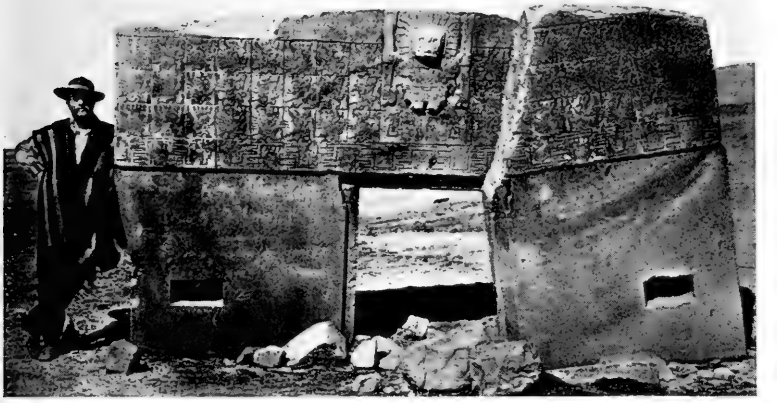

FIG. 33.—Monolithic "gateway," Tiahuanaco, Peru, from Stübel and Uhle.

the addition of monolithic doorways and other examples, but these suffice to show that the erection of megaliths attained a high development in South as in Central America. A people where this power was so highly developed naturally built stones of great size into their temples and fortresses as that of Sacsahuaman, which Squier regarded the greatest specimen of cyclopean style in America. The measurements of the size of the corner-stones of buildings at Cuzco, or salient angles of the component stones of the trinchera-like walls of this fortress are extraordinary; one of the foundation stones is said, by Squier, to be "27 feet high, 14 broad, and 12 in thickness."

[1] Compare with Squier's cut of these sun-circles the ball court or batey described by Schomburgk, in Santo Domingo, West Indies.

FIG. 34.—Sun-circle, Sillustani, Peru, from Squier.

FIG. 35.—Colossal wall, Cuzco, Peru, from Squier.

The plain near Acora, Peru, is covered with many rude monuments in the forms of circles and rectangles constructed of unwrought upright stones, which Squier finds "almost identical" with cromlechs of Europe, and "might be transferred to Brittany or Wales and pass for structures contemporary with the thousand rude monuments of antiquity found in those regions."

The long, and at times seemingly tortuous, trail we have followed has led the speaker to the following generalization. Although the megaliths are among the oldest buildings or architectural structures erected by man, all, from the simplest to the most complex, belong to a series wholly distinct from that including habitations of the living. From the rude uncut monoliths to the perfection of architectural expression, the Parthenon, there are many and varied forms of religious edifices, temples, and shrines, but none of them were erected primarily as human residences. Man has never built as good a dwelling for himself as for his ancestors or gods. Man's noblest architectural efforts are not for abodes for himself while living, but in response to a striving for ideals far higher than personal vanity or shelter for his family. Even dwellings of despots shrink into insignificance in comparison with the creations of a race influenced by the highest religious feeling. The habitations of the builders of the great temples whose ruins astound us by their magnitude, are forgotten; they do not belong in the same series as the megaliths we have studied; they were built by individuals for shelter and personal comfort. Megalithic monuments are expressions of a community feeling influencing man to coöperate for ideals higher than self and should be judged by a very different standard. Temples are not modified human dwellings, but evolutions of the same religious ideal which led man in early times to erect monoliths and colossi.

FIG. 36.—Corner of massive wall. Cuzco, Peru, from Squier.

After what has been said on the geographical distribution of monoliths we may dismiss without serious consideration the theory that they were made by one and the same great race. Equally unattractive is the specious corollary that migrations of culture, save within limits, can be traced by them.

They represent a phase of religious thought, of spontaneous origin almost identically expressed. Commonly associated with tombs or burial places, they are almost universally connected with the cult of the dead. They are both cultural and religious, or expressions of a phase of racial feeling at a time before the two had been differentiated.

In closing it is well to emphasize the main object of the preceding pages and to point out that monoliths and colossi are geographically widespread and not limited to one continent or to any one race of man.

They express a profound racial self-consciousness of power amounting to a religious feeling; incidentally as in arts,[1] institutions, beliefs, and languages, environment furnishes material for or modifies the expression of this consciousness and stimulates endeavor, but culture is due to mental efforts to overcome environment by invention.

If you will bear with me for a few moments longer I will close with a plea for the comparative method of study in culture history. The objection that the existence of megalithic structures with like form and meaning in both the Old and New Worlds does not indicate derivation of one from the other is a lame argument against the use of the comparative method of discovering what has caused these resemblances. The speaker would heartily agree that likenesses in the megalithic habit do not indicate identity of culture, but he believes that these resemblances have a deep significance which comparisons may reveal.

As is apparent to those familiar with the literature of archeology, few new facts are here added to our knowledge of great stone monuments, nor is it claimed that the comparison of monoliths of the Old and New Worlds is an original thought. An attempt has been made to show, by a comparison of similar stone objects, that there is a unity in mental action among very different races of man, and that this similarity, modified somewhat in expression by geographical environment, is an important factor in human history.

[1] Of late the term "material culture" is commonly used by ethnologists in a rather loose way, apparently embracing all material objects characteristic of culture. This is a convenient term, but the intrinsic association of religion and culture cannot be lost sight of in studies of human expression.

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# NEW RACES OF ANTELOPES FROM BRITISH EAST AFRICA

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# NEW RACES OF ANTELOPES FROM BRITISH EAST AFRICA

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The present paper deals with mammal material in the United States National Museum from collections made by the Smithsonian African Expedition under the direction of Col. Theodore Roosevelt, the Paul J. Rainey African Expedition, and the Abbott Expedition to Kilimanjaro. In addition to this material the Field Museum of Chicago has loaned the National Museum the collection of antelopes gathered by Carl E. Akeley in British East Africa. The writer is indebted to the Field Museum for the privilege of describing from their material the new race of pygmy antelope from Mt. Kenia.

**NESOTRAGUS MOSCHATUS AKELEYI**, new subspecies

Kenia Pygmy Antelope

*Type* from the southeast slope of Mt. Kenia, altitude 7,000 feet, British East Africa; adult female, Cat. No. 17824, Field Museum of Chicago; collected by Carl E. Akeley; date not known; original number, 342.

*Characters.*—Body color much darker than *Nesotragus moschatus,* the dorsal region chestnut brown, the white of the throat separated medially for half its length by a fulvous band; legs darker with black pasterns and stripe in front to knee; pelage long, hair on rump 30 mm. long.

*Coloration.*—Median dorsal area of body chestnut brown, changing on lower sides to vinaceous-tawny; legs ochraceous-tawny, the pasterns fuscous, a black stripe in front to the knees; tail fuscous, somewhat darker than the body, below marked by a narrow white line. Crown of head bay, the snout with a broad streak of fuscous, a small white spot above the eye; cheeks vinaceous-tawny in contrast to the white lips, chin and throat; back of ears fuscous; inner side and base whitish. Middle throat with a broad band four inches long, of vinaceous-tawny separating the white of the upper and lower throat. Under parts white with a streak of white down the inside of each leg to the knee.

*Measurements.*—Tanned skin: head and body, 625 mm.; tail, 50; hindfoot, 145; ear, 50. Skull: condylo-basal length, 109; zygomatic breadth, 51; upper tooth row, 38; $PM^1$ to muzzle, 31; nasals, 43 x 16; diameter of orbit, 24; length of premaxillæ, 38; orbit to muzzle, 55. Premolars unworn, the milk teeth only recently shed.

*Remarks.*—Five specimens of this race belonging to the Field Museum of Chicago have been examined. Four of these specimens were collected in the Kenya Forest by Carl E. Akeley for whom the race has been named. The other specimen is from the Kijabe Forest. Unfortunately no adult male is in the collection, the two males being immature individuals, unsuitable for a type with half-grown horns and with their milk teeth still in use, so that it has been necessary to select an adult female as the type. This pygmy or suni antelope is strictly an inhabitant of forests in the interior highlands. The race here described is confined to the highland forest covering Kenia, the Aberdare Range and the Kikuyu Escarpment.

**NESOTRAGUS MOSCHATUS DESERTICOLA, new subspecies**

Desert Pygmy Antelope

*Type* from Maji-ya-chumvi, British East Africa; aged female, Cat. No. 182261 U. S. National Museum; collected December 9, 1911, by Edmund Heller; original number, 2574.

*Characters.*—Color much lighter than *Nesotragus moschatus,* cinnamon-rufous, only slightly darker on median dorsal region; white of throat almost continuous, only broken by a narrow band of fulvous one inch wide; legs light colored, fulvous, but pasterns dark, fuscous; tail very light, whitish, only the median dorsal line dusky brown; pelage short, hair on rump 20 mm. long; body size as in *moschatus.*

*Coloration.*—Dorsal color bright cinnamon-rufous, the median area only slightly darker, hazel; sides cinnamon-buff contrasting very little with the white underparts; legs ochraceous-buff lighter and brighter than the sides; pasterns fuscous; tail greyish in effect, sides and under surface white, the tip and dorsal stripe fuscous. Crown of head cinnamon-rufous bordered below by a whitish supraocular stripe; midline of snout dusky; orbital ring dusky, cheeks and sides of head cinnamon-rufous; upper lips, chin and throat white; middle of throat with white areas separated by a narrow band of fulvous one inch wide; ears on back dusky like snout, the inner side and base whitish. Underparts silky white with a white stripe extending down the inner side of each leg to the knee.

*Measurements.*—In the flesh: head and body, 580 mm.; tail, 80; hindfoot, 163; ear, 67. Skull: condylo-basal length, 105; zygomatic breadth, 51; upper tooth row, 35; $PM^1$ to muzzle, 30; nasals, 43 x 16; diameter of orbit, 23; length of premaxillæ, 35; orbit to muzzle, 55. Aged, the premolars greatly worn; nasals notched for 5 mm. at tips.

*Remarks.*—Besides the type, a male topotype is in the collection which is fully mature but with a damaged skull. The horns in this specimen are 2½ inches long and heavily ringed for two-thirds of their length. Horns parallel and extending backward in line with profile of snout. The male specimen is somewhat darker than the female, but the white areas are the same in extent as in the type. This race inhabits the edge of the desert tract or nyikae, living in the dense thickets of acacias, euphorbias, aloes and sanseveria growth. It is the lightest of all the races. Compared to specimens of *kirchenpaueri* from Kilimanjaro, collected by Dr. Abbott, *deserticola* is much lighter and less rufous with lighter crown patch and darker pasterns or hoof bands.

### RHYNCHOTRAGUS KIRKI NYIKÆ, new subspecies

Nyika Dik-dik

*Type* from Ndi, near Voi, British East Africa; adult male, Cat. No. 182228, U. S. National Museum; collected by Edmund Heller, November 1, 1911; original number, 2541.

*Characters.*—Resembling *Rhynchotragus kirki* most closely, but in size decidedly larger, equalling that of *R. hindei* from which it differs by lighter coloration.

*Coloration.*—Dorsal region ochraceous-tawny changing gradually on sides to buff; whole dorsal region vermiculated by dusky annulations of hair; underparts sharply defined against this vermiculated area by a wide band of light ochraceous-buff succeeded by the pure white of the median ventral area. Legs uniform ochraceous-tawny; tail buffy-grey vermiculated by dusky; posterior border of thighs clothed by long white hair in sharp contrast to the buffy grey rump and sides. Head with coronal crest ochraceous-tawny vermiculated only in central part by dusky; snout lighter, cinnamon-buff; orbital area white with a blackish diagonal streak through the eye to the anteorbital gland; sides of head buffy faintly vermiculated with dusky; back of ears buffy, inner side white; chin and lips white, fore throat pure ochraceous-buff; middle throat vermiculated heavily with dusky like nape.

*Measurements.*—Flesh: head and body 600 mm.; tail, 42; hind foot, 193; ear, 70. Skull: greatest length, 116; condylo-basal length, 107; greatest breadth, 57; nasals, 19 x 18; length of premaxillæ, 41; gnathion to nasals, 39; gnathion to orbit, 58; gnathion to $PM^1$, 28; length of upper tooth row, 37.5. Fully adult, the premolars showing some wear; length of horns, straight, 53.

*Remarks.*—Four specimens are in the collection representing this race; one adult male from Voi, and a mated pair from Maji-ya-Chumvi. This is a light colored desert race which occupies the low desert area south of the Tana River as far as the slopes of Kilimanjaro. North of the Tana River we have the typical *kirki* occupying the coast region, while inland we find the lightest and smallest of the races, *Rhynchotragus kirki minor*. There is a large series of the latter race in the Rainey collection from the Marsabit district.

**GAZELLA GRANTI ROOSEVELTI, new subspecies**

Roosevelt Grant Gazelle

*Type* from Kitanga Farm, Athi Plains, British East Africa; adult male, Cat. No. 162009, U. S. National Museum; shot by Theodore Roosevelt, April 26, 1909; original number, 8.

*Characters.*—Nearest typical *Gazella granti* of Ugogo, German East Africa in color, but differing by its darker coloration, smaller and narrower horns. From *Gazella granti robertsi* it differs by decidedly less widely spread horns and somewhat darker color in the males and further by the female being marked by a distinct dark flank band. From *G. g. serengetæ* it differs by the wider and undivided white rump patch and considerably lighter body coloration.

*Coloration.*—Dorsal color vinaceous-cinnamon paling toward head and on sides where it becomes pinkish-buff; top of rump and hinder border of thighs marked by a wide area of pure white which is continuous with the white basal portion of tail, terminal half of tail black; rump area bordered in front by a broad clove-brown pygal stripe two inches wide; flanks with a very slight indication of the flank band, consisting of a lighter band of light buff bordering the broad band of pinkish-buff above along middle of sides of body; outside of legs pinkish-buff like the sides; hoofs in front bordered by hair brown. Underparts, inside of legs and lower throat silky white; top of head and median line of snout cinnamon-rufous, the middle of snout marked by a large clove-brown blotch; greyish hair about horn bases and a blackish area above the eyes; the sides of face marked by a broad white band above eye extending forward to dark snout spot,

bordered below by an ill-defined narrow dusky cinnamon streak from the eye to the muzzle; orbital area white with a bister brown supraocular spot extending to horn base; tip of snout pale pinkish buff, the lips and chin white; forethroat white like the chin, the midthroat pinkish-cinnamon like the nape; ears pinkish-cinnamon, bordered at the tip by narrow border of bister, inside and spot at notch white.

*Measurements.*—In the flesh (of No. 162013, old male; type not measured): head and body, 1,480 mm.; tail, 275; hindfoot, 475; ear, 160. Skull: condylo-basal length, 268; greatest width, 115; nasals, 71 x 35; gnathion to orbit, 139; gnathion to $PM^1$, 66; length of premaxillæ, 90; gnathion to nasals, 75; length of upper tooth row, 77. Aged male, the premolars and the first molar worn down to the gums, the central fossettes completely worn away. Length of horns along curve, 25 inches; greatest spread, 18¼ inches.

*Remarks.*—Four adult male skins are in the collection from the Athi Plains and the Naivasha district. The dark lateral band is wanting in all except one, where it is faintly indicated far back on the flank. In the immature male, however, the dark flank band is well marked. A single female is in the collection and in this specimen the flank band and the dark pygal stripe are very pronounced.

### GAZELLA GRANTI SERENGETÆ, new subspecies

Serengeti Grant Gazelle

*Type* from Taveta, western edge of the Serengeti Plains, Kilimanjaro district, British East Africa; adult male, Cat. No. $\frac{18961}{34703}$, U. S. National Museum; shot by Dr. W. L. Abbott; exact date not known; original number, 23.

*Characters.*—Most closely allied in size to typical *Gazella granti* from which it differs by having the white rump patch divided by a narrow streak of the cinnamon of the back extending onto the base of the tail; in this character it approaches *Gazella petersi,* which however has the rump broadly divided by the color of the back and differs by smaller and more parallel horns and smaller bodily size.

*Coloration.*—Dorsal color mikado-brown paling toward head and on sides where it becomes pinkish-buff; top of rump and hinder border of thighs marked by a wide area of pure white which is continuous with the white basal portion of tail, terminal half of tail black; white rump patch narrow, only one inch wide at base of tail, and on hinderparts of thighs; brown of back extending on tail as a narrow dorsal stripe to the black tip; only basal one-third of tail white; terminal two-thirds black; black pygal band well marked; no

dark flank band; outside of legs pinkish-buff like the sides; hoofs in front bordered by hair brown. Underparts and inside of legs and lower throat silky white; top of head and median line of snout cinnamon-rufous, the middle of snout marked by a clove-brown blotch; grayish hair about horn bases and a blackish area above the eyes, the sides of face marked by a broad white band above eye extending forward to the dark snout spot, bordered below by an ill-defined narrow dusky-cinnamon streak from the eye to the muzzle; orbital area white with a bister brown supraocular spot extending to horn base; tip of snout pale pinkish-buff, the lips and chin white, forethroat white like the chin, the midthroat pinkish-cinnamon like the nape; ear pinkish-cinnamon, bordered at the tip by narrow border of bister, inside and spot at notch white.

*Measurements.*—No flesh measurements available. Skull: condylo-basal length, 257 mm.; greatest width, 108; nasals, 60 x 30; gnathion to orbit, 137; length of premaxillæ, 83; gnathion to $PM^1$, 61; gnathion to nasals, 74; length of upper tooth row, 80. Age, old; premolars much worn. Length of horns along curve, 20½ inches; greatest spread of horns, 9½ inches.

*Remarks.*—Three skins are in the collection collected by Dr. Abbott near Taveta. The two males agree in having the rump patch divided by a narrow line of the dorsal color. The female is without the divided rump patch and with the dark flank band and pygal stripe very wide and deep in color.

### GAZELLA GRANTI RAINEYI, new subspecies

Rainey Grant Gazelle

*Type* from the Isiola River, Northern Guaso Nyiro, British East Africa; adult male, Cat. No. 182016, U. S. National Museum; shot by Paul J. Rainey, June 30, 1911; original number, 2318.

*Characters.*—Resembling *Gazella granti brighti* most closely but differing chiefly by the presence of a dark pygal band or border to the white flank patch; dorsal color darker and size of horns usually greater and more widespread at tips. Differs from *Gazella granti lacuum* by darker coloration and the presence in the adult female of a dark flank band. From *Gazella granti roosevelti* it differs by the decidedly smaller and more parallel horns and by the smaller and lighter colored dark nose spot.

*Coloration.*—Dorsal color light vinaceous-cinnamon paling toward head and on sides where it becomes pinkish-buff; top of rump and hinder border of thighs marked by a wide area of pure white which

is continuous with the white basal portion of tail, terminal half of tail black; rump area bordered in front by a bister pygal stripe one-half inch wide; flanks with a very slight indication of the flank band, a lighter band of light buff bordering the broad band of pinkish-buff above along middle of body; outside of legs pinkish-buff like the sides; hoofs in front bordered by hair brown. Underparts and inside of legs and lower throat silky white; top of head and median line of snout cinnamon-rufous, the middle of snout marked by a dark sepia blotch; greyish hair about horn bases and a blackish area above the eyes; the sides of face marked by a broad white band above eye extending forward to the dark snout spot, bordered below by an ill-defined narrow dusky cinnamon streak from the eye to the muzzle; orbital area white with a bister brown supraocular spot extending to horn base; tip of snout pinkish-buff, the lips and chin white; fore-throat white like the chin, the midthroat pinkish-cinnamon like the nape; ears pinkish-cinnamon, bordered at the tip by a narrow border of bister, inside and spot at notch white.

*Measurements.*—In the flesh: head and body along curve, 1,370 mm.; tail, 245; hindfoot, 448; ear, 158. Skull: condylo-basal length, 254; greatest width, 105; nasals, 62 x 28; gnathion to nasals, 82; gnathion to orbit, 138; premaxillæ length, 81; gnathion to $PM^1$, 64; length of upper tooth row, 78. Adult; the premolars showing little wear, the fossettes being still large and deep. Length of horns along curve, 21½ inches; greatest spread, 6¾ inches.

*Remarks.*—There are in the collection seven male skins from the Northern Guaso Nyiro River and the region south of Marsabit. These show some variation in the intensity of the dark pygal band, but in only one is it completely obsolete. The five skins of females are all marked by a heavy flank band and by wide black pygal stripes.

## KEY TO RACES OF *GAZELLA GRANTI*

$A^1$ Cinnamon of back extending onto tail as a narrow line separating the whole rump patch or else stopping within one inch of base; tail chiefly black only basal ⅓ white ..... *serengetæ.*

$A^2$ Cinnamon of back well separated from tail by a broad white rump patch 2 or 3 inches wide; black of tail less extensive, confined to terminal one-half.

$B^1$ A dark flank band in adult males ..... *notata.*

$B^2$ Flanks without dark band in adult males.

$C^1$ A dark pygal stripe bordering the white rump patch in adult males.

$D^1$ Horns turned outward and widespread, the tips hooked backward ..... *robertsi.*

D² Horns not turned outward and widespread, the tips not hooked backward.
E¹ Horns evenly spreading in an ellipse, the tips approaching one another.
F¹ Dorsal color darker cinnamon, horns longer..*granti.*
F² Dorsal color lighter cinnamon, horns smaller *roosevelti.*
E² Horns more nearly parallel, not curved outward.
F¹ Dorsal color darker, dark flank band obsolete in the adult female .....*lacuum.*
•F² Dorsal color lighter, dark flank band distinct in the adult female .....*raineyi.*
C² No dark pygal stripe bordering the white rump patch.....*brighti.*

Typical *Gazella granti* is found only in Central German East Africa in Ugogo, where it was originally discoverel by Speke and Grant in 1860 during their journey of discovery of the source of the Nile. This point marks the southern limit of its range in Africa. Here it was found inhabiting a dry arid saline valley at some 3,000 feet elevation. From this point the species ranges northward through the Rift Valley as far north as Lake Zwai in southern Abyssinia, where the race *Gazella granti lacuum* occurs. Westward the species spreads to the southern shores of the Victoria Nyanza and enters the Nile watershed. In this southwestern corner it has evolved a widespread horned form which has been named *G. g. robertsi.* At the northwestern corner another race appears, *G. g. brighti,* which is the palest and the least banded of all. Near the coast at Kilimanjaro we find the darkest race, *G. g. screngetæ,* which is somewhat intermediate in color with the still darker *G. petersi.* The latter species carries the *G. granti* type still farther east and north to the mouth of the Tana River. Peter's gazelle is, however, much smaller and darker than any of the races of *Gazella granti,* and is not known to intergrade with it. Occupying the central part of the range and also the most elevated region we have *Gazella granti roosevelti.* Lying between this elevated region on the southern edge of the Abyssinian desert we meet with the shorter horned race known as *G. g. raineyi.* The horns reach their maximum spread in the southern race, *G. g. robertsi,* but are also widespread and large in the neighboring typical *G. granti.* As we go northward the horns become more parallel and shorter until the extreme is reached in narrowness and shortness in *G. g. brighti,* inhabiting the country draining into Lake Rudolf from the west. *Gazella granti notata* is apparently a highly colored local form occurring only on the high plateau flanking the Lorogi Mountains on the

southwest and bears no very close relationship to the other races. The female specimens, although showing some racial color differences, do not parallel the males in their horn characters, but show great individual variation in the length and the shape of these structures. The material available for study, however, is still quite inadequate to determine the extent of such variation. The highland races known as *G. g. roosevelti* and *G. g. robertsi* are grasers, while the desert forms, such as *G. g. brighti* and *G. g. raineyi,* are browsers. Slight structural differences in the narial opening of the skull in such races can already be noticed which are to be traced to such differences in food habits. The narial opening in *raineyi,* for instance, is always three or more millimeters greater than in *G. g. roosevelti.* The snout is lengthening in the browsing races as indicated by the lengthening of the narial opening in the browsing forms.

The specimens most carefully studied in determining the geographical races of *Gazella granti* are the extensive series in the U. S. National Museum. At this institution five out of the eight races are represented by specimens of complete skins and skulls. The material consists of 40 complete skins and skulls of adults, 31 of which are male and 9 of which are female specimens. In addition there are 16 head skins with their skulls and 15 skulls unaccompanied by skins. Besides this material the writer has examined and made notes upon the types and other specimens in the British Museum and has also made a cursory examination of specimens in the Berlin Museum.

### CEPHALOPHUS MONTICOLA MUSCULOIDES, new subspecies

Nandi Blue Duiker

*Type* from Kagumega Forest, British East Africa; adult male, Cat. No. 182388, U. S. National Museum; collected by Edmund Heller, February 13, 1912; original number, 2709.

*Characters.*—Underparts light colored, contrasting conspicuously with the dark sides; body size greater; skull, 112 mm. in length.

*Coloration.*—Median dorsal coloration of head and body fuscous, merging on the sides and underparts to ecru-drab; legs somewhat darker than back, benzo brown; hinder border of rump and base of tail darkening to fuscous black; terminal half of tail white; the hair basally fuscous. Midline of belly, throat to chin and inside of legs whitish. Top of head to muzzle uniform fuscous, cheeks and orbital region ecru-drab gradually shading into the whitish chin and throat; ears fuscous on back, the inner side whitish like throat.

*Measurements.*—Length of fresh skin, 525 mm.; tail, 85; hindfoot, 170; ear from notch, 55. Skull: condylo-basal length, 112; zygomatic breadth, 55; upper tooth row, 32; $PM^1$ to muzzle, 39; nasals, 39 x 22; orbit to muzzle, 68; diameter of orbit, 24; length of premaxillæ, 34; condylo-incisive length of mandible, 92; diastema, 28.

*Remarks.*—Seven skins and three skulls are in the collection from the Kakumega Forest. They agree in differing from Uganda skins of *aequatorialis* by their lighter underparts and larger size. These specimens represent a highland race of the widespread blue duiker, which extends across Africa from the west coast as far as the Nandi Forest lying on the western slope of the Mau Escarpment, in British East Africa. Although living relatively close to the Uganda blue duiker the present race inhabits a forest 2,000 feet or more higher and much colder.

**REDUNCA REDUNCA TOHI, new subspecies**

Swahili Reedbuck

*Type* from Mariakani, British East Africa; adult female, Cat. No. 182289, U. S. National Museum; shot by Edmund Heller, January 2, 1912; original number, 2603.

*Characters.*—Size smaller than *Redunca wardi;* basal length of skull 223 mm.; coloration lighter and purer tawny, the black lining on the dorsal surface being much less; dark leg streaks much narrower or obsolete; pelage shorter and thinner; length on back 20 mm., in *R. wardi,* averaging 30 mm.

*Coloration.*—Color of upper parts tawny, purest on sides and legs; dorsal region darkest owing to prevalence of black tipped hairs which are absent on sides and limbs. Crown of head with a dusky brown patch between ears; midline of snout speckled by dusky; sides of head pure yellow-ochre, orbital area lighter buff in color; chin and upper throat cream; back of ears much darker than body; general effect snuff-brown, the hair covering however tawny; inner side and base to bare spot cream-buff. Legs ochraceous-buff with a narrow dusky brown stripe in front from hoofs to shoulders on forelegs, but only reaching halfway to hocks on hindlegs. Tail tawny above, white below, the tip chiefly white. Underparts pure white sharply defined on sides against the tawny-ochraceous, the white reaching as far forward as the chest and extending as a narrow line down the inside of the legs.

*Measurements.*—Head and body, 1,260 mm.; tail, 185; hindfoot, 390; ear from notch, 155. Skull: condylo-basal length, 223; zygomatic breadth, 88; muzzle to orbit, 130; upper tooth row, 58; width of palate across $M^1$, 54; $PM^1$ to muzzle, 78; nasals, 95 x 20. Old female skulls of *R. wardi* are much larger and heavier, their average length being 240 mm., almost an inch longer than *R. tohi.*

*Remarks.*—Five specimens are in the collection from the type locality; two of them old females, one adult female, one immature male and one nursing young. The male is too young to show adult horn characters, but all the specimens agree in differing from *R. wardi* by their purer tawny color and smaller size. *Redunca redunca tohi* is a smaller lighter colored race which is confined to the immediate vicinity of the coast where it inhabits the grassy parklike country between the coco-palm zone and the desert nyikae. On the slopes of Kilimanjaro this race reaches its farthest inland range. It however does not connect with *R. wardi* from which it is separated by a 150-mile stretch of desert.

This buck is known to the Swahili as tohi.

**ADENOTA KOB ALURÆ, new subspecies**

*Type* from Rhino Camp, Lado Enclave; adult male, Cat. No. 164788, U. S. National Museum; shot by Theodore Roosevelt, January 14, 1910; original number, 590.

*Character.*—Like *Adenota kob thomasi* in color but decidedly smaller; hair shorter, not exceeding 20 mm. in length on neck; skull smaller and flatter in both sexes; size of hoofs smaller; approaching *Adenota kob* in its small size and standing quite intermediate between it and *Adenota thomasi,* but differing in having the head more extensively white, the entire orbital region being white and the ears also showing a tendency to whiteness, in some being uniform buffy on the back without the blackish tip. The old males, however, never assume the black coat characteristic of this sex in *Adenota leucotis,* or do they show as a rule the white ears.

*Coloration.*—Color of head and body zanthine orange, lightening on lower sides and midline of throat to ochraceous-buff; back of ears lighter than rest of head, ochraceous-buff, the tips very little darker, ochraceous-tawny; orbital region, base and sides of ears, lips and borders of nostrils, chin and upper throat, chest and underparts, inside of legs, to knee and hock, underside of tail and band above hoofs and false hoofs, white; front of forelegs from light hoof bands to shoulders, front of hind legs from hoof band to hock and tip of

tail blackish brown. The figure of Thomas kob in the "Book of Antelopes" is quite faulty and fails to show the white hoof bands and the dark tip to the tail and ears, which are characteristic of the equatorial kobs.

*Measurements.*—No flesh measurements available; tanned skin, length, 1,570 mm.; tail, 220; hindfoot, 385; ear, 125. Skull: condylobasal length, 285; zygomatic breadth, 107; length of upper tooth row, 68; tooth row to tip of premaxillæ, 96; width of palate from outside of $M^1$, 67; height of brain case from fronto-parietal suture to lower surface of basi-sphenoidal process, 97; nasals, 118 x 25; length of premaxillæ, 90. The type is a very aged specimen with the premolars worn down almost level with the gums and to such an extent that the enamel folds are quite lost. The horn tips are also worn away leaving the horns quite short and without the upward sweep which gives them their characteristic S-shape.

The hair in this race is considerably shorter on the neck. At the hair whorl it is 20 mm. or less in length, while in Guas Ngishu specimens the hair at the same point usually exceeds 30 mm. There are in the National Museum nine specimens from Rhino Camp, Lado Enclave, and nine specimens from the Guas Ngishu for comparison. The male skulls do not show much difference in size with the exception of the flatness of the brain case, but the two female skulls from Rhino Camp are decidedly smaller than the three of this sex from the Guas Ngishu Plateau.

*Remarks.*—The kobs in East Africa and Uganda are limited to the Nile watershed throughout which they are universally distributed over the grassy plains areas. All the Nile kobs appear to be races of the western species or Buffon kob, *Adenota kob*. At their northern limit in the Nile Valley the old males usually assume deep seal brown or black upper parts similar to the adult livery of the sable antelope and the male of the Nile lechwe, *Onototragus megaceras*. Some individuals, however, do not assume this dark coat except to a slight degree, that is only upon the sides of the throat, the shoulders and the legs and flanks and snout. Such rufous colored individuals were described as a new race, *A. nigroscapulata,* by Matschie in 1899. More recently in 1906 Lydekker applied the name *A. vaughani* to similarly colored specimens from the same region. Both of these races are based on immature or rufous colored individuals of the white-eared kob with which they agree in having the ears white or cream-buffy on the outer surface and the lower parts of the legs, halfway to the knees whitish. Some of these rufous individuals show, by the worn condition of their

teeth and the obliteration of some of the sutures in their skulls, themselves really aged animals, and it is quite evident that the black livery is to some extent an individual character, although chiefly an age affair. Specimens identical in coloration with both *A. nigroscapulata* and *A. vaughani* from the mouth of the Bahr-el-Ghazal are in the Smithsonian African Collection shot by Colonel Roosevelt. Some of the upper Nile specimens as well as the more remote ones from the Guas Ngishu Plateau occasionally exhibit whitish ears with the dark tips nearly obsolete. It is probable that somewhere in the upper Bahr-el-Ghazal, perhaps near Meshra-er-Rek, the race here described meets *leucotis*. The white-eared is without doubt local and confined to the extreme northern limit of the range of the kobs in the Nile Valley. Westward we find little or no change with the exception of the restriction of the white orbital area in the coloration of the kobs between the Lado and the Senegal and Nigerian regions, notwithstanding the vast extent of country.

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# THE COMPARATIVE HISTOLOGY OF THE FEMUR

(With Three Plates)

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# THE COMPARATIVE HISTOLOGY OF THE FEMUR

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(With Three Plates)

The comparative study of the minute structure of the femur was begun by the present writer in 1909. The first report described 46 microsections of the femora of as many different animals and was published in the Transactions of the American Microscopical Society of April, 1911. Following the first report and largely upon the suggestion of Dr. Aleš Hrdlička, Curator of the Division of Physical Anthropology in the United States National Museum, the writer has extended his investigations to man of different ages and races, as well as to many additional genera and species of animals; and an abstract of these further studies which revealed many important and new points, is here presented.

For the valuable material, facilities for study, and courtesies extended, the writer is especially indebted to the Division of Physical Anthropology of the United States National Museum; and to the Division of Mammals and Reptiles of the same institution; the Departments of Reptiles, Birds, and Mammals of the American Museum of Natural History, and the Departments of Anatomy and Medicine of the Northwestern, the Tulane, and the Creighton Universities.

The total number of genera and species whose femora have up to this date been examined amounts to 400, including amphibians, reptiles, birds, mammals, and man. The observations have been made on complete cross-sections of the femur at the middle of the shaft. Embryological, adolescent, adult, and senile bones of the same species were examined whenever it was possible, and controlling studies were also made on other bones of the body. The drawings have been made for the most part with the aid of the Edinger apparatus.

The investigations, which are of pioneer nature, have brought out many facts that are new to science. The existence of three types of

bone, together with a number of combinations of these types, is established. They might be called the early, intermediate, and advanced, or, more definitely, the undifferentiated, laminar, and Haversian-system types. As a matter of convenience they will be referred to as the first, the second, and the third types, respectively. They are illustrated in plate 1. They are doubtless connected intimately with vascular development, and may be defined as follows:

The *first type* (pl. 1, fig. 1) is composed of homogeneous bone substance enclosing more or less numerous lacunæ, from which radiate their minute canaliculi. It is very poor in vascular canals. The lacunæ present a simple concentric arrangement; they may be comparatively few or many in number; they may be round or oval in shape, with few or again many canaliculi; and the bone may show an approach to the simplest form of lamination.[1]

The *second type* (pl. 1, fig. 2) is composed of groups of concentric laminæ which show vascular canals running parallel to the axis of the bone, as well as about the laminæ, and are frequently crossed by smaller canals running in various directions. The lacunæ are considerable in number, and may be oval, or long and narrow, according to the species.

The *third type* (pl. 1, fig. 3) is composed of Haversian systems, such a system is defined by Cunningham as follows: "The Haversian system consists of a central or Haversian canal which contains a vessel of the bone. Around this osseous lamellæ are arranged concentrically, separated here and there by interspaces called lacunæ, in which the bone corpuscles are lodged. Passing from these lacunæ are many fine channels called canaliculi. These are disposed radially to the Haversian canal and pass through the osseous lamellæ. They are occupied by the slender processes of the bone corpuscles."

These three types, either singly or in combination, enter into the formation of the femora of all animals; and there is no suggestion of any additional form of bone structure. Taken as a whole, combinations of types are more common in the structure of bone than single types, and are more frequent in the mammals than in the classes below them.

[1] The term *lamellæ* is restricted in this paper to the small concentric layers of bone surrounding the Haversian canal, while that of *laminæ* is applied to the larger more or less irregular rings of bone that run concentrically in relation to the medullary canal.

As to the significations of these types, the subject has been studied from the following standpoints:

(1) The grade of the animal in biological classification.
(2) Geographical location.
(3) Sex.
(4) Age.
(5) Function.
(6) Individuality.
(7) Health; and
(8) Heredity.

1. The first type of bone appears as the basic structure in the amphibians, reptiles, birds, and mammals. It exists, in a pure or but little complicated form, throughout life, in the amphibians, in the lizards, in some of the birds, and in the bats, excepting the Pteropus. It exists or predominates in the fetal life of higher animals, including man. It may well be regarded as the simplest and oldest or fundamental form of bone structure. Its first variation is shown by a change of the round or oval to long and narrow lacunæ, by a more concentric arrangement of the lacunæ, and by increase in vascularity, which is accompanied by a change from the first to the second or third type of bone structure.

The second or intermediary type of bone structure develops as a rule from the first type and represents often, though not invariably, a stage in the differentiation of the bone from the first to the third type. Traces of it are seen first in the amphibians and reptiles, while more pronounced instances of it occur in a few birds, some of the mammals, and at some stages of development, especially in some races, in man. It is best represented in certain mammals, such as the various deer.

The third type, foreshadowed in a few amphibians, appears in part in some of the reptiles and a few birds; it is more strongly represented in certain mammals, and is characteristic of man.

2. The effect of *geographical position* upon bone variation is not yet reducible to exact deductions. However, it is a fact that the femora of the African and Asiatic elephants differ from each other very materially.

3. As to *sex,* the femora examined showed no evidence that this is an important factor in the minute structural variation of the bone.

4. *Age* influences the type of the bone very greatly; at least so in the higher mammals and particularly in man. All femora of higher mammals, and especially man, change in structure with advancing

development of the subject. Some femora, however, arrive at a completion, or rather at a cessation of the changes, regardless of the stage reached, earlier than others. The only future change in such bones is senility. The progress, however irregular or incomplete it may be, is always from the first towards the second or the third type, never the reverse.

5. The effect of *function* upon variation in bone structure can scarcely be doubted, but the exact causes and effects are as yet difficult to determine. In the study of 50 genera of bats, the small Pteropus presents still, like the rest of the bats, the first type of bone structure, while the large Pteropus shows already an early and crude third type in process of formation. In a turkey of 16 pounds weight only the second type appeared, while in a turkey of 32 pounds weight there was noticeable a number of Haversian systems. In many femora of all classes the linea aspera, the most "functional" part of the bone, is composed chiefly of third type units regardless of the type of the rest of the bone. Finally, a lack of function in an adult bone doubtless favors an earlier setting in of senile changes.

6. *Individual* variations are rare in the lower vertebrates and increase in frequency in the higher forms. But they are mostly of secondary importance, the characteristic structure in species remaining pretty true. The slight variations present are probably partly accidental, partly hereditary and partly functional.

7. Variations due to *health and disease* remain very largely for studies in the future. They will be almost wholly restricted to man.

8. *Hereditary influence* finally, is clearly demonstrated by the predominance of a certain form of structure in every given species. In families the subject needs much further attention.

## DETAILS CONCERNING GENERA

### AMPHIBIANS

The amphibians present the following conditions:

1. Simple first type bone with round and oval lacunæ and few canaliculi. In some forms cancellous bone occupies the medullary canal; this is seen, for instance, in the *Amblystoma tigrinum,* one of the most primitive amphibians.

2. A division of the simple bone into two concentric laminæ, external and internal.

3. A differentiation into external, central and internal laminæ; and

4. In a few amphibians, as in the Toad group, very crude Haversian systems become outlined in the central lamina. These primitive

systems are composed of Haversian canals communicating with adjacent lacunæ by a few canaliculi. No concentric arrangement of the lacunæ and no Haversian system lamellæ are in evidence.

## REPTILIANS

The reptilian femora show much the same conditions as those of the amphibians, but the differentiation of bone structure has in some forms advanced to a greater extent. Some species present the simple first type of bone. This is especially the case in the lizards. But in the turtles, curiously, a fairly well developed third type of bone structure has made its appearance. Again cancellous bone, which is not a structural feature of the lizards, is generally present in the turtles. These are remarkable differences and separate widely the two genera.

## BIRDS

Birds present in general the appearance of an incompleted development of the structural state. The first, second, as well as the third type of bone structure are found, and also various combinations, but all give the impression of incompleteness. The bone units are rather dim and unsatisfactory. The first type is present in some birds and is generally of a very simple form. The second type appears in a larger number of species and is, perhaps, the most representative type in birds. In some of these femora a few Haversian systems appear, especially in the posterior ridge, and in some birds of large size the second type structure is reinforced by some Haversian systems in the anterior wall. Finally, in a few species the central ring of lamellæ has become displaced by Haversian systems and the bone must be classified as that of the third type. As a rule the systems are rather dim and do not stand out clear cut. Their lacunæ are oval and their canaliculi bushy. In a few birds the medullary canal is occupied by cancellous bone. In about half the bird femora the medullary canals are full of marrow, while in the remainder they are empty. Comparing the birds with the reptiles, there is a distinct increase in the proportion of differentiation, although this has not reached full development.

## MAMMALS

In these animals the bone structure is in general much more differentiated than in birds. As a rule the types and their combinations have lost the illy defined characters so frequently present in the foregoing classes. Furthermore, type combinations are more common.

The first type is present in certain genera. It was found in 50 different genera of bats and a number of genera of shrews. In a few of these forms the division of the bone substance into three concentric rings has occurred. In one genus, the Pteropus, this modification is well marked, and beyond that, rather crude Haversian systems are found in the central ring, the bone showing thus an advance toward the third type.

Quite a large number of mammalian femora present a well marked second type structure. The laminæ are well developed, and enclose long, narrow lacunæ, with straight canaliculi. In all these bones Haversian systems are found in the posterior ridge corresponding to the linea aspera. A few mammals show a pure third type of bone structure. In such animals the first and second types are eliminated and fully developed Haversian systems have taken their places. But only three or four of the 178 mammalian femora (other than bats and shrews) examined were composed of this type.

By far the greatest number of mammalian femora shows combinations of the first and third type. In these bones the structural units are well developed, but vary much in proportions. But they frequently occupy the same relative positions. The laminæ, with bone structure of the first type, are external and internal, while the Haversian systems occupy the central ring. The second and third types form the structure of also a large number of mammals. In this combination the units are well developed and about equally important. Finally, in still another large group of mammals, the femora show all the first, second and third types of bone structure, in varying proportions.

Looking over the mammals as a whole, it is noticed that their femora exhibit structural differentiation much more advanced and definite than that observed in the femora of other animals. From species to species there are many variations.

It is a peculiar fact that amphibians, reptiles, birds, and mammals all present, though in a widely varying proportion, the first type as well as some form of advanced type of bone structure. The advanced type is the variable factor and occurs in the greatest variety of forms and combinations. The early or first type differs merely in simplicity. It is more simple in the amphibians than in the mammals. The third type, on the other hand, in amphibians, merely a suggestion, is better developed in reptiles, still better in birds and in mammals reaches its highest state of advancement. Clean cut, well developed third type

units are not at all common below mammals, but are the important structures of mammals and especially man.

## MAN

The human fetus presents in varying combination the first and second type of structure with wide canals and incompletely formed lacunæ. As development progresses, the first and second type bone is gradually displaced by the Haversian system structure.

More in detail, in the very young human fetus of two to three months, the first type of bone structure is present in an incomplete form and is marked off into irregular areas by crude, branching canals. As fetal life advances the canals become less branching and more concentric. Gradually the first becomes the second type of bone and remains so until about one year after birth, when sufficient differentiation has occurred by the formations of Haversian systems to make it second and third type, or first, second and third type combination. Throughout childhood and youth, the laminæ tend to disappear and to be replaced by Haversian systems, until the bone development is completed. In the early period, a horseshoe-shaped band of laminæ is often observed forming the anterior and lateral walls of the bone. A remnant of this horseshoe may remain throughout life in those femora which do not complete the third type differentiation. The proportion of this remnant to the other bone units in the adult bone varies greatly and the result is that adult femora present many secondary variations.

A white child, a Pueblo Indian, and a Peruvian Indian child, each about one year of age, exhibited already a combination of the second and third types of bone structure. A femur of an Egyptian child of the XIIth Dynasty showed the development of the Haversian system directly from the circulation, which is an evidence of the causal association of bone structure with the development of the vascular system of the bone.

On the whole, the study of human femora from fetal life and childhood shows various transitional stages from the first and second to the third type of bone.

## ADULT HUMAN FEMORA

The adult human femora are, in general, characterized by the predominance of a well differentiated third type of structure. An

exclusive presence of the first type of structure has never been found in the adult human femur. The most primitive form is a combination of the first and third types. The proportions of the structural units varies greatly. In some femora, the first type was found to amount to more than half of the section, while in others it is reduced to a small fraction. In other human femora there will be a second and third, instead of first and third type combination; and still others, the bone shows all the three types. When the first type is present, it is generally found in the form of a horseshoe band extending under the external surface of the bone—the heel of the shoe embracing the posterior ridge. Segments of laminæ with a first type of bone, frequently found in bone sections, are the remains of a disappearing horseshoe band of first type units. In a complete third type bone, the first and second type units have been entirely displaced by well developed Haversian systems. There may be cancellous bone around the medullary canal.

Three human races have been examined, namely, the black, the white (including the ancient Egyptian), and the yellow-brown. An early and late differentiation has been found in each. The negro, modern white, Egyptian of the XIIth Dynasty, the Pueblo and Peruvian Indians all show these variations. The variations are the same in kind, but somewhat different in degree. The negro bone, barring individual exceptions, does not perhaps equal that of the other races in the degree of the differentiation.

The posterior ridge is generally composed of Haversian systems. This occurs in each race.

Senile changes, absent or very rare in animals, are unexpectedly frequent in human femora, particularly those of civilized races.

## SENILE CHANGES

After a human bone has reached its developmental limitation and perhaps the climax of its function, it soon begins to undergo certain changes which are properly those of degeneration of senility. Such changes are evidently far more common than is supposed. Age in years is not to be the determining factor. A femur may be more or less senile at 30 or 40 years of age. There is no structural differentiation beyond the Haversian system type; when that has been completed it may remain as such for years, but sooner or later a process of aging sets in. The senile changes begin around the canals of the Haversian systems. They involve first the systems around the medul-

lary canal. As the changes extend the bone becomes lighter in weight and its walls become thinner (pl. 3, figs. 1, 2, 3, 4, 5). It is a slow destruction.

TABLE OF TYPE PERCENTAGES

| | Amphibians | Reptiles | Birds | Mammals | Man—Adult | Man—Fetus Child, Youth |
|---|---|---|---|---|---|---|
| Number | 34 | 35 | 39 | 178 | 105 | 13 |
| First type | 97% | 77% | 30% | 23% | 0% | 0% |
| Second type | 0 | 0 | 23% | 13% | 0 | 54.8% |
| Third type | 0 | 0 | 10% | 2.5% | 37% | 0 |
| First and second type | 0.3% | 0 | 2.5% | 0 | 0 | 7.8% |
| Second and third type | 0 | 0 | 13% | 11% | 13% | 14.3% |
| First and third type | 0 | 0 | 11% | 27.5% | 33% | 77% |
| First, second and third type | 0 | 0 | 5% | 11% | 15% | 15.4% |
| Undeveloped third type | 3% | 23% | 5.5% | 7% | 0 | 0 |
| Medullary canal, full | 100% | 100% | 54% | 100% | 100% | 100 |
| Medullary canal, empty | 0 | 2% | 46% | 0 | 0 | 0 |
| Senile | 0 | 0 | 0 | 0.1% | 56% | 0 |

Fig. 1

Fig. 2

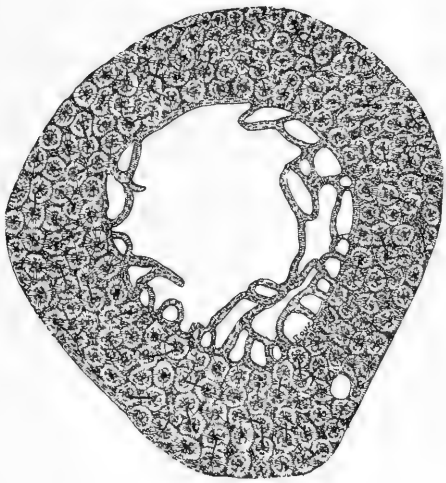

Fig. 3

THE THREE TYPES OF BONE STRUCTURE

FIG. 1.—First type as seen in the amphibian, Nyctalus aviator.
FIG. 2.—Second type as seen in the turkey.
FIG. 3.—Third type as seen in man.

Fig. 1

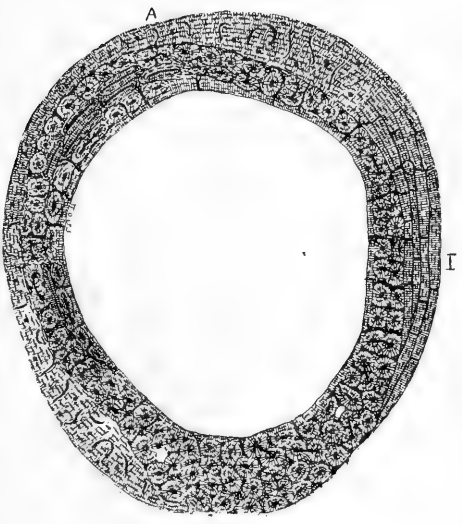


Fig. 2

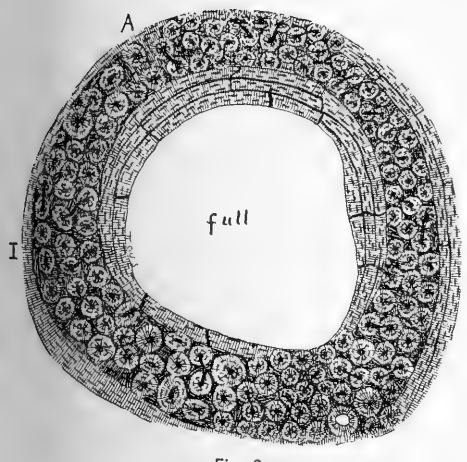


Fig. 3

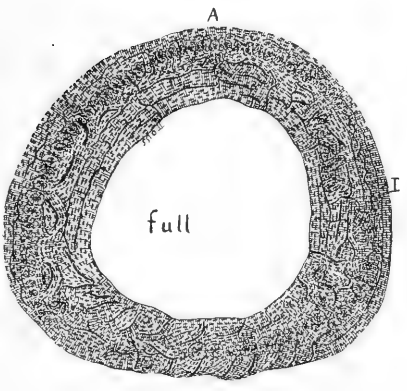


Fig. 4

SECTIONS OF FEMORA, SHOWING VARIOUS COMBINATIONS OF TYPES.

FIG. 1.—Right femur of a sloth bear, Melursus labiatus. No. 2272, A. M. N. H.
FIG. 2.—Left femur of a jackal, canis. No. 7172, U. S. N. M.
FIG. 3.—Right femur of a coyote, canis latrans.
FIG. 4.—Left femur of a badger, taxidea Americana.

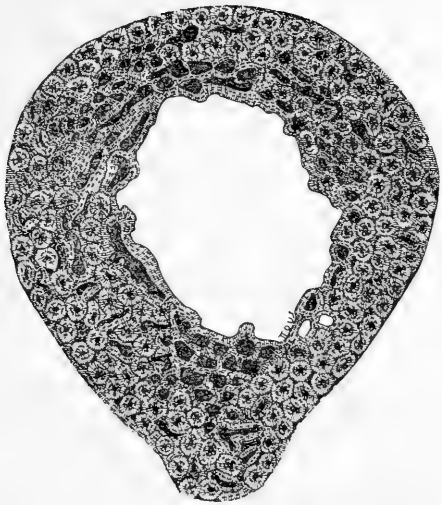

Fig. 1

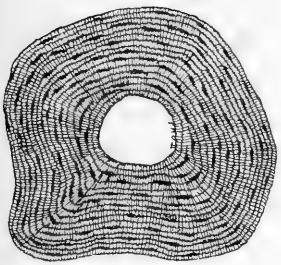

Fig. 2

Fig. 3

Fig. 4

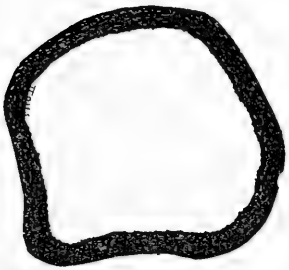

Fig. 5

SENILE CHANGES IN THE HUMAN FEMUR

FIG. 1.—Left femur of a colored man. Large black spaces represent senile absorption of bone.
FIG. 2.—A single Haversian system, much enlarged, without definite signs of senility.
FIG. 3.—A single Haversian system, much enlarged, showing early signs of senility.
FIG. 4.—A single Haversian system, much enlarged, showing a later stage of senility.
FIG. 5.—A single Haversian system, much enlarged, showing the latest stage of senility.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 61, NUMBER 9

# DESCRIPTIONS OF THREE NEW AFRICAN WEAVER-BIRDS OF THE GENERA ESTRILDA AND GRANATINA

BY

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(PUBLICATION 2236)

CITY OF WASHINGTON
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# DESCRIPTIONS OF THREE NEW AFRICAN WEAVER-BIRDS OF THE GENERA *ESTRILDA* AND *GRANATINA*

By EDGAR A. MEARNS

ASSOCIATE IN ZOÖLOGY, UNITED STATES NATIONAL MUSEUM

This paper is the nineteenth dealing with the results of the Smithsonian African Expedition under the direction of Col. Theodore Roosevelt. It includes one new form from the collection of the Childs Frick African Expedition.

The names of special tints and shades of colors used in this paper conform to Robert Ridgway's "Color Standards and Color Nomenclature," issued March 10, 1913. All measurements are in millimeters.

### ESTRILDA RHODOPYGA POLIA, new subspecies

Gato Waxbill

*Type-specimen.*—Adult male, Cat. No. 247436, U. S. National Museum; collected on the Gato River, altitude 4,000 feet, southern Abyssinia, May 2, 1912, by Edgar A. Mearns. (Original number, 21687.)

*Characters.*—Similar to *Estrilda rhodopyga rhodopyga* from northeast Africa, but more heavily cross-barred above and below, whiter on the throat, and paler on the chest and abdomen. From *Estrilda rhodopyga hypochra* Mearns (described below) it differs in being much more heavily cross-barred above and below, and grayer on the upper surface. The bill of typical *E. r. polia* differs from other subspecies in having a broad red band on the sides.

*Measurements of type* (adult male).—Length (of skin), 100; wing, 46; tail, 45; culmen (chord), 10; tarsus, 12.5.

*Geographical range.*—Lowlands of southern Abyssinia and adjacent region of Somaliland (Dr. A. Donaldson Smith), south to Mount Lololokui (Edmund Heller), the northern Guaso Nyiro River, and Mombasa, British East Africa (Dr. Glover M. Allen).

*Remarks.*—Specimens from the coast and adjacent portion of British East Africa are slightly darker than those from Somaliland and

southern Abyssinia, and sometimes lack the red band on the sides of the bill. They are, in fact, intermediate between the forms *hypochra* and *polia,* but nearer the latter.

**ESTRILDA RHODOPYGA HYPOCHRA, new subspecies**

Kapiti Waxbill

*Type-specimen.*—Adult male, Cat. No. 213786, U. S. National Museum; collected between Kapiti Plains Station, Uganda Railway, and camp at Potha, British East Africa, April 27, 1909, by Edgar A. Mearns. (Original number, 15632.)

*Characters.*—Similar to *Estrilda rhodopyga rhodopyga* from northeast Africa, but paler and browner above and below. On the upper parts the cross-bars or vermiculations are fainter, becoming almost obsolete on the under parts. The crown is less grayish, the throat whiter, and the carmine red of the lower back and outer surface of wings less restricted. The under parts are isabella color instead of tawny-olive. Bill black, with a trace of red on sides. Size similar to the typical form.

*Measurements of type* (adult male.)—Length (of skin), 103; wing, 47; tail, 45; culmen (chord), 9.5; tarsus, 12.

*Average measurements of three adult male topotypes.*—Wing, 46.7; tail, 44.7; culmen (chord), 9.7; tarsus, 13.3.

*Measurements of adult female* (Cat. No. 118268, Taveta, British East Africa, Dr. W. L. Abbott).—Wing, 44; tail, 43; culmen (chord), 9.6; tarsus, 13.

*Geographical range.*—Interior of British East Africa, from Kapiti Plains to Taveta.

*Remarks.*—The young of this subspecies have been described by Oberholser.[1]

The subspecies of *Estrilda rhodopyga* Sundevall are as follows:

1. *Estrilda rhodopyga rhodopyga* C. J. Sundevall, Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, Ärg. VII, No. 5, for May, 1850, p. 126. Type locality: Northeast Africa (Hedenborg, coll.).

2. *Estrilda rhodopyga polia,* new subspecies. Type locality: Gato River, near Gardulla, southern Abyssinia.

3. *Estrilda rhodopyga hypochra,* new subspecies. Type locality: Kapiti Plains, British East Africa.

[1] Proc. U. S. Nat. Mus., XXVIII, No. 1411, July 8, 1905, p. 880.

4. *Estrilda rhodopyga centralis* Konrad Kothe, Ornith. Monatsb., XIX, No. 4, April, 1911, p. 70. Type locality: Kissenje, north shore of Lake Albert, Uganda.

5. *Estrilda rhodopyga frommi* Konrad Kothe, Ornith. Monatsb., XIX, No. 4, April, 1911, p. 70. Type locality: Karema, Lake Tanganyika.

### GRANATINA IANTHINOGASTRA ROOSEVELTI,[1] new subspecies

Roosevelt's Cordon-bleu

*Type-specimen.*—Adult male, Cat. No. 214634, U. S. National Museum; collected on the Southern Guaso Nyiro River, Sotik District, British East Africa, June 14, 1909, by Edgar A. Mearns. (Original number, 16045.)

*Characters.*—Larger than *Granatina ianthinogastra ianthinogastra* or *G. i. hawkeri.* Males, compared with typical *ianthinogastra* from the Tana River, British East Africa, are decidedly more grayish on the mantle, less rufescent on the head, and with darker, more brownish under wing-coverts and edging to the under surface of the inner webs of the quills. *Granatina ianthinogastra hawkeri,* the only previously described form of this species, inhabits the desert regions of Somaliland, and is slightly distinguished from typical *ianthinogastra* by its paler coloration, adult males having the mantle and wings paler grayish brown, and the head paler and more ochraceous than in the other forms. Females of *roosevelti* show differences, similar to those mentioned above, in the coloration of the upper parts; the feathers surrounding the eye are bluish instead of pale lilac; and the lower abdomen and crissum are dark, with no trace of the whiteness or pale rustiness which those parts invariably present in *ianthinogastra* and *hawkeri.*

*Measurements of type* (adult male).—Length (of skin), 130; wing, 60; tail, 70; culmen (chord), 12; tarsus, 18.

*Geographical range.*—Sotik District, British East Africa.

*Remarks.*—The three subspecies of *Granatina ianthinogastra* are represented in the material before me by 50 specimens, obtained at localities ranging from northern Abyssinia south to the plains east of Mount Kilimanjaro and west to the Sotik District of British East Africa. Series of topotypes of each form are included in this collection, the greater part of which was gathered by the author and others on the Childs Frick African Expedition, 1911-12.

[1] Named in honor of Col. Theodore Roosevelt, leader of the Smithsonian African Expedition.

The salient differences in the three forms of *Granatina ianthinogastra* may be stated as follows:

| *Granatina ianthinogastra ianthinogastra* | *Granatina ianthinogastra hawkeri* | *Granatina ianthinogastra roosevelti.* |
|---|---|---|
| *Adult Male.*<br>Mantle snuff brown.<br>Head orange cinnamon.<br>Middle rectrices black.<br>Wing. Tail. Culmen. Tarsus.<br>52.4 62 10.9 15.9 | *Adult Male.*<br>Mantle drab.<br>Head cinnamon.<br>Middle rectrices sepia.<br>Wing. Tail. Culmen. Tarsus.<br>55 62 10.7 16 | *Adult Male.*<br>Mantle cinnamon drab.<br>Head sayal brown.<br>Middle rectrices black.<br>Wing. Tail. Culmen. Tarsus.<br>60.8 68.5 11.5 18 |
| *Adult Female.*<br>Pale feathers around eye pallid soft blue-violet.<br>Lower abdomen whitish buff.<br>Under tail-coverts pale pinkish buff.<br>Wing. Tail. Culmen. Tarsus.<br>51 57 10.9 15.4 | *Adult Female.*<br>Pale feathers around eye pallid soft blue-violet.<br>Lower abdomen buffy white.<br>Under tail-coverts dirty white.<br>Wing. Tail. Culmen. Tarsus.<br>51 54 10.3 15.5 | *Adult Female.*<br>Pale feathers around eye wistaria blue.<br>Lower abdomen tawny-olive.<br>Under tail-coverts blackish brown, with paler edges to the feathers.<br>Wing. Tail. Culmen. Tarsus.<br>60.5 63 11.2 18 |
| *Young in First Plumage.*<br>Unspotted below.<br>Bill blackish, horn color on base of mandible.<br>Under parts clay color, paler on throat, whitish on lower abdomen and crissum. | *Young in First Plumage.*<br>Not seen. | *Young in First Plumage.*<br>Unspotted below.<br>Bill blackish, horn color on base of mandible.<br>Under parts nearly uniform snuff brown. |

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 61, NUMBER 10

# DESCRIPTIONS OF FOUR NEW AFRICAN THRUSHES OF THE GENERA PLANESTICUS AND GEOCICHLA

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(PUBLICATION 2237)

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# DESCRIPTIONS OF FOUR NEW AFRICAN THRUSHES OF THE GENERA *PLANESTICUS* AND *GEOCICHLA*

By EDGAR A. MEARNS

ASSOCIATE IN ZOÖLOGY, UNITED STATES NATIONAL MUSEUM

Three of the forms herein described are from the collection made by the Paul J. Rainey African Expedition, and one from the Smithsonian African Expedition, under the direction of Colonel Theodore Roosevelt.

The names of special tints and shades of colors used in this paper conform to Robert Ridgway's "Color Standards and Color Nomenclature," issued March 10, 1913. All measurements are in millimeters.

## PLANESTICUS HELLERI, new species

Heller's Thrush

*Type-specimen.*—Adult female, Cat. No. 217722, U. S. National Museum; collected at Mount Mbololo, altitude 4000 feet, east of Mount Kilimanjaro, British East Africa, November 9, 1911, by Edmund Heller, on the Paul J. Rainey African Expedition. (Original number, 417.)

*Description of the adult female* (type and only specimen).—Top and sides of head black; remainder of upper parts brownish olive, slightly darker on the wings and tail, which show traces of dusky cross-bars; chin, throat, and chest mouse gray, with a trace of white spotting on the chin, black shaft-stripes on the throat, and a wash of ferruginous on the lower chest; abdomen and crissum white, the under tail-coverts white, bordered laterally with gray; sides, axillars, under wing-coverts, and inner webs of quills orange-brown; flanks olive-gray mixed with white; thighs brownish-gray mixed with rusty. Bill, feet, and claws apparently yellow or orange. Four primaries are emarginated on outer webs.

*Measurements of type* (adult female).—Wing, 108; spurious primary, 16; tail, 79; culmen (chord), 22; tarsus, 30.5.

*Remarks.*—This species is not closely related to any other African thrush, but slightly resembles the Asiatic *Turdus chrysolaus* Temminck in coloration, except that the head is black.

**PLANESTICUS OLIVACEUS POLIUS, new subspecies**

Samboru Thrush

*Type-specimen.*—Adult male, Cat. No. 217725, U. S. National Museum; collected at 6,000 feet altitude on Mount Lololokui, in the Samboru country, north of the Guaso Nyiro River, in British East Africa, September 8, 1911, by Edmund Heller. (Original number, 317.)

*Characters.*—Most closely related to *Planesticus olivaceus abyssinicus* (Gmelin), but smaller (see tabulated measurements below), grayer on the upper surface, as well as on the chest, throat, and sides of head and neck; lores blacker; the blackish shaft-streaks on chin and throat sparser and narrower; abdomen and sides paler and more olivaceous orange; the orange of the under surface of the wing is confined to the axillars and under wing-coverts, not extending upon the inner webs of the under surface of the quills.

*Description of adult male and female.*—Upper surface mouse gray; wings and tail darker, the quills and rectrices crossed by indistinct, rather broad, blackish bars; lores black; chin, throat, sides of head, and neck light mouse gray; chin and upper throat with a few central shaft-stripes of blackish; abdomen, sides, axillars, and under wing-coverts ochraceous-buff; flanks olive-gray; anal region white; under tail-coverts neutral gray with broad central white stripes occupying the entire end of the feathers; bill apparently orange; feet and claws brownish yellow.

*Measurements of type* (adult male).—Wing, 110; spurious primary, 28; tail, 86; culmen (chord), 20; tarsus, 31.5.

*Material.*—Eight skins, in the Paul J. Rainey collection: three are from Mount Lololokui, and five from Mount Gargues, in northern British East Africa, all collected by Edmund Heller.

*Remarks.*—From Jackson's Thrush (*Planesticus olivaceus elgonensis*), this subspecies may readily be distinguished by its inferior size and paler, more grayish, coloration.

COMPARATIVE MEASUREMENTS (IN MILLIMETERS) OF THREE SUBSPECIES OF *PLANESTICUS OLIVACEUS* (LINNÆUS).

| Name | Sex | No. of specimens | Wing | Spurious primary | Tail | Culmen (chord) | Tarsus |
|---|---|---|---|---|---|---|---|
| Planesticus olivaceus olivaceus... | ♂ | 1 | 120.5 | 24.0 | 92.0 | 22.5 | 30.0 |
| Planesticus olivaceus olivaceus... | ♀ | 1 | 120.0 | 30.5 | 93.0 | 23.0 | 31.0 |
| Planesticus olivaceus polius..... | ♂♀ | 5 | 112.2 | 26.6 | 90.7 | 20.5 | 31.0 |
| Planesticus olivaceus polius..... | ♂ | 3 | 110.3 | 26.0 | 89.8 | 21.5 | 31.2 |
| Planesticus olivaceus abyssinicus. | ♂ | 7 | 116.4 | 25.2 | 91.9 | 22.1 | 32.4 |
| Planesticus olivaceus abyssinicus. | ♀ | 7 | 113.7 | 26.1 | 87.1 | 20.9 | 32.4 |

**GEOCICHLA PIAGGIÆ KENIENSIS, new subspecies**

Mount Kenia Ground-Thrush

*Type-specimen.*—Adult male, Cat. No. 215455, U. S. National Museum; caught in rat trap set in bamboo forest on the west slope of Mount Kenia, at the altitude of 10,000 feet, British East Africa, September 27, 1909, by J. Alden Loring. (Original number, 411.)

*Characters.*—Closely related to *Geocichla piaggiæ piaggiæ* (A. Bouvier), but general coloration darker; no white on tail-feathers; eye-ring composed of specialized feathers, resembling those of the genus *Zosterops,* forming a broad circle of white around the eye.

*Description of adult male and female.*—General color of upper parts olive-citrine, shading into saccardo's olive on rump and upper tail-coverts; head with forehead and supra-loral region argus brown shading to the color of the back on cervix and auriculars; lores black, fading to chestnut in the anterior malar region; orbital ring pure white; wing with lesser coverts grayish olive, with wide yellowish olive tips; median wing-coverts olivaceous black, broadly tipped with fan-shaped white spots; exposed portion of greater wing-coverts olive, with the white terminal spots chiefly confined to the outer webs; primary coverts dark sepia, their outer webs broadly banded with yellowish citrine; wing-quills grayish brown, washed with olive-citrine on outer webs of secondaries, and with tawny-olive on the unemarginated portion of the outer webs of primaries; tail saccardo's umber, the shafts white below; no white tips to rectrices; chin, throat, and jugulum amber brown, becoming ochraceous-tawny on chest and flanks, rapidly fading to white on abdomen and thighs; under tail-coverts entirely white; axillars with basal half white, residue pale brownish gray; under wing-coverts olive-brown at base, white terminally; wing-quills with inner webs white at base, excepting the two outermost primaries, which have no white; iris hazel; bill black; feet pale brown, darker than in *Geocichla gurneyi raineyi.*

*Description of young.*—Four immature male topotypes, taken by the author October 8 to 11, 1909, are assuming the adult plumage, but are more or less spotted with brownish black, from the throat to the chest, on a general background of sudan brown, composed of mixed first and second plumages; the dark markings, being terminal, conform to the shapes of the feather-tips, varying from V-shape (anteriorly) to crescentic; wing-spots and abdomen, which in adults are pure white, are faintly washed with orange-brown; under tail-coverts broadly margined with reddish brown instead of being

all white; upper parts brownish olive instead of olive-citrine, with much less argus brown on the forehead and supra-loral region; feet darker brown than those of adults; with narrow reddish shaft-streaks on the feathers of the crown, occiput, back, and scapulars, which are absent in adults; these central stripes are obsolete on the back, and plainest on the scapulars; tail bistre. Both young and adults lack white tips to the rectrices.

*Measurements of type* (adult male).—Length of skin, 202; wing, 100; spurious primary, 32.5; tail, 92; culmen (chord), 20; tarsus, 36.

*Average measurements of four adult male topotypes.*—Wing, 100.8; spurious primary, 32.5; tail, 91; culmen (chord), 19.3; tarsus, 35.

*Average measurements of four adult female topotypes.*—Wing, 99; spurious primary, 29.5; tail, 89.8; culmen (chord), 19.1; tarsus, 35.2.

*Remarks.*—This ground-thrush inhabits the bamboo zone on the west side of Mount Kenia from 8,000 to 9,000 feet. Mr. Heller obtained an adult female at the summit of the neighboring Aberdare Mountains, altitude 11,000 feet. Of the thirteen specimens obtained, five were taken in traps set for small mammals, the remainder having been shot. The form is known only from the Kenia and Aberdare mountains.

### GEOCICHLA GURNEYI RAINEYI, new subspecies

Rainey's Ground-Thrush

*Type-specimen.*—Adult male, Cat. No. 217721, U. S. National Museum; caught in rat trap set in the forest at the summit of Mount Mbololo, altitude 4,400 feet, British East Africa, November 9, 1911, by Edmund Heller. (Original number, 419.)

*Description of type* (adult male).—Mantle olive-brown, this color shading into dresden brown on rump, innermost secondaries, and exposed portion of outer webs of remaining quills; head with crown and occiput deep olive-gray, this color faintly tinged with tawny on forehead; supra-loral spots of ochraceous-tawny; lores ochraceous-buff, slightly mixed with brownish black; a short-feathered eye-ring of light buff anteriorly, white posteriorly, with a central spot of dusky olive, above and below, corresponding to the dark anterior band of the auriculars; ear-coverts dark grayish brown, crossed by a broad oblique central band of light ochraceous-buff; cervix, supra-auricular region, and sides of neck olive-gray, tinged with tawny like the forehead; rectrices uniform prout's brown, with

shafts of quills white below; feathers of lesser wing-coverts dusky olive, broadly tipped with olive-brown, the outer row with terminal fan-shaped spots of ochraceous-tawny; median and greater wing-coverts dark olive with large terminal fan-shaped white spots; primary-coverts dark olive-buff, black terminally; chin, throat, breast, and flanks ochraceous-tawny, rapidly shading to white on abdomen and thighs; under tail-coverts white throughout; bend of wing, and axillars, white; under wing-coverts dark brown; basal portion of inner webs of quills white, except the two outermost primaries; bill dark; feet light.

*Measurements of type.*—Length of skin, 208; wing, 105; spurious primary, 28; tail, 87; culmen (chord), 21; tarsus, 35 (about); middle toe, with claw, 27.

*Remarks.*—This subspecies is more closely related to *Geocichla gurneyi otomitra* Reichenow, inhabiting Kondeland, than to *G. g. kilimensis* Neumann, the form occurring on Mount Kilimanjaro.

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By EDGAR A. MEARNS

ASSOCIATE IN ZOÖLOGY, UNITED STATES NATIONAL MUSEUM

Four of the forms here described are from the collection made by the Childs Frick African Expedition, 1911-1912; and two are from the Smithsonian African Expedition 1909-1910 collection, made under the direction of Col. Theodore Roosevelt.

The names of special tints and shades of colors used in this paper conform to Robert Ridgway's "Color Standards and Color Nomenclature, issued March 10, 1913. All measurements are in millimeters.

## CISTICOLA ROBUSTA ABAYA, new subspecies

Abaya Grass-Warbler

*Type-specimen.*—Adult male, Cat. No. 245693, U. S. National Museum; collected on the southeast shore of Lake Abaya, altitude 3,600 feet, southern Abyssinia, March 21, 1912, by Edgar A. Mearns. (Original number, 20797.)

*Characters.*—Most closely related to *Cisticola robusta robusta* Rüppell from Schoa and *C. r. tana* (described below); paler than *robusta* and darker than *tana*.

*Description of type and only specimen* (adult male).—Pileum dark brown, with the feathers narrowly bordered with olive-buff; ear-coverts buffy white tipped with pale gray; lores dirty white; nape cinnamon-buff, with dark centers to the feathers; mantle brownish black, all of the feathers bordered with light buffy gray, producing a spotted or somewhat striped appearance; rump drab-gray, unspotted; a few upper tail-coverts with black apical spots; wing with secondaries dark brown, with yellowish gray edging to the feathers; primaries with basal three-fifths edged with snuff brown on outer webs; outer wing-coverts light drab, with dark centers to the feathers; rectrices grayish brown, with broad subterminal bars or spots of black, and with grayish-white tips, the middle pair darkest, and all obscurely fasciated; under parts olive-buff, fading to white on chin, throat, and sides of face, and deepening to pale vinaceous on outer aspect of thighs; axillars, under wing-coverts, and inner edges of quill-feathers vinaceous-buff; iris light grayish brown; bill

brownish black above, grayish flesh color below; feet and claws pale brown.

*Measurements of type* (adult male).—Length of skin, 145; wing, 74; spurious primary, 28 x 6; tail, 57; culmen (chord), 14.5; tarsus, 28.

**CISTICOLA ROBUSTA TANA, new subspecies**

Tana Grass-Warbler

*Type-specimen.*—Adult male, Cat. No. 245695, U. S. National Museum; collected at Camp No. 5 (Childs Frick Expedition), Tana River, British East Africa, August 19, 1912, by Edgar A. Mearns. (Original number, 23756.)

*Characters.*—A pallid, grayish race, having the black markings more restricted than in any other known form of *Cisticola robusta.* It most closely resembles *C. r. abaya* (described above).

*Description of type and only specimen* (adult male).—Pileum clay color, with narrow brown shaft-stripes; nape clay color, with dark centers to the feathers; ear-coverts buffy white, with pale drab feather-tips, which are minutely freckled with brown; lores dirty white; mantle pale drab-gray with dark brown shaft-streaks; rump drab-gray, unspotted; a few upper tail-coverts spotted with blackish; wing with secondaries dark brown, bordered with pale ochraceous-buff; primaries with basal three-fifths edged with saccardo's umber on outer webs; outer wing-coverts light grayish olive, with darker centers; rectrices dark grayish brown, subterminally banded with black, and with buffy white tips, the middle pair darkest, and all obscurely fasciated; under parts olive-buff, becoming whitish on the chin, throat, and sides of face; outer aspect of thighs pale vinaceous; axillars, under wing-coverts, and inner border of quill-feathers vinaceous-buff.

*Measurements of type* (adult male).—Length of skin, 135; wing, 70; spurious primary, 27 x 5; tail, 53; culmen (chord), 13; tarsus, 27.5.

**CISTICOLA SUBRUFICAPILLA BODESSA, new subspecies**

Bodessa Grass-Warbler

*Type-specimen.*—Adult male, Cat. No. 245778, U. S. National Museum; collected at Bodessa, near the Sagan River, southern Abyssinia, May 27, 1912, by Edgar A. Mearns. (Original number, 21986.)

*Characters.*—Similar in size to *Cisticola subruficapilla æquatorialis* Mearns, color paler and browner, with the dark shaft-stripes of the

mantle obsolete; under parts paler, and less rufescent on the thighs.

*Description of the adult male and female in breeding plumage.*—Pileum and cervix snuff brown; mantle pale sepia brown with slightly darker centers to the feathers; wings sepia, with drab edging to the wing-coverts and inner secondaries, and with outer webs of quills tinged with prout's brown; middle pair of rectrices drab throughout; remaining rectrices drab, subterminally banded with black, and tipped with whitish drab; chin and throat whitish; sides and flanks pale grayish drab; middle of chest, abdomen, and under tail-coverts white, faintly tinged with clay color; thighs clay color; axillars, under wing-coverts, and greater part of inner webs of quills cinamon-buff; iris light reddish brown; male with bill brownish black, plumbeous on basal half of mandible, and with inside of mouth black; female with bill dark brown above, horn color on mandible and sides of maxilla, and with inside of mouth yellow; both sexes with feet brownish flesh color, and with claws dark brown.

*Description of young in first plumage.*—Crown and nape tawny-olive; mantle yellowish drab; wings pale sepia, the feathers edged with dresden brown; rectrices dresden brown with indication of numerous cross-bars, and with the pale feather-tips washed with brown; chin, throat, and sides of face chartreuse yellow; middle of abdomen whitish; sides washed with drab-gray; crissum, flanks, thighs and lining of wings pale cinnamon-drab; bill above brown, flesh color on mandible and sides of maxilla at base; inside of mouth yellow in both sexes.

*Measurements of type* (adult male).—Length of skin, 130; wing, 65.0; spurious primary, 26 x 5.5; tail, 57.5; culmen (chord), 13.5; tarsus, 25.

*Average measurements of nine adult males.*—Wing, 66.2; tail, 56.5; culmen (chord), 13.5; tarsus, 23.6.

*Average measurements of two adult females.*—Wing, 53; tail, 45.8; culmen (chord), 12; tarsus, 21.3.

*Geographical range.*—Valley of the Galana Sagan River and the Stephanie and Rudolf lake-basins.

*Material.*—Thirteen specimens from the Sagan River, Bodessa, and Lake Stephanie, southern Abyssinia and northern British East Africa.

### CISTICOLA SUBRUFICAPILLA FRICKI, new subspecies

Frick's Grass-Warbler

*Type-specimen.*—Adult male, Cat. No. 217992, U. S. National Museum; collected on the east shore of White Lake Abaya, southern Abyssinia, altitude 3,600 feet, March 20, 1912, by Childs Frick.

*Characters.*—Most closely related to *Cisticola subruficapilla borea* Mearns,[1] from the Lado region of the Upper Nile, but smaller, with the mantle more distinctly streaked with blackish, and the under parts more buffy.

*Description of the adult male and female in breeding plumage.*—Pileum and cervix buckthorn brown, with dark-brown centers to the feathers; mantle drab-brown with broad black shaft-stripes to the feathers; wings sepia, with drab edging to the wing-coverts and inner secondaries, and with outer webs of quills bordered with prout's brown; middle pair of rectrices cinnamon-brown, subterminally banded with brownish black, and tipped with clay color; remaining rectrices grayish brown, subterminally broadly banded with black, and tipped with whitish drab; chin and throat whitish; middle of chest, abdomen, and crissum buffy white, palest mesially; sides of chest, and flanks, pale, grayish drab; thighs clay color; axillars, under wing-coverts, and inner webs of quills cinnamon-buff; iris dark reddish brown; bill brownish black above, grayish flesh color below; feet and claws pale brown; male with inside of mouth black; female with inside of mouth flesh color.

*Measurements of type* (adult male).—Length of skin, 136; wing, 70; spurious primary, 28 x 5.5; tail, 61; culmen (chord), 14; tarsus, 24.5.

*Average measurements of forty adult males.*—Wing, 67.4; tail, 58; culmen (chord), 13.9; tarsus, 23.6.

*Average measurements of eleven adult females.*—Wing, 55.6; tail, 48.6; culmen (chord), 12.4; tarsus, 21.3.

*Geographical range.*—Abaya Lake Basin, southern Abyssinia.

*Material.*—Fifty-three specimens from the Abaya lakes and Gato River Valley, near Gardulla, southern Abyssinia.

### CISTICOLA NATALENSIS NILOTICA, new subspecies

Jebel Grass-Warbler

*Type-specimen.*—Adult female, Cat. No. 217132, U. S. National Museum; collected at "Rhino Camp," Lado Enclave, latitude 2° 55′ north, on the west bank of the Nile (Bahr el Jebel), some fifteen miles north of the station of Wadelai, January 20, 1910, by Edgar A. Mearns. (Original number, 18132.)

*Characters.*—Most closely related to *Cisticola natalensis inexpectata* Neumann, but with a slightly longer tail and shorter, stouter bill.

[1] Smithsonian Miscellaneous Collections, Vol. 56, No. 25, p. 3, November 23, 1911.

The general color of the upper parts is a paler, more yellowish brown; and the stripes on the crown and mantle are broader and more sharply defined.

*Measurements of type* (adult female).—Wing, 55; tail, 54; culmen (chord), 11.2; depth of bill, 4.7; tarsus, 24.

**PYROMELANA FLAMMICEPS CHANGAMWENSIS, new subspecies**

Changamwe Fire-crowned Bishop-Bird

*Type-specimen.*—Adult male (winter plumage), Cat. No. 215886, U. S. National Museum; collected at Changamwe, east coast of British East Africa, November 22, 1909, by Edgar A. Mearns. (Original number, 17548.)

*Characters.*—Most closely related to *Pyromelana flammiceps rothschildi* Neumann. Females and males of *P. f. rothschildi* in nonbreeding plumage may be distinguished from *P. f. changamwensis* by their smaller bills and by their much lighter striping on the pileum and mantle. The west coast forms, *flammiceps* and *sylvatica,* are smaller and less ochraceous.

*Measurements of type.*—Length of skin, 130; wing, 73; tail, 48; culmen (chord), 16.2; greatest depth of bill, 13; greatest breadth of maxilla, 11; tarsus, 21.

*Measurements of adult female.*—Length of skin, 120; wing, 65; tail, 41; culmen (chord), 16; greatest depth of bill, 12; greatest breadth of maxilla, 11; tarsus, 21.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 61, NUMBER 12

# POPULUS MACDOUGALII: A NEW TREE FROM THE SOUTHWEST

(With One Plate)

BY
J. N. ROSE

(Publication 2239)

CITY OF WASHINGTON
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The Lord Baltimore Press
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# POPULUS MACDOUGALII: A NEW TREE FROM THE SOUTHWEST

By J. N. ROSE

(With One Plate)

In 1904 Dr. D. T. MacDougal obtained photographs and specimens of a strange poplar, which I then considered new, but the description of which I reserved for further information. Recently I received the following communication from Mr. S. B. Parish:

"I am sending you under another cover specimens of a Populus which does not well agree with any species of which I have a description. It belongs in the delta lands of the Colorado River, at least to Yuma, where it is abundant in the bottom lands on both sides of the river. It also comes into the Salton Sink, along the Alamo and New rivers. In the settled part of the Sink it is very generally cultivated, but is not indigenous. The Indio and Mecca specimens are from cultivated trees.

"I have seen no very large trees, and I am inclined to believe that it does not attain to a large size, or to a very great age. But this opinion might be modified by further observation."

**POPULUS MACDOUGALII Rose, sp. nov.**

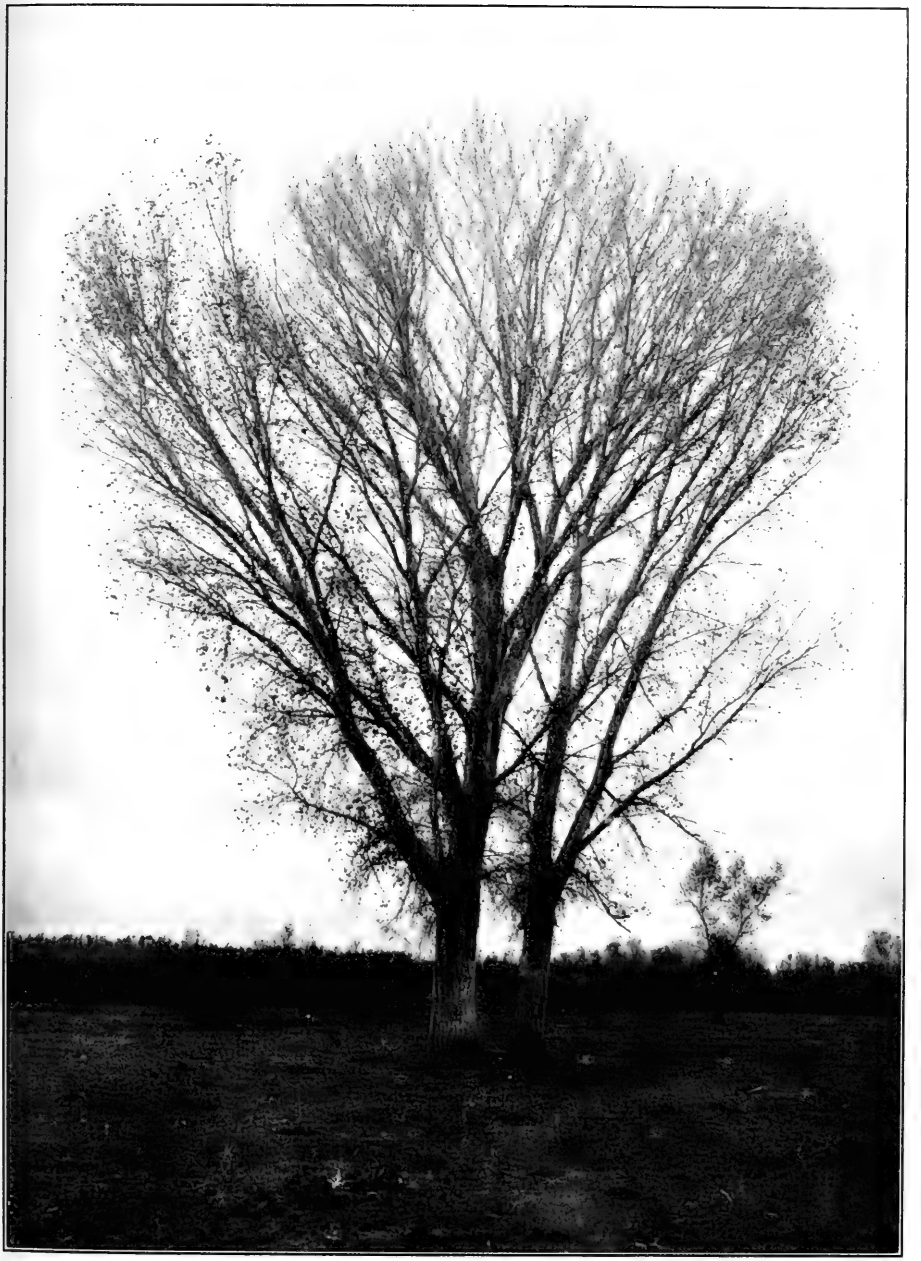
Small tree, usually 10 meters high, or more, the trunk proper about 5 meters long; branches strict, ascending; bark on trunk, when mature, light gray, moderately fissured; bark on branches, even the larger ones, smooth and light gray, appearing almost white; twigs light gray; young growth very pubescent, but the two-year-old parts glabrate; mature leaves much wider than long, often 11 cm. broad, moderately acuminate, truncate at base, sometimes slightly cuneate, the margins with shallow crenations, when young, with very pubescent petioles and less pubescent blades; mature petioles strongly flattened, often scantily pubescent; racemes 5 to 6 cm. long; pedicels short (3 to 5 cm. long).

Type in the United States National Herbarium, No. 692069, collected on Mecca Flats, in the Salton Basin, California, February 28, 1913, by S. B. Parish (No. 8471).

This species is common in the Colorado Delta as far north as Yuma, Arizona, and is also found around springs and wells in the Cahuilla Basin, around Salton Lake.

This tree is especially characterized by its broad leaves, with nearly truncate bases and shallow-toothed margins. It is most nearly related to *Populus fremontii,* but is of much lower stature, with more pubescent branches and with leaves of different shape and toothing. It is named for Dr. D. T. MacDougal, who first brought it to my attention.

The illustration used here is from a photograph taken by Dr. D. T. MacDougal at Colonia Lerdo, February, 1904.



POPULUS MACDOUGALII Rose

SMITHSONIAN MISCELLANEOUS COLLECTIONS
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# NEW ANTELOPES AND CARNIVORES FROM BRITISH EAST AFRICA

BY

EDMUND HELLER
Naturalist, Smithsonian African Expedition

(PUBLICATION 2240)

CITY OF WASHINGTON
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# NEW ANTELOPES AND CARNIVORES FROM BRITISH EAST AFRICA

By EDMUND HELLER

NATURALIST, SMITHSONIAN AFRICAN EXPEDITION

Further study of the collections of African mammals in the United States National Museum, secured by expeditions under the direction of Col. Theodore Roosevelt, Paul J. Rainey, and Dr. W. L. Abbott, has resulted in the discovery of the new races described in the present paper.

## TRAGELAPHUS SCRIPTUS OLIVACEUS, new subspecies

Swahili Bushbuck

Type from Maji-ya-Chumvi, British East Africa; adult male, Cat. No. 182267, U. S. Nat. Mus.; collected by Edmund Heller, Dec. 11, 1911. (Original No. 2580.)

*Characters.*—Dorsal coloration of male grayish-olive without any rufous suffusion; sides and hindquarters marked by white spots; legs seal-brown; neck short-haired without evident collar; dorsal mane white. Female cinnamon, the sides of the body crossed by 6 to 8 white transverse bars; white spots on lower sides and on hind quarters. Skull with enlarged bullae. Body size smaller than *Tragelaphus scriptus delamerei* of the Kenia highlands.

*Coloration of adult male (type).*—Body grayish-olive sparingly lined by buffy, midline of back with a crest of longer white tipped hair; middle of body crossed by an indistinct white bar; lower sides with a line of irregular white spots; hindquarters spotted by several conspicuous white spots. Breast dark seal-brown without the olive tinge of the back; belly white. Forelegs seal-brown with a white bar on inside of thighs; another back of knee and a white spot on inside from knee to pasterns; front of pasterns marked by two large white spots. Hind legs with a white spot behind the hock and a broad white stripe on inside of leg from the hock to the pasterns, the latter with two large white spots in front as in the forelegs. Tail bushy, the hair above and on sides olive-brown with a narrow streak of white on underside; hair at tip indistinctly blackish; neck

hair brown without a definite collar, short haired to the white bar on lower throat where the long olive hair of body begins abruptly; upper throat with a large median white spot. Crown of head and snout olive-brown, the latter without white chevrons; sides of head ochraceous-tawny; cheeks below eye marked by two large white spots; upper lips, chin and forethroat white; back of ears olive-brown, the tips becoming seal-brown, inside and base whitish. The adult female has the sides of the body bright ochraceous-tawny with the median area much darker, cinnamon-brown through the center of which extends a thin white dorsal mane from withers to tail; sides of body marked with 6 or 7 transverse white stripes, the anterior ones being the longest; lower sides with a line of white spots and hindquarters with about a dozen similar spots irregularly arranged. Breast buffy lighter than the sides; belly white. Legs bright-tawny with white areas arranged as in the male. Tail showing much more white below than that of the male, only the median dorsal line being cinnamon like the body color. Collar on neck more distinctly marked than in the male. Crown of head bright rufous, the snout dorsally olive-brown with narrow white chevrons from eye to snout, rest of head colored as in the male.

*Measurements in the flesh.*—Head and body, 1120; tail, 200; hind-foot, 365; ear, 142. Skull adult but not aged, the first premolar only showing wear; condylo-basal length, 228; greatest breadth, 95; length of upper tooth row, 66; gnathion to tooth row, 66; length of bullæ, 37; height of bullæ above basioccipital, 13; nasals, 80 x 20; length of premaxillæ, 57. Length of horns on curve of keel, 12 inches.

The race here described inhabits the edge of the Taru Desert and the moist coast strip from Kilimanjaro northward at least as far as the Tana River. It is a decidedly lighter colored race than either *massaicus* or *delamerei* and is readily distinguishable by its lack of any rufous coloration in the male.

### AMMELAPHUS IMBERBIS AUSTRALIS, new subspecies

East African Lesser Kudu

Type from Longaya water, Marsabit district, British East Africa; adult female, Cat. No. 182073, U. S. Nat. Mus.; collected by Marius A. Johnston, July 21, 1911. (Original No. 2380.)

*Characters.*—Resembling *Ammelaphus imberbis* of Somaliland closely but differing by darker coloration, absence of the white spot on front of pasterns on the forelegs and shorter horns.

*Coloration.*—Dorsal color bright ochraceous-tawny lined sparingly with black along median region; vertebral line marked by an ill-defined white and black dorsal stripe; sides crossed by twelve conspicuous transverse stripes from the dorsal stripe to the underparts; lower sides and breast ochraceous, the midline of chest marked by a broad black stripe but the belly and groins pure white. Forelegs pure ochraceous without the white spot on front of pasterns; band above hoofs and back of pasterns black; a black band on back of leg just above the knee. Hindlegs ochraceous with a white spot on front of pasterns and a black band above hoofs and back of pasterns black; a white stripe on inside of leg from the white of the belly to the hock. Tail tawny above, white below, with tip seal-brown. Neck somewhat lighter than the body, ecru-drab with a narrow black stripe on nape from head to withers; a white patch on forethroat and a larger oval one near base. Crown of head tawny banded in front by white chevron bars from the eyes to the snout; median line of snout walnut-brown; sides of head ecru-drab with two white spots below eye and a short white postocular stripe; lips and chin white, the white on forethroat bordered by dusky; back of ears ochraceous, the tip narrowly margined by blackish; inside and base white.

*Measurements in the flesh.*—Head and body along curve, 1490; tail, 360; hindfoot, 470; ear, 206. Skull aged, the premolars much worn. Greatest length, 300; condylo-basal length, 285; greatest breadth, 110; orbit to gnathion, 165; gnathion to tooth row, 80; length of upper tooth row, 87; width of palate at $M^1$, 72; length of premaxillæ, 85; nasals, 115 x 31; vertical diameter of orbit, 45.

Another female from the same locality is in the collection. It agrees with the type minutely in coloration. Specimens of the lesser kudu from Somaliland in the Field Museum of Chicago are lighter colored and have the white spot in front of the pasterns well marked. No males are in the National Museum however for comparison.

### STREPSICEROS STREPSICEROS BEA, new subspecies

East African Greater Kudu

Type from Donyo Gelsha on the escarpment east of Lake Baringo; adult female, Cat. No. 163247. U. S. Nat. Mus.; shot by Kermit Roosevelt October 10, 1909. (Original No. 410.)

*Characters.*—Similar to the Abyssinian race *Strepsiceros strepsiceros chora* in the reduced number of body stripes, but decidedly darker in color on median dorsal region, ear tips and bands on pasterns; pelage longer with the white stripes more distinctly marked.

Brighter colored than the typical race from South Africa with the stripes much more conspicuous although less in number.

*Coloration.*—Body ochraceous-tawny, the median dorsal region seal-brown, with a white stripe following vertebral column from withers to rump; sides marked by eight transverse white bands on the right side and six on the left which extend from the median dorsal stripe to the ventral surface or lower sides; underparts ochraceous with a broad blackish stripe medially on breast; groins and inside of legs whitish; front of legs ochraceous; band above hoofs and back of pasterns black, front of pasterns with a large blotch of whitish; tail tawny-ochraceous like the body; tip darker walnut-brown, below white. Neck drab-gray, the nape with a thin mane of long dusky brown hair, the mane wanting along the basal part of neck but reappearing again on the withers. Crown of head walnut-brown, crossed on the snout by a wide diagonal white band from the eye, which meets its fellow on the snout; sides of face ecru-drab, two indistinct white spots below the eye; lips and chin white; back of ears hair brown, the terminal one-half seal-brown, inside and base whitish.

No flesh measurements are available of specimens from British East Africa. An adult male was shot at the same locality by Kermit Roosevelt, but as this specimen is now mounted the female was selected as the type. In the male the hair is thinner and the transverse light stripes are less distinct. The much more distinct striping and longer hair of this race are very evident on comparison with the three specimens from South Africa in the National Museum and the group from Somaliland in the Field Museum of Chicago.

The skull of the female compared to skulls from South Africa has a much narrower basisphenoid area below the bullæ which are very large; tooth row longer; interorbital region much flatter; nasal processes of premaxillæ much more slender; lachrymal-nasal sinus larger; terminal notches in nasal bones short. Skull of type old, the first premolar worn down below the fossette.

Greatest length of skull, 380; condylo-basal length, 960; greatest breadth, 150; gnathion to orbit, 203; diameter of orbit, 55; length of upper tooth row, 110; gnathion to tooth row, 102; nasals, 140 x 37; width of palate across $M^1$, 95; width of basisphenoid between bullæ, 21; height of bullæ above sphenoid, 30; length of premaxillæ, 100; nasal notch, 18.

The kudu found near Baringo are confined to a few square miles of country among rocky hills and are widely separated from any

other group. One hundred miles north near the south shore of Lake Rudolf are a few others, while to the south the nearest ones occur on the German border near the Southern Guaso Nyiro River. Wide breaks of this sort, however, are characteristic of the distribution of the greater kudu owing to the isolated nature of the hilly and rocky country which they select as their haunts.

### KOBUS DEFASSA RAINEYI, new subspecies

Rainey Defassa Waterbuck

Type from the Amala River, British East Africa; adult male, Cat. No. 181961, U. S. Nat. Mus.; shot by Paul J. Rainey, May 14, 1911. (Original No. 2203.)

*Characters.*—A large race exceeding in body size that of any other in British East Africa. Coloration nearest *Kobus defassa tjaderi* of Laikipia but differing by the more reddish body coloration and more restricted black snout patch which ends in front of the interorbital region. Distinguishable from *Kobus defassa nzoiæ* by larger body size, narrower skull and absence of rufous on the nape.

*Coloration.*—Body cinnamon-drab in effect, the color made up of a mixture of cinnamon hair with black tips interspersed sparingly with white hairs, the black tone due to the black tipped hairs gives a dark cast to the whole coloration; back darkest, sides lighter and more grayish; breast fuscous-brown without cinnamon vermiculation; belly and posterior surface of hindquarters white, the latter in sharp contrast to the dark back and sides. Tail darker than back, seal-brown without cinnamon mixture, a narrow streak on under side whitish to within a few inches of the tip. Legs from knees and hock uniform dark seal-brown with a fringe of whitish hair about hoofs and false hoofs. Neck slightly lighter than the body, the sides and throat grayish with a white patch on forethroat and with the nape decidedly cinnamon. Forehead uniform rufous from horn bases to front of eyes; ridge of snout to muzzle black or seal-brown variegated by a few scattered white hairs; tip of snout bordering muzzle, upper lips and chin white; sides of snout tawny lined by black; a broad white stripe above eye from the middle to an inch in front of angle on sides of snout. Cheeks below eye grayish like sides of neck. Back of ears cinnamon, gradually growing darker toward tip where they are broadly seal-brown on both sides; inside except extreme tip white.

*Measurements in the flesh.*—Tail, 410; hindfoot, 510; ear, 210. Skull, condylo-basal length, 390; greatest breadth, 155; nasals, 152

x 48; orbit to gnathion, 242; length of upper tooth row, 110; vertical diameter of orbit, 50; $PM^1$ to gnathion, 123; length of premaxillæ, 110; length of anterior nares, 83; width of palate across $M^1$, 97; width between bullæ, 35. Skull old, the last molar showing considerable wear and the suture between basioccipital and basisphenoid fully anchylosed. Skull distinguishable from *nzoiæ* by its narrowness of palate, long tooth row and narrowness of basioccipital between the tympanic bullæ.

Four specimens are in the collection from the headwaters of the Amala River near the German border of British East Africa. These agree with the type in coloration of body and large size of skull.

### KOBUS ELLIPSIPRYMNUS KURU, new subspecies

Swahili Waterbuck

Type from Taveta, Kilimanjaro district, British East Africa; immature male, Cat. No. $\frac{18950}{34694}$, U. S. Nat. Mus.; collected by Dr. W. L. Abbott.

*Characters.*—Mostly closely allied to *Kobus ellipsiprymnus thikæ* of the Athi Plains, but differing from this race by its darker, sepia-brown color; legs darker brown but snout not darker than body color and showing little contrast to the color of the forehead.

*Coloration.*—Median dorsal region uniform dark brown, warm sepia of Ridgway; sides lighter, deep brownish drab in color; breast drab, the belly whitish. White stripe on hindquarters not continuous across rump; broad and distinct on sides however. Tail sepia like back, the tip very little darker; a narrow line of white on underside. Legs from knees and hocks uniform sepia-brown, darker than the sides; a white fringe above hoofs and false hoofs. Neck somewhat lighter than the body, dark brownish-drab; nape uniform in color with the throat; a whitish blotch on upper throat. Sides of head like the neck in color, dorsal surface of snout sepia-brown but not contrasting with the more reddish cinnamon-brown forehead; rhinarium of snout bordered by a white band; lips and chin white; a broad white area at front angle of eye about two inches long. Area about eyes and back of ears ochraceous-tawny; tips of ears sepia-brown, inside white.

No flesh measurements of the type are available and the skull is also missing at present. The skull is recorded, however, by Doctor True, who gives the horn length as ten inches. A skin with horns this length is in the collection from Juja Farm, which is within a few miles

of the type locality of *thikæ*. The Juja Farm skin is much lighter than the type but agrees well in color with adults from Juja Farm. Several skins from Juja Farm and the Northern Guaso Nyiro are in the National Museum and all are conspicuously lighter than the Taveta skin. A mounted specimen, an older male but still somewhat immature, from Taveta is in the Museum. The horns of this specimen are 19 inches in length. The coloration is much lighter than that of the type owing to its exposure to light for a long period, approximately twenty years. It is surprising how little individual variation in color is shown in a series of *thikæ* from Juja Farm near Nairobi. Specimens from the Northern Guaso Nyiro and from Mtoto Andei agree with these in tone of coloration. The dimensions of the adult skull No. 39693 from Taveta are: condylo-basal length, 350; greatest breadth, 156; nasals 143 x 41; diameter of orbit, 50; orbit to gnathion, 220; length of premaxillæ, 116; upper tooth row, 109; $PM^1$ to gnathion, 107; width of palate across $M^1$, 85; age, last milk molar still in use, and last molar just erupted.

Among the Swahili tribes of the coast district the waterbuck is known as kuru.

### OREOTRAGUS OREOTRAGUS AUREUS, new subspecies

Marsabit Klipspringer

Type from the summit of Mt. Lololokwi, north of the Northern Guaso Nyiro; adult female, Cat. No. 182149, U. S. Nat. Mus.; collected by Edmund Heller, Sept. 15, 1911. (Original No. 2458.)

*Characters.*—Female lacking horns as in *Oreotragus oreotragus saltatrixoides* of the Abyssinian highlands, but body color lighter than that race, golden yellow; legs much lighter than body color, dark spot above hoof large; crown of head different in color from body, rufous. Differs from *Oreotragus oreotragus schillingsi* by the absence of horns in the female, the light colored legs, the presence of a dark spot above the hoofs and by lighter and more yellowish coloration.

*Coloration of the type.*—Dorsal color bright buff-yellow everywhere speckled by seal-brown owing to the basal color of the hair showing beneath the narrow yellow tips of the hair, yellow purest on neck; midline of back showing most blackish; rump uniform in color with the back; sides sharply defined against the pure white of the underparts. Tail rudimentary and not differentiated by color or longer hair from the rump. Forelegs lighter colored than the back, buffy with less of the dark hair bases showing through on out-

side, the inside uniform whitish like the underparts; a heavy black band about the hoofs which reaches halfway to the false hoofs. Hindlegs like the fore but the inside from hocks to hoof uniform in color with the outside. Crown of head russet lined heavily by black; snout on the sides buffy like the legs, the median portion blackish; lips and chin whitish; midline of throat buff-yellow without darker vermiculations. Back of ears clothed by short buffy hairs, central portion and margin blackish, except on lower inner border, which is marked by a white bar or spot; inside and base whitish.

*Measurements in the flesh.*—Head and body, 830; tail, 75; hind-foot, 225; ear, 93. Skull, condylo-basal length, 130; greatest breadth, 76; nasals, 41 x 22; gnathion to orbit, 66; vertical diameter of orbit, 29; length of premaxillæ, 35; upper tooth row, 52; gnathion to $PM^1$, 29; width of palate across $M^3$, 48; post orbital constriction, 48. Skull old, the premolars much worn and the sphenoidal sutures obliterated by anchylosis. Premaxillæ at tips slender, not broadly club-shaped as *schillingsi.*

Six specimens of this race from the Rainey Expedition are in the National Museum. Five of these are females, all of which are without horns or any evidence of horn cores on the skulls. One is a male with well developed horns. From Lololokwi, the type locality, there are two females; one specimen from the middle course of the Guaso Nyiro and three others from the rock kopjes of the northern edge of the West Kenia Plateau. These specimens agree closely in color with the type. The range of this species meets that of *schillingsi,* a race in which the females have as well developed horns as the males, in the region about Lake Baringo. To the eastward the southern limit of the range is no doubt marked by the Tana River. Along the frontiers of the two races there is no indication in specimens of a transition from the hornless to the horned females. All of the female specimens of *schillingsi* examined are well horned, the longest horned specimen of the race being that of a female. The coloration of this race, however, shows no striking color differences with the others in which the females are hornless. The horned character of the females, which is the chief character of the race, was not known to the describer, Herr Oscar Neumann. His specimens had not been sexed in the field by the collectors and the skins were cut in such a way that no evidence of sex remained. His specimens, however, were all horned and on this account they were classed as males.

**PROTELES CRISTATUS TERMES, new subspecies**

Masailand Aard Wolf

Type from the headwaters of the Amala River west of the Loita Plains, British East Africa; adult female, Cat. No. 181523, N. S. Nat. Mus.; collected by Edmund Heller, May 8, 1911. (Original No. 2154.)

*Characters.*—Intermediate in coloration between typical *Proteles cristatus* of South Africa and *Proteles cristatus septentrionalis* of Somaliland. Interorbital region black haired, crown of head grizzled, feet black, and ears blackish as in *cristatus;* body stripes narrow; ground color of body grayish fulvous; tail only black on terminal third as in *septentrionalis;* muzzle and chin black; throat grayish-buffy with fulvous suffusion.

*Measurements in the flesh.*—Head and body, 680; tail 310; hind-foot, 142; ear, 97. Skull adult but sutures open. Condylo-basal length, 136; basilar length, 125; zygomatic breadth, 75; breadth of brain case, 46; interorbital width, 26; post orbital width, 33; length of upper tooth row, 40; breadth at canines, 34; nasals, 42 x 11; condylo-basal length of mandible, 96.

Besides the type there are two other specimens in the National Museum collection from British East Africa. One of these is from the same locality as the type and the other is from the Northern Guaso Nyiro River from the vicinity of Neumann's boma. This latter specimen is much more fulvous than those from the higher plateau of the Loita. In its lack of grayish coloration and suppression of the black areas this form approaches the Somaliland race. The stomach of the type was crammed by a mass of termites upon which the animal had been feeding.

**NANDINIA BINOTATA ARBOREA, new subspecies**

Kavirondo Nandinia

Type from the Lukosa River, northeast of Kisumu, British East Africa; adult male, No. 182374; U. S. Nat. Mus.; collected by Edmund Heller, Feb. 11, 1912. (Original No. 2695.)

*Characters.*—Differs decidedly from *Nandinia binotata binotata* of West Africa by the much narrower black rings on the tail, the narrower black neck stripes and absence of spots on the lower sides of the body. It approaches more closely the coloration of *gerrardi* of Nyasaland with which it agrees in the narrowness of the tail rings, but is at once distinguishable by the presence of the three black stripes on the nape and the larger and more conspicuous spots on the dorsal surface.

The flesh measurements are: Head and body, 550; tail, 625; hind-foot, 95; ear, 38. Skull fully adult with high sagittal and lambdoidal crests, but basisphenoid and parietal sutures still evident. Condylo-basal length, 106; basal length, 100; zygomatic breadth, 63; interorbital breadth, 20; post interorbital constriction, 16; nasals, 27 × 10; palatal length, 47; mastoid breadth, 42; upper tooth row, 44; length of $PM^{m^4}$ on outer side, 8.2.

Three specimens, male, female and young, are in the National Museum, collected by the Rainey Expedition in the Kakumega forest northeast of Kisumu. The adult male has been selected as the type. The female is somewhat lighter in general tone of coloration. The half-grown young specimen is much more grayish than the adults and lacks the tawny suffusion. The two light spots on shoulders are much better marked, however, in the young. The dark rings in the tail of the adults are best marked on the median dorsal line, and are broken or absent on the underside. The terminal one-third of the tail is without any indication of the dark cross bars, the hairs of which are uniformly black tipped. The specimens have been compared with the material in the British Museum and also with a series of flat skins of *binotata* in the National Museum from Kasai, Congo drainage.

The genus *Nandinia* has not previously been reported from British East Africa, the specimen from Ruwenzori recorded by Thomas being the most eastern record.

### MUNGOS DENTIFER, new species

Type from Maji-ya-Chumvi, British East Africa; adult female, Cat. No. 182732, U. S. Nat. Mus.; collected by Edmund Heller, Dec. 14, 1911. (Original No. 4865.)

*Characters.*—A small species similar to *Mungos ochraceus,* but size less and hair annulated; color similar to *Mungos zombae,* but much more annulated; skull similar to *Mungos lasti,* but much smaller, with more inflated brain case; mandible with first premolar present as in *Mungos lasti,* this character separating these two species from all their allies.

*Coloration.*—General dorsal color grizzled buffy and blackish, except the median dorsal area which is mars-brown, due to the color of the underfur predominating by the wearing off of the tips of the longer annulated hairs; tip of the tail with a subterminal band of rufous followed by a black tip, the rufous spreading on underside halfway to base; feet like back in color; underparts without the blackish vermiculation, the color more uniform tawny-olive.

*Measurements.*—Head and body, 270; tail, 205; hindfoot, 45; ear, 23. Skull, condylo-basal length, 54; zygomatic breadth, 28; postorbital constriction, 10; palate breadth across $PM^4$, 18.5; length of upper tooth row to front of canine, 20; length upper carnasial, 6; condylo-incisive length of mandible, 34.5; length at coronoid process, 12; length of tooth row to front of $PM_2$, 17.5.

The type is an old adult, all of the skull sutures having disappeared, but the teeth show very little wear. Another specimen from the same locality is in the collection. It is immature, the sutures of the skull still being open and the milk canines are just being pushed out of place by the permanent ones. The color of this specimen is less grizzled, the black annulations being very narrow, the feet are almost uniform ochraceous-buff and the subterminal rufous area of the tail is much greater. The specimen is a male and is somewhat larger than the type. The mandible shows the first small premolars like the type. The three skulls of *lasti* from Zanzibar in the British Museum all have these first lower premolars, but they are lacking in all the other races of small mungooses. The Zanzibar species does not otherwise closely resemble this coast form. It differs widely by its uniform dark rich brown color, larger size, longer tail and skull with a much less inflated brain case. This new species is much nearer *zombæ* in size, proportions and coloration but is decidedly more grizzled, smaller in size and possesses an additional lower premolar.

### MUNGOS ALBICAUDUS FEROX, new subspecies

Type from Changamwe, British East Arica; adult female, Cat. No. 163294, U. S. Nat. Mus.; collected by Dr. E. A. Mearns, Nov. 25, 1909. (Original No. 7275.)

*Characters.*—Allied to *Mungos albicaudus ibeanus* most closely, but coloration much lighter, being blackish only on median dorsal region, and size somewhat larger, almost equalling *Mungos albicaudus grandis* of South Africa; color as light as *Mungos albicaudus leucurus* of the Nile Valley, but size much larger, with third lower molar very much larger.

*Coloration.*—Ground color buff, the median dorsal region blackish, due to the presence of long black tipped hairs; sides grizzled by longer annulated black and white hairs; the dense underfur everywhere buffy; feet blackish (dark seal-brown), the dark color covering forearm and extending on thighs as a streak to hips; tail white, the tip only pure white, the basal half having the hairs annulated with a broad subterminal band of black; underparts buffy, scantily varie-

gated by longer annulated hairs; head more grayish, the hair covering chiefly annulated black and white; muzzle and chin with black hair chiefly; back of ears black.

*Measurements.*—Head and body, 560; tail, 440; hindfoot, 125; ear, 20. Skull, condylo-basal length, 110; zygomatic breadth, 525; post-orbital constriction, 22; width of palate across $PM^4$, 35; length of upper tooth row to front of canine, 44.5; condylo-incisive length of mandible, 79; height at coronoid, 24; length of last lower molar, 7.8; breadth of last lower molar, 5.

Teeth much worn in type, the cusps of the molars worn down to the general tooth level, so that the cusp formulæ cannot be determined. Skin tanned and preserved in a flat condition. A series of skins of *ibeanus* from the vicinity of the type locality are blackish, the underfur showing only on sides and where it is grayish and not buddy. The white-tailed *mungos* inhabiting the coast district of East Africa is a light colored race like leucurus of the north with the large bodily size of the southern race, *grandis*. The last lower molar exceeds in width that of *grandis* by three millimeters, but the skull is almost the exact size of the type of the southern race.

### BDEOGALE CRASSICAUDA OMNIVORA, new subspecies

Northern Four-toed Mungoose

Type from Mazeras, British East Africa; adult female, Cat. No. 182275, U. S. Nat. Mus.; collected by Edmund Heller, Dec. 21, 1911. (Original No. 2588.)

*Characters.*—Resembling *Bdeogale crassicauda crassicauda* in size and proportions, but color of tail and feet darker, black rather than seal-brown; body color lighter owing to the scantiness of black tipped hairs which allows the buffy underfur to predominate, giving the coat a grizzled effect. This race differs decidedly from *tenuia* of Zanzibar, which is a short tailed species with a uniform brown body coloration and smaller body size.

*Measurements of the type in the flesh.*—Head and body, 420; tail, 245; hindfoot, 81; ear, 34. Skull fully adult, all the sutures being obliterated, but the cheek teeth have prominent unworn tubercles or cusps. Condylo-basal length, 85; basal length, 80; zygomatic breadth, 46; mastoid breadth, 33; interorbital width, 18; post orbital constriction, 14; palatal length, 50; width across $PM^4$, 28; length of upper tooth row, 40; width of $M^1$, 7.

Besides the type there is another adult female in the collection from Mazeras. This specimen is slightly larger with more worn

teeth than the type and agrees with it in coloration. A newly-born young is in the collection also. This specimen is quite different from the adults, being uniform seal-brown everywhere without any of the buffy grizzle of the adult except on the forehead. The type has been compared with specimens in the British Museum and with measurements and notes made from the types of *crassicauda* and *puisa* in the Berlin Museum.

The body coloration resembles closely that of the white-tailed mungoose in its grizzling and also in the buff color of the underfur. Stomach contents of the type, beetles and the remains of a mouse.

**ICTONYX CAPENSIS ALBESCENS, new subspecies**

Ibean Zorilla

Type from the summit of Mount Lololokwi, northern Guaso Nyiro district, British East Africa; adult male, Cat. No. 182724, U. S. Nat. Mus.; collected by Edmund Heller, Sept. 15, 1911. (Original No. 4318.)

*Characters.*—Most closely allied to *Ictonyx capensis intermedia* of the Upper Nile in coloration but distinguishable by the more extensive white areas of the head and body, the white face markings coalescing and forming a broad band across the face or forehead; white of back very extensive, the black areas on nape and shoulders reduced to narrow lines. From *shoae* of the Abyssinian highlands *albescens* may be distinguished by the absence of a black bar on the forehead separating the frontal and post orbital white areas, and by the more extensive white areas of the back and tail; not distinguishable however in size. This race exceeds the typical race *capensis* somewhat in size and is easily separable from it by the great reduction of the black areas in its coloration.

*Measurements in the flesh.*—Head and body, 340; tail, 275; hind-foot, 58; ear, 27. Skull aged, all the sutures having coalesced and the sagittal and lambdoidal crests well developed; the upper molar shows much wear and the canines are short and blunt.

*Measurements.*—Condylo-basal length, 67; basal length, 62; greatest breadth, 42; interorbital breadth, 18; post orbital constriction, 15; mastoid breadth, 35; palatal length, 32.5; upper tooth row, 25; length of $PM^4$ on outer edge, 7.2.

The type is the only specimen from Mount Lololokwi, but there are three others from Nairobi which agree with it in coloration. The types in the British Museum have been compared as well as the extensive series of specimens in that institution with the type of *albescens*.

**FELIS OCREATA NANDAE, new subspecies**

Nandi Wild Cat

Type from the headwaters of the Lukosa River, Nandi escarpment, altitude 7,000 feet, British East Africa; adult male, Cat. No. 182367, U. S. Nat. Mus.; collected by Edmund Heller, Feb. 9, 1912. (Original No. 2688.)

*Characters.*—Coloration very dark and at once distinguishable from the other East African races, all of which are light colored. Median dorsal color blackish, vermiculated sparingly with tawny, sides crossed by distinct dark bands; underparts rich ochraceous spotted with black; upper surface of feet and legs ochraceous like the belly. Ears much darker than in the other races, blackish throughout, with a very slight tawny suffusion.

*Measurements of the type in the flesh.*—Head and body, 530; tail, 410; hindfoot, 140; ear, 63. Skull adult, but sutures still distinct and teeth unworn. Greatest length, 101; basal length, 87; condylo-basal length, 94; zygomatic breadth, 69; interorbital breadth, 20; post orbital constriction, 35; breadth of brain case, 47; palatal length, 39; width of mesopterygoid fossa, 14; length of upper carnasial on outer edge, 10; nasals, 27 x 14.

Besides the type there are three other specimens in the National Museum which were collected at the base of the Nandi escarpment on the lower edge of the Kakumega forest. These are somewhat lighter than the type, but they agree with it in being distinctly darker than *ugandæ*. This race in its dark color is almost equalled by the type of *rubida* from Mombuttu in the Congo watershed. This type has been examined at the British Museum and is considerably darker than average specimens from Mombuttu in the same collection, and actually represents a much lighter race than *nandae*.

**FELIS OCREATA TAITAE, new subspecies**

Desert Wild Cat

Type from Voi, British East Africa; adult female, Cat. No. 182220, U. S. Nat. Mus.; collected by Edmund Heller, Oct. 27, 1911. (Original No. 2533.)

*Characters.*—A light colored race resembling closely typical *Felis ocreata* of Abyssinia, but differing by having the breast marked by distinct spots, the darkest of which are fuscous; ears very light in color, the backs fulvous without darker tips. From *Felis ocreata ugandae* this race differs by its decidedly lighter coloration and smaller body size.

*The type measured in the flesh.*—Head and body, 495; tail, 310; hindfoot, 118; ear, 58. Skull adult, the basisphenoid sutures obliterated. Greatest length, 87; basal length, 74; condylo-basal length, 80; zygomatic breadth, 63; interorbital breadth, 17; post orbital constriction, 33; breadth of brain case, 43; palatal length, 33; width of mesopterygoid fossa, 11; nasals, 25 x 11.

Besides the type there is another adult female in the National Museum from the Northern Guaso Nyiro River near its junction with the Isiola. The tip of the tail in the type is now missing, but that of the other specimen which agrees in body coloration minutely with the type has the terminal portion of the tail banded with black to the same extent as in typical *ocreata.*

Specimens representing *ocreata* from Abyssinia in the British Museum have the breast unspotted and the underparts lighter buff, but the color of the dorsal surface and the underfur is quite the same as in *taitae.*

SMITHSONIAN MISCELLANEOUS COLLECTIONS
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# Descriptions of Five New African Weaver-Birds of the Genera Othyphantes, Hypargos, Aidemosyne, and Lagonosticta

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# DESCRIPTIONS OF FIVE NEW AFRICAN WEAVER-BIRDS OF THE GENERA OTHYPHANTES, HYPARGOS, AIDEMOSYNE, AND LAGONOSTICTA

By EDGAR A. MEARNS

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Four of the forms here described are from the collection made by the Childs Frick African Expedition, 1911-1912; and one is from the Smithsonian African Expedition collection, 1909-1910, under the direction of Col. Theodore Roosevelt.

The names of special tints and shades of colors used in this paper conform to Robert Ridgway's "Color Standards and Color Nomenclature," issued March 10, 1913. All measurements are in millimeters.

### OTHYPHANTES FRICKI, new species

Frick's Weaver

*Type-specimen.*—Adult male. Cat. No. 247071, U. S. National Museum; collected at Aletta (Aleta), Sidamo, southern Abyssinia, March 9, 1912, by Edgar A. Mearns. (Original number, 20628.)

*Characters.*—The breeding plumage of the adult male is quite similar to that of *Othyphantes reichenowi* (Fischer); and the adult female, in breeding plumage, is only distinguishable from *Othyphantes stuhlmanni* (Reichenow) by the greater breadth of the shaft-stripes of the mantle, and the slightly darker, more greenish olive of the mantle, rump, and upper tail-coverts.

*Description of the adult male in breeding plumage.*—Forehead and most of crown apricot yellow; a band round the back of the ear-coverts, sides of upper neck, cheeks, and entire under parts empire yellow; auricular patch, back of head and neck, and mantle brownish black, the latter with the unworn feathers more or less edged with olive-yellowish-green; lower back, rump, upper tail-coverts, and rectrices warbler green; wings brownish black with pyrite yellow edges to the feathers, these edges being confined to the ends of the lesser and median coverts, the outer edges of the greater coverts and quills; iris pale yellow; bill black; feet and claws pale brown. In unworn plumage the yellow extends over the entire head and nape, but, posteriorly, the yellow feather-tips quickly disappear with wear.

*Description of the adult female in breeding plumage.*—Top and sides of head brownish black; back, rump, and upper tail-coverts yellowish olive-green, the mantle, only, with broad black shaft-streaks; wings as in the male; entire under parts empire yellow.

*Description of young in first plumage* (females, still attended by parents).—Top of head, back, rump, and upper tail-coverts warbler green, washed with brownish-grayish on the mantle, which is also shaft-streaked with brown; wings brown, with buffy-white outer edges to the secondaries, and pyrite yellow edges to the coverts and outer edge of primaries; auricular patch duskier than crown; under parts pinard yellow anteriorly, becoming pale drab-gray on lower abdomen and crissum.

*Measurements of type* (adult male).—Length of skin, 150; wing, 80; tail, 62; culmen (chord), 18.2; tarsus, 24.

*Average measurements of four adult males.*—Wing, 80.25; tail, 60.5; culmen (chord), 18.5; tarsus, 23.5.

*Average measurements of three adult female topotypes.*—Wing, 78; tail, 59; culmen (chord), 17.33; tarsus, 22.2.

*Material.*—Four adult males and three adult females, all in breeding plumage; also two young in first plumage; all from Sidamo.

*Geographical range.*—Sidamo and Djamdjam districts of Abyssinia.

*Remarks.*—The fortunate circumstance of my being in Sidamo when this species was in breeding plumage, and finding both sexes and the young associated, enables me to unite them as opposite sexes of one species. Without having examined the specimens, I suppose the few examples of *Othyphantes reichenowi* recorded from southern Abyssinia to be males of *O. fricki,* and the two females from Sidamo and Djamdjam recorded as *O. stuhlmanni* by Neumann to be females of *O. fricki.*

I find the species of *Othyphantes* from East Africa to be very similar in size, after averaging the measurements of our series of *stuhlmanni, reichenowi, emini,* and *baglafecht.* It is evident that, up to the present time, no ornithologist has studied these species with material sufficient to elucidate all of their plumages or their geographic distribution and interrelations.

### HYPARGOS NIVEOGUTTATUS MACROSPILOTUS, new subspecies

Meru Twin-spot

*Type-specimen.*—Adult male, Cat. No. 246922, U. S. National Museum; collected in the Meru Forest, north of the Equator, British East Africa, August 10, 1912, by Edgar A. Mearns. (Original number, 23560.)

*Characters.*—This form differs from *Hypargos niveoguttatus niveoguttatus* (Peters) in the following respects: Size larger; under parts jet black, with larger and more numerous white twin-spots on sides; mantle more yellowish brown; chin, throat, sides of head, and chest darker red.

*Measurements of type* (adult male).—Length of skin, 120; wing, 57; tail, 56; culmen (chord), 13; tarsus, 18.

**AIDEMOSYNE INORNATA, new species**

Plain Silver-bill

*Type-specimen.*—Female, Cat. No. 217336, U. S. National Museum; collected at El Dueim, White Nile, Sudan, Africa, March 13, 1910, by Edgar A. Mearns. (Original number, 18715.)

*Characters.*—Similar to *Aidemosyne cantans cantans* (Gmelin), but larger, and without transverse bars or vermiculations on the upper parts.

*Description of type* (adult female).—Crown, upper side of neck, mantle, upper rump, and inner portion of wings pale broccoli brown; feathers of forehead with darker centers and paler edges, giving a scale-like appearance which becomes obsolete on the occiput; sides of head of a color similar to that of the mantle but more buffy; tail and outer two-thirds of wing seal brown; chin and throat buffy white, faintly spotted with yellowish brown; remainder of under parts white perceptibly washed with buff; under side of wing, except tips of outer primaries, buff; some grayish white on under side of outer rectrices.

*Measurements of type* (adult female).—Length of skin, 106; wing, 57; tail, 45; culmen (chord), 11; tarsus, 13.5.

*Remarks.*—It is probable that some specimens of the present species have been included in published measurements of *Aidemosyne cantans cantans.* Reichenbach, in Die Singvogel, 1862, pl. xvi, fig. 146, figures a bird similar to the present species together with three individuals of *A. cantans,* but the colors are much more intense.

Mr. H. F. Witherby[1] collected specimens, at the same season and in the same region, of a species of *Aidemosyne* which may be, in whole or in part, the same as *inornata;* but he gives no measurements, although he carefully describes the changes resultant from "moulting from the immature to the mature plumage." The form *inornata* may prove to be merely a very large and pallid subspecies of *Aidemosyne cantans,* of which the subspecies *cantans* was restricted to West Africa by Lorenz and Hellmayr when they described *Aidemosyne cantans orientalis.*[2]

[1] *Cf.* Ibis, 1901, p. 247; also, in this connection, pp. 519 and 618.

[2] Ornithologische Monatsberichte, ix, 1901, p. 39.

**AIDEMOSYNE CANTANS MERIDIONALIS, new subspecies**

East-African Silver-bill

*Type-specimen.*—Adult male, Cat. No. 247534, U. S. National Museum; collected at the south base of the Indunumara Mountains, British East Africa, July 16, 1912, by Edgar A. Mearns. (Original number, 23048.)

*Characters.*—Most closely related to *Aidemosyne cantans orientalis* (Lorenz and Hellmayr) from South Arabia, from which it differs only in being slightly larger and considerably paler above. The dark cross-bars of the upper surface are narrower, and the upper side of the head and neck, and the mantle, lighter, more grayish, brown. The forehead has a more scaled appearance, produced by the paler edging to the feathers. There is also a more buffy tinge to the under parts.

*Measurements of type* (adult male).—Length of skin, 90; wing, 52; tail, 40; culmen (chord), 9.2; tarsus, 12.5.

*Average measurements of fourteen adult males of Aidemosyne cantans meridionalis* (Hawash River, Abyssinia, south to the Indunumara Mountains, British East Africa).—Wing, 51.4; tail, 41.8; culmen (chord), 9.5; tarsus, 12.5.

*Average measurements of sixteen adult females of Aidemosyne cantans meridionalis* (French Somaliland, south through Abyssinia to the Meru River, in British East Africa).—Wing, 50; tail, 40.6; culmen (chord), 9.7; tarsus, 12.4.

*Average measurements of seven adult males of Aidemosyne cantans orientalis from Aden, central south Arabia.*—Wing, 49.9; tail, 43.4; culmen (chord), 9.9; tarsus, 11.2.

*Average measurements of six adult females of Aidemosyne cantans orientalis from Aden, Arabia.*—Wing, 49.3; tail, 41; culmen (chord), 9.8; tarsus, 12.

*Geographical range.*—Northeast Africa, from the Red Sea to German East Africa.

*Remarks.*—On crossing the Red Sea to French Somaliland a very pale form of *Aidemosyne* was found at Djibouti which contrasts strikingly with specimens from Aden; rising thence to the Hawash Valley, Abyssinia, a slightly darker form occurs which remains quite constant through Abyssinia and British East Africa.

**LAGONOSTICTA RUBRICATA FRICKI, new subspecies**

Frick's Fire-Finch

*Type-specimen.*—Adult male, Cat. No. 247543, U. S. National Museum; collected on the Gato River, near Gardulla, Abyssinia, April 19, 1912, by Edgar A. Mearns. (Original number, 21388.)

*Characters.*—Most closely related to *Lagonosticta rubricata hildebrandti,* but smaller; coloration paler, less intense; mantle less olive tinted, and washed with red; crown slate color, very slightly washed with red; chest and sides morocco red instead of ox-blood red; sides sparsely spotted with pure white. As pointed out by Ogilvie-Grant (Ibis, 1908, p. 272), *Lagonosticta rubricata rhodopareia* Heuglin, from Keren, in Bogosland, differs in having the top of the head brownish gray without any wash of red—the opposite condition from *hildebrandti.*

*Measurements of type.*—Length of skin, 103; wing, 48; tail, 47; culmen (chord), 10.5; tarsus, 15.

*Geographical range.*—Basins of Abaya and Stefanie lakes, Abyssinia.

*Material.*—Sixteen specimens from Gato River, near Gardulla, Sagan River, Bodessa, and Tertale.

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# NOTES ON THE RECENT CRINOIDS IN THE BRITISH MUSEUM

BY

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# NOTES ON THE RECENT CRINOIDS IN THE BRITISH MUSEUM

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## PREFACE

During the summer of 1910 I paid a short visit to the British Museum for the purpose of studying the magnificent collection of recent crinoids, more especially the comatulids, preserved in that institution.

Thanks to the courtesy of Professor F. Jeffrey Bell, who, in the most generous manner and, I fear, at no inconsiderable personal inconvenience, did everything which lay in his power to facilitate and to expedite my work, I was able in the limited time at my disposal to examine the entire collection of recent comatulids, taking copious notes on all the specimens upon which published records have been based, and identifying all of the unnamed material, at the same time drawing up diagnoses of such new species as I found.

It was my wish to leave with Professor Bell my diagnoses of these new species so that he might describe them under his own name, as it seemed somewhat presumptuous for me to publish new and interesting observations based upon the material under the care of Professor Bell; he, however, with his usual courtesy, insisted that he had no such feeling about the matter, and urged me to publish the descriptions of the new species I found under my name alone as opportunity offered.

It would take months of study and preparation to do adequate justice to the comatulid collection of the British Museum, and I therefore feel that I owe the Trustees of the institution and Professor Bell an apology for presenting in printed form the results of my necessarily somewhat cursory examination; but on the other hand I was able to clear up many obscure points and to settle definitely many determinations about which there has always been much doubt, especially in regard to species of which the types are in the continental museums which I visited either just before or just after my

visit to London, so that these notes, though not extended, possess a certain value.

While at the British Museum I examined and took notes upon about 1538 specimens, distributed in the several families as follows: Comasteridæ 417, Zygometridæ 25, Himerometridæ 180, Stephanometridæ 15, Mariametridæ 29, Colobometridæ 84, Tropiometridæ 91, Calometridæ 5, Thalassometridæ 72, Charitometridæ 64, Antedonïdæ 513, Pentametrocrinidæ 11, Atelecrinidæ 2, Pentacrinitidæ 7, and Holopidæ 2; 21 specimens examined were not identified.

## Family COMASTERIDÆ A. H. Clark

### Subfamily CAPILLASTERINÆ A. H. Clark

#### Genus PALÆOCOMATELLA A. H. Clark

#### PALÆOCOMATELLA DIFFICILIS (P. H. Carpenter)

*Actinometra difficilis* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 93, pl. 52, figs. 1, 2 (1).

*Actinometra pulchella* 1888. P. H. CARPENTER, *T. c.*, p. 304 (part) (1).

1. *"Challenger" Station No. 192.*—One specimen. There are sixteen or seventeen cirrus segments, of which the third, a transition segment, is the longest, about three and one-half times as long as its median diameter, slightly constricted centrally. The cirri are proportionately very long, the distal end of the second segment being nearly as far from the center of the animal as the anterior angle of the IIBr axillary. The outer cirrus segments have rather strong dorsal processes.

On page 93 of the "Challenger" Report Carpenter, under the name of *Actinometra difficilis,* refers to this specimen, citing the two figures on plate 52, and says of it, "the two outer radials [*i. e.,* the two ossicles of the IBr series], the two distichals [IIBr series], and the first two brachials are respectively united by syzygy;" but later (p. 306), referring to the same specimen and the same figures, he says, "after repeated changes of opinion I have come to the conclusion that there is a bifascial articulation [*i. e.,* synarthry] in each case."

The former meager diagnosis, combined with the reference to the figures, in spite of the fact that it is based upon misconception of the structure of the animal and is therefore wholly erroneous, serves, according to the rules of the International Committee on nomenclature, to establish the name *difficilis,* even though he suppressed this name later.

### Genus COMATELLA A. H. Clark

### COMATELLA NIGRA (P. H. Carpenter)

1. *No Locality.*—One specimen. One of the division series is of four segments, of which the two outer are united by synarthry.

### COMATELLA STELLIGERA (P. H. Carpenter)

*Actinometra tenax* 1874. Lütken, Cat. Mus. Godeffroy, vol. 5, p. 190 (1).
*Actinometra stelligera* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 308 (1, 2, 3).
*Antedon bassett-smithi* 1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 393 (4).
*Actinometra simplex* 1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 396 (5).
*Actinometra maculata* 1894. Bell, *T. c.*, p. 395 (6); p. 396 (7, 8).

1. *Samoa and Fiji.*—One specimen with thirty-three arms; all the division series are external in reference to the IBr series.

2. *Reef of Atagor; Professor J. B. Jukes.*—One specimen.

3. *"Challenger" Station No. 174.*—Two specimens.

4. *Macclesfield Bank; 13-36 fathoms.*—One specimen.

5. *Macclesfield Bank; 13 fathoms.*—One specimen with twenty arms; the cirrus segments number eighteen.

6. *Parry's Shoal; 12 fathoms.*—One specimen with twenty-one arms 90 mm. long; the cirri are XXV, 17-20 (usually the latter), 15 mm. to 18 mm. long. This specimen is very like No. 5, but the whole animal is a trifle stouter. The color is green, with fine yellow spots.

7. *Macclesfield Bank; 13-36 fathoms.*—One specimen with twenty arms 80 mm. long; the cirri are XXII, 18-20 (usually the latter), 18 mm. long; the centrodorsal has a broad flat dorsal pole 5 mm. in diameter. The color is red brown.

8. *Macclesfield Bank.*—One specimen with twenty-six arms; the cirri are X, 18.

### COMATELLA MACULATA (P. H. Carpenter)

*Actinometra maculata* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 307 (1).—1902. Bell, in Gardiner, Fauna and Geography of the Maldive and Laccadive Achipelagoes, vol. 1, part 3, p. 225 (2).
*Actinometra* sp. 1898. Bell, Proc. Zoöl. Soc. London, 1898, p. 849 (3).
*Actinometra multiradiata* 1909. Bell, Trans. Linn. Soc. (Zoöl.), (2), vol. 13, part 1, p. 20 (4).

1. *"Challenger" Station No. 186.*—One specimen, resembling the specimen which I described from Bowen (*Actinometra fusca* [Lütken, MS.], "Challenger" Report, p. 307; Vid. Medd. fra den Naturhist. Forening i København, 1909, p. 138) but with somewhat larger cirri.

2. *West Reef, Hulule, Male, Maldives.*—One specimen with seventeen arms.

3. *Outer part of reef at Rotuma; "the only crinoid seen at Rotuma or Funafuti."*—One specimen.

4. *Salomon; from reef; 8/6/05.*—One specimen with twenty-six arms 85 mm. long; the cirri are XXI, 15-18 (usually 17 or 18). Compared directly with the type of the species (1) this specimen is found to differ only in its more numerous arms; all the IIIBr series are developed externally.

### Genus NEOCOMATELLA A. H. Clark

### NEOCOMATELLA EUROPÆA A. H. Clark

*Actinometra pulchella* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 304 (part) (1).

1. *"Porcupine" Station No. 31 (1870); 477 fathoms.*—One specimen, small and badly broken, with twenty arms. One of the IIBr series is lacking, and a single IIIBr series is developed, externally, on another ray. The mouth is subcentral. Only one cirrus stump with four segments is present; the cirrus segments are exceptionally long, the fourth being four times as long as broad, or even rather longer.

### NEOCOMATELLA ATLANTICA A. H. Clark

*Actinometra pulchella* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 304 (part) (1).

1. *St. Paul's Rocks, 10-80 fathoms; "Challenger."*—One large badly broken specimen with twenty arms. The distal dorsal edges of the pinnule segments are very strongly everted and produced so that the dorsal pinnule profile is deeply serrate. The longest cirrus stump remaining is 12.5 mm. long with nine segments, the sixth the longest, slightly over twice as long as broad; the following segments are slightly shorter; the sixth and following have the distal dorsal edge slightly produced.

### Genus CAPILLASTER A. H. Clark

### CAPILLASTER SENTOSA (P. H. Carpenter)

*Actinometra sentosa* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 325 (1).—1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 225 (2).

1. *Banda; "Challenger."*—Two specimens.

2. *North Male, Maldives.*—One fine specimen.

## CAPILLASTER MULTIRADIATA (Linné)

*Actinometra multiradiata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 322 (1).—1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 394 (2).—BRIT. MUS., MS. (3).

*Actinometra fimbriata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 317 (4, 5).—1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 396 (6, 7, 8, 9).—1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 225 (10.)—BRIT. MUS., MS. (11, 12, 13).

*Actinometra coppingeri* 1884. BELL, "Alert" Report, p. 168 (14).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 320 (15, 16).

*Actinometra parvicirra* 1888. BELL, Proc. Zoöl. Soc. London, 1888, p. 384; p. 387 (17).—1894. THURSTON, Madras Government Museum Bulletin, No. 2, p. 106; p. 114 (17.)—BRIT. MUS., MS. (18, 19).

*Antedon anceps* BRIT. MUS., MS. (20).

*Actinometra multifida* BRIT. MUS., MS. (21).

1. *"Challenger" Station No. 186.*—One specimen.

2. *Northwestern Australia.*—Three specimens.

3. *No Locality.*—One specimen with seventeen arms about 40 mm. long; three of the IIBr series are 2 and two are 4 (3 + 4); each of the latter bears internally a IIIBr 3 (2 + 3) series. The IIBr 2 series may be immediately followed by a syzygial pair (the normal first syzygial pair) or the second and third brachials may be united by syzygy; these two types of proximal arm structure are of about equal frequency. There are 21 cirrus segments.

Half of the animal alone would certainly be identified as *Comatella maculata,* the other half as *Capillaster multiradiata.*

4. *Banda; "Challenger."*—Two specimens.

5. *"Challenger" Station No. 208.*—One specimen.

6. *Macclesfield Bank; 22-30 fathoms.*—One specimen with seventeen arms.

7. *Macclesfield Bank; 23-40 fathoms.*—One specimen.

8. *Macclesfield Bank; 30-40 fathoms.*—One specimen.

9. *Macclesfield Bank; 45 fathoms.*—One specimen.

10. *Male, Maldives.*—One fine specimen with twenty-two arms.

11. *Tizaid Reef; 27 fathoms.*—One specimen.

12. *Tizaid Reef; 8½ fathoms.*—One specimen.

13. *No Locality.*—One specimen.

14. *Flinders Island, Clairmont, northeastern Australia; 11 fathoms; sand and mud; "Alert."*—One specimen.

15. *Banda; 17 fathoms; "Challenger."*—One specimen.

16. *Zamboanga; 10 fathoms; "Challenger."*—One specimen.

17. *Tuticorin, Madras Presidency; E. Thurston.*—Two specimens, one with twenty-one, the other with twenty-five arms.

18. *No Locality.*—One specimen; five of the IIIBr series are 1, and one is 3 (2 + 3).

19. *"Antarctic Expedition."*—One specimen.

20. *Blanche Bay, New Britain; Arthur Willey.*—One specimen with twelve arms; the arms expand very rapidly to about the sixteenth brachial, then taper distally; the brachials are shaped essentially as those of *Comatula solaris,* strongly convex externally, with a strongly concave anterior border; they are also strongly triangular instead of being more or less oblong as usual.

21. *Singapore.*—One specimen with fourteen arms 120 mm. long; the cirri are 20 mm. long and are composed of twenty-one segments.

### Genus NEMASTER A. H. Clark

### NEMASTER LINEATA (P. H. Carpenter)

*Actinometra lineata* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 327 (1).

1. *Bahia, 7-20 fathoms; "Challenger."*—Three specimens with twenty-nine, twenty-nine and nineteen arms.

### Genus COMISSIA A. H. Clark

### COMISSIA PEREGRINA (Bell)

*Actinometra peregrina* 1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 402 (1).

1. *Macclesfield Bank; 55-60 fathoms.*—One specimen. The cirri are XIII, 25-30 (usually nearer the latter), 20 mm. long; the fifth is a transition segment. The mouth and the anal tube are equally excentric. The ten arms are 120 mm. long; the synarthrial tubercles are only slightly evident; the distal edges of the brachials are moderately produced; the distal intersyzygial interval is three oblique muscular articulations.

This species is closely related to *C. lütkeni,* but may be at once distinguished by the greater number of cirrus segments. There is a great development of small spines, especially on the pinnulars, so that the animal has the curiously "dry" feeling characteristic of *C. lütkeni,* and especially of *C. dumetum.*

### COMISSIA PECTINIFER A. H. Clark

*Comissia pectinifer* 1911. A. H. Clark, Annals and Mag. Nat. Hist. (8), vol. 7, p. 644 (1).

1. *Christmas Island; H. M. S. "Flying Fish."*—One specimen. The centrodorsal is discoidal, moderately large; the bare polar area

is flat; the cirrus sockets are arranged in three crowded marginal rows.

The cirri are XXXIV, 14-16 (usually the latter), 14 mm. long; the eighth is a transition segment; the longer proximal segments are nearly or quite twice as long as broad, slightly constricted centrally; the last two segments before the penultimate are about as long as broad to one-third broader than long; the outer cirrus segments are very highly polished and bear small dorsal tubercles.

The ten arms are about 90 mm. long; the ossicles of the IBr series are so closely joined that the articulation between them has all the appearance of a syzygy, but they are well separated laterally; the arms resemble those of the other species of *Comissia;* the distal edges of the brachials overlap rather strongly; syzygyies occur between the third and fourth brachials, again between the eleventh and twelfth and fifteenth and sixteenth, and distally at intervals of three oblique muscular articulations.

There are terminal combs on the pinnules as far as $P_4$; the comb of $P_4$ has fifteen or sixteen teeth, beyond which are a few segments which do not bear processes; the teeth are exceptionally long; in $P_4$ there are only nine segments preceding the comb; $P_1$ is 12 mm. long, and bears a comb composed of twenty-five very long teeth.

**COMISSIA IGNOTA A. H. Clark**

*Actinometra,* sp. nov. 1884. Bell, "Alert" Report, p. 510 (1, 2).
*Comissia ignota* 1911. A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, p. 17 (1, 2).
*Actinometra pectinata* Brit. Mus., MS. (1).

1. *Marie Louise Island, Amirante Group; 17 fathoms; "Alert."*—Nine specimens, one of which is six rayed.

This is the type locality of the species, and it was from these specimens that the original description was drawn up.

2. *Isle des Neufs, Amirante Group; 17 fathoms; coral; "Alert."*—One specimen.

**Genus LEPTONEMASTER A. H. Clark**

**LEPTONEMASTER VENUSTUS A. H. Clark**

1. *Cuba.*—Two specimens.

Subfamily Comactiniinæ A. H. Clark

**Genus COMATULELLA A. H. Clark**

**COMATULELLA BRACHIOLATA (Lamarck)**

*Comatula rosea* Brit. Mus., MS. (1).

1. *Port Phillip, Victoria.*—One fine specimen.

### Genus COMATULA Lamarck

### COMATULA ROTALARIA (Lamarck)

*Actinometra jukesii* 1879. P. H. CARPENTER, Proc. Roy. Soc., vol. 28, p. 390 (1).

*Actinometra jukesi* 1884. BELL, "Alert" Report, p. 168 (2, ?3, ?4).

*Actinometra paucicirra* 1884. BELL, "Alert" Report, p. 169 (3, 4).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 291 (6, 7).

1. *Cape York; Professor J. B. Jukes.*—One specimen.

2. *Albany Island, Queensland; 3-4 fathoms; mud; "Alert."*—One large and typical specimen with twenty arms.

3. *Prince of Wales Channel, Torres Strait; 7 fathoms; "Alert."*—One fine specimen.

4. *Prince of Wales Channel, Torres Strait; 5-7 fathoms; sand and shell; "Alert."*—Two small specimens, one with three, the other with four cirri. These are the types of *paucicirra.*

5. *Torres Strait; 4 fathoms; "Alert."*—Two twenty armed specimens; one has one cirrus stump remaining; in both the centrodorsal is not yet sunk to the level of the dorsal surface of the radials.

6. *"Challenger" Station No. 187; Cape York.*—About a dozen specimens; all appear to be twenty armed and typical.

7. *Aru (Arrow) Islands; "Challenger."*—Small specimens which have not entirely lost their cirri.

8. *No Locality.*—One fine specimen with twenty-one arms; the centrodorsal is stellate, countersunk to the level of the dorsal surface of the radials; there are no subradial clefts; the single IIIBr series is externally developed, and resembles the IIBr series.

9. *Holothuria Bank.*—One specimen.

10. *Holothuria Bank; 34 fathoms.*—One specimen.

### COMATULA ETHERIDGEI A. H. Clark

*Comatula ethridgei* 1911. A. H. CLARK, Memoirs of the Australian Museum, vol. 4, part 15, p. 741 (1, 2).

1. *Holothuria Bank; 38 fathoms.*—Three specimens.

2. *Baudin Island, northwestern Australia; 8-15 fathoms.*—One specimen.

These have been described in detail in the reference cited.

### COMATULA SOLARIS (Lamarck)

*Antedon milberti* 1884. BELL, "Alert" Report, p. 156 (10).

*Actinometra solaris* 1884. BELL, *T. c.*, p. 164 (1); p. 165 (2).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 288 (1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14).

*Actinometra solaris* var. *albonotata* 1884. BELL, *T. c.*, p. 165 (3).
*Actinometra intermedia* 1884. BELL, *T. c.*, p. 166 (4).—BRIT. MUS., MS. (6).
*Actinometra robusta* 1884. BELL, *T. c.*, p. 167 (5, ?7).
*Actinometra strota* 1884. BELL, *T. c.*, p. 167 (6, ?8).—1888. P. H. CARPENTER, *T. c.*, p. 290 (11, 16).

1. *Prince of Wales Channel, Torres Strait; 5-7 fathoms; "Alert."*—Two specimens.

2. *Torres Strait; 10 fathoms; sand; "Alert."*—Four specimens, three of which are small.

3. *Albany Island, Queensland; 3-4 fathoms; "Alert."*—One specimen.

4. *Albany Island; 3-4 fathoms; mud; "Alert."*—Six specimens.

5. *Port Curtis; 5-11 fathoms; "Alert."*—One magnificent specimen.

6. *Port Molle; "Alert."*—One specimen.

7. *Prince of Wales Channel; "Alert."*—Six specimens.

8. *Port Molle; 12 fathoms; "Alert."*—One fine specimen; there are no cirri; the centrodorsal is reduced to a pentagonal plate which is not quite sunk to the level of the radials.

9. *Fitzroy Island, Queensland; "Alert."*—One specimen.

10. *Port Denison; "Alert."*—One specimen.

11. *Cape York; "Challenger."*—Five specimens.

12. *"Challenger" Station No. 187.*—Six specimens.

13. *Billiton.*—Three specimens, all of the slender armed type; this species appears never to attain the stout armed *"robusta"* form except in Australia.

14. *Singapore.*—One specimen of the slender armed type.

15. *Holothuria Bank, northwestern Australia.*—One specimen.

16. *Cape York; Professor J. B. Jukes.*—Seven specimens.

17. *No Locality; Professor J. B. Jukes.*—One specimen.

18. *No Locality.*—One specimen.

### COMATULA PURPUREA (J. Müller)

*Actinometra solaris* 1884. BELL, "Alert" Report, p. 165 (1).
*Actinometra pectinata* 1884. BELL, *T. c.*, p. 165 (2).
*Actinometra alternans* 1884. BELL, *T. c.*, p. 169 (3).
*Actinometra pectinata* BRIT. MUS., MS. (1, 2, 4).

1. *Torres Strait; "Alert."*—One specimen.

2. *Dundas Strait, northwestern Australia; 17 fathoms; mud; "Alert."*—Two small specimens with the characteristic cirrus arrangement already developed.

3. *Port Molle; 12-20 fathoms; rock; "Alert."*—One specimen.

4. *No Locality.*—One specimen.

5. *Dimes Island, New Guinea.*—One young specimen.

6. *Australia.*—One specimen.

### COMATULA PECTINATA (Linné)

*Antedon irregularis* 1884. BELL, "Alert" Report, p. 161 (1).—1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 394 (22).

*Actinometra solaris* 1884. BELL, "Alert" Report, p. 164 (2, 3, 4, 5, 6, 7, 8, 9).—BRIT. MUS., MS. (10, 11).

*Actinometra* sp. juv. 1884. BELL, "Alert" Report, p. 170 (12).

*Actinometra pectinata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 284 (13, 14).—1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 394 (15, 16, 17, 18, 19, 20, 21).—BRIT. MUS., MS. (24, 25, 26).

*Actinometra parvicirra* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 394 (23).

*Comatula rosularis* BRIT. MUS., MS. (27).

*Actinometra echinoptera* BRIT. MUS., MS. (28).

1. *Prince of Wales Channel; 7 fathoms; sand; "Alert."*—One young specimen.

2. *Prince of Wales Channel; 7 fathoms; sand; "Alert."*—One small specimen.

3. *Warrior Reef, Torres Strait; "Alert."*—One specimen.

4. *Port Curtis; 0-11 fathoms; sand and shell; "Alert."*—One specimen.

5. *Arafura Sea; "Alert."*—One specimen.

6. *Thursday Island; "Alert."*—Three specimens.

7. *Thursday Island; 4-6 fathoms; "Alert."*—One small specimen.

8. *Thursday Island; "Alert."*—One specimen with arms 65 mm. long.

9. *Thursday Island; "Alert."*—Two specimens.

10. *Port Molle; 14 fathoms; rock; "Alert."*—Two specimens.

11. *Port Molle; 14 fathoms; rock; "Alert."*—One specimen.

12. *Dundas Strait, northwestern Australia; 17 fathoms; mud; "Alert."*—One young specimen.

13. *Cape York; 8-12 fathoms; "Challenger."*—One specimen.

14. *Zamboanga; 10 fathoms; "Challenger."*—Two specimens of the stout armed type.

15. *Holothuria Bank; 34 fathoms.*—One eleven armed specimen.

16. *Holothuria Bank; 24 fathoms.*—Five specimens.

17. *North side of Holothuria Bank; 36 fathoms.*—Two fine specimens.

18. *Holothuria Bank.*—Two specimens.

19. *Baudin Island, northwestern Australia*—One specimen.

20. *Northwestern Australia.*—Seven specimens.

21. *Northwestern Australia.*—One young.

22. *Baudin Island; 8-15 fathoms.*—Two small specimens.

23. *Bassett-Smith Bank; 9 fathoms.*—One specimen.

24. *14° 50′ S. lat., 125° 40′ E. long.*—Two small specimens.

25. *Billiton.*—One specimen with moderately stout arms, and cirri XV.

26. *Singapore.*—One specimen of the slender armed type.

27. *No Locality.*—One specimen.

28. *No Locality.*—One specimen.

29. *No Locality.*—One specimen.

### Genus COMACTINIA A. H. Clark

### COMACTINIA ECHINOPTERA (J. Müller)

*Actinometra meridionalis* Brit. Mus., MS. (1, 2).

1. *22° S. lat., 40° W. long.; 35-40 fathoms.*—Three specimens, two small and one large; the latter has ten arms 100 mm. long, and eleven cirrus segments.

2. *Barbados.*—One specimen.

### COMACTINIA MERIDIONALIS (Agassiz and Agassiz)

*Actinometra meridionalis* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 301 (1).—Brit. Mus., MS. (2, 3).

1. *Bahia; 7-20 fathoms; "Challenger."*—Four specimens.

2. *18° 50′ S. lat., 38° 47′ W. long.; 30-34 fathoms; 75° Fahr.*—One specimen with arms 60 mm. long, resembling the specimens called *brasiliensis* by Lütken.

3. *Gulf Stream; 100 fathoms; A. Agassiz.*—One specimen.

## Subfamily Comasterinæ A. H. Clark

### Genus COMASTER L. Agassiz

### COMASTER BELLI (P. H. Carpenter)

*Actinometra belli* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 334 (1).

*Actinometra nobilis* 1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 394 (2).

*Actinometra multifida* 1894. Bell, *T. c.*, p. 394 (3).

1. *"Challenger" Station No. 186.*—Two specimens; one has five large cirri; the other resembles the specimens from Torres Strait in the U. S. National Museum collection.

2. *Western Australia.*—One specimen; the cirri are XII, 17-18, 13 mm. long; there are slight dorsal tubercles on the last six seg-

ments; the carination of the earlier pinnule segments is very prominent.

3. *Northwestern Australia.*—One specimen, with VII cirri.

### COMASTER TYPICA (Lovén)

*Actinometra multifida* 1884. BELL, "Alert" Report, p. 169 (1, 2).
*Actinometra variabilis* 1884. BELL, "Alert" Report, p. 169 (3).
*Actinometra typica* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 296 (4).—1899. BELL, Willey's Zoölogical Results, part 2, p. 134 (5).

1. *Prince of Wales Channel, Torres Strait; 5-7 fathoms; "Alert."*—One young specimen with sixty-four arms 75 mm. long; there are usually six post-radial axillaries; the cirri are VII, 15; they are becoming reduced, and show signs of disappearing.

2. *Australia.*—Two specimens, just like those determined as *typica* in the collection of the Australian Museum; both are small; there are five or six post-radial axillaries; the interradial dorsal perisomic areas are heavily plated; there are no cirri, though the cirrus sockets are still well formed.

3. *Thursday Island; 3-4 fathoms; sand; "Alert."*—Four specimens; there are six post-radial axillaries.

4. *Near Kandavu, Fiji; "Challenger."*—One small specimen.

5. *Blanche Bay, New Britain; Dr. Willey.*—Two specimens.

### COMASTER GRACILIS (Hartlaub)

*Actinometra* sp. 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 402 (1).
*Actinometra typica* 1899. BELL, Willey's Zoölogical Results, part 2, p. 134 (2).—BRIT. MUS., MS. (5).
*Antedon indica* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224 (3).
*Actinometra stellata* BRIT. MUS., MS. (4).
*Actinometra tridistichata* BRIT. MUS., MS. (1).

1. *Macclesfield Bank; 30 fathoms.*—One specimen.

2. *Blanche Bay, New Britain; Dr. Willey.*—One specimen; there are three or four post-radial axillaries.

3. *Hulule, Maldives.*—One specimen; in some cases VBr are present.

4. *Fiji.*—One specimen.

5. *"Section A. Ship"; 7 fathoms.*—Arms.

### COMASTER MULTIBRACHIATA (P. H. Carpenter)

*Actinometra multibrachiata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 299 (1).

1. *Banda; 17 fathoms.*—One specimen, exactly like the large specimens which I have recorded from the Philippine Islands; the subradial clefts are large and deep.

### COMASTER DISTINCTA (P. H. Carpenter)

*Actinometra distincta* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 295 (1).

*Actinometra parvicirra* 1888. P. H. CARPENTER, *T. c.*, p. 338 (2).—1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 396 (3).

*Antedon brevicirra* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 400 (4).

1. *Zamboanga; 10 fathoms.*—One specimen.

2. *Zamboanga; 10 fathoms.*—One specimen; there are apparently twenty-one arms; one cirrus remains, with twelve segments. The characteristic terminal combs and the presence of combs on the distal pinnules show that this is a species of *Comaster* and not of *Comanthus.*

3. *Macclesfield Bank.*—One specimen with between thirty-five and forty arms.

4. *Macclesfield Bank; 20-35 fathoms.*—One small specimen with numerous cirri and about forty-five arms.

### COMASTER FRUTICOSUS A. H. Clark

*Actinometra regalis* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 396 (1).

1. *Macclesfield Bank; 30 fathoms.*—One specimen; the cirri are XVII, 13-15; there are about one hundred and fifty arms.

## Genus COMANTHERIA A. H. Clark

### COMANTHERIA ALTERNANS (P. H. Carpenter)

*Actinometra alternans* 1884. BELL, "Alert" Report, p. 169 (1).

1. *Port Molle; 12-20 fathoms; rock; "Alert."*—One fine specimen.

### COMANTHERIA BRIAREUS (Bell)

*Antedon briareus* 1884. BELL, "Alert" Report, p. 163 (1).

*Actinometra divaricata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 332 (2).

*Actinometra parvicirra* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 394 (3).

*Actinometra duplex* BRIT. MUS., MS. (4).

*Actinometra typica* BRIT. MUS., MS. (5).

1. *Port Denison; 3-4 fathoms; "Alert."*—One specimen.

2. *Banda; 17 fathoms; "Challenger."*—One specimen.

3. *Baudin Island; 8-15 fathoms; October, 1890.*—One specimen with between seventy-five and eighty arms.

4. *Bassett-Smith Bank; 9 fathoms.*—One small specimen.

5. *Billiton.*—One small specimen.

### COMANTHERIA ROTULA A. H. Clark

*Actinometra parvicirra* Brit. Mus., MS. (1).

1. *No Locality.*—One specimen with thirty-four arms 70 mm. long; the IIBr series are 4 (3 + 4) and the IIIBr series are 2; a single IVBr series is present, 2, developed externally on the only IIIBr 4 (3 + 4) series, which itself is external. The cirri are V, 13, 6 mm. long, small and weak.

### Genus COMANTHINA A. H. Clark

### COMANTHINA SCHLEGELII (P. H. Carpenter)

*Actinometra multifida* 1884. Bell, "Alert" Report, p. 169 (1).

*Actinometra nobilis* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 336 (2).—Brit. Mus., MS. (9, 12).

*Actinometra duplex* 1888. P. H. Carpenter, *T. c.*, p. 335 (3).—1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 396 (6).—Brit. Mus., MS. (5, 7).

*Actinometra regalis* 1888. P. H. Carpenter, *T. c.*, p. 347 (4).—Brit. Mus., MS. (10).

*Actinometra typica* 1902. Bell, in Gardiner, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 225 (8).

1. *Percy Island, Queensland; "Alert."*—One specimen with sixty-three arms 85 mm. to 90 mm. long; a single cirrus with fifteen segments remains. The interradial dorsal perisomic plating is very heavy, the plates being exceptionally thick, and rounded dorsally. The five key plates stand out large and prominent in the interradial angles, being especially convex dorsally.

2. *Zamboanga; "Challenger."*—Five specimens, exactly like those in the U. S. National Museum from the Philippine Islands.

3. *Banda; "Challenger."*—A young specimen with five cirri remaining.

4. *Banda; "Challenger."*—Two immature specimens; one has the cirri VIII, 15-17; the other has four large and two small cirri, and a few cirrus stumps.

5. *Bassett-Smith Bank; 9 fathoms.*—One small specimen with a remarkable development of interradial plating.

6. *Macclesfield Bank; 13 fathoms.*—One specimen; the centrodorsal bears the stumps of a row of cirri.

7. *Blanche Bay, New Britain.*—One specimen; there are XIII stout cirri about the edge of the centrodorsal.

8. *Suvadiva, Maldives.*—One enormous specimen.

9. *Philippines.*—One specimen.

10. *Malacca.*—One specimen.

11. *Solomon Islands; H. M. S. "Penguin."*—One large specimen.

12. *No Locality.*—One specimen.

### Genus COMANTHUS A. H. Clark
### Specific Group BENNETTIA A. H. Clark
### COMANTHUS BENNETTI (J. Müller)

*Actinometra bennetti* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 396 (1).—1899. BELL, Willey's Zoölogical Results, vol. 2, p. 134 (2, 5).

*Actinometra grandicalyx* 1899. BELL, Willey's Zoölogical Results, vol. 2, p. 134 (3).

*Actinometra peroni* BRIT. MUS., MS. (4).

1. *Macclesfield Bank; 13 fathoms.*—One small specimen.

2. *Loyalty Islands.*—One large specimen; the cirri are XXIV, 21-22, smooth, stout and well developed, arranged in two rows on the centrodorsal; the outer IIIBr series are 2; all the other division series are 4 (3 + 4); VBr series are present.

3. *New Britain.*—One specimen.

4. *Lelti Island.*—One beautiful specimen with seventy-two arms, resembling the specimen from the Pelew Islands in the Copenhagen Museum.

5. *Loyalty Islands.*—One specimen similar to No. 2, but with somewhat larger and stouter cirri; the cirri are XXXIII, 21; the division series are 4 (3 + 4) except the IIIBr series which are mostly 2; when IIIBr 4 (3 + 4) series occur they are internal; VBr series are present.

### COMANTHUS TRICHOPTERA (J. Müller)

*Actinometra trichoptera* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 345 (1).—1888. BELL, Ann. and Mag. Nat. Hist. (6), vol. 2, p. 402 (2).—1890. P. H. CARPENTER, Proc. Roy. Soc. Victoria, vol. 2 (N. S.), p. 135 (3).—BRIT. MUS., MS. (4, 5).

1. *Port Jackson, New South Wales; "Challenger."*—One specimen.

2. *Port Phillip; Victoria; J. Bracebridge Wilson.*—Two specimens.

3. *Port Phillip Head; J. Bracebridge Wilson.*—Twenty-three specimens.

4. *No Locality.*—One specimen.

5. *No Locality.*—One specimen.

### COMANTHUS WAHLBERGII (J. Müller)

*Actinometra parvicirra* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 338 (1).—1905. BELL, Marine Investigations in South Africa, vol. 4, p. 141 (2, 3).

*Antedon capensis* 1905. BELL, Marine Investigations in South Africa, vol. 4, p. 139 (4).

*Actinometra paucicirra* BRIT. MUS., MS. (5).

1. *Simon's Bay, Cape Colony; 10-20 fathoms; "Challenger."*—One specimen with twenty arms, resembling those from the Cape of Good Hope and from False Bay.

2. *False Bay, Cape of Good Hope.*—Eight specimens; of these one has thirteen arms, one has fifteen, three have sixteen, two have seventeen, and one has nineteen. The centrodorsal is broad, flat and circular just as in *C. trichoptera.* The cirri are VI-XII, 15-16; the sixth is a transition segment. The arms are short, stout and rapidly tapering, suggesting the conditions found in *Comatulella brachiolata.* The division series are close together and broad, and their component ossicles have everted distal edges. The brachials overlap conspicuously.

3. *False Bay, Cape of Good Hope.*—Two specimens; one of these has the cirri XXV, 15-17; the sixth is a transition segment; there are twenty-one arms; nine IIBr 4 (3 + 4) series are present, and there are two IIIBr 2 series, one external and one internal. A smaller specimen has nineteen arms and cirri XIV, 13-14.

4. *Cape of Good Hope.*—Two specimens.

5. *Cape of Good Hope.*—Four specimens; three of these have twenty and one has twenty-one arms; in the last the arms are 60 mm. long; the cirri are XII, 15-16, 10 mm. long; the fifth, sixth or seventh (usually the sixth) is a transition segment; the centrodorsal is thin discoidal, the broad flat dorsal pole 4 mm. in diameter. Attached to the cirri of one of the twenty armed specimens I found thirteen pentacrinoid young; these possess seventeen columnars.

6. *Cape of Good Hope.*—One small specimen.

7. *Cape of Good Hope; Station No. 508A.*—Twenty young specimens with from ten to twelve arms.

8. *No Locality.*—One specimen with twenty arms.

*Remarks.*—This species, which is entirely distinct from *C. parvicirra,* has never been properly understood. The centrodorsal is broad and flat, just as in *C. trichoptera,* but the cirri are not so slender as in that species. The brachials have rather strongly everted distal ends. The division series are broad and very close together laterally. The arms expand somewhat from the base to about the twelfth or fourteenth brachial. The transition segment in the cirri is usually not particularly marked.

On the whole this species comes closest to *C. trichoptera,* but it is a much smaller form with shorter and stouter arms and stouter cirri.

Most of the specimens recorded above from False Bay have an arm length of from 30 mm. to 35 mm., and a cirrus length of 7 mm.

### COMANTHUS SAMOANA A. H. Clark

*Actinometra parvicirra* Brit. Mus., MS. (1).
*Actinometra trachygaster* Brit. Mus., MS. (2).

1. *No Locality.*—One specimen with twenty arms 60 mm. long; seven of the IIBr series are 2, the other three being 4 (3 + 4).

2. *Samoa.*—Two specimens.

### Specific Group VANIA A. H. Clark
### COMANTHUS ANNULATA (Bell)

*Actinometra annulata* 1882. Bell, Proc. Zoöl. Soc. London, 1882, p. 535, pl. 35 (1).
*Actinometra parvicirra* 1887. Bell, Sci. Trans. Roy. Dublin Soc. (2), vol. 3, p. 645 (2, 3).—1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 338 (6, 7).—1888. Bell, Proc. Zoöl. Soc. London, 1888, p. 384 (8).—1894. Thurston, Madras Government Museum Bulletin, No. 1, p. 28 (8).
*Actinometra valida* 1888. P. H. Carpenter, "Challenger" Reports, Comatulæ, p. 314 (4).
*Actinometra littoralis* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 346 (5).
*Actinometra gracilis* (Lütken) Brit. Mus., MS. (13).

1. *Cape York.*—Four specimens; one of these has forty arms and VIII cirri, deficient on a part of the periphery of the centrodorsal; another has thirty-nine arms and IX cirri, lacking on a part of the periphery of the centrodorsal; a third specimen has thirty-nine arms and cirri XII, 16-17; all of the division series with the exception of one IIBr series are 4 (3 + 4); the fourth specimen is broken.

2. *Ceylon.*—One specimen with forty-three arms; seven of the IIBr series are 2 and three are 4 (3 + 4); the IIIBr and subsequent series are all 4 (3 + 4); there are only very small rudiments of cirri.

3. *Ceylon.*—One specimen with about forty arms.

4. *"Challenger" Station No. 186.*—One specimen.

5. *Banda; 17 fathoms; "Challenger."*—One specimen, resembling the one from Torres Strait in the U. S. National Museum.

6. *"Challenger" Station No. 174.*—One specimen with about forty arms; the centrodorsal is stellate with rudimentary cirrus stumps.

7. *Banda; "Challenger."*—One specimen with about forty arms; the centrodorsal is small and countersunk, entirely without cirri.

8. *Tuticorin, Madras; E. Thurston.*—Two specimens; one has sixty-eight arms; there are IV cirri, one large, the remainder diminishing in size; the larger have 13-14 segments; the other has forty-three arms and cirri XV, 14-16.

9. *Holothuria Bank; 34 fathoms.*—Two specimens.

10. *Northeastern Australia; J. B. Jukes.*—One specimen.

11. *Torres Strait; J. B. Jukes.*—One specimen.

12. *Solomon Islands; H. M. S. "Penguin."*—One specimen.

13. *No Locality.*—One small specimen with forty-four arms; the cirri are IV, 16-17.

### COMANTHUS PARVICIRRA (J. Müller)

*Actinometra cumingii* 1884. BELL, "Alert" Report, p. 167 (14).

*Actinometra parvicirra* 1884. BELL, *T. c.*, p. 168 (11, 13).—1887. BELL, Sci. Trans. Roy. Dublin Soc. (2), vol. 3, p. 645 (15).—1888. BELL, Proc. Zoöl. Soc. London, 1888, pp. 384, 387 (15, 17).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 339 (1, 3, 4, 7, 8, 10, 12).—1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 396 (19, 20, 21, 22, 23, 24, 26, 27, 28).—1894. THURSTON, Madras Government Museum Bulletin, No. 2, p. 106 (15); p. 114 (17).—BRIT. MUS., MS. (30).

*Actinometra cumingi* 1887. BELL, Sci. Trans. Roy. Dublin Soc. (2), vol. 3, p. 645 (16).—1888. BELL, Proc. Zoöl. Soc. London, 1888, p. 387 (16).—1904. CHADWICK, in HERDMAN, Report Ceylon Pearl Oyster Fisheries, vol. 2, Suppl. Report XI, p. 153 (16).—BRIT. MUS., MS. (33).

*Actinometra elongata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 311 (6).

*Actinometra simplex* 1888. P. H. CARPENTER, *T. c.*, p. 312 (9).

*Actinometra rotalaria* 1888. P. H. CARPENTER, *T. c.*, p. 313 (5).—1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 396 (25, 29).—BRIT. MUS., MS. (32).

*Actinometra quadrata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 331 (2).

*Actinometra variabilis* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 394 (18).

*Antedon cumingi* 1894. THURSTON, Madras Government Museum Bulletin, No. 2, p. 117 (17).

1. *Amoy, China; Swinhoe.*—Twenty-eight specimens.

2. *Tongatabu; "Challenger."*—One specimen with sixteen arms.

3. *Ternate; "Challenger."*—One specimen with twenty arms

80 mm. long; all of the IIBr series are present, two 2 and eight 4 (3 + 4).

4. *Zamboanga; "Challenger."*—Four specimens, with fourteen, twenty-two, thirty-two and thirty-three arms respectively; in the first there are five well developed cirri, interradial in position; in the others the cirri are much reduced or rudimentary.

5. *Zamboanga; "Challenger."*—One specimen.

6. *Banda; "Challenger."*—Two specimens, one with about forty arms; the centrodorsal is small, and sunk to the level of the radials; the other is the type of Carpenter's *Actinometra elongata.*

7. *Banda; "Challenger."*—One small specimen with eighteen arms and four cirri.

8. *Admiralty Islands; "Challenger."*—One small specimen.

9. *Admiralty Islands; "Challenger."*—One specimen.

10. *"Challenger" Station No. 186.*—Two specimens; one is small with sixteen arms, the other larger with thirty arms.

11. *Warrior Reef, Torres Strait; "Alert."*—One specimen with twenty arms.

12. *Torres Strait; Professor J. B. Jukes.*—One specimen.

13. *Port Molle; "Alert."*—One specimen with fifteen arms and cirri IX, 11-12; there are five IIBr 4 (3 + 4) series; the interradial plating is just beginning to develop.

14. *Port Molle; "Alert."*—One small specimen.

15. *Ceylon.*—One specimen with twenty arms.

16. *Ceylon.*—One small specimen.

17. *Madras.*—Two specimens.

18. *Bassett-Smith Bank; 9 fathoms.*—Two specimens.

19. *Macclesfield Bank; 10-13 fathoms.*—One specimen with twenty arms and cirri II, 11. This is a slender specimen with the spinosity of the brachials, pinnulars and pinnule tips exaggerated.

20. *Macclesfield Bank; 22-30 fathoms.*—One specimen with eighteen arms.

21. *Macclesfield Bank; 22-30 fathoms.*—One specimen with twenty-two arms.

22. *Macclesfield Bank; 13-36 fathoms.*—Two specimens, each with twenty arms; one has VII, the other no cirri.

23. *Macclesfield Bank; 29-32 fathoms.*—One specimen with sixteen arms; there are no IIIBr series; three cirri are present, all on one semi-circumference of the centrodorsal.

24. *Macclesfield Bank; 22-30 fathoms.*—Two small specimens; one has fourteen arms, the other sixteen arms and two cirri.

25. *Macclesfield Bank; 13-36 fathoms.*—One specimen with

twenty-one arms; the ten IIBr series are 2; the single IIIBr series, which is internally developed, is 4 (3 + 4); there are four cirri.

26. *Macclesfield Bank; 13 fathoms.*—Two specimens; the larger has twenty arms.

27. *Macclesfield Bank; 13-36 fathoms.*—One specimen with about thirty arms; there are V cirri.

28. *Macclesfield Bank; 26 fathoms.*—One small specimen with fourteen arms.

29. *Macclesfield Bank; 20-35 fathoms.*—One specimen with thirteen arms.

30. *Fremantle, Western Australia.*—One specimen.

31. *Seychelles; 34 fathoms.*—Two specimens; one of these is typical, with twenty arms and four cirri; the other is a small individual.

32. *No Locality.*—One specimen.

33. *Mauritius.*—Two small specimens, with thirteen and fourteen arms respectively, very close to, if not, *C. parvicirra.*

## Family ZYGOMETRIDÆ A. H. Clark

### Genus ZYGOMETRA A. H. Clark

### ZYGOMETRA MICRODISCUS (Bell)

*Antedon microdiscus* 1884. Bell, "Alert" Report, p. 163 (1, 2).
*Antedon multiradiata* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 96 (4).—Brit. Mus., MS. (5, 8, 11).
*Antedon variipinna* Brit. Mus., MS. (3).
*Antedon macronema* Brit. Mus., MS. (10).

1. *Port Molle, Queensland; 12 fathoms.*—In this, the type specimen, the disk is just beginning to regenerate. The enormously long proximal pinnules, which recall those of such species of *Himerometra* as *H. bartschi,* and the very long cirri, which are from 40 mm. to 45 mm. in length, are the characteristic features of the species.

2. *Nicol Bay, northwestern Australia.*—Two specimens.

3. *Albany Island; "Alert."*—One specimen.

4. *"Challenger" Station No. 187.*—These two specimens, the types of Carpenter's *Antedon multiradiata,* are in reality small examples of this form.

5. *Holothuria Bank.*—One fine specimen.

6. *Northwestern Australia.*—One broken specimen with about forty arms.

7. *Torres Strait; 10 fathoms; sand.*—One specimen.

8. *Lewis Island, Dampier Archipelago, Western Australia.*—One specimen.

9. *Holothuria Bank.*—Fragments.
10. *No Locality.*—One specimen.
11. *Lewis Island, Dampier Archipelago.*—One specimen.
12. *Somerset Passage; 5-9 fathoms.*—One specimen.

### ZYGOMETRA ELEGANS (Bell)

*Antedon elegans* 1884. Bell, "Alert" Report, p. 162 (1, 2, 3).
*Antedon irregularis* 1884. Bell, *T. c.*, p. 161 (6).
*Antedon fluctuans* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 94 (4, 5).

1. *Port Molle; 12-20 fathoms; "Alert."*—Examination of these types shows that this species has shorter cirri than the preceding, and small and weak proximal pinnules.
2. *Port Molle; 12-20 fathoms; rock; "Alert."*—One specimen.
3. *Port Molle; 12-20 fathoms; rock; "Alert."*—One small specimen.
4. *"Challenger" Station No. 190.*—Three specimens.
5. *Torres Strait; 10 fathoms; sand; "Alert."*—One small specimen.
6. *Prince of Wales Channel; 7 fathoms; sand.*—One young specimen with arms 20 mm. long; on one of the rays the original synarthry has not as yet become changed into a pseudosyzygy.
7. *Baudin Island, northwestern Australia.*—One small specimen.
8. *Baudin Island; 8-15 fathoms.*—One very small specimen.

### ZYGOMETRA PUNCTATA A. H. Clark

*Heterometra bengalensis* 1911. A. H. Clark, Australian Museum Memoirs, vol. 4, p. 768 (1).—Die Fauna Südwest-Australiens, vol. 3, Lief. 13, pp. 440, 443, 444, 446 (1).
*Zygometra punctata* 1912. A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, p. 24.

1. *Holothuria Bank; 15 fathoms.*—One specimen with eighteen arms and cirri X, 29-31, 20 mm. long; long dorsal spines are developed on the cirri from the eleventh segment onward.

### Genus EUDIOCRINUS P. H. Carpenter
### EUDOCRINUS INDIVISUS (Semper)

*Eudiocrinus granulatus* 1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 397, pl. 23 (1).

1. *Macclesfield Bank; 34-40 fathoms.*—This is a large specimen, the arms being between 85 mm. and 90 mm. long; there are 18-20 cirrus segments. I can see no differences whatever between this specimen and others undoubtedly referable to *indivisus* which I have examined from the Philippine Islands.

## Family HIMEROMETRIDÆ A. H. Clark

### Genus AMPHIMETRA A. H. Clark

### AMPHIMETRA CRENULATA (P. H. Carpenter)

*Antedon decipiens* 1884. Bell, "Alert" Report, p. 159 (1, 2, 3, 4).
*Antedon irregularis* 1884. Bell, *T. c.*, p. 161 (5, 6, 7).
*Actinometra solaris* 1884. Bell, *T. c.*, p. 164 (8).
*Antedon variipinna* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 256 (9, 10, 14).—1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 394 (12, 13, 15, 17).—Brit. Mus., MS. (11).
*Antedon philiberti* Brit. Mus., MS. (16).

1. *Prince of Wales Channel; "Alert."*—Two small specimens.

2. *Prince of Wales Channel; 7-9 fathoms; "Alert."*—One specimen.

3. *Arafura Sea; 32-36 fathoms; mud, sand and shell; "Alert."*—One small specimen.

4. *Dundas Strait, northwestern Australia; 17 fathoms; mud; "Alert."*—One specimen.

5. *Prince of Wales Channel; "Alert."*—Thirty-four small specimens.

6. *Prince of Wales Channel; 7 fathoms; sand; "Alert."*—Thirty-six specimens.

7. *Torres Strait; 10 fathoms; sand.*—Eleven fine specimens.

8. *Prince of Wales Channel; 5-7 fathoms; "Alert."*—One small specimen.

9. *Aru Islands; "Challenger."*—Three specimens.

10. *Torres Strait; "Alert."*—Five specimens.

11. *14° 50′ S. lat., 125° 40′ E. long.*—One small specimen.

12. *Holothuria Bank; 24 fathoms.*—Six typical, large, very rugged specimens, with the lateral processes on the pinnule segments exceptionally well pronounced; one of the specimens has ten, one eleven, one twelve, one thirteen, one fifteen and one seventeen arms.

13. *Northeast of Holothuria Bank; 15-20 fathoms.*—One small specimen with fifteen arms.

14. *"Challenger" Station No. 186.*—Two small specimens.

15. *Holothuria Bank; 38 fathoms.*—Four small ten armed specimens.

16. *Northeastern Australia; Professor J. B. Jukes.*—One specimen.

17. *Baudin Island, Western Australia.*—One specimen with greatly exaggerated lateral processes on the segments of the proximal pinnules.

### AMPHIMETRA NEMATODON (Hartlaub)

*Antedon milberti* 1884. Bell, "Alert" Report, p. 156 (1).

1. *Port Molle, Queensland; 12-20 fathoms.*—One small specimen.

### AMPHIMETRA ANCEPS (P. H. Carpenter)

*Antedon clemens* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 229 (2).

*Antedon anceps* 1888. P. H. Carpenter, *T. c.*, p. 254 (1).

1. *"Challenger" Station No. 212.*—Three specimens; these appear to be small specimens of the species which I described in detail under the name of *Craspedometra aliena* (Proc. U. S. Nat. Mus., vol. 37, p. 31).

2. *"Challenger" Station No. 212.*—One specimen; this most certainly represents the same species as do the preceding.

### AMPHIMETRA PRODUCTA (A. H. Clark)

*?Antedon lævissima* Brit. Mus., MS. (1).

1. *Fadiffolu, Maldives.*—One ten armed specimen; there are 23-25 cirrus segments which from the tenth onward bear small dorsal spines; the segments of the lower pinnules have slightly projecting and spinous distal ends.

### AMPHIMETRA FLORA, new species

*Antedon lævissima* 1902. Bell, in Gardiner, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224 (1, 2, 3).

*Description.*—The cirri are XV, 30, stout, as in *A. milberti;* all the segments are subequal, and all are broader than long, the longest being about one-third broader than long; the tenth and following bear prominent and sharp dorsal spines.

There are twelve arms 170 mm. long.

The longest proximal pinnules are about 20 mm. long and rather slender; the distal ends of their segments are perfectly smooth; the earlier segments are strongly carinate.

1. *Mulan, Maldives.*—One specimen, from which the preceding description was taken.

2. *Mulan, Maldives.*—One specimen with ten arms 180 mm. long, similar to the preceding; the cirri, as in the specimen described, are stout, strongly curved, and about 20 mm. long; the proximal pinnules are strongly carinate basally.

3. *Mulan, Maldives.*—One specimen with thirteen arms rather smaller than the two preceding, but with the proximal pinnules rather more strongly carinate; there are 29-30 cirrus segments, of which the tenth or eleventh and following bear dorsal spines.

### AMPHIMETRA AFRICANA A. H. Clark

*Amphimetra africana* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 20 (1, 2).
*Antedon ?milberti* BRIT. MUS., MS. (1).
*Actinometra* sp. BRIT. MUS., MS. (2).

1. *Zanzibar.*—One young specimen; the cirri are XVI, 25-27; the tenth and following segments bear long sharp dorsal spines; there are ten arms.

2. *Waxin.*—One specimen; this has twenty-three arms 120 mm. long; the IIBr series are 4 (3 + 4) and the IIIBr series are 2; the cirri are XX, 27; long sharp dorsal spines are developed from the tenth segment onward.

### AMPHIMETRA MILBERTI (J. Müller)

*Antedon milberti* 1884. BELL, "Alert" Report, p. 156 (1).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 194 (2, 3).

1. *Port Molle; "Alert."*—One specimen.

2. *"Challenger" Station No. 212.*—One typical, but rather small specimen.

3. *"Challenger" Station No. 203.*—One specimen.

### AMPHIMETRA MOLLERI (A. H. Clark)

*Antedon milberti* BRIT. MUS., MS. (1).

1. *Java Sea.*—One specimen.

2. *? Brazil.*—One specimen.

### AMPHIMETRA DISCOIDEA (A. H. Clark)

*Antedon milberti* 1884. BELL. "Alert" Report, p. 156 (1, 2, 3, 4, 5, 6, 7).—1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 394 (8, 9, 10).—BRIT. MUS., MS. (11).
*Actinometra brachiolata* BRIT. MUS., MS. (12).

1. *Port Molle; 12-20 fathoms; "Alert."*—One fine specimen.

2. *Port Molle; "Alert."*—Three specimens.

3. *Port Denison; "Alert."*—Three specimens.

4. *Port Denison; "Alert."*—Three beautiful large specimens.

5. *Prince of Wales Channel; 7-9 fathoms; sand; "Alert."*—Fourteen specimens.

6. *Torres Strait; 10 fathoms; sand; "Alert."*—Seven specimens; all are brownish yellow, the cirri deep purple, narrowly banded with white at the articulations.

7. *Torres Strait; 10 fathoms; sand; "Alert."*—One specimen, entirely purple.

8. *Northwestern Australia; 8-15 fathoms.*—Two specimens; in color these are slaty gray, purplish ventrally.

9. *Holothuria Bank; 15 fathoms.*—One specimen.

10. *Western Australia.*—Three typical specimens.

11. *No Locality.*—One specimen.

12. *No Locality.*—One specimen.

### AMPHIMETRA PAPUENSIS A. H. Clark

*Actinometra intricata* Brit. Mus., MS. (1).

1. *Tonga and Fiji.*—One small specimen; the cirri have twenty-five segments, of which the outer are more spiny than usual; this resembles the specimens from Hood Lagoon and Port Moresby, New Guinea, in the collection of the Australian Museum.

### AMPHIMETRA PINNIFORMIS (P. H. Carpenter)

1. *Holothuria Bank; 15 fathoms.*—One specimen, probably of this species; the ten arms are 50 mm. long; the cirri have twenty-two segments, of which the fifth and following bear long dorsal spines, and of which the longest are not quite so long as broad.

### AMPHIMETRA DENTICULATA (P. H. Carpenter)

*Antedon denticulata* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 130 (1).

1. *"Challenger" Station No. 190.*—This species was well described and figured by Carpenter; it proves to belong to the genus *Amphimetra,* and is related to *A. pinniformis.*

### Genus HIMEROMETRA A. H. Clark

### HIMEROMETRA MARTENSI (Hartlaub)

1. *Pulau Obin, Singapore.*—One specimen, resembling those from Singapore in the Copenhagen and U. S. National Museums.

### HIMEROMETRA ROBUSTIPINNA (P. H. Carpenter)

*Antedon inopinata* 1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 398 (1).

1. *Macclesfield Bank; 13-36 fathoms.*—The centrodorsal resembles that of the other species of the genus.

The cirri are XXX, 26-34, 30 mm. to 35 mm. long, stout; the sixth- or seventh-eighth segments are the longest, slightly broader than long to half again as broad as long; the segments in the outer half of the cirri are about twice as broad as long; the outer segments are slightly carinate, the carination on the last six or seven terminating distally in a small spine.

The forty-six arms are 140 mm. long; nine of the IIBr series are 4 (3 + 4), and one is 2; the IIIBr series are all 4 (3 + 4) except one (internal); the remaining division series are all 4 (3 + 4), except two IVBr series which are 2; the division series are strongly convex and widely separated, as is usual in the genus.

The proximal pinnules are about 20 mm. long with from seventeen to twenty segments, very stout and nearly smooth, the distal edges of the segments being only very slightly swollen; all the segments are short, about twice as broad as long in the proximal half of the pinnules, becoming about as long as broad toward the tip.

*Remarks.*—This species is very similar to the succeeding, but the cirri are larger and rather stouter and the proximal pinnules are shorter, about as stout in the proximal part but tapering more rapidly and without the flagellate tip; the segments in the outer part of these pinnules also do not possess the strongly everted distal edges seen in those of *H. sol.* The cirri of *H. robustipinna* are in their details much the same as those of *H. sol* but for the presence of a distinct, though small, spine on the last five or six segments; that on the antepenultimate is nearly as large as the opposing spine.

### HIMEROMETRA SOL A. H. Clark

*Antedon palmata* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224 (1, 2).

1. *Kolumaduli, Maldives; 38 fathoms.*—The centrodorsal is thick discoidal, with a strongly concave dorsal pole 4 mm. in diameter.

The cirri are XXI, 25, 27, 28, and 30, 25 mm. to 30 mm. long; the longest segments, in the proximal third, are nearly or quite as long as broad; the distal segments are slightly broader than long, sometimes as much as one-third broader than long; the terminal ten or twelve have a small and low median dorsal tubercle, sometimes scarcely noticeable until near the end of the cirrus; the opposing spine is well developed and conspicuous. The cirri as a whole are stout, stouter than those of the other species of the genus, with approximately subequal segments.

The forty-one arms are 140 mm. long; the IIBr series are 4 (3 + 4); the IIIBr series are 4 (3 + 4) externally, 2 internally;

the IVBr series (when present) are 4 (3 + 4). The division series are strongly convex and widely separated as is usual in the genus.

$P_D$ is 18 mm. long with from thirty to thirty-two (usually the latter) segments, which are nearly twice as broad as long in the proximal half, but become about as long as broad in the distal third and terminally as long as broad; after the fourth or fifth the segments develop strongly everted and produced distal dorsal edges, this character gradually dying away in the distal third of the pinnule; this eversion is smooth and not serrate. The proximal pinnules are very stout, but also very long, and taper distally to a flagellate tip as in *H. magnipinna;* but the eversion of the distal ends of the segments is much greater than in that species, and the cirri are stouter.

2. *Kolumaduli, Maldives; 38 fathoms.*—One specimen; the cirri are XXXV, 27-29; there are fifty-one arms; only one of the division series (a IIIBr series internally developed) is 2, all the others being 4 (3 + 4); the proximal pinnules are exactly as in the other, 18 mm. to 21 mm. long.

### Genus HETEROMETRA A. H. Clark

### HETEROMETRA QUINDUPLICAVA (P. H. Carpenter)

*Antedon quinduplicava* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 262 (1).

1. *"Challenger" Station No. 212.*—One specimen, resembling those collected by the "Albatross" in the Philippines; the outer cirrus segments are slightly carinate dorsally.

### HETEROMETRA REYNAUDII (J. Müller)

*Antedon reynaudi* 1887. Bell, Sci. Trans. Roy. Dublin Soc. (2), vol. 3, p. 645.—1888. Bell, Proc. Zoöl. Soc. London, 1888, pp. 384, 387 (1).—1894. Thurston, Madras Government Museum Bulletin, No. 2, p. 114 (1).

1. *Tuticorin, Madras.*—Two fine specimens, one with eighteen, the other with seventeen arms; in the former the arms are 90 mm. and the cirri 25 mm. long; one of the IBr series has no further division.

### HETEROMETRA SAVIGNII (J. Müller)

*Antedon savignyi* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, pp. 252, 380 (2).

1. *Gulf of Suez.*—Two specimens, both small.

2. *Kurrachi.*—Seven specimens; one with seventeen, two with eighteen, one with nineteen, two with twenty and one with twenty-

one arms. The largest has the arms 130 mm. and the cirri 25 mm. long. The specimen with twenty-one arms has three IIBr 2 series; two of them are on the same post-radial series, one of these being followed by a single internal IIIBr 2 series. One of the specimens with eighteen arms has a single internal IIIBr 2 series. In the remaining specimens only IIBr 4 (3 + 4) series are present.

No differences could be detected between these specimens and those from the Gulf of Suez.

## Family STEPHANOMETRIDÆ A. H. Clark

### Genus STEPHANOMETRA A. H. Clark

### STEPHANOMETRA TUBERCULATA (P. H. Carpenter)

*Antedon tuberculata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 232 (1).—1899. BELL, Willey's Zoölogical Results, vol. 2, p. 133 (2).
*Antedon ?spicata* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 396 (3).

1. *"Challenger" Station No. 174.*—One specimen with thirty arms; $P_1$ is slender and flexible, becoming very slender and flagellate distally; $P_2$ is much enlarged, stiff and spine-like, nearly half again as long as $P_3$, with twelve segments; $P_3$ resembles $P_2$, but is shorter and slightly less stout; $P_4$ is very short, small, but more or less stiffened; $P_5$ resembles $P_4$.

2. *Lifu, Loyalty Islands.*—Two specimens, one with thirty arms 120 mm. long; the cirri are LII, 25-28 (usually 25), 20 mm. to 30 mm. long; $P_2$ has fifteen segments; $P_3$ has eleven or twelve segments. The other is similar.

3. *Macclesfield Bank; 20-35 fathoms.*—One specimen smaller than the type, but otherwise exactly like it.

4. *Pulau Obin, Singapore.*—One specimen with thirty arms.

5. *Cocos Island; Dr. Wood-Jones.*—One specimen with thirty arms.

### STEPHANOMETRA MARGINATA (P. H. Carpenter)

*Antedon marginata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 230 (1).

1. *"Challenger" Station No. 208.*—$P_3$, though not especially enlarged and about the length of the succeeding pinnules, is more of the character of $P_2$ and is somewhat stouter than the succeeding; it is flagellate distally; $P_2$ curves strongly backward and is not erect, as is usual in *S. monacantha.*

Possibly this species is a form of *S. monacantha,* though probably it is distinct.

### STEPHANOMETRA MONACANTHA (Hartlaub)

*Antedon flavomaculata* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 400 (1).

1. *Macclesfield Bank; 13 fathoms.*—One small specimen with arms 65 mm. long; $P_2$ has thirteen segments.

### STEPHANOMETRA INDICA (Smith)

*Comatula indica* 1879. SMITH, Ann. and Mag. Nat. Hist. (4), vol. 17, p. 406 (1); Phil. Trans. Roy. Soc., vol. 168, p. 564 (1).

*Antedon indica* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 225 (1).

*Antedon palmata* 1888. BELL, Proc. Zoöl. Soc. London, 1888, pp. 384, 387 (2, 3).—1894. THURSTON, Madras Government Museum Bulletin, No. 1, pp. 28 (2), 53 (?); No. 2, pp. 106 (?), 114 (?).

*Actinometra maculata* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 225 (4).

*Antedon ?spicata* BRIT. MUS., MS. (5).

1. *Rodriguez.*—One broken specimen. This species is best described as resembling *S. monacantha,* but with $P_2$ longer and composed of more numerous segments; though slender distally, $P_2$ is not flagellate.

2. *Tuticorin, Madras.*—One large specimen.

3. *Tuticorin, Madras.*—One beautiful specimen with thirty arms 110 mm. long; $P_2$ is rather longer than usual and has fifteen or sixteen segments.

4. *Hulule, Male, Maldives.*—One specimen with thirty arms about 85 mm. long; as is usual in the species of this genus which have thirty arms all the IIIBr series are external; the cirri are XXIX, 22-23, 20 mm. long; $P_2$ is 14 mm. to 16 mm. long with from thirteen to fifteen segments; $P_3$ is small and weak like $P_4$, and is not more than half as long as $P_1$; this is very similar to the somewhat larger specimen recorded just above (2).

5. *Male, Maldives.*—One specimen with twenty-five arms resembling the preceding (3) but slightly larger; $P_2$ has from thirteen to sixteen segments.

6. *Muhlos, Maldives.*—One specimen with fourteen arms 65 mm. long; $P_1$ is long and very slender; $P_2$ is enlarged and stiff, but distally flagellate, with fifteen segments; $P_3$ and the following pinnules are scarcely more than half as long as $P_2$; $P_1$ is long and very slender; the cirri are smooth with from seventeen to nineteen segments, of which the shorter distal are slightly carinate.

7. *Seychelles; 34 fathoms; "Sea Lark."*—One small specimen.

## Family MARIAMETRIDÆ A. H. Clark

### Genus MARIAMETRA A. H. Clark

### MARIAMETRA VICARIA (Bell)

*Antedon vicaria* 1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 400 (1).
*Antedon ?variispina* 1894. Bell, *T. c.*, p. 396 (2).

1. *Macclesfield Bank; 30-40 fathoms.*—One specimen; the cirri are XXIII, 29-31 (usually 29), slender, 20 mm. long; long sharp dorsal spines are developed from the ninth or tenth segment onward; the longest cirrus segment (just before the development of the dorsal spines) is about twice as long as broad.

The twenty-four arms are 60 mm. long; the dorsolateral ornamentation of the division series and arm bases occupies exactly the same areas as in *M. subcarinata,* but it is much more prominent and more irregular; instead of having a finely and evenly tuberculated surface the sides of the rays are converted into a spongy looking mass which causes the edges of the rays to appear denticulate; the median keel on the division series and brachials is much higher than in *M. subcarinata.* The arms and division series have a narrow dark purple median line. IIIBr series when developed are always external.

The disk is covered with small plates.

2. *Macclesfield Bank; 50 fathoms.*—One specimen; the cirri are XXIII, 33-36, 23 mm. long; dorsal spines are developed from the tenth segment onward; in this specimen the cirrus segments are not so long proportionately as in the preceding. One of the cirri is regenerating the distal portion.

There are between twenty-five and thirty arms 65 mm. long; very fine spines are developed in the areas of ornamentation; these little fuzzy spines cover the radials and a small part of the proximal edge of the $IBr_1$, extending thence upward interradially; at the articulations the ornamentation extends somewhat dorsalward, following along the articular divisions, and it may even narrowly bridge the division series at the synarthries, a condition not occurring so markedly in the other specimen.

In both individuals the division series are sharply flattened laterally, and both have the same median carination of the division series and lower brachials and the same deep purple narrow median line.

### Genus DICHROMETRA A. H. Clark

### DICHROMETRA FLAGELLATA (J. Müller)

1. *Pulau Obin, Singapore.*—Five specimens.

### DICHROMETRA AFRA A. H. Clark

1. *Zanzibar.*—Two small specimens.

### Genus LIPAROMETRA A. H. Clark

### LIPAROMETRA ARTICULATA (J. Müller)

*Antedon articulata* 1884. Bell, "Alert" Report, p. 160 (1).
*Antedon reginæ* 1884. Bell, "Alert" Report, p. 160 (2).

1. *Port Molle, Queensland; 12-20 fathoms; rock; "Alert."*—One specimen.

2. *Port Molle, Queensland; 12-20 fathoms; rock; "Alert."*—One specimen; the cirri are about XXV, 29, 30, 32, 34; the longest cirrus segments are about as long as broad, and the distal are about one-third broader than long; stout, though not long, dorsal spines are developed from the thirteenth or fifteenth onward; as a whole the cirri are moderately stout.

The thirty-eight arms are about 100 mm. long.

$P_1$ is 14 mm. long; $P_2$ is about 22 mm. long, very slender and delicate, flagellate, soft and not stiffened, with forty-three segments which are only slightly longer than broad; $P_3$ is similar to $P_2$, but the following pinnules are shorter; $P_4$ is 10 mm. long. There is but a slight difference in basal stoutness between the earlier pinnules, but $P_2$ and $P_3$ taper much less rapidly than the others.

### LIPAROMETRA REGALIS (P. H. Carpenter)

*Antedon regalis* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 237 (1).

1. *Tongatabu Reefs; "Challenger."*—One specimen; this species is much like the Japanese *L. grandis,* but it is a smaller and in every way more delicate form; there are no distal cirrus spines. The figure given of it in the "Challenger" report is excellent.

### Genus LAMPROMETRA A. H. Clark

### LAMPROMETRA PROTECTUS (Lütken)

*Antedon conjungens* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 233 (1).
*Antedon similis* 1888. P. H. Carpenter, *T. c.,* p. 235 (2).
*Antedon occulta* 1888. P. H. Carpenter, *T. c.,* p. 236 (3).
*Antedon palmata* 1888. Bell, Proc. Zoöl. Soc. London, 1888, pp. 384, 387 (4).—1894. Thurston, Madras Government Museum Bulletin, No. 1, pp. 28 (4), 53 (?); No. 2, pp. 106 (?), 114 (?).
*Antedon indica* 1899. Bell, Willey's Zoölogical Results, vol. 2, p. 133 (5).
*Antedon æquipinna* Brit. Mus., MS. (6).
*Antedon protectus* Brit. Mus., MS. (7).

1. *Cebu Reefs; "Challenger."*—One specimen; I cannot see any way in which it differs from true *protectus.*

2. *"Challenger" Station No. 174.*—One specimen with thirty arms; none of the cirrus segments are quite so long as broad.

3. *"Challenger" Station No. 174.*—Three specimens.

4. *Rameswaram, Gulf of Manaar.*—Two small specimens.

5. *Blanche Bay, New Britain.*—One specimen.

6. *Fiji.*—One specimen.

7. *Tonga.*—One typical specimen.

8. *Andaman Islands.*—One specimen.

9. *Edge of Reef off Nam-Zit Island.*—One specimen.

*Remarks.*—I cannot see that the type of Carpenter's *Antedon similis* presents any valid characters by which it may be separated from the earlier *Antedon protectus.*

It also appears to be the same thing as Bell's *Antedon moorei,* though the type of the latter is a young and immature individual with the dorsal processes on the outer cirrus segments a trifle more conspicuous.

The type of *Antedon similis* is regularly thirty armed, and is in every way stouter than the type of *Antedon moorei;* the cirrus segments are never quite so long as broad, while the earlier are longer than broad in *moorei.*

The pinnules of the type of *Antedon similis* resemble those of certain varieties of *protectus.*

### LAMPROMETRA GYGES (Bell)

*Antedon gyges* 1884. Bell, "Alert" Report, p. 160 (1).
*Antedon tenera* 1890. Hartlaub, Nachr. Ges. Göttingen, Mai 1890, p. 180.—1891. Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, p. 66.
*Antedon articulata* Brit. Mus., MS. (2, 3).

1. *Thursday Island; 3-4 fathoms.*—One specimen; the cirri are XXXV, 24-29 (usually 28), 20 mm. to 25 mm. long; from the eleventh onward the segments are strongly carinate dorsally or are supplied with broadly rounded dorsal spines. The arms are forty-one in number (four being broken off), 80 mm. long. $P_2$ is the longest, but slender, similar to $P_1$ but longer; $P_3$ is slender and weak, not nearly so long as $P_1$; the basal segments of these earlier pinnules are more or less carinate.

2. *Port Essington, Coburg Peninsula, Northern Territory of South Australia.*—One specimen.

3. *North of Cape Hillsboro'; H. M. S. "Rattlesnake."*—One specimen.

### LAMPROMETRA PALMATA (J. Müller)

*Antedon palmata* Brit. Mus., MS. (1, 2).

1. *Red Sea.*—One fine specimen.

2. *Muscat.*—One specimen with thirty-six arms and cirri XLV, 22-25.

*Remarks.*—Carpenter's record of this species from Ceylon ("Challenger" Report, Comatulæ, p. 379) is based upon an example of *Lamprometra protectus; L. palmata* does not occur farther eastward than Arabia.

## Family COLOBOMETRIDÆ A. H. Clark

### Genus CENOMETRA A. H. Clark

### CENOMETRA EMENDATRIX (Bell)

*Antedon emendatrix* 1892. Bell, Ann. and Mag. Nat. Hist. (6), vol. 9, p. 428 (1).

*Antedon spicata* 1909. Bell, Trans. Linn. Soc. (Zoöl.), (2), vol. 13, part 1, p. 20 (2).

1. *Mauritius.*—Four specimens, with twelve, fourteen, nineteen and twenty-one arms; $P_2$ is comparatively slender; the proximal segments of the lower pinnules are strongly carinate.

2. *Seychelles; 39 fathoms; "Sea Lark."*—Four specimens; one of these has twenty-two arms 100 mm. long; there are two IIIBr series, both externally developed; $P_2$ has from nineteen to twenty-one segments, of which the proximal are carinate; the cirri are XX, 32-35; another has fourteen arms 90 mm. long, and cirri XIV, 34-41; a third specimen has about fifteen arms; the fourth, and smallest, specimen has twelve arms, a single derivative from a IBr axillary bearing both a IIBr series and beyond it an external IIIBr series.

### CENOMETRA CORNUTA A. H. Clark

*Antedon* sp. (near *macronema*) 1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 394 (1).

1. *No Locality.*—One broken specimen.

2. *Adele Island, northwestern Australia.*—One specimen with twenty-six arms about 110 mm. long.

The cirri are XIV, 35-37, about 20 mm. long, rather slender, with short segments none of which are less than twice as broad as long; the proximal segments are flattened dorsally; in the distal half of the cirri the segments bear dorsally a pair of tubercles with their apices well separated.

The lateral processes on the ossicles of the division series are broad with truncated or roundedly incised outer margins.

The twenty-six arms are about 110 mm. long.

$P_2$ is very stout and very strongly curved with from eleven to fourteen (usually twelve) segments, most of which are about as long as broad; on the distal side the distal ends are strongly everted and serrate, this being well marked on the second; there is a very slight straight edged blunt carination of the first three segments of the earlier pinnules, which is quite different in appearance from the high sharp convex carination characteristic of *C. emendatrix.*

Both of the specimens are alike in color, white and purple in bands about one-quarter of an inch in width, the cirri brown.

### Genus CYLLOMETRA A. H. Clark

### CYLLOMETRA MANCA (P. H. Carpenter)

*Antedon manca* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 226 (1).

1. *"Challenger" Station No. 192.*—The longest cirrus segments are scarcely longer than broad; the dorsal spines on the outer cirrus segments are not nearly so broad as those of *C. disciformis,* but resemble rather those of *C. albopurpurea.*

### CYLLOMETRA ALBOPURPUREA A. H. Clark

1. *Inland Sea, Japan.*—Three fine specimens with fourteen, fifteen and nineteen arms 70 mm. to 80 mm. long.

### CYLLOMETRA DISCIFORMIS (P. H. Carpenter)

*Antedon disciformis* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 228 (1).

1. *Cebu Reefs.*—Four specimens; the dorsal spines on the outer cirrus segments are long and sharp; the longest cirrus segments are nearly twice as long as broad.

### Genus DECAMETRA A. H. Clark

### DECAMETRA TIGRINA (A. H. Clark)

1. *Toba Harbor, Japan.*—One specimen.
2. *Japan.*—Two specimens, one large and one small.

### DECAMETRA INFORMIS (P. H. Carpenter)

*Antedon informis* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 205 (1).

1. *"Challenger" Station No. 208.*—One specimen, well figured by Carpenter.

### DECAMETRA ALAUDÆ A. H. Clark

*Decametra alaudæ* 1911. A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, p. 33 (1, 2).

1. *Cargados Carajos; 30 fathoms; "Sea Lark."*—Two specimens, one large and one small; in the former the cirri are XV, 26, small and slender, all the segments subequal, about twice as broad as long; the ten arms are 90 mm. long; $P_1$ is slender and flagellate, 8 mm. long, with twenty-one segments which are about as long as broad; $P_2$ is much larger and stouter, tapering very gradually, stiffened, 11 mm. long, with sixteen segments, of which the fifth-seventh are half again as long as broad and the remainder about as long as broad or broader than long; from the fourth onward the segments have projecting distal edges and distal angles, the whole pinnule reminding one strongly of $P_2$ in *Cenometra;* $P_3$ is similar to $P_2$ but smaller and much more slender and flagellate distally, 10 mm. long, with nineteen segments; $P_4$ and the following pinnules are slender, small and weak, 6 mm. long; the distal pinnules are very slender, 10 mm. long.

2. *Cargados Carajos; 30 fathoms; "Sea Lark."*—One specimen; the cirri are XVII, 27-28, 14 mm. long, moderately slender; all the segments are subequal, about half again as broad as long; a transverse ridge begins to develop on the sixth or seventh, this becoming a pair of small low tubercles on the tenth or twelfth; the ten arms are 90 mm. long; $P_a$ is absent; $P_1$ is slender, small and weak, 5 mm. long, with thirteen segments; $P_2$ is the largest pinnule, though it is not especially enlarged; it is slender and flagellate distally, 9 mm. long, with eighteen segments, most of which are nearly twice as long as broad; the outer have slightly prominent distal edges, and especially distal angles; $P_3$ is intermediate between $P_1$ and $P_2$; $P_4$ and the following pinnules are small and weak; the distal pinnules are very slender, 9 mm. long.

### DECAMETRA MOLLIS (A. H. Clark)

1. *Kurrachi.*—Six specimens; the cirri are XII-XV, 20-23 (usually 22), 10 mm. long; the dorsal processes on the outer segments are very small; the ten arms are 65 mm. long; $P_1$ has about thirteen segments and resembles $P_2$, but is usually about 1 mm. shorter and proportionately more slender; $P_2$ is the largest, but is slender, about 5 mm. long; most of its segments are about twice as long as broad, or even longer; the segments number about fourteen; those in the outer half are more or less prismatic, and have projecting outer

corners; $P_3$ is about like $P_1$; $P_4$ is shorter, and $P_5$ is shorter still; sometimes $P_1$ is considerably shorter than $P_2$ or than $P_3$.

### DECAMETRA MOEBIUSI A. H. Clark

*Antedon lævissima* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224 (1).

*Decametra möbiusi* 1911. A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, p. 31.

1. *Fadiffolu, Maldives.*—One specimen with arms 30 mm. long; there are 15 cirrus segments; $P_2$ is slender, not greatly longer than $P_1$, composed of elongated segments with overlapping distal ends; $P_1$ is longer than $P_3$ and the following pinnules.

2. *Muhlos, Maldives.*—Three specimens with an arm length of from 55 mm. to 60 mm.; the cirri are XIV, 15, rather slender; $P_1$ is about two-thirds as long as $P_2$, much more slender and less stiffened; $P_2$ is long but comparatively slender, with twelve segments, of which the distal are twice as long as broad and have projecting distal edges; $P_3$ and the following pinnules are shorter than $P_1$.

### DECAMETRA TAPROBANES (A. H. Clark)

*Antedon laevissima* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 224 (1, 2, 3).

1. *Fadiffolu, Muhlos, Maldives.*—One specimen.

2. *Muhlos, Maldives.*—Two specimens; the cirri are XIV, 24; $P_1$ is soft; $P_3$ resembles $P_2$, but is smaller.

3. *Muhlos, Maldives.*—One specimen; there are 23 cirrus segments; $P_2$ is much enlarged, but $P_1$ and $P_3$ are also enlarged somewhat.

### DECAMETRA ARABICA A. H. Clark

*Antedon carinata* BRIT. MUS., MS. (1).

*Description.*—The cirri are XIX, 26-27, 13 mm. long, slender; the proximal segments about twice as broad as long, the terminal about as long as broad; the ninth or tenth and following bear small paired dorsal spines.

The ten arms, which resemble those of the other species of the genus, are 110 mm. long.

$P_a$ is absent; $P_1$ is very small and weak, 4.5 mm. long; $P_2$ is 9 mm. long, composed of fifteen segments, most of which are twice as long as broad, with the distal edges produced and spinous and the distal angles produced, suggesting the conditions seen in *Oligometra serripinna;* the pinnule is comparatively slender, though stiff, and tapers evenly to the tip; $P_3$ is similar but shorter, 6 mm. to 7 mm.

long; $P_4$ is 4.5 mm. long; $P_5$ is similar, but shorter; the following pinnules are small and weak; the slender distal pinnules are 9.5 mm. long.

1. *Locality.*—Muscat, Arabia.

*Remarks.*—The material consists of sixteen specimens, of which that described is the largest.

The color is yellow, narrowly but frequently banded with purple, the cirri purplish; or, purple and yellow in large blotches.

### Genus COLOBOMETRA A. H. Clark

### COLOBOMETRA PERSPINOSA (P. H. Carpenter)

*Antedon insignis* 1882. BELL, Proc. Zoöl. Soc. London, 1882, p. 534 (1).
*Antedon loveni* 1884. BELL, "Alert" Report, p. 158 (1).

1. *Port Denison, Queensland; 3-4 fathoms; "Alert."*—One specimen.

### Genus OLIGOMETRIDES A. H. Clark

### OLIGOMETRIDES ADEONÆ (Lamarck)

*Antedon adeonæ* 1884. BELL, "Alert" Report, p. 156 (1).
*Antedon pinniformis* 1884. BELL, *T. c.*, p. 156 (2).
*Antedon bidens* 1884. BELL, *T. c.*, p. 158 (3).

1. *"Alert" Station No. 87.*—One specimen; the cirri are (about) XX, 21; the transverse ridge has moved so far back that it is near the proximal end of the cirrus segments, and the distal dorsal border of the segments has become prominent so that the bidentate appearance (in lateral view) is produced; the ten arms are 65 mm. long; $P_1$ is the longest pinnule, and is stiffened; $P_2$ is similar, but slightly shorter; $P_3$ is similar, but slightly shorter than $P_2$; the ends of the segments of these proximal pinnules tend to be slightly prominent. The general appearance of the animal is strikingly like that of *Tropiometra carinata.*

2. *Dundas Strait; northwestern Australia.*—One specimen.

3. *Torres Strait; 10 fathoms; sand; "Alert."*—One specimen, similar to that from Station No. 87.

4. *Baudin Island; 8-15 fathoms.*—One specimen.

### Genus OLIGOMETRA A. H. Clark

### OLIGOMETRA CARPENTERI (Bell)

*Antedon milberti* 1884. BELL, "Alert" Report, p. 156 (1).—1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 394 (4).
*Antedon carpenteri* 1884. BELL, "Alert" Report, p. 157 (2, 3).
*Antedon scripinna* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 394 (5, 6).

1. *Prince of Wales Channel, Torres Strait; 7-9 fathoms; sand; "Alert."*—One specimen.

2. *Port Curtis, Queensland; 7 fathoms; "Alert."*—One typical specimen with arms 55 mm. long.

3. *Port Curtis; 11 fathoms; sand and shell; "Alert."*—Three specimens.

4. *Northwestern Australia; 8-15 fathoms.*—Two specimens.

5. *Holothuria Bank; 24 fathoms.*—One specimen with the cirri XIV, 13-14.

6. *Holothuria Bank; 39 fathoms.*—One specimen exactly like the specimens from Queensland in the collection of the Australian Museum; the cirri are XI, 16-18.

7. *Bassett-Smith Bank; 9 fathoms.*—Two specimens.

8. *Baudin Island, northwestern Australia; 8-15 fathoms.*—One small specimen.

### OLIGOMETRA SERRIPINNA (P. H. Carpenter)

*Antedon carinata* 1894. Bell, Proc. Zoöl. Soc. London, 1894, p. 396 (1).

1. *Macclesfield Bank; 29-32 fathoms.*—One specimen.

### OLIGOMETRA ELECTRÆ A. H. Clark

1. *Red Sea, southeast of Messawa, Eritréa (15° 02′ 30″ N. lat., 41° 13′ 30″ E. long.); 20 fathoms; Cable-repair Ship "Electra."*—One specimen; this is an exceptionally ornate form with extravagantly developed processes on the proximal pinnules.

### OLIGOMETRA OCCIDENTALIS A. H. Clark

*Oligometra serripinna* var. *occidentalis* 1911. A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, p. 33 (1).

1. *Cargados Carajos; 30 fathoms; "Sea Lark."*—Nine specimens; the cirri are XIV-XVII, 18-22 (usually 19-20); the distal segments are about as long as broad; $P_2$ is much larger than $P_1$ or $P_3$, and is composed of nineteen segments, most of which are about as long as broad or slightly longer than broad; the lateral processes at the distal ends of the outer pinnule segments are only slightly developed, and are small and delicate; the segments of the pinnules succeeding $P_2$ have rather strongly projecting distal edges and angles; the arms are from 70 mm. to 80 mm. long.

### OLIGOMETRA CALEDONIÆ A. H. Clark

*Oligometra caledoniæ* 1911. A. H. Clark, Bull. du Mus. d'hist. nat. de Paris, No. 4, 1911, p. 254.

1. *No Locality; Professor J. B. Jukes.*—One specimen.

## Family TROPIOMETRIDÆ A. H. Clark

### Genus TROPIOMETRA A. H. Clark

### TROPIOMETRA CARINATA (Lamarck)

*Antedon carinata* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 199 (1, 2).

*Antedon capensis* 1905. Bell, Marine Investigations in South Africa, vol. 4, p. 139 (3-10).

1. *Mauritius.*—Two specimens.
2. *Zanzibar.*—Seven specimens.
3. *Investigations in South Africa, Station No. 160.*—Two specimens.
4. *Investigations in South Africa, Station No. 165.*—One specimen; there are 28 cirrus segments.
5. *Investigations in South Africa, Station No. 15610.*—Two specimens.
6. *Investigations in South Africa, Station No. 96.*—Two specimens.
7. *Investigations in South Africa, Station No. 11801.*—Twenty-five specimens.
8. *Investigations in South Africa, Stations Nos. 15597/8.*—Three specimens.
9. *Investigations in South Africa, Stations Nos. 97, 98, 155.*—Two large specimens.
10. *Cape of Good Hope.*—One specimen.

### TROPIOMETRA INDICA A. H. Clark

*Antedon adeonæ* 1887. Bell, Sci. Trans. Roy. Dublin Soc. (2), vol. 3, p. 645 (1).—1888. Bell, Proc. Zoöl. Soc. London, 1888, p. 387 (1, 2, 3).

1. *Ceylon.*—Fourteen specimens; the cirri are XXVI-XXIX, 23-26, 21 mm. or 22 mm. long; the outer segments are twice as broad as long as in *T. carinata;* the last four taper rather rapidly; the cirri are rather slender and weak, but very numerous, giving the animal a very characteristic appearance; they are arranged very irregularly, approximately in two and a partial third row on the centrodorsal; the proximal pinnules are stiffened.
2. *Ceylon.*—Three specimens.
3. *Tuticorin, Madras.*—One specimen.

**TROPIOMETRA PICTA (Gay)**

*Antedon dübeni* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 181 (1).

*Antedon carinata* 1888. P. H. CARPENTER, *T. c.*, p. 199 (2, 3, 4).—BRIT. MUS., MS. (5, 7, 8).

1. *Bahia; 20 fathoms; "Challenger."*—One young specimen.
2. *Bahia; 7-20 fathoms; "Challenger."*—Eleven specimens.
3. *Rio de Janeiro.*—Three specimens.
4. *St. Helena; E. W. Alexander.*—Two fine specimens; there are twenty-five cirrus segments.
5. *Rio de Janeiro; Charles Darwin.*—One large specimen.
6. *Thirty-three miles east of Pernambuco; 23 fathoms.*—Three specimens.
7. *No Locality.*—Four specimens.
8. *No Locality.*—One specimen.

## Family CALOMETRIDÆ A. H. Clark

### Genus OREOMETRA A. H. Clark

### OREOMETRA MARIÆ A. H. Clark

*Antedon macronema* BRIT. MUS., MS.

*Description.*—The centrodorsal is thick discoidal, bearing a single fairly regular marginal row of cirrus sockets; the broad flat polar area is 4 mm. in diameter.

The cirri are XV, 44-47, 25 mm. to 27 mm. long, rounded rhombic in cross section, suggesting the cirri of *Neometra acanthaster,* but with the angles, as seen in cross section, less sharp and more rounded; all the segments are approximately equal, about twice as broad as long; the ventral and lateral distal edges of the segments project rather strongly over the bases of those succeeding; the cirri taper slightly in the outer half; on about the fourth segment a faint, very narrow longitudinal median ridge is visible; after the middle of the cirrus this becomes a narrow, low, sharp carination, slowly increasing in height distally so that terminally the segments bear fairly prominent rounded dorsal spines; in the distal third of the cirri supplementary spines appear, one on either side of the median carination, at first small and confined to the vicinity of the distal edge of the segments, but becoming terminally nearly as large as the median spine; the spine on the antepenultimate segment is single; the opposing spine is transversely flattened. As a whole the cirri are moderately stout, suggesting strongly those of *Neometra spinosissima.*

The radials are moderate in size, resembling those of *Neometra multicolor,* except that they are not produced interradially, or those of *Ptilometra macronema.* Their proximal border is marked with a series of crescentic gouges in which the proximal portion of the basal cirrus segments are lodged, and which represent the upper part of the cirrus sockets. These last are all partly on the centrodorsal and partly on the radials; the central canal, however, is always on the centrodorsal, though it may be only slightly below its margin.

The two elements of the IBr series appear to be united by syzygy, though the union is probably by a very close synarthry; the $IBr_1$ is oblong, two and one-half to three times as broad as long; the $IBr_2$ (axillary) is broadly pentagonal, twice as broad as long; the $IBr_1$ has a sharp tubercle in the middle near the proximal border, and another smaller one in the middle of its distal (anterior) margin; the $IBr_2$ (axillary) has a tubercle in the middle of each of the two distal edges; the $IIBr_1$ and the first brachials have a median tubercle on their proximal border, like the $IBr_1$; the $IIBr_2$ has a tubercle on each of its distal borders, like the $IBr_2$. The IBr series are broad, in close lateral apposition, and slightly flattened laterally, just as in *Ptilometra macronema,* and as in that species the component ossicles are very thin dorsoventrally. The IIBr series are 4 (3 + 4); the axillaries and preceding ossicles resemble those of the IBr series.

The seventeen arms are 60 mm. long; the brachials in general resemble those of such species as *Gephyrometra propinqua;* as in that species there is a rather sharp overlap, especially at the disto-lateral angles; the arms do not become laterally flattened distally, nor carinate.

Side and covering plates are well developed on the arms and pinnules, as is usual in the genus; sacculi are abundant.

The disk is lacking.

$P_1$ is about 7 mm. long, small and weak, rather strongly prismatic, flexible, with eighteen segments; it is at first moderately stout, but tapers rapidly after the proximal third, becoming exceedingly slender and flagellate in the outer half; the proximal segments are broader than long, the distal slightly longer than broad; the first segment is about twice as large as the second, though it does not strike one as being especially enlarged; the second segment is also enlarged, but very slightly; it has a small dorsal carinate process, as has also the third, which is not enlarged. $P_2$ is stiff and spine-like, 8 mm. long, with ten segments, of which the first is short with a slight rounded dorsal carination, though not otherwise modified; the second is about

as long as broad, and the remainder are much elongated with slightly spinous distal ends. $P_3$ and $P_4$ are equal, slightly longer than $P_2$ but similar to it, with twelve segments; the first segment of $P_3$ may bear a slight rounded dorsal carination. $P_5$ is about as long as $P_2$, but more slender and less spinous; the following pinnules are shorter than $P_5$ and are composed of eleven segments which have slightly prominent distal ends. The distal pinnules are 9 mm. long. All the pinnules are prismatic.

The ventral aspect of the radial pentagon shows it to be that of a typical member of the Calometridæ.

In color the calyx, division series, and the sides of the arms are light brown; a broad median band on the arms, most of the pinnules and the cirri are white.

*Locality.*—Unknown.

### Genus CALOMETRA A. H. Clark

### CALOMETRA DISCOIDEA (P. H. Carpenter)

*Antedon discoidea* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 134 (1).

1. *"Challenger" Station No. 192.*—Four specimens, two large and two small; the $IBr_1$ are extended laterally to an anterior process from the radials so that there is a very prominent gap between the axillaries; the cirri are 38 mm. long; the longest cirrus segments are about one-third longer than broad or slightly longer.

## Family THALASSOMETRIDÆ A. H. Clark

### Genus PTILOMETRA A. H. Clark

### PTILOMETRA MACRONEMA (J. Müller)

*Antedon wilsoni* 1888. Bell, Ann. and Mag. Nat. Hist. (6), vol. 2, pp. 402, 403 (1).—1890, P. H. Carpenter, Proc. Roy. Soc. Victoria (N. S.), vol. 2, p. 135 (1).

*Antedon incommoda* 1888. Bell, Ann. and Mag. Nat. Hist. (6), vol. 2, p. 404 (4).

*Antedon macronema* 1890. P. H. Carpenter, *T. c.*, p. 135 (2, 3).

1. *Port Phillip, Victoria.*—Seven young specimens.

2. *Port Phillip.*—A beautiful large specimen with eighteen arms resembling those in the Australian Museum collection from Kangaroo Island.

3. *Port Phillip.*—One beautiful specimen.

4. *Port Phillip.*—One young specimen.

5. *South Australia.*—Two specimens.

### PTILOMETRA MUELLERI A. H. Clark

*Antedon mauonema* 1885. Bell, Proc. Linn. Soc. New South Wales, vol. 9 (1894), p. 497 (1, 3).

*Antedon macronema* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 212 (2).—Brit. Mus., MS. (4).

1. *Port Stephens, New South Wales.*—Four fine specimens.

2. *Port Jackson, New South Wales; 30-35 fathoms; "Challenger."*—Two typical specimens.

3. *Port Stephens; 6-8 fathoms.*—Four typical specimens.

4. *No Locality.*—Two specimens.

5. *Port Phillip, Victoria.*—One beautiful specimen.

## Genus ASTEROMETRA A. H. Clark

### ASTEROMETRA LONGICIRRA (P. H. Carpenter)

*Antedon longicirra* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 103 (1).

1. *"Challenger" Station No. 192.*—One specimen; the $IBr_1$ bears a short median ridge with a profile as figured; the axillary bears three tubercles.

### ASTEROMETRA MIRIFICA A. H. Clark

*Antedon longicirra* 1893. Bell, Journ. Linn. Soc. (Zoöl.), vol. 24, p. 339 (1).

1. *Sahul Bank; 11° 30′ S. lat., 125° E. long.*—Three specimens; one of these has the arms 105 mm. long and the cirri 87 mm. long; another is similar; the third is very small with arms only 35 mm. long, but it has already developed the compressed and overlapping brachials and the strong proximal carination of the adults.

*Remarks.*—This species is very easily distinguished from *A. longicirra* by the stout high keels on the ossicles of the IBr series and first two brachials, which are practically confluent on succeeding ossicles; the axillaries bear a single sharp keel.

## Genus STYLOMETRA A. H. Clark

### STYLOMETRA SPINIFERA (P. H. Carpenter)

*Antedon spinifera* Brit. Mus., MS. (1).

1. *Barbados, British West Indies.*—One specimen.

## Genus COSMIOMETRA A. H. Clark

### COSMIOMETRA GARDINERI A. H. Clark

*Cosmiometra gardineri* 1911. A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, p. 38 (1).

1. *Saya de Malha; 135 fathoms; "Sea Lark."*—One specimen; this species is closely related to *C. woodmasoni;* the cirri are longer

and more slender than in that form, 30 mm. long, with 29-31 segments which are proportionately longer; there are twenty arms; the carination of the division series is broader than in *woodmasoni;* the lower brachials have a broad median keel quite different from the faintly indicated crest of *woodmasoni;* the outer brachials are very strongly overlapping and broadly carinate, the raised portion, when viewed dorsally, having a triangular shape, the apex of the triangle being proximal; the same type of carination is found in *woodmasoni,* but the triangles are narrower.

### COSMIOMETRA WOODMASONI (Bell)

*Antedon wood-masoni* 1893. Bell, Journ. Linn. Soc. (Zoöl.), vol. 24, p. 340 (1).

1. *Sahul Bank.*—One specimen; the arms are 110 mm. long; in general this species resembles *C. crassicirra* from the Hawaiian Islands; the division series are strongly, but roundedly, carinate; there are 40-41 cirrus segments, of which the seventh is a transition segment; the cirri are comparatively short and stout, 27 mm. in length.

### Genus STENOMETRA A. H. Clark

### STENOMETRA QUINQUECOSTATA (P. H. Carpenter)

*Antedon quinquecostata* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 215 (1).

1. *"Challenger" Station No. 192.*—Three specimens, two large and one small; the cirri are proportionately larger and stouter than those of the Japanese *S. dorsata;* the arms are 100 mm. long; the sides of the division series are denticulate; the lateral portions of the proximal borders of the ossicles of the division series are also more or less denticulate; the crest of the carination is sharp, and nearly or quite straight; there is no pronounced denticulation.

### Genus STIREMETRA A. H. Clark

### STIREMETRA SPINICIRRA (P. H. Carpenter)

*Antedon spinicirra* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 112 (1).

1. *"Challenger" Station No. 164.*—Three specimens; this is a curious small and delicate little species with curiously long cirrus spines.

### STIREMETRA ACUTIRADIA (P. H. Carpenter)

*Antedon acutiradia* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 113 (1).

1. *"Challenger" Station No. 175.*—One specimen; this is a small species; it is well figured by Carpenter.

### STIREMETRA BREVIRADIA (P. H. Carpenter)

*Antedon breviradia* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 110 (1, 2).
*Antedon variospina* Brit. Mus., MS. (2).

*"Challenger" Stations Nos. 175 (1) and 170a (2).*—Four specimens; this species was well figured by Carpenter.

*Remarks.*—One of the specimens from the second locality bears the manuscript name *Antedon variospina,* a name which Carpenter inadvertently allowed to slip into the "Challenger" report.

### Genus PARAMETRA A. H. Clark

### PARAMETRA GRANULATA A. H. Clark

*Antedon compressa* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 222 (1).

1. *"Challenger" Station No. 201.*—One specimen; the division series and lower brachials have a prominent narrow median keel which is continued along the arm and passes into the distal carination; the division series and lower brachials are considerably smoother than those of *P. compressa,* due to the absence of the eversion of their proximal and distal edges.

### PARAMETRA COMPRESSA (P. H. Carpenter)

*Antedon compressa* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 222 (1).

1. *"Challenger" Station No. 192.*—Two specimens; the carination on the earlier segments is confined to the axillaries and the second brachials, and is rounded and inconspicuous; the lower brachials and the ossicles of the division series have rather strongly everted edges.

### Genus CROTALOMETRA A. H. Clark

### CROTALOMETRA MAGNICIRRA (Bell)

*Antedon magnicirra* 1905. Bell, Marine Investigations in South Africa, vol. 4, p. 141 (1, 2).

1. *Stations Nos. 12885/6.*—Six specimens; the cirri are XV-XXV, 60-63; the eighth or ninth is a transition segment; the cirrus sockets

are arranged in ten columns, the two in each radial area separated from each other by furrows.

2. *Station No. 12792.*—One specimen.

### CROTALOMETRA PORRECTA (P. H. Carpenter)

*Antedon porrecta* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 250 (1).

1. *"Challenger" Station No. 344.*—One large and two small specimens; in the former the cirri are XIV, 50 mm. to 54 mm. long; the eighth or ninth is a transition segment. This species is remarkable for the great size and stoutness of its cirri.

### Genus THALOSSOMETRA A. H. Clark

### THALASSOMETRA LUSITANICA (P. H. Carpenter)

*Antedon lusitanica* 1884. P. H. CARPENTER, Proc. Roy. Soc. Edinburgh, vol. 12, p. 368 (1).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 109 (1).

1. *"Porcupine" Station 17a; 1870.*—Three specimens, agreeing with the published figures.

### THALASSOMETRA LATIPINNA (P. H. Carpenter)

*Antedon latipinna* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 116 (1).

1. *"Challenger" Station No. 232.*—One specimen; the edges of the ossicles of the IBr series are finely spinous; the brachials as far as they are preserved are finely spinous on the dorsal surface.

### THALASSOMETRA ECHINATA (P. H. Carpenter)

*Antedon echinata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 119 (1).

1. *"Challenger" Station No. 170.*—One small specimen.

### THALASSOMETRA PERGRACILIS A. H. Clark

*Antedon gracilis* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 107 (1).

1. *"Challenger" Station No. 214.*—Four specimens; this is a slender species, about the build of *Th. attenuata* though more robust basally.

**THALASSOMETRA MULTISPINA (P. H. Carpenter)**

*Antedon multispina* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 248 (1, 2).

1. *"Challenger" Station No. 344.*—Two specimens and one pentacrinoid young; the spines covering the animal are exceptionally fine.

2. *"Challenger" Station No. 135.*—One broken specimen.

**THALASSOMETRA BISPINOSA (P. H. Carpenter)**

*Antedon bispinosa* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 115 (1).

1. *"Challenger" Station No. 147.*—One specimen; this is a well developed and comparatively large species.

**Genus AGLAOMETRA A. H. Clark**

**AGLAOMETRA VALIDA (P. H. Carpenter)**

*Antedon valida* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 104 (1).

1. *"Challenger" Station No. 214.*—Two specimens; this is a large species, resembling in a general way *A. eupedata;* the anterior edges of the radials and the lateral edges of the IBr series and first two brachials are conspicuously dentate with fine well separated teeth.

**AGLAOMETRA INCERTA (P. H. Carpenter)**

*Antedon incerta* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 106 (1).

1. *"Challenger" Station No. 170a.*—One specimen; this is a large, robust species; the edges of the ossicles of the IBr series are spinous; the synarthrial tubercles resemble those of certain species of *Psathyrometra.*

## Family CHARITOMETRIDÆ A. H. Clark

**Genus PACHYLOMETRA A. H. Clark**

**PACHYLOMETRA ANGUSTICALYX (P. H. Carpenter)**

*Antedon angusticalyx* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 242 (1).

1. *"Challenger" Station No. 214.*—Five small specimens.

### PACHYLOMETRA INÆQUALIS (P. H. Carpenter)

*Antedon inæqualis* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 244 (1, 2, 3).

1. *"Challenger" Station No. 174.*—Two specimens, one large, and one small, the latter with only eleven arms.
2. *"Challenger" Station No. 175.*—One small specimen.
3. *"Challenger" Station No. 170.*—Three large specimens.

### PACHYLOMETRA SCLATERI (Bell)

*Antedon sclateri* 1905. BELL, Marine Investigations in South Africa, vol. 4, p. 140 (1, 2, 3).

*Antedon magnicirra* BRIT. MUS., MS. (4, 5).

1. *Station No. 12711.*—Seven specimens.
2. *Station No. 12676.*—Five specimens.
3. *No Locality.*—Eleven specimens.
4. *Station No. 12792.*—Four specimens.
5. *Stations Nos. 12885/6.*—One specimen.

*Remarks.*—The centrodorsal bears radial furrows.

### PACHYLOMETRA DISTINCTA (P. H. Carpenter)

*Antedon distincta* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 247 (1).

1. *"Challenger" Station No. 210.*—One specimen, resembling those in the U. S. National Museum from the Philippine Islands.

### PACHYLOMETRA FLEXILIS (P. H. Carpenter)

*Antedon flexilis* 1888. P. H. CARPENTER, "Challenger'" Report, Comatulæ, p. 217 (1).

1. *"Challenger" Station No. 192.*—Two fine specimens; this is a large, robust and handsome species.

### PACHYLOMETRA PATULA (P. H. Carpenter)

*Antedon patula* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 219 (1).—1893. BELL, Journ. Linn. Soc. (Zoöl.), vol. 24, p. 341 (2).

1. *"Challenger" Station No. 192.*—Two specimens.
2. *Sahul Bank.*—One young specimen.

**PACHYLOMETRA ROBUSTA (P. H. Carpenter)**

*Antedon robusta* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 220 (1).

*Antedon patula* 1893. Bell, Journ. Linn. Soc. (Zoöl.), vol. 24, p. 341 (2).

1. *"Challenger" Station No. 192.*—One specimen; this is a magnificent species, remarkable for its stoutness; it is well figured in the "Challenger" report.

2. *Sahul Bank.*—One specimen with ten arms.

**Genus GLYPTOMETRA A. H. Clark**

**GLYPTOMETRA TUBEROSA (P. H. Carpenter)**

*Antedon tuberosa* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 126 (1).

1. *"Challenger" Station No. 210.*—Two specimens, and some pentacrinoid larvæ; in the larger specimen the ornamentation is prominent and pearly; the median keels are not quite so prominent as they are shown in the figure; in the smaller specimen the keels are proportionately larger and more regular.

**Genus CHLOROMETRA A. H. Clark**

**CHLOROMETRA ACULEATA (P. H. Carpenter)**

*Antedon aculeata* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 128 (1).

1. *"Challenger" Station No. 214.*—One specimen; this is a small species with a narrow carination.

**Genus CHARITOMETRA A. H. Clark**

**CHARITOMETRA BASICURVA (P. H. Carpenter)**

*Antedon basicurva* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 120 (1).

1. *"Challenger" Station No. 170a.*—Five specimens; this species was well figured by Carpenter.

**CHARITOMETRA INCISA (P. H. Carpenter)**

*Antedon incisa* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 124 (1).

1. *"Challenger" Stations Nos. 170a and 174.*—Three specimens.

### Genus PŒCILOMETRA A. H. Clark

### PŒCILOMETRA ACŒLA (P. H. Carpenter)

*Antedon acœla* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 132 (1).

1. *"Challenger" Station No. 214.*—Six specimens; the constriction of the lower portion of the calyx seems to be a valid character for differentiating this species from *P. scalaris.*

### Genus STROTOMETRA A. H. Clark

### STROTOMETRA PARVIPINNA (P. H. Carpenter)

*Antedon parvipinna* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 127 (1).

1. *"Challenger" Station No. 192.*—One specimen; this species is closely related to *S. hepburniana;* it is a larger form with much less expanded genital pinnules; there is a delicate median carination on the ossicles of the IBr series and on the first two brachials, which is easily traceable all along the arm; $P_2$ is rather more like $P_1$ than $P_3$, though it is larger and has some of the characteristics of the latter. There are 11-13 cirrus segments.

## Family ANTEDONIDÆ Norman

## Subfamily ANTEDONINÆ A. H. Clark

### Genus ANTEDON de Fréminville

### ANTEDON PETASUS (Düben and Koren)

*Antedon petasus* BRIT. MUS., MS. (1).
*Antedon bifida* BRIT. MUS., MS. (2).

1. *Bergen, Norway.*—Two specimens.
2. *Norway.*—Three specimens.

### ANTEDON BIFIDA (Pennant)

*Antedon rosacea* 1886. DENDY, Proc. Roy. Phys. Soc., Edinburgh, vol. 9, p. 180, pl. 10 (18).—1886. DENDY, Studies Biol. Laboratory Owens College, vol. 1, p. 299 (18).—1891. SLADEN, Proc. Roy. Irish Acad. (3), vol. 1, p. 687 (23).—1897. SLADEN, Trans. Roy. Irish Acad., vol. 31, p. 78 (3).—BRIT. MUS., MS. (2, 18, 23, 26).

*Antedon bifida* 1889. BELL, Ann. and Mag. Nat. Hist (6), vol. 4, p. 432 (29).—1892. BELL, Proc. Roy. Dublin Soc. (N. S.), vol. 7, p. 522 (24).—1892. BELL, Cat. Brit. Echinod. in Brit. Mus., p. 54 (4, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24, 27, 28, 29, 30, 34, 35, 36).—1905. KEMP,

Rep. Fishery Board Ireland, 1902-3, part 2, No. 6, p. 179 (3).—Brit. Mus., MS. (3, 5, 7, 8, 20, 25, 26, 31, 33, 37, 38).
*Antedon rosaceus* Brit. Mus., MS. (1, 9, 10, 32).
*Comatula patulata* Brit. Mus., MS. (35).

1. *Balta Sound, Shetland.*—Nineteen specimens; the cirri are XVIII-XXVI, 11-15 (usually 14-15); they are of the type characteristic of *A. bifida,* which differs from the type characteristic of *A. petasus* in being less strongly curved distally and composed in the outer portion of proportionately longer segments which are less flattened laterally, and hence appear less broad in lateral view. Some of these specimens have one or two cirri rather abruptly different from the rest and like those of *A. petasus,* with a more or less marked difference between the proximal and distal portions.
2. *Shetland; shallow water.*—About six specimens.
3. *Rockall.*—One specimen.
4. *Loch Hourn.*—One specimen.
5. *Off Tobermory, Mull; 30 fathoms.*—Two small specimens.
6. *Loch Etive; 15-20 fathoms.*—One specimen.
7. *Firth of Lorn; 5-110 fathoms.*—One specimen.
8. *Firth of Lorn; 20-30 fathoms.*—Two large specimens.
9. *Firth of Lorn; 50 fathoms.*—One specimen.
10. *Firth of Lorn; 50 fathoms.*—One fine specimen; the cirri are unusually numerous.
11. *Loch Craignish.*—Seven specimens.
12. *Loch Craignish.*—Six specimens.
13. *Four miles southeast of Sanda; 30-38 fathoms.*—Four specimens, showing an approach to *A. petasus.*
14. *Between the island of Sanda and Ailsa Craig; 24 fathoms.*—One fine specimen, showing an approach to *A. petasus.*
15. *Lamlash Bay, Arran; 7 fathoms.*—Dry pentacrinoids.
16. *Lamlash Bay, Arran.*—Seven specimens.
17. *Between Great Cumhae and Wemyss Ground.*—One specimen.
18. *Millport, Firth of Clyde.*—One twelve armed specimen.
19. *Firth of Clyde.*—Two specimens.
20. *Scotland.*—Thirteen specimens.
21. *Calf of Man.*—One specimen.
22. *Off Liverpool.*—Three specimens.
23. *Blacksod Bay, Ireland; 4 fathoms.*—Six specimens.
24. *Cleggan Bay, Ireland; 8-11 fathoms.*—One specimen.
25. *Roundstone, Ireland.*—About forty specimens.
26. *Roundstone, Ireland.*—Pentacrinoids.

27. *Kenmare River, Ireland.*—Two specimens.
28. *Kenmare River, Ireland.*—One specimen.
29. *Southwestern coast of Ireland; 250 fathoms.*—Four specimens; the cirri are XVIII- (about) XXX, 15-16.
30. *Plymouth.*—Eight specimens.
31. *Berry Head, Brixham; 13 fathoms.*—Five specimens.
32. *Herm, Channel Islands.*—Four specimens; the cirri are XXI-XXVIII, 12-13 (usually the latter).
33. *Herm, Channel Islands; tide mark.*—Three specimens.
34. *Entrance of British Channel.*—One specimen.
35. *British Ocean.*—Two medium-sized specimens.
36. *British Seas.*—Nine specimens.
37. *No Locality; Dr. Gray's collection.*—One specimen.
38. *No Locality.*—Two specimens.

#### ANTEDON HUPFERI Hartlaub

1. *Gorée, West Africa.*—Three specimens; there are 11-13 cirrus segments.

#### ANTEDON MEDITERRANEA (Lamarck)

*Comatula mediterranea* Brit. Mus., MS. (6).
*Antedon rosacea* Brit. Mus., MS. (2, 3, 7).
*Antedon bifida* Brit. Mus., MS. (4).
*Antedon phalangium* Brit. Mus., MS. (1).

1. *Bay of Marseilles; 60-80 meters.*—One specimen.
2. *Bay of Marseilles.*—Three specimens.
3. *Bay of Marseilles.*—One specimen.
4. *Nice.*—Two specimens.
5. *Naples.*—One fine specimen.
6. *Spezia.*—One specimen.
7. *No Locality.*—One specimen.

#### ANTEDON ADRIATICA A. H. Clark

*Antedon bifida* Brit. Mus., MS. (1).

1. *Trieste.*—Two specimens.

### Genus COMPSOMETRA A. H. Clark

#### COMPSOMETRA INCOMMODA (Bell)

*Antedon wilsoni* 1888. Bell, Ann. and Mag. Nat. Hist. (6), vol. 2, p. 403 (2).—Brit. Mus., MS. (3, 6).
*Antedon incommoda* 1888. Bell, Ann. and Mag. Nat. Hist. (6), vol. 2, p. 404 (1, 3).—1889. Bell, Ann. and Mag. Nat. Hist. (6), vol. 3, p. 292.

*Antedon* sp nov. 1889. P. H. Carpenter, Proc. Roy. Soc. Victoria (N. S.), vol. 1, p. 135 (1, 2, 3, 4, 5).
*Antedon pumila* 1889. Bell, Ann. and Mag. Nat. Hist. (6), vol. 3, p. 292 (4).
*Compsometra lacertosa* 1910. A. H. Clark, Proc. U. S. Nat. Mus., vol. 38, p. 275.

1. *Port Phillip, Victoria.*—Twenty-nine specimens.
2. *Port Phillip.*—Seven specimens.
3. *Port Phillip.*—Three fine specimens.
4. *Port Phillip.*—One specimen.
5. *Port Phillip Head.*—One specimen.
6. *South Australia.*—Two specimens.

### COMPSOMETRA LOVENI (Bell)

*Antedon loveni* 1882. Bell, Proc. Zoöl. Soc. London, 1882, p. 534 (1).
*Antedon pumila* 1884. Bell, "Alert" Report, p. 157 (1).—1885. Bell, Proc. Linn. Soc. New South Wales, vol. 9 (1884), p. 497 (2).—1889. Bell, Ann. and Mag. Nat. Hist. (6), vol. 3, p. 292.—1890. P. H. Carpenter, Proc. Roy. Soc. Victoria (N. S.), vol. 2, p. 135 (3).

1. *Port Jackson; 0-5 fathoms; "Alert."*—One specimen.
2. *Nelson's Bay, Port Stephens.*—Four specimens.
3. *Port Phillip, Victoria.*—One specimen.

### Genus IRIDOMETRA A. H. Clark

### IRIDOMETRA ÆGYPTICA A. H. Clark

*Iridiometra ægyptica* 1911. A H. Clark, Proc. U. S. Nat. Mus., vol. 40, p. 42 (1).

1. *Suez; 10 fathoms.*—One broken specimen; the cirri are XXV, 14-16 (usually 15-16), 10 mm. to 13 mm. long, comparatively stout; the first segment is short, the second about as long as broad, the fourth or fifth the longest, about two and one-half times as long as the median diameter; the following segments decrease slowly in length so that the antepenultimate is about one-third longer than broad. The longer proximal segments are constricted centrally and have enlarged distal ends; there are no dorsal processes; the opposing spine is prominent, terminal, and directed obliquely forward; the cirri as a whole are rather strongly compressed laterally.

The ten arms are apparently about 40 mm. long, and resemble those of *I. nana.*

$P_1$ is short, evenly tapering, about 5 mm. long, with eight segments which become twice as long as broad distally; $P_2$ is considerably larger and much longer, but evenly tapering and very slender distally, 9.5 mm. long with twelve segments which become much

elongated in the outer portion; $P_3$ is larger than $P_2$, being much the largest pinnules on the arm, 13 mm. long with from eighteen to twenty segments, of which the distal are much elongated, three times as long as broad; the pinnule becomes very slender distally, and the ends of the component segments are slightly swollen, though not projecting nor spinous; $P_4$ is small and weak, 4.5 mm. to 5 mm. long, the outer segments much elongated and with somewhat swollen ends; $P_5$ is slightly longer than $P_4$; the following pinnules are similar to $P_5$, gradually becoming more slender and increasing in length distally.

*Remarks.*—The pinnulation of this species is not very different from that of *I. parvicirra,* but the cirri are very much larger than those of that species.

### IRIDOMETRA SCITA A. H. Clark

1. *Billiton.*—Two specimens.
2. *Macclesfield Bank; 35-41 fathoms.*—One specimen.

### IRIDOMETRA NANA (Hartlaub)

1. *Male, Maldives.*—Five specimens; the largest has an arm length of 60 mm.

### HYBOMETRA, new genus

GENOTYPE.—*Hybometra senta,* new species.

The characters of the genus are included with those of the type species in the following description.

### HYBOMETRA SENTA, new genus and species

*Description.*—The general appearance of the animal resembles that of *Florometra magellanica* when not quite fully grown, but the centrodorsal is rounded conical as in *Hathrometra prolixa;* the brachials are very strongly overlapping with produced and very highly spinous distal edges; syzygies occur between the third and fourth brachials, again between the ninth and tenth and fourteenth and fifteenth, and distally at intervals of three (often four) oblique muscular articulations.

Cirri lost.

The ten arms are 90 mm. long; the distal edges of the brachials overlap very strongly, and are exceedingly spiny.

No $P_1$ preserved; $P_2$ is 9 mm. long, very slender, but very stiff and spine-like, with about fifteen segments, of which the first is rather large, half again as broad as long, the second is somewhat longer,

the third is about as long as broad, and the sixth and following are greatly elongated and very slender, with expanded and spinous distal ends; $P_3$ is similar, very slightly when at all longer, but slightly stouter, with fifteen segments, of which the outer are exceedingly elongated; $P_4$ is similar to $P_3$ and of the same length, very slightly larger basally; $P_5$ is 11 mm. long, resembling $P_4$, but bearing a fusiform gonad; $P_6$ is similar to $P_5$ and of the same length; the following pinnules increase gradually in length, $P_{14}$ being 14 mm. long with twenty-two segments, most of which are greatly elongated with very spinous distal ends; the distal pinnules are 15 mm. long. All the pinnules are slender and all are stiff, especially the lower, which are thorn-like; this stiffness, together with the exceptional development of spines on the distal borders of their component ossicles, gives the pinnules a great similarity to the pinnules of the species of *Colobometra*.

1. *Thirty-three miles east of Pernambuco, Brazil; 23 fathoms.*—One specimen.

## Subfamily ZENOMETRINÆ A. H. Clark

### Genus LEPTOMETRA A. H. Clark

### LEPTOMETRA PHALANGIUM (J. Müller)

*Antedon mediterraneus* 1872. WYVILLE THOMSON, Proc. Roy. Soc. Edinburgh, vol. 7, p. 765.

*Antedon phalangium* 1881. P. H. CARPENTER, Zool. Anzeiger, JG. 4, p. 521 (4, 5, 6, 7, 8).—1884. P. H. CARPENTER, Proc. Roy. Soc. Edinburgh, vol. 12, p. 361 (4, 5, 6, 7, 8).—1886. P. H. CARPENTER, Trans. Linn. Soc. (Zoöl.), (2), vol. 2, p. 475 (1, 3, 4, 5, 6, 7, 8).—1894. KŒHLER, Mem. Soc. Zool. France, vol. 7, p. 425 (2).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 158 (1, 3, 4, 5, 6, 7, 8).—BRIT. MUS., MS. (2).

1. *Carthagena; "Porcupine," 1870*—Three large specimens; the cirri are from 50 mm. to 55 mm. long; the distal intersyzygial interval is two oblique muscular articulations eight times, three oblique muscular articulations fourteen times, and four oblique muscular articulations twice.

2. *La Ciotat.*—Two specimens.

3. *Naples.*—Two specimens.

4. *Skerki Bank; 30-120 fathoms; "Porcupine," 1870.*—Four specimens.

5. *Skerki Bank; "Porcupine,"*—Six specimens; the cirri are from 43 mm. to 55 mm. long and are composed of 43-44 segments, the last five tapering rapidly to a sharp point.

6. *Bay of Benzert; 50-100 fathoms; "Porcupine," 1870.*—Five specimens.

7. *Bay of Benzert; "Porcupine," 1870.*—Four small specimens, exactly like specimens from Naples of the same size; there are 36-38 cirrus segments.

8. *Naples; Stazione Zoologica.*—One specimen; the cirri are from 55 mm. to 60 mm. long, XI, 47-48.

**LEPTOMETRA CELTICA (Barrett and McAndrew)**

*Comatula woodwardii* 1857. BARRETT, Ann. and Mag. Nat. Hist. (2), vol. 19, p. 33 (7).

*Comatula celtica* 1858. BARRETT and MCANDREW, Ann. and Mag. Nat. Hist. (2), vol. 20, p. 44 (7).

*Antedon celticus* 1871. WYVILLE THOMSON, Proc. Roy. Soc. Edinburgh, vol. 7, p. 765.

*Antedon phalangium* 1881. P. H. CARPENTER, Zool. Anzeiger, JG. 4, p. 521 (7).—1884. P. H. CARPENTER, Proc. Roy. Soc. Edinburgh, vol. 12, p. 361 (1, 2, 3, 4, 5, 6, 7, 9).—1884. VON GRAFF, "Challenger" Report, Myzostoma, p. 32 (1, 2, 3, 4, 5, 6, 7, 9).—1886. P. H. CARPENTER, Trans. Linn. Soc. (Zoöl.), (2), vol. 2, p. 475 (1, 2, 3, 4, 5, 6, 7, 9).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 158 (1, 2, 3, 4, 5, 6, 7, 9).—1889. BELL, Ann. and Mag. Nat. Hist. (6), vol. 4, p. 433 (8).—1892. BELL, Cat. Brit. Echinod. in Brit. Mus., p. 59 (1, 2, 3, 4, 5, 6, 7, 8).—1892. BELL, Sci. Proc. Roy. Dublin Soc. (N. S.), vol. 7, p. 522.

1. *The Minch.*—Seventeen specimens.

2. *The Minch; 60 fathoms; "Porcupine."*—Three specimens.

3. *The Minch; "Porcupine," 1869.*—Three specimens.

4. *The Minch.*—Seven specimens.

5. *The Minch.*—Fifteen specimens.

6. *"Porcupine" Station No. 13 (1870); off Cape Mondego; 220 fathoms.*—Four specimens; the cirri are from 40 mm. to 45 mm. long with 42-48 (usually 43-44) segments; the arms are 75 mm. long.

7. *Sound of Skye; 25-40 fathoms.*—The cirri are 40 mm. long and are composed of 47 segments, of which those in the outer half are very slightly longer than broad, becoming slightly longer again terminally; the arms are 125 mm. long.

8. *Southwestern coast of Ireland; 250 fathoms; "Flying Fox."*—One specimen; the rays are in close lateral contact.

9. *Off Cape Sagres; 45 fathoms; "Porcupine."*—Four specimens, one very small; there are 49 segments in the longest cirri.

10. *? Skerki Bank; "Dacia."*—One very small specimen. This individual probably came from the Seine Bank; it could not have been taken on the Skerki Bank, as the species does not occur there.

*Remarks.*—This species may be instantly distinguished from the Mediterranean *L. phalangium* by a glance at the cirri; these are

proportionately shorter and do not taper distally as do those of *L. phalangium,* so that they appear considerably stouter distally. While in the proximal third of the cirri the segments are of the same proportions as those in the proximal third of the cirri of *L. phalangium,* in the distal half they become shorter so that in the distal third they are usually only one-third again as long as broad and may be even shorter, nearly or quite as broad as long. In *L. phalangium* there is no decrease in the proportionate length of the cirrus segments distally, all the segments being about twice as long as broad. In *L. celticus* as the segments become shorter in the outer part of the cirri the distal dorsal edge becomes somewhat swollen so that the dorsal profile of the cirri is slightly scalloped; in *L. phalangium* these edges are always perfectly smooth.

The specimens from the Minch have the cirri XIV-XXIV, 43-50 (usually 43-47), 30 mm. to 40 mm. (usually 35 mm. to 40 mm.) long; the arms are from 105 mm. to 115 mm. in length; the distal intersyzygial interval was counted in twenty-seven cases, and found to be: two oblique muscular articulations, once; three oblique muscular articulations, ten times; four oblique muscular articulations, ten times; five oblique muscular articulations, five times; six oblique muscular articulations, once.

### Genus ADELOMETRA A. H. Clark

### ADELOMETRA ANGUSTIRADIA (P. H. Carpenter)

*Antedon angustiradia* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 253 (1).

1. *"Challenger" Station No. 192.*—One specimen.

### Genus BALANOMETRA A. H. Clark

### BALANOMETRA BALANOIDES (P. H. Carpenter)

*Antedon balanoides* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 207 (1).

1. *"Challenger" Station No. 201.*—One specimen.

## Subfamily Perometrinæ A. H. Clark

### Genus PEROMETRA A. H. Clark

### PEROMETRA AFRA A. H. Clark

*Perometra afra* 1911. A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, p. 43 (1).

1. *Providence Island, northeast of Madagascar; 125 fathoms; Professor J. Stanley Gardiner.*—Four specimens, three with fourteen and one with eleven arms. These were described in detail in the reference cited.

### PEROMETRA PUSILLA (P. H. Carpenter)

*Antedon pusilla* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 131 (1).

1. *"Challenger" Station No. 192.*—One specimen; this is a species of the genus *Perometra*, but it differs from *P. diomedeæ* in possessing $P_a$; the synarthrial tubercles are also much more strongly developed than in *P. diomedeæ* of equal size; the radials have the characteristic features of the radials of *P. diomedeæ*.

## Subfamily Heliometrinæ A. H. Clark

### Genus HELIOMETRA A. H. Clark

### HELIOMETRA GLACIALIS (Leach)

*Asterias pectinata* 1774. Phipps, A Voyage toward the North Pole, p. 284 (?2).—1775. Phipps, Voyage au pole boréal fait en 1773, p. 200 (?2).—1820. Scoresby, An Account of the Arctic Regions, vol. 1, p. 551 (?2).—1834. Dewhurst, The Natural History of the Order Cetacea and the oceanic inhabitants of the Arctic Regions, p. 284, species V (?2).

*Alecto glacialis* 1830. (Leach), Catalogue of the Contents of the Museum of the Royal College of Surgeons of London, part 4, fasc. 1, p. 14, No. 85A (?30, ?31, ?32, ?33).—1833. (Owen), Descriptive and Illustrated Catalogue of the Physiological Series of Comparative Anatomy contained in the Museum of the Royal College of Surgeons in London, vol. 1, p. 119, No. 435A (?30, ?31, ?32, ?33).—1837. (Anonymous), Penny Encyclopedia, vol. 7, pp. 390, 391 (?30, ?31, ?32, ?33).—1867. Knight, Natural History, or the Second Division of the English Encyclopedia, vol. 3, pp. 98, 100 (?30, ?31, ?32, ?33).

*Comatula glacialis* Brit. Mus., MS. (30, 31, 32, 33).

*Comatula* sp. 1859. Forbes, in Forbes and Godwin-Austen, The Natural History of the European Seas, p. 47 (?3).

*Antedon celticus* 1873. Wyville Thomson, The Depths of the Sea, pp. 76, 124, (4, 5, 6, 7).

*Antedon eschrichtii* 1877. Duncan and Sladen, Ann. and Mag. Nat. Hist. (4), vol. 20, pp. 451, 468, 469 (10, 12, 14, 19, 20, 21, 22, 26).—1879. P. H. Carpenter, Proc. Roy. Soc., vol. 28, p. 386 (24).—1881. Duncan and Sladen, Memoir of the Arctic Echinodermata, p. 73 (10, 12, 14).—1886. Levinsen, Dijmphna-Togtets Zool.-botanisk Ulbytte, p. 410 (1).

*Antedon celtica* 1881. Duncan and Sladen, Memoir on the Arctic Echinodermata, p. 75 (11 [figured specimen], 13).—1881. P. H. Carpenter, Zool. Anzeiger, JG. 4, p. 521 (23).—1884. P. H. Carpenter, Proc. Roy. Soc. Edinburgh, 1883-1884, pp. 365, 375.—Brit. Mus., MS. (11, 13).

*Antedon quadrata* 1884. P. H. Carpenter, Proc. Roy. Soc. Edinburgh, 1883-1884, p. 375 (6, 7).—1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 149 (6, 8, 9, 11, 13, 23).—Brit. Mus., MS. (6, 8, 9, 23).

*Antedon eschrichti* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 138 (1, 2, 3, 4, 5, 7, 10, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24).—1892. BELL, Cat. Brit. Echinod. in Brit. Mus., p. 53 (4, 6, 7).—BRIT. MUS., MS. (1, 2, 3, 5, 7, 10, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 29).
*Antedon bifida* BRIT. MUS., MS. (4).

1. *Kara Sea; "Dijmphna."*—One small specimen.
2. *Northern coast of Spitzbergen.*—One medium-sized specimen.
3. *Spitzbergen.*—Four specimens.
4. *60° 14′ N. lat., 6° 17′ W. long.; 632 fathoms.*—One specimen.
5. *"Porcupine" Station No. 57 (1869).*—Two specimens.
6. *"Triton" Station No. 4; 60° 22′ N. lat., 3° 21′ W. long.; 327-430 fathoms.*—One specimen.
7. *"Triton" Station No. 4.*—One specimen.
8. *"Valorous" Station No. 6; 64° 05′ N. lat., 56° 47′ W. long.; 410 fathoms; sandy mud.*—One small specimen; $P_1$ and $P_2$ are similar; $P_3$ is like the succeeding pinnules and is only slightly longer than $P_4$.
9. *Same locality; 466 fathoms.*—One small specimen.
10. *Franklin Pierce Bay, Greenland; 13 fathoms.*—Four large specimens; one of them is especially rugged and tuberculous.
11. *Discovery Bay, Greenland; 25 fathoms.*—One specimen; this was figured by Duncan and Sladen.
12. *Discovery Bay; 25 fathoms; hard bottom.*—One fine specimen.
13. *Discovery Bay; 25 fathoms; hard bottom.*—One small specimen.
14. *Franklin Pierce Bay; "Discovery."*—One specimen.
15. *Greenland; 60 fathoms.*—One specimen.
16. *Greenland.*—Three specimens.
17. *Greenland.*—One medium-sized specimen.
18. *Greenland.*—Two pentacrinoid larvæ.
19. *Arctic Expedition, 1875-'76.*—One fine specimen.
20. *Arctic Expedition, 1875-'76.*—One specimen.
21. *Arctic Expedition; Coll. Hart.*—One small specimen.
22. *Arctic Expedition; Coll. Hart.*—One specimen.
23. *"Challenger" Station No. 48.*—Four small specimens.
24. *"Challenger" Station No. 48.*—Two specimens.
25. *Cape Napoleon.*—Three specimens.
26. *No Locality ("Discovery" collection).*—Eight specimens.
27. *No Locality.*—One specimen.
28. *No Locality.*—One medium-sized specimen.
29. *No Locality.*—One specimen.

30. *No Locality.*—One specimen.
31. *No Locality; Admiralty.*—One fine specimen.
32. *No Locality.*—One fine specimen.
33. *No Locality.*—One specimen.

### Genus PROMACHOCRINUS P. H. Carpenter

### Subgenus PROMACHOCRINUS P. H. Carpenter

### PROMACHOCRINUS KERGUELENSIS (P. H. Carpenter)

*Promachocrinus kerguelensis* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 350 (1).
*Promachocrinus kerguelenensis* 1908. BELL, National Antarctic Expedition, Natural History, vol. 4, Echinod., p. 3 (2, 3, 4, 5, 6).
*Antedon antarctica* 1908. BELL, *T. c.*, p. 4 (7).

1. *Kerguelen Island; "Challenger."*—One small specimen.
2. *East End of Barrier; 100 fathoms; "Discovery."*—One specimen.
3. *Winter Quarters; "Discovery."*—One very large specimen.
4. *Winter Quarters, No. 10 Hole; "Discovery."*—Three large specimens; the cirri have 38-39 segments.
5. *Off Coulman Island; 100 fathoms; "Discovery."*—Four specimens, three yellow and one purple.
6. *Christmas Harbor; "Discovery" Station No. 149E.*—Two specimens, one large and one small.
7. *Winter Quarters, No. 10 Hole; "Discovery."*—One specimen.

### Subgenus ANTHOMETRA A. H. Clark

### ANTHOMETRA ADRIANI (Bell)

*Antedon adriani* 1908. BELL, National Antarctic Expedition, Natural History, vol. 4, Echinod., p. 4 (1, 2, 3, 4, 5, 6, 7, 8).

1. *Winter Quarters, 130 fathoms; "Discovery."*—One specimen.
2. *Winter Quarters, 130 fathoms; "Discovery."*—One fine specimen.
3. *Winter Quarters, 124 fathoms; "Discovery."*—Two specimens.
4. *Winter Quarters, No. 10 Hole; 127 fathoms; "Discovery."*—One small specimen.
5. *Winter Quarters, No. 10 Hole; "Discovery."*—One small specimen.
6. *Winter Quarters, No. 10 Hole; "Discovery."*—Two young specimens, with the carination of the arms well marked.
7. *Winter Quarters, No. 10 Hole; "Discovery."*—Two large specimens.

8. *Mts. Erebus and Terror.*—Seven specimens.

*Remarks.*—This species is a true *Promachocrinus* in spite of the strong carination of the arms and the comparative slenderness of the cirri; both of these characters are seen, feebly developed, in the young of the other species of the genus as well as in the young of *Heliometra glacialis.* The longest cirri are about 55 mm. long and are composed of about 50 segments; the arms are strongly carinate from about the fourth brachial outward.

### Subgenus SOLANOMETRA A. H. Clark

### SOLANOMETRA ANTARCTICA (P. H. Carpenter)

*Antedon antarctica* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 144 (1).—1908. BELL, National Antarctic Expedition, Natural History, vol. 4, Echinod., p. 4 (3).

*Antedon australis* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 146 (2).

*Antedon adriani* 1908. BELL, National Antarctic Expedition, Natural History, vol. 4, Echinod., p. 4 (4).

1. *"Challenger" Station No. 151.*—Three specimens.

2. *"Challenger" Station No. 150.*—Two specimens.

3. *Winter Quarters; "Discovery."*—Several specimens; these are probably *antarctica,* but their small size renders accurate determination difficult.

4. *Mts. Erebus and Terror; "Discovery."*—Two specimens.

*Remarks.*—The short cirri with comparatively few segments and the extraordinary roughness of the arms and pinnules, combined with the shortness of their component segments, distinguish this species from all the others of the genus.

I cannot find a single valid character whereby the specimens upon which is based Carpenter's name *australis* may be specifically differentiated from those which he called *antarctica;* they have the same extraordinary roughness of the arms and pinnules and the same short cirri composed of short segments, and are undoubtedly merely small and somewhat immature specimens. The character relied upon by Carpenter in separating the two forms is the same as that which he invoked to separate *Heliometra quadrata* from *H. glacialis; quadrata* has since been shown to be but the young of *glacialis,* and similarly *australis* now proves to be but the immature of *antarctica.*

In my paper on the crinoids of the Paris Museum (Bull. du Museum d'hist. nat., 1911, No. 4, p. 258), I wrote, under the heading of *Heliometra magellanica,* "Cette espèce est la même que l'*Antedon australis* et aussi que l'*Antedon rhomboidea* décrite par Carpen-

ter dans le rapport sur les échantillons recueillis par le ' Challenger.' " This, of course, is an error; *Antedon australis* is the same as *A. antarctica,* and *A. rhomboidea* is the same as *A. magellanica.*

### Subgenus FLOROMETRA A. H. Clark

### FLOROMETRA MAGELLANICA (Bell)

*Antedon eschrichti* var. *magellanica* 1882. BELL, Proc. Zoöl. Soc. London, 1882, p. 651 (1).

*Antedon rhomboidea* 1888. P. H. CARPENTER, " Challenger " Report, Comatulæ, p. 148 (2, 4).

1. *Swallow Bay, Straits of Magellan; 12 fathoms; mud and rock.*—One specimen; $P_3$ is like the following pinnules; $P_1$ and $P_2$ are very long and flagellate with short segments; the arms are 190 mm. long.

2. *" Challenger " Station No. 308.*—One specimen; this resembles the specimen in the U. S. National Museum from Panama; the ossicles of the IBr series and the lower brachials have spinous edges and a few scattered spines along the borders; the lower segments of the proximal pinnules are very strongly carinate.

3. *Near Cape Providence, Straits of Magellan; H. M. S. " Sylvia."* —One specimen, closely resembling the type.

4. *Tom Bay, Patagonia.*—One young specimen.

*Remarks.*—So far as I am able to see the types of Carpenter's *Antedon rhomboidea* only differ from the type of Bell's *Antedon eschrichti* var. *magellanica* in being slightly more spinous proximally. This is merely an indication of immaturity. The two supposed species are undoubtedly identical.

### Genus CYCLOMETRA A. H. Clark

### CYCLOMETRA FLAVESCENS A. H. Clark

*Cyclometra flavescens* 1911. A. H. CLARK, Proc. Biol. Soc. Washington, vol. 24, p. 87 (1).

1. *South of Ras Sharwein, Arabia, or northwest of Sokotra (14° 20′ N. lat., 52° 30′ E. long.); 1200 fathoms; " Electra."*—One specimen, described in detail in the reference cited.

### Genus HATHROMETRA A. H. Clark

### HATHROMETRA PROLIXA (Sladen)

*Antedon prolixa* 1881. SLADEN, in DUNCAN and SLADEN, Memoir on Arctic Echinod., p. 77 (1).—1888. P. H. CARPENTER, " Challenger " Report, Comatulæ, pp. 166 (in text), 377 (1).—1892. BELL, Cat. Brit. Echinod. in Brit. Mus., p. 58 (2, 3).—1892. DANIELSSEN, Den Norske nordhavs-Expedition, 1876-8, vol. 5, No. 21, pp. 19, 23 (4).—BRIT. MUS., MS. (5).

*Antedon hystrix* 1884. P. H. CARPENTER, Proc. Roy. Soc. Edinburgh, vol. 12, p. 365 (2, 3).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 165 (2, 3).

*Antedon celtica* BRIT. MUS., MS. (4).

1. *Discovery Bay, Greenland.*—Five medium-sized specimens.

2. *? Cold Area of Faroe Channel; "Porcupine," 1869.*—One specimen.

3. *"Triton" Station No. 4; 60° 22′ N. lat., 8° 21′ W. long.; 327-430 fathoms.*—One specimen with nine arms; in one of the post-radial series the first and second brachials of the two arms are very close together and are followed by a common syzygial pair (third and fourth brachials).

4. *"Vøringen" Station No. 373.*—Two specimens.

5. *Finmark.*—One fine specimen.

### HATHROMETRA DENTATA (Say)

*Antedon sarsii* 1882. VERRILL, Amer. Journ. Arts and Sci., vol. 23, p. 135 (?2).

*Antedon dentatum* 1882. VERRILL, *T. c.*, pp. 219, 222 (1, 2).—1889. (VERRILL), Report Commissioner of Fish and Fisheries, 1886, p. 860 (1, 2).

*Antedon dentata* 1884. VERRILL, Report Commissioner of Fish and Fisheries, 1882, pp. 657, 661 (1, 2).

*Antedon tenella* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 169 (1, 2).

1. *Off Martha's Vineyard.*—Four specimens.

2. *Off Martha's Vineyard; 183-258 fathoms.*—Three specimens.

### HATHROMETRA NORVEGICA A. H. Clark

*Antedon tenella* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 169 (1).—1892. BELL, Cat. Brit. Echinod. in Brit. Mus., p. 57 (1).—BRIT. MUS., MS. (2, 3, 4).

*Antedon sarsii* BRIT. MUS., MS. (5).

1. *"Triton" Station No. 5; 285-433 fathoms.*—Two specimens; there are nineteen cirrus segments.

2. *Trondhjem Fjord, Norway; 150-300 fathoms.*—Twenty-two specimens; the arms are from 75 mm. to 80 mm. long; the cirri have 19-20 segments.

3. *Trondhjem Fjord; 150-300 fathoms.*—Two fine specimens.

4. *Norway; 800 fathoms.*—One beautiful large specimen with arms about 90 mm. long; the cirri have 21-22 segments; the gonads are much swollen.

5. *Norway.*—One specimen.

**HATHROMETRA SARSII (Düben and Koren)**

*Antedon tenella* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 169 (1).

*Antedon sarsii* BRIT. MUS., MS. (1).

1. *Shetland.*—Two specimens.

**Genus TRICHOMETRA A. H. Clark**

**TRICHOMETRA ?DELICATA A. H. Clark**

*Antedon alternata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 179, pl. 32, fig. 6 (1).

1. *"Challenger" Station No. 218.*—One specimen; this example undoubtedly belongs to some species of the genus *Trichometra,* probably to *T. delicata.*

**Genus ISOMETRA A. H. Clark**

**ISOMETRA ANGUSTIPINNA (P. H. Carpenter)**

*Antedon lineata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 183 (1).

*Antedon angustipinna* 1888. P. H. CARPENTER, *T. c.,* p. 189 (2).

1. *"Challenger" Station No. 320.*—One specimen.

2. *"Challenger" Station No. 320.*—One specimen.

*Remarks.*—This is a small and delicate species.

Subfamily THYSANOMETRINÆ A. H. Clark

**Genus THYSANOMETRA A. H. Clark**

**THYSANOMETRA TENUICIRRA (P. H. Carpenter)**

*Antedon tenuicirra* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 186 (1).

*Antedon notata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 187 (in text), pl. 33, figs. 4, 5 (2).

1. *"Challenger" Station No. 219.*—One specimen; this species is closely related to *Th. tenelloides,* but it is a smaller form with longer brachials which are not so nearly oblong; there is the same short segmented $P_1$; $P_2$ and $P_3$ are large and stiffened; $P_2$ is slightly larger and longer than $P_3$; $P_4$ is smaller than $P_2$ and $P_3$.

2. *"Challenger" Station No. 219.*—One specimen, smaller than the preceding; there are fifteen cirrus segments, of which the proximal are very long; $P_1$ is short with comparatively few long segments; $P_2$ and $P_3$ are large.

### Genus COCCOMETRA A. H. Clark

#### COCCOMETRA HAGENII (Pourtalès)

*Antedon hagenii* 1869. POURTALÈS, Bull. Mus. Comp. Zoöl., vol. 1, No. 11, p. 355 (1).—1888. A. AGASSIZ, Bull. Mus. Comp. Zoöl., vol. 15 ("Three Cruises of the 'Blake,'" vol. 2), p. 124 (1).

*Antedon hageni* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 377 (1).

1. *Off Sombrero, West Indies; 105 fathoms.*—Four specimens.

## Subfamily BATHYMETRINÆ A. H. Clark

### Genus THAUMATOMETRA A. H. Clark

#### THAUMATOMETRA CYPRIS, new name

*Antedon alternata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 179, pl. 32, figs. 5, 7, 8, 9 (1).

1. *"Challenger" Station No. 236.*—One specimen.

#### THAUMATOMETRA ALTERNATA (P. H. Carpenter)

*Antedon alternata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 179, pl. 18, figs. 1, 2, 3 (1, 2).

1. *"Challenger" Station No. 169.*—One specimen.
2. *"Challenger" Station No. 170A.*—Two specimens.

#### THAUMATOMETRA LONGIPINNA (P. H. Carpenter)

*Antedon longipinna* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 185 (1).

1. *"Challenger" Station No. 320.*—One specimen; this is a delicate little species.

#### THAUMATOMETRA ABYSSORUM (P. H. Carpenter)

*Antedon abyssorum* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 190 (1).

1. *"Challenger" Station No. 147.*—Two specimens; this form has the general appearance of a small specimen of *Th. tenuis;* it was well figured by Carpenter.

#### THAUMATOMETRA LÆVIS (P. H. Carpenter)

*Antedon lævis* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 187 (1).

1. *"Challenger Station No. 214.*—One specimen; this is a very small and delicate species; Carpenter's figure of it is excellent.

**THAUMATOMETRA REMOTA (P. H. Carpenter)**

*Antedon remota* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 184 (1).

1. *"Challenger" Station No. 174.*—Three specimens; this species, like most of the others in the genus, is very small and delicate; it was well figured by Carpenter.

**THAUMATOMETRA EXIGUA (P. H. Carpenter)**

*Antedon exigua* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 178 (1).

1. *"Challenger" Station No. 145.*—Three specimens.

**THAUMATOMETRA HIRSUTA (P. H. Carpenter)**

*Antedon hirsuta* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 188 (1).

1. *"Challenger" Station No. 145.*—One specimen.

**Genus BATHYMETRA A. H. Clark**

**BATHYMETRA CARPENTERI A. H. Clark**

*Antedon abyssicola* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 191 (1).

*Bathymetra carpenteri* 1908. A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, p. 235 (1).

1. *"Challenger" Station No. 160.*—One specimen, well figured by Carpenter.

**BATHYMETRA ABYSSICOLA (P. H. Carpenter)**

*Antedon abyssicola* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 191 (1).

1. *"Challenger" Station No. 244.*—One specimen, well figured.

## Family PENTAMETROCRINIDÆ A. H. Clark

**Genus THAUMATOCRINUS P. H. Carpenter**

**THAUMATOCRINUS NARESI (P. H. Carpenter)**

*Promachocrinus naresi* 1888. P. H. Carpenter, "Challenger" Report, Comatulæ, p. 352 (1).

1. *"Challenger" Station No. 214.*—One specimen.

*Remarks.—Decamterocrinus borealis,* which I recently combined with *Th. naresi* as a synonym, is in reality a perfectly good species.

It is easily distinguished from the allied forms by the small size of the first and the large size of the second brachial, the latter being nearly or quite twice as large as the former. In *Th. naresi* the first three brachials are all of about the same size. *Th. borealis* is larger and more rugged than *Th. naresi.*

### THAUMATOCRINUS RENOVATUS (P. H. Carpenter)

*Thaumatocrinus renovatus* 1884. P. H. CARPENTER, Phil. Trans. Roy. Soc., 1883, p. 919.

*Promachocrinus abyssorum* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 351 (1, 2).

1. *"Challenger" Station No. 147.*—Two specimens.

2. *"Challenger" Station No. 158.*—One specimen.

*Remarks.*—This is a small and delicate species.

### Genus PENTAMETROCRINUS A. H. Clark

### PENTAMETROCRINUS JAPONICUS (P. H. Carpenter)

*Eudiocrinus japonicus* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 499 (1).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 84 (1).

1. *"Challenger" Station No. 235.*—Three specimens; these resemble the medium-sized specimens which I recorded from Japan.

### PENTAMETROCRINUS SEMPERI (P. H. Carpenter)

*Eudiocrinus semperi* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 497 (1).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 82 (1).

1. *"Challenger" Station No. 169.*—Two specimens; the disk is covered with a very close and abundant fine plating.

### PENTAMETROCRINUS VARIANS (P. H. Carpenter)

*Eudiocrinus varians* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 496 (1).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 81 (1).

1. *"Challenger" Station No. 205.*—Two specimens; these resemble the larger specimens which I have recorded from Japan and from the Indian Ocean.

## Family ATELECRINIDÆ Bather

### Genus ATELECRINUS P. H. Carpenter

#### ATELECRINUS BALANOIDES (P. H. Carpenter)

*Atelecrinus balanoides* 1881. P. H. CARPENTER, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, p. 166 (1).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 70 (1).

1. *"Challenger" Station No. 122.*—One specimen.

#### ATELECRINUS WYVILLII P. H. Carpenter

*Atelecrinus wyvillii* 1882. P. H. CARPENTER, Journ. Linn. Soc. (Zoöl.), vol. 16, p. 492 (1).—1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 72 (1).

1. *"Challenger" Station No. 174C.*—One specimen.

## Family PENTACRINITIDÆ J. E. Gray

### Genus ENDOXOCRINUS A. H. Clark

#### ENDOXOCRINUS PARRÆ (Gervais)

*Pentacrinus mülleri* 1884. P. H. CARPENTER, "Challenger" Report, Stalked Crinoids, p. 306 (1).

1. *Near St. Eustatius; 531 fathoms; "Investigator."*—One specimen.

2. *Barbados.*—Arms.

### Genus ISOCRINUS H. von Meyer

#### ISOCRINUS ASTERIA (Linné)

*Pentacrinus asterius* 1884. P. H. CARPENTER, "Challenger" Report, Stalked Crinoids, p. 300 (1).

1. *Off Saba; 320 fathoms; "Investigator."*—One specimen.

#### ISOCRINUS DECORUS (Wyville Thomson)

*Pentacrinus decorus* 1884. P. H. CARPENTER, "Challenger" Report, Stalked Crinoids, p. 330 (1, 2).

1. *Off Saba; 320 fathoms; "Investigator."*—Three specimens; one of them has an enormously long stem showing the method of attachment.

2. *Near St. Eustatius; 531 fathoms; "Investigator."*—One specimen.

### Genus METACRINUS P. H. Carpenter

#### METACRINUS ROTUNDUS (P. H. Carpenter)

*Metacrinus rotundus* 1884. P. H. CARPENTER, "Challenger" Report, Stalked Crinoids, p. 344 (1).—1885. P. H. CARPENTER, Trans. Linn. Soc. (Zoöl.), (2), vol. 2, p. 436 (1).

1. *Japan; 70 fathoms.*—One specimen.

## Family HOLOPIDÆ

### Genus HOLOPUS d'Orbigny

#### HOLOPUS RANGII d'Orbigny

*Holopus rawsoni* 1870. GRAY, Ann. and Mag. Nat. Hist. (4), vol. 8, p. 394 (1).

*Holopus rangi* 1884. P. H. CARPENTER, "Challenger" Report, Stalked Crinoids, p. 199 (1).

1. *Barbados; 5 fathoms; Sir Rawson Rawson.*—Two specimens.

## UNIDENTIFIED SPECIMENS

## Family COMASTERIDÆ A. H. Clark

### COMASTER species

1. *Macclesfield Bank; 23-25 fathoms.*—One specimen with fifteen arms 55 mm. long; two IIIBr series are developed on two IIBr series; there is one additional IIBr series; the cirri are VII, but apparently will be lost when the animal is adult.

2. *Macclesfield Bank; 26 fathoms.*—Two smaller specimens.

## Family MARIAMETRIDÆ A. H. Clark

### ANTEDON MOOREI Bell

*Antedon moorei* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 401 (1).

1. *Macclesfield Bank; 13 fathoms.*—One specimen. The cirri are XVIII, 21-25, 17 mm. long; the longest proximal segments are about one-third longer than broad; the outer thirteen segments are slightly broader than long, and bear moderately developed dorsal spines.

The thirty-two arms are 60 mm. long; the IIBr and IIIBr series, which are both 2, are in close lateral apposition, and the lateral borders of the component ossicles appear to be somewhat produced.

$P_1$ is similar to $P_2$, but not quite so long nor so stout, and it tapers somewhat more rapidly. $P_2$, which is the longest and largest pinnule on the arm, is considerably larger on the outer arms arising from each IBr axillary than on the inner; it is long, enlarged, slightly stiff-

ened, and tapers evenly to a flagellate and delicate tip, exactly resembling $P_2$ in *L. protectus;* it is composed of from sixteen to twenty-one segments, of which the third is about as long as broad and the distal are twice as long as broad; it is about one-half again as long as $P_1$. $P_3$ is about as long as $P_1$, but is slightly stouter and tapers less rapidly, more nearly resembling $P_2$; it is composed of sixteen segments. The following pinnules are small and weak.

**ANTEDON FIELDI Bell**

*Antedon fieldi* 1894. BELL, Proc. Zoöl. Soc. London, 1894, p. 401 (1).

1. *Macclesfield Bank; 22-30 fathoms.*—One specimen; this appears to be a small species belonging to some genus of Mariametridæ or Colobometridæ; there are strong transverse ridges on the cirrus segments.

2. *Macclesfield Bank; 13 fathoms.*—One similar specimen.

## Family TROPIOMETRIDÆ A. H. Clark

**? TROPIOMETRA species**

*Antedon adeonæ* 1884. BELL, "Alert" Report, p. 156 (1).

1. *Port Molle, Queensland; 12-20 fathoms; "Alert."*—One specimen of what appears to be a new species of *Tropiometra* characterized by very slender cirri.

2. *"Alert" Station No. 87.*—One similar specimen.

## Family THALASSOMETRIDÆ A. H. Clark

**THALASSOMETRA species**

1. *Northwest of Sokotra (14° 20′ N. lat., 52° 30′ E. long.); 1200 fathoms; Cable-repair Ship "Electra"; 7/10/'09.*—One very fragmentary specimen of a new species of *Thalassometra;* the long and numerous spines on the calyx and arm bases suggest an affinity with *Th. bispinosa.*

## Family CHARITOMETRIDÆ A. H. Clark

**PACHYLOMETRA species**

1. *Northwest of Sokotra (14° 20′ N. lat., 52° 30′ E. long.); 1200 fathoms; Cable-repair Ship "Electra"; 7/10/'09.*—One large specimen with twelve arms, the IIBr series being 4 (3 + 4); the cirri are long; the calyx and arm bases are fairly smooth.

## Family ANTEDONIDÆ Norman

### COMPSOMETRA species

1. *Lewis Island, Dampier Archipelago, Western Australia.*—Eleven specimens, possibly referable to *C. loveni.*

### HATHROMETRA species

*Antedon dentata* 1884. P. H. CARPENTER, Proc. Roy. Soc. Edinburgh, vol. 12, p. 362 (1, 2).

*Antedon tenella* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 169 (1, 2).

1. *"Porcupine" Station No. 51.*—One specimen partially decalcified and not specifically determinable, though it appears to belong to *H. prolixa.*

2. *"Porcupine" Station No. 54.*—One specimen; the cirri are stouter than those of *H. sarsii;* the longest cirrus segments are about four or four and a half times as long as the median diameter, not greatly constricted centrally; the centrodorsal is low and conical. Probably this is a young specimen of *H. prolixa.*

### THAUMATOMETRA species

1. *Northwest of Sokotra (14° 20′ N. lat., 52° 30′ E. long.); 1200 fathoms; Cable-repair Ship "Electra"; 7/10/'09.*—One specimen, apparently of a new species of the genus.

## TYPE SPECIMENS OF COMATULIDS IN BRITISH MUSEUM

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**Cenometra emendatrix** (Bell) ..... p. 33
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**Cyllometra manca** (P. H. Carpenter) ..... p. 34
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The British Museum collection also includes the specimens upon which the following names, now known to be synonyms, are based:

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*Actinometra divaricata* P. H. Carpenter ..... **Comantheria briareus**, p. 13
*Actinometra duplex* P. H. Carpenter ..... **Comanthina schlegelii**, p. 14
*Actinometra elongata* P. H. Carpenter ..... **Comanthus parvicirra**, p. 18
*Actinometra intermedia* Bell ..... **Comatula solaris**, p. 8
*Actinometra jukesii* P. H. Carpenter ..... **Comatula rotalaria**, p. 8
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*Antedon bidens* Bell.....**Oligometrides adeonæ**, p. 37
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The following manuscript names are found on specimens in the British Museum collection:

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**Comatula purpurea**, p. 9
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**Comanthus bennetti**, p. 15

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*Actinometra brachiolata* BRIT. MUS., MS.....**Amphimetra discoidea**, p. 24

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*Actinometra cumingi* 1904. CHADWICK, in HERDMAN, Report Ceylon Pearl Oyster Fisheries, vol. 2, Suppl. Rep. XI, p. 153.
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*Actinometra elongata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 311.....**Comanthus parvicirra**, p. 18

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*Actinometra maculata* 1894. BELL, Proc. Zoöl. Soc. London, 1894, pp. 395, 396.
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*Actinometra maculata* 1902. BELL, in GARDINER, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, part 3, p. 225.
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*Actinometra pectinata* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 284.....**Comatula pectinata**, p. 10
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*Actinometra simplex* 1888. P. H. CARPENTER, "Challenger" Report, Comatulæ, p. 312.....**Comanthus parvicirra**, p. 18
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SMITHSONIAN MISCELLANEOUS COLLECTIONS
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# A NEW SHRUB OF THE GENUS ESENBECKIA FROM COLOMBIA

BY

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BERLIN

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# A NEW SHRUB OF THE GENUS ESENBECKIA FROM COLOMBIA

By DR. K. KRAUSE, Berlin

Among the plants collected in Colombia by Mr. Henry Pittier I have found a species of Rutaceae belonging to the genus Esenbeckia Kunth which I have been unable to identify with any species heretofore known and which I venture to describe as *Esenbeckia Pittieri,* in honor of its collector.

**ESENBECKIA PITTIERI Krause, sp. nov.**

Arbuscula erecta parva fruticulosa ramulis tenuibus subteretibus vel apicem versus paullum complanatis glabris cortice dilute brunneo leviter longitudinaliter striato obtectis. Folia simplicia ad ramulorum apices dense conferta; petiolus brevis tenuis supra leviter canaliculatus basi paullum dilatatus, 1.5-2 cm. longus; lamina tenuiter coriacea utrinque glaberrima oblongo-lanceolata vel anguste oblongo-lanceolata apice latiuscule acuminata basin versus sensim cuneatim angustata, 9-12 cm. longa, 2.5-3.5 cm. lata, nervis primariis utrinque 4-6 angulo obtuso a costa patentibus marginem versus arcuatim adscendentibus supra paullum impressis subtus distincte prominentibus percursa. Rami floriferi 15-16 cm. longi; racemis tenuibus divaricatim patentibus, 4-5 cm. longis, sparsissime pilosis vel omnino glabris, laxifloris. Bracteae lineari-subulatae acutae. Pedicelli graciles patentes, 5-8 mm. longi. Flores parvi viridescentes; calycis laciniae late ovatae apice subacutae margine minute ciliolatae, vix 0.5 mm. longae; petala crassiuscula ovata circ. 1.5-1.8 mm. longa (in sicco nigro-punctulata); stamina dimidium petalorum paullum superantia antheris parvis ovoideis obtusis; discus leviter undulatus; ovarium depresso-globosum stilo crassiusculo paullum longiore coronatum.

Colombia: Forests of El Yarumal, between Corinto and Tacueyó, State of Cauca, alt. 2,200 m., January 19, 1906, *H. Pittier,* no. 1,014; (U. S. National Herbarium, no. 531,213, type).

This species belongs to the section Pachypetalae and, though apparently very closely allied to *E. leiocarpa* Engl. and *E. cornuta* Engl., is distinguished from these by its glabrous branches and leaves and by the shape of the latter.

Fruiting material was not collected.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
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# NEW RACES OF UNGULATES AND PRIMATES FROM EQUATORIAL AFRICA

BY
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# NEW RACES OF UNGULATES AND PRIMATES FROM EQUATORIAL AFRICA

By EDMUND HELLER

NATURALIST, SMITHSONIAN AFRICAN EXPEDITION

The present paper deals with African mammal material in the United States National Museum collected by the Smithsonian African Expedition under the direction of Colonel Theodore Roosevelt and by the Paul J. Rainey Expedition to British East Africa.

### GORGON ALBOJUBATUS MEARNSI, new subspecies

Loita White-Bearded Wildebeest

*Type* from the Loita Plains, British East Africa; adult male, Cat. No. 163020, U. S. Nat. Mus.; shot by Dr. E. A. Mearns, June 28, 1909; original number 6809.

*Characters.*—Differs from the typical *Gorgon albojubatus* of the Athi Plains by dark colored limbs, smaller body size, the skull being decidedly less in length; and less widespread horns which are curved downward well below lower margin of orbit and about level with the foramen magnum. In *albojubatus* the horns extend much more horizontally, their lower edge not extending below the lower edge of the orbit.

Coloration of type: dorsal color drab-gray spotted and banded by dark patches due to the tips of the hair becoming dark brown as though representing an old worn pelage, the new alone being drab-gray. This faded condition of the hair is not seasonal but is a chronic condition in the wildebeest. Limbs darker than the body, uniform olive-brown deepening somewhat on the pasterns. Chest, fore part of belly and lower sides much darker than the back, clove-brown, the chest medially black. Groins, axillæ and inside of legs drab-gray like the back. Tail like the back in color and furnished along the lower surface and at the tip with a long black tuft of hair fully as long as the tail itself. Neck like the back in ground color but showing ragged cross bands of dark hair bases; a mane of long black hair extends the whole length of the nape and is continued as a black line on the back as

far as the rump. The throat marked by a mane of long buffy or whitish hair from the chin to the chest. Top of snout from the interorbital region to the muzzle and far down on the sides to the lower level of the eyes deep black, the blackness at muzzle spreading down around the mouth and uniting with the black chin; the upper lips whitish at tip of snout and walnut-brown on the sides. Sides of head drab-gray like the neck with a slightly lighter streak bordering the black face blaze from the eye to the angle of the mouth. Crown seal-brown and showing some contrast to the black forehead. Back of ears black and united with the dark crown patch by a narrow bridge of dark color, rest of base and inside pale drab-gray.

No flesh measurements of the type are available but an adult male specimen from the same locality, No. 181851, U. S. Nat. Mus., had dimensions in the flesh as follows: Head and body, 2,000 mm.; tail, 645; hindfoot, 515; ear, 200. The skull of the type shows considerable age, the last molars showing wear, the horn points being much worn down and the fronto-nasal suture quite obliterated. Condylobasal length, 430; greatest length, 457; greatest breadth, 185; nasals, 222 x 40; orbit to gnathion, 300; length of premaxillæ, 192; vertical diameter of eye, 58; upper tooth row, 101; width of palate across $M^2$, 95; tooth row to gnathion, 142. Length of horns on curve, 15½ inches; greatest spread, 20⅝ inches; spread at tips, 13½.

A series of twelve skins, with their skulls, of this new race is in the National Museum from the Loita Plains and six skins and skulls from the Kapiti or Athi Plains representing *albojubatus*. The series from the Loita representing *mearnsi* shows much darker legs accompanied by darker body color on the chest, sides and underparts. In the typical *albojubatus* of the Athi the legs are drab or tawny-olive and never as dark as olive-brown or sepia. No difference in the color of the throat, mane or forehead is evident in these two series but the ears at the base in *albojubatus* show a tendency to lose the bridge of dark color from the back of the ear to the crown patch. The horns in the Loita Plains specimens agree in showing a much deeper sweep downward from the head than do those of typical *albojubatus* from the Athi Plains.

*Gorgon* has been employed as the genus of the brindled wildebeests owing to their marked distinctness in skull shape and horns from the white-tailed gnu which is the type of the genus *Connochætes* of Lichtenstein. *Gorgon* was proposed by Gray in 1850 for the brindled wildebeest, *G. taurinus*.

**BUBALIS LELWEL KENIÆ, new subspecies**

Kenia Lelwel Hartebeest

*Type* from the North Kenia Plateau, 20 miles northeast of Nyeri near the Meru road; adult male, Cat. No. 182009, U. S. Nat. Mus., shot by Paul J. Rainey, June 27, 1911; original number, 2310.

*Characters.*—Resembling *Bubalis lelwel jacksoni* closely in coloration and size but differing by the more widely spread or divergent horns and by decidedly shorter horn pedicle. From *cokei* or any of its races it is at once distinguishable by its V-shaped horns, longer head and larger body size.

Dorsal coloration uniform cinnamon-rufous, the color becoming gradually lighter on the sides and belly where it is ochraceous-buff. Legs like the sides without any black markings except a black border to the clefts of the hoofs in front. Terminal half of tail furnished with a long black tuft. Crown of head and snout darker and more rufous than the back. Ears like the back except on inside where they are clothed by white hair. Tip of chin black in marked contrast to the tawny throat.

Dimensions of the type in the flesh: head and body along curve of back, 2,000 mm.; tail, 570; hindfoot, 540; ear, 280. Skull: condylo-basal length, 431; greatest length from bifurcation of horn pedicle, 495; length of horn pedicle from bifurcation to orbit, 143; least width of pedicle, 111; gnathion to tooth row, 150; width of palate across $PM^2$, 88; length of premaxillæ, 140; nasals, 223 x 42; vertical diameter of orbit, 50. Adult, but not aged, the teeth showing very little wear.

There is one other specimen in the collection besides the type. This is also a male but from a locality some 20 miles farther west. It is much younger than the type having just shed its milk molars. In coloration it is quite light, being uniform buff in color without the rufous tinge of the type.

The horns of the type are broadly V-shaped with the tips turned sharply backward at right angles and parallel in direction. Length along front curve, 21¼ inches, spread at tips, 10¼ inches; circumference at base, 11¾ inches. The horn pedicle is much wider than in *jacksoni,* the least width being considerably greater than two-thirds of the length.

The Kenia lelwel is confined to the plateau region drained by the Northern Guaso Nyiro and flanking Mount Kenia on the north. It represents the extreme western range of the lelwel type of hartebeest.

Westward it connects with true *jacksoni* in the region west of Lake Baringo. It occurs in very limited numbers, is exceedingly wary and is seldom secured by sportsmen.

### SYLVICAPRA GRIMMIA DESERTI, new subspecies

Desert Bush Duiker

*Type* from Voi, British East Africa; adult male, Cat. No. 182219, U. S. Nat. Mus.; collected by Edmund Heller, October 27, 1911; original number, 2532.

*Characters.—Sylvicapra grimmia deserti* is decidedly lighter than the other East African races of bush duikers with more vertically directed horns and shorter pelage. Body size large. Dorsal coloration buffy without any approach to the tawny color of the highland races and with the dark chin spots obsolete or but faintly indicated.

Color of the type: dorsal color buff speckled very lightly by narrow dusky vermiculations to the hair; underparts white, the breast showing but a slight tendency toward the ochraceous color of *hindei*. Legs buffy like the body but lacking the darker vermiculation; from the fetlocks to hoofs solid fuscous-brown which is continued upward in front as an indefinite darker leg stripe. Tail with a median black dorsal stripe, the sides and under surface white in sharp contrast. Head ochraceous marked by a broad seal-brown or black median stripe from the muzzle to the horn bases. Lips, chin, and forethroat white, the chin marked on sides by two faint drab-gray spots representing the blackish patches of *hindei*. Eye lashes and anteorbital stripe black. Ears on back covered by a short scattered growth of ochraceous hair but general color tone dark brownish due to the dark skin; inner side and base white. Throat and nape ochraceous-buff, slightly darker than the body.

Measurements of type in the flesh: Head and body, 810 mm.; tail, 110; hindfoot, 260; ear, 105. Skull, adult, with last molar in place but with milk molars still in use: greatest length, 166; condylobasal length, 156; greatest breadth, 72; nasals, 63 x 30; length of premaxillæ, 48; vertical diameter of orbit, 26; orbit to gnathion, 87; tooth row to gnathion, 49; length of upper tooth row, 51. Length of horns, straight, 4⅛ inches; spread at tips, 2⅝ inches. Angle of horns with profile of dorsal surface of head, 130°.

Besides the type there are four adult females in the National Museum collected by the Rainey Expedition. Two of these are from Voi, one from Maji-ya-Chumvi, and the other from Mariakani sta-

tion. They all agree closely in their light buffy coloration. The horn character, however, may not be constant as it is based on a single specimen. A large series of the highland races, however, do not show any variation toward vertically directed horns. *Deserti* is a lowland race occupying the Taru Desert and the nyikæ of the coast slope generally as far north no doubt as the Tana River. It differs strikingly from the Athi Plains race described as *hindei* which is a dark tawny form. A series of seven specimens of the latter in the National Museum have been available for comparison with *deserti*. The lowland Nile race, *roosevelti*, is a much smaller and darker colored animal and is readily distinguishable by its small size from all the East African races.

**COLOBUS ABYSSINICUS ROOSEVELTI**, new subspecies

Mau Colobus Monkey

*Type* from the Mau forest near Enjoro, British East Africa, adult male, Cat. No. 163261, U. S. Nat. Mus.; shot by Colonel Theodore Roosevelt, December 6, 1909; original number (Heller) 513.

*Characters.*—Resembling most closely *Colobus abyssinicus matschiei* of the Kavirondo country but differing by its smaller size, shorter and more extensively black tail and the presence of a sagittal crest on the skull when aged. From the white-tailed *Colobus* of the Kikuyu Escarpment, the Aberdares, and Mount Kenia it is easily distinguishable by the absence of the large white tail, the white tail tuft being reduced to the terminal one-fourth of the tail, the basal three-fourths of which is clothed by short black hair.

Four specimens of this race shot by Colonel Roosevelt near Enjoro are in the National Museum. These have been compared with a series of five specimens of *matschiei* from the Kakumega forest which are practically topotypes. The skulls of *matschiei* are decidedly larger and their pareital ridges do not unite on the occipital region to form a crest but run parallel and widely separated to their junction with the lambdoidal crest.

No flesh measurements of this race are available. The type skull has the following dimensions: greatest length, 117 mm.; basilar length, 85; zygomatic breadth, 86; post orbital construction, 45; median nasal length, 26.4; width of palate in front between premolars, 22; width of palate at last molar, 20; length of upper molar series, 32.5. An adult male of *matschiei* of the same age has a skull length of 127 and a zygomatic width of 92.

The Mau forest near Enjoro where Colonel Roosevelt obtained the types represents the extreme eastern limit of this race. It is primarily a highland race occupying the high forest of the Mau Escarpment. Along the western edge of the Mau Escarpment in the Kavirondo country it meets the race described by Neumann as *matschiei* which is really the lowland Uganda *Colobus* which extends as far east as the Kavirondo district and the slopes of Mount Elgon.

**COLOBUS ABYSSINICUS PERCIVALI, new subspecies**

Uaragees Colobus Monkey

*Type* from Mount Uaragess, British East Africa; adult male, Cat. No. 182138, U. S. Nat. Mus.; collected by Edmund Heller, August 22, 1911; original number 2447.

*Characters.*—The *Colobus* inhabiting Mount Uaragess may be distinguished from typical *Colobus abyssinicus caudatus* of Kilimanjaro by the smaller white tail tuft, longer tail, larger body size and skull. The latter is distinguishable from *caudatus* by the union of the temporal ridges into a sagittal crest. In typical *caudatus* the white tail tuft is of immense size and occupies the whole tail with the exception of the basal one-fourth which is black but in the Uaragess race the whole basal half of the tail is black the white tuft being reduced to the terminal half. In the Abyssinian race, *abyssinicus,* the white tail tuft is still further reduced and is limited to the terminal fourth.

The measurements of the type in the flesh were: head and body, 645 mm.; tail, 645; hindfoot, 190; ear, 38. Skull of the type old with the occipital sutures obsolete, but molars show little wear: greatest length, 102; basilar length, 87; zygomatic breadth, 89; post-orbital constriction, 45; median length of nasal bones, 15; width of palate at last molar, 20; length of upper molar series, 35; length of mandible, 92. Besides the type there is one other specimen, an adult male, from Mount Uaragess in the collection. These have been compared with a series of 17 adult males from Kenia, Kijabe and Kilimanjaro. The largest in this series is exceeded in body size and length of tail by the type. The Uaragess race is confined to the forested summit of Mount Uaragess where it is a rather rare animal. But one troupe of some 20 individuals was noted during a week's sojourn on the northern peak. The forested area of Uaragess is separated from that of Mount Kenia by a hundred-mile stretch of low desert which completely isolates this race from communication with the *caudatus* inhabiting Kenia. Named for A. Blaynel Percival to whom the

describer is indebted for much assistance during his stay on Mount Uaragess.

### COLOBUS ABYSSINICUS TERRESTRIS, new subspecies

Lado Colobus Monkey

*Type* from Rhino Camp, Lado Enclave; adult female, Cat. No. 164756, U. S. Nat. Mus.; shot by Kermit Roosevelt, January 20, 1910; original number (Heller) 623.

*Characters.*—Differs from the other races of *Colobus abyssinicus* by the reduced amount of white in the mantel and the great length of the tail. It approaches most closely in coloration to *matschiei* or *occidentalis* but has decidedly less white in the mantel covering the sides and the rump. The white tail tuft is limited to the terminal one-fourth, the rest of the tail being covered by short black hair. White of tail tuft and mantel much shorter haired than in *matschiei*. Tail greatly exceeding head and body in length. Skull smaller than *matschiei*.

Measurements of the type in the flesh: head and body, 540 mm.; tail, 775; hindfoot, 158; ear, 30. In an adult female of *matschiei* the tail is only 655. The skull of the type is old and has a well-marked sagittal crest on the occipital region: greatest length, 102; basilar length, 75; zygomatic breadth, 72; post orbital constriction, 42.5; median length of nasals, 11; upper molar series, 29; width of palate at last molar, 20.

The type is the only specimen in the National Museum. Small troupes of this race were seen by Kermit Roosevelt near the banks of the Nile, but were not observed by other members of the expedition. They were found in small scattered acacia trees which they deserted when hard pressed and ran across country to the next nearest grove in the manner of baboons. The Colobus monkeys of the highlands of East Africa have quite different habits and live in dense forests where they move about through the trees by leaping from one branch to another and descend to the ground rarely to escape an enemy. They are not known to inhabit acacia trees.

### LASIOPYGA LEUCAMPAX MAUÆ, new subspecies

Mau Forest Monkey

*Type* from the summit of the Mau Escarpment between Londiani and Sirgoit, British East Africa, adult male, Cat. No. 173002, U. S. Nat. Mus.; collected by John Jay White, November 1, 1910.

*Characters.*—Resembling *Lasiopyga leucampax neumanni* but dorsal coloration olivaceous (grayish-olive of Ridgway) without the gray cast of that race and with the shoulders more extensively black; body size larger; skull longer and narrower with well-developed sagittal crest in age; teeth larger and heavier.

No flesh measurements of this race are available. The skull of the type measures: greatest length, 122 mm.; basilar length, 87; zygomatic breadth, 77; post orbital constriction, 41; median length of nasals, 26; length of upper molar series, 28; width of palate at $M^3$, 21. The skull shows considerable age and has a well-marked sagittal crest running the whole length of the brain case. The cheek teeth and the middle incisors show much wear.

The type is the only specimen in the National Museum, but there is a series of nine specimens of the closely allied *neumanni* from the Kakumega Forest for comparison in the museum collected by the Rainey Expedition. This series which is very uniform smoke-gray on the back exhibits practically no variation in tone and is easily distinguishable from the specimen collected by John Jay White. The largest male in the series has a considerably smaller skull than the type. The race here described occupies the highland forest of the Mau Escarpment and is the easternmost representative of the Congo group known as *leucampax* of which *neumanni* is the lowland Uganda and Kavirondo race.

### LASIOPYGA ALBOGULARIS MARITIMA, new subspecies

Coast Forest Monkey

*Type* from Mazeras, British East Africa; adult female, Cat. No. 182272, U. S. Nat. Mus.; collected by Edmund Heller, December 17, 1911; original number, 2585.

*Characters.*—*Lasiopyga albogularis maritima* differs from the other East African races by lighter coloration and absence of black lining or black tips to the hair on the back and underparts. Back ochraceous-tawny; underparts light smoke-gray without the blackish vermiculation so prevalent in *kolbi* and *kibonotensis*.. Body size somewhat smaller. Skull small with narrow palate and large cheek teeth.

Measurements of the type in the flesh: head and body, 420 mm.; tail, 675; hindfoot, 125; ear, 31. Skull: greatest length, 95; basilar length, 62; zygomatic width, 62; post orbital constriction, 42; median length of nasals, 16; length of upper molar series, 25; width of palate at last molar, 18.

There are three female specimens of this race from Mazeras in the National Museum. The type is fully adult with the sphenoidal sutures of the skull anchylosed but the two others are somewhat immature. This small series has been compared with five females of *kolbi* from the Aberdares and Kenia and five females of *kima* from the Taita Hills. From these two races they are easily distinguishable by their light coloration and absence of black lining to the pelage. *Maritima* is a lighter and somewhat smaller race confined to the forests clothing the summits of the coast hills.

### LASIOPYGA ALBOGULARIS KIMA, new subspecies

Taita Forest Monkey

*Type* from Mount Mbololo, Taita District, British East Africa; adult male, Cat. No. 182242, U. S. Nat. Mus.; collected by Edmund Heller, November 6, 1911; original number, 2555.

*Characters.*—Resembling closely *Lasiopyga albogularis kolbi* of the Kikuyu highlands from which it is distinguishable by its lighter and less rufous back, the smaller extent of the white throat patch and collar and the smaller body size. From *kibonotensis* of Kilimanjaro it is distinguishable by the white of the throat patch extending farther upward on the sides of the neck toward the nape. In this character it is quite intermediate between *kolbi* and the latter, but it is lighter colored and smaller than either of these races.

Flesh measurements of the type: length of head and body, 510 mm.; tail, 600 (defective at tip, perfect tail usually 725); hindfoot, 150; ear, 38. Skull: greatest length, 113; basilar length, 83; zygomatic breadth, 77; post orbital constriction, 44; median length of nasals, 20; length of upper molar series, 27; width of palate at last molar, 22. Skull of type old with the middle incisors much worn and with the temporal ridges uniting at the parietal suture but not forming a high narrow crest.

Ten specimens of this race are in the National Museum collected by the Rainey Expedition upon Mount Mbololo and Mount Umengo of the Taita Hill region. They are confined to the forests at the extreme summits of the hills, and their cover is at present rapidly disappearing before the ax and fire of the agricultural Wataita who are constantly enlarging their fields at the expense of the forest. The Wataita are fond of the flesh of the *kima* and owing to their persecution it is extremely shy and difficult to stalk. The name kima is used universally by the Swahili for this monkey and it is also employed by the Wataita who occasionally corrupt it to gima.

**LASIOPYGA ASCANIUS KAIMOSÆ, new subspecies**

Kavirondo White-nosed Monkey

*Type* from the Upper Lukosa River, near the mission station of Kaimosi, British East Africa; adult male, Cat. No. 182371, U. S. Nat. Mus.; collected by Edmund Heller, February 10, 1912; original number, 2692.

*Characters.*—Closely allied to *Lasiopyga ascanius schmidti* of the Manyema and Uganda country from which it is distinguishable by the brighter colored tail which is orange-rufous, the more blackish limbs which lack reddish vermiculation and the general darker and less reddish coloration of the upper parts.

The type measured in the flesh: head and body, 550 mm.; tail, 780; hindfoot, 145; ear, 30. Skull: greatest length, 100; basilar length 68; zygomatic breadth, 68; post orbital constriction, 42; median length of nasals, 16; length of upper molar series, 24; length of mandible, 70; length of lower molar series, 28.

The Rainey Expedition collected a large series of specimens from Kaimosi, the head of the Lukosa River on the lower slopes of the Nandi Escarpment and the Kakumega Forest. This material is now in the National Museum. It represents the eastern limits of the *ascanius* group of *Lasiopyga* in Africa which has not previously been reported so far east as British East Africa. They were found abundant in the dense forests where they lived in proximity to colobus and the large gray forest monkeys, *Lasiopyga leucompax neumanni.* When alarmed they uttered a peculiar, low, chirping, bird-like note very unlike the barking calls of other African monkeys.

**LASIOPYGA PYGERYTHRA TUMBILI, new subspecies**

Coast Tumbili Monkey

*Type* from Ndi, Taita District, British East Africa; adult male, Cat. No. 182229, U. S. Nat. Mus.; collected by Edmund Heller, November 1, 1911; original number, 2542.

*Characters.*—A very pale desert race of *Lasiopyga pygerythra* having the back olive-buff in color, the limbs grayish and the hands and feet black only on their distal parts. The dorsal surface shows none of the tawny reddish tint so prevalent in the other East African races. From *johnstoni* of Kilimanjaro it may be distinguished by its lighter dorsal coloration and smaller amount of black on the hands and feet. *Rubellus* of the Kenia and Nairobi districts differs

by its darker back which is decidedly ochraceous-tawny and by its wholly black feet and hands as well as larger body size.

The measurements of the type in the flesh were: head and body, 460 mm.; tail, 620; hindfoot, 133; ear, 32. The skull is that of an aged animal with the occipital sutures no more evident and the incisor teeth well worn. The temporal ridges do not form a sagittal crest but the median occipital region is marked by a flattened raised band. Greatest length, 104; basilar length, 70; zygomatic breadth, 70; post-orbital constriction, 44; median length of nasals, 17; length of upper molar series, 26; width of palate at last molar, 18.

A series of 13 specimens of this race is in the National Museum from Ndi, Voi, Changamwe, and Mtoto Andei stations collected by the Rainey Expedition. Most of these were collected at Ndi, a Taita village at the north base of Mount Mbololo. Here they were found living in the acacia trees on the steep sides of the mountain from which they descended daily to the small stream near the village to drink. Others were seen in fig trees growing near the banks of the Voi River close to the station. This monkey is called by the Swahili "tumbili" and the name has been adopted by many of the inland tribes and the resident Europeans for the monkeys of the *pygerythra* group.

### LASIOPYGA PYGERYTHRA ARENARIA, new subspecies

Desert Tumbili Monkey

*Type* from the Merille waterholes, Marsabit Road, British East Africa; adult male, Cat. No. 182201, U. S. Nat. Mus.; collected by Edmund Heller, July 25, 1911; original number, 387.

*Characters.*—Closely resembling *Lasiopyga pygerythra callida* of Naivasha but separable by the more tawny dorsal coloration, less extensively black feet, shorter pelage and longer tail. From *rubellus* of the Mount Kenia region it may be distinguished by its darker dorsal coloration and lighter colored limbs and tail.

There are no flesh measurements of the type available but a specimen (Cat. No. 182140, U. S. Nat. Mus.) of the race from the base of Mount Uaragess had the following dimensions: head and body, 445 mm.; tail, 650; hindfoot, 129; ear, 33. Skull of type old with worn molars and incisors. Sagittal crest low and short. Greatest length, 99; basilar length, 64; zygomatic breadth, 70; post orbital constriction, 42.5; median length of nasals, 22; length of upper molar series, 24; width of palate at last molar, 18.

Along the banks of the Northern Guaso Nyiro this monkey was found very abundant. It is commonly found in the large flat-topped acacia in small troupes. It is found throughout the desert wherever there is water available. At Merille they came daily to the waterholes to drink but they were quite cautious in approaching the waterholes which were fifty yards from any cover in the midst of the flat sandy riverbed. Besides the type there are 16 specimens from the middle course of the Guaso Nyiro and two from the lower slopes of Mount Uaragess.

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# ANTHROPOLOGICAL WORK IN PERU IN 1913, WITH NOTES ON THE PATHOLOGY OF THE ANCIENT PERUVIANS

With Twenty-Six Plates

BY

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## I. INTRODUCTION

In 1910 the writer made a brief visit to Peru, resulting in the acquisition of some valuable data and of important skeletal collections,[1] but this gave merely a taste of the anthropological riches of the country and created a strong desire for further work in that part of the South American continent.

An opportunity to extend the investigations was afforded the early part of the year 1913, in connection with the preparation of anthropological exhibits for the Panama-California Exposition at San Diego; and three busy months were spent on the Peruvian coast and in certain parts of the mountain region of Peru, in exploring the ancient cemeteries.

Due to adverse climatic conditions, poor means of communication and transportation, the backward state of the people, and the prevalence of infectious diseases, the journey proved uncommonly difficult. For these reasons and also because of the impossibility of further extending the absence from Washington, it became necessary to limit the territory to be covered. Notwithstanding these conditions however, much was learned, while a large number of the rarer specimens were gathered for further study.

Before proceeding with the account of what was accomplished, grateful acknowledgment should be made to the Peruvian authorities and to good friends in different parts of the country, for the generous help extended to the expedition. The writer wishes espe-

[1] Reported by the writer in "Some results of recent anthropological exploration in Peru," Smithsonian Misc. Coll., Vol. 56, No. 16 (Publication 2005), Washington, 1911, pp. 1-16, with 4 plates.

cially to thank His Excellency the President of Peru, who personally granted the needed permits for the exploration; to Sr. Luis Felipe Paz Soldan, the Director de Gobierno, who assisted the writer with the permits and in other matters; to the Hon. Ministro de Fomento, and the Srs. Ingenieros José Bravo and C. W. Sutton, who rendered valuable aid in more than one direction; to Mr. H. Clay Howard, the U. S. Minister at Lima, who gave much official and friendly aid with the Peruvian authorities; to W. R. Grace & Co., both at New York and at Lima, who helped the expedition very materially with introductions and in facilitating the transport of the collections; to Sr. Miro Quesada, editor of "El Comercio," for his kind recommendations to the President of Peru in regard to the expedition; to the excellent friends, Senator Sr. Victor Larco, of Trujillo, and Sr. Enrique Fracchia, of Lomas, without whose generous aid a large part of the work in the Chan-Chan and the Nasca regions could not have been accomplished; to the family Tello, of Huarochirí, to the members of which the writer is indebted for many favors; and last but not least to Messrs. Otto Holstein and R. H. McGeary, officials, respectively, of the Central and North Eastern Peruvian Railroads, who assisted with transportation and in other directions. And these names by no means complete the list of those who unselfishly helped in one way or another toward the success of the trying work.

The principal objects of the trip were, to determine, as far as possible, the anthropological relation of the mountain people with those of the coast; to make further studies regarding the distribution of the coast type; to determine the type of the important Nasca group of people; and to extend the writer's researches on Indian and especially pre-Columbian pathology. Advance was made along all these lines, although the limits or final words were not reached in any case. The earlier conclusions of the writer were in the main corroborated, but the new facts add details and show exceptions. With regard to the mountain regions, much remains for future determination. As to the pathology of the native Peruvians before contact with the whites, the main work can perhaps now be regarded as done, or nearly so, though individual variation in different morbid processes seems inexhaustible, and much in this line will doubtless appear in further collections.

The total skeletal material examined on this journey was enormous, the collections alone filling over 30 cases. No excavation, however, was undertaken, attention being restricted, on the coast, to the

bones upon the surface of ancient cemeteries, exploited by the peons and occasionally by persons "higher up" for the sake of the pottery and other valuables buried with the bodies; and to the usually equally exploited burial caves or houses in the mountains. This procedure was necessary on account of the limited time available for the journey, as well as to comply with the terms of the official permits. It had the unequaled advantage of enabling the writer to examine an immense number of specimens. This made it possible to learn promptly many facts offered by the material, and to make representative collections in a relatively short time. These precious and now rapidly disappearing opportunities present, however, also certain disadvantages which can be compensated for only by patient and prolonged excavation. They render difficult and in many respects impossible, any exact statistical determinations, and only rarely do they give opportunity to examine all the parts of the individual skeleton.

As heretofore mentioned the opportunities for anthropological and pathological studies on the prehistoric material in Peru are on the wane, and should be taken full advantage of before they are largely lost, which is seemingly a matter of only a few years. In 1910, after the writer returned from Peru, he called the attention of the Anthropological Society of Washington to the vandalism going on unrestrainedly in the richest burial grounds and ruins of that country, and a resolution was adopted by the Society calling the attention of the Peruvian Government to the necessity of stopping this wanton destruction.[1] As a result, a set of rules was promulgated by the president of Peru prohibiting unauthorized excavations and exportation of archeological specimens from the republic.[2] These rules were published and communicated to the various Peruvian authorities concerned in the subject and while they failed to accomplish their full purpose, yet they have diminished the excavations to a very large extent, and have especially made the peon wary, so that in many instances he now hides the traces of his work by covering the bones. Meanwhile the destruction by the elements of the skeletal remains left on the surface is rapidly advancing, so that cemeteries that were still rich in such material in 1910, to-day, in many cases, offer little more than useless rubbish. The laws against the destructive work of the peon will doubtless be more fully enforced

[1] See Science, 1911, p. 552; The American Anthropologist, 1911, p. 317.

[2] Edict of August 11, 1911, published in the *El Comercio* and other Peruvian periodicals; translation in The American Anthropologist, 1912, p. 204.

in the future, as they should be, and four or five years hence, except in the mountains and the more sheltered localities, but little will be found in Peru for the anthropologist without costly and time consuming excavation.

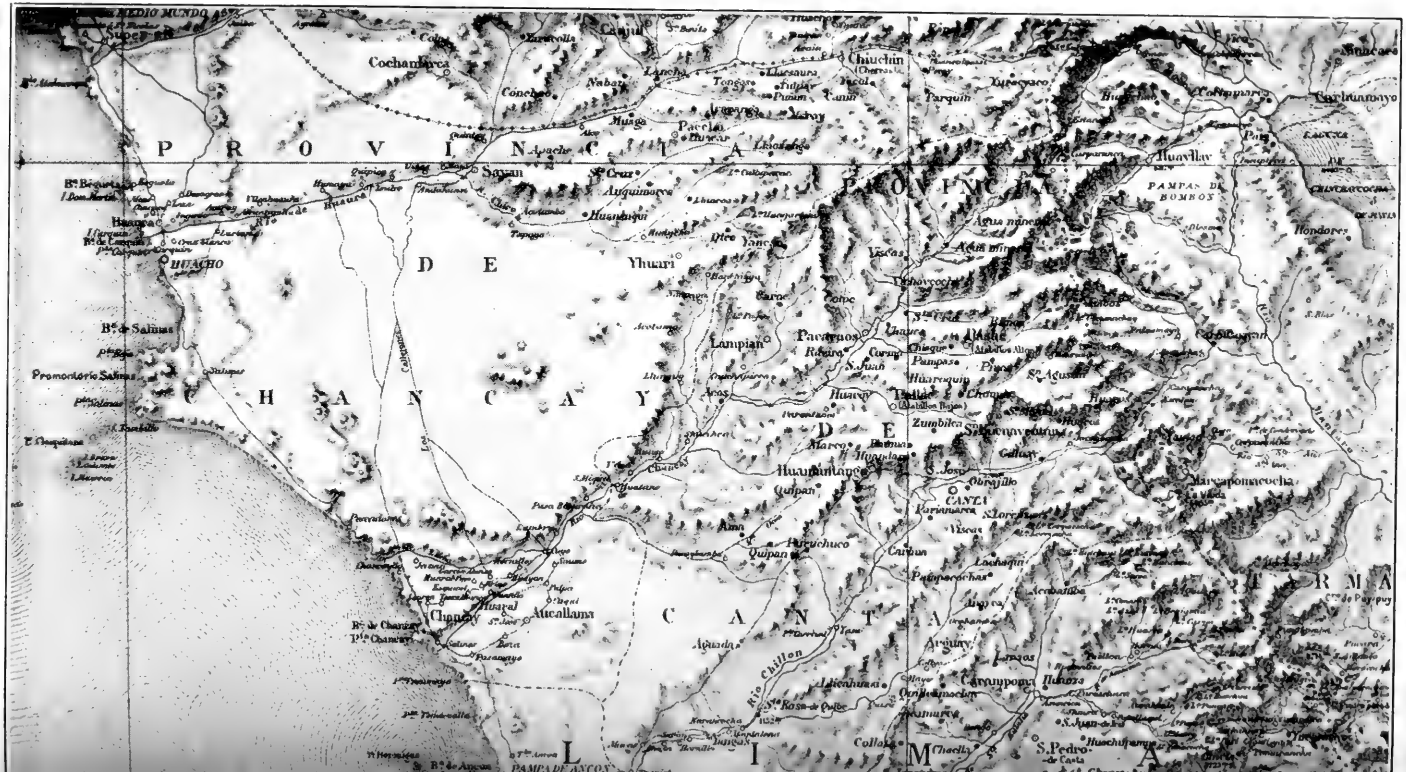
## II. EXPLORATIONS IN THE SIERRAS: REGION OF HUAROCHIRI

The rugged, high, mountainous district southeast of Lima, known as the province of Huarochirí, is entered either from the line of the Central Peruvian Railroad, or by a detour from the coast. The former route involves the passing through localities infected with dangerous diseases peculiar to certain parts of Peru, the *uta* and especially the *verruga,* as well as some long and steep ascents. The other route passes through a healthier territory, but means two to three days arduous journeying, devoid for the most part of all accommodations for man and beast.

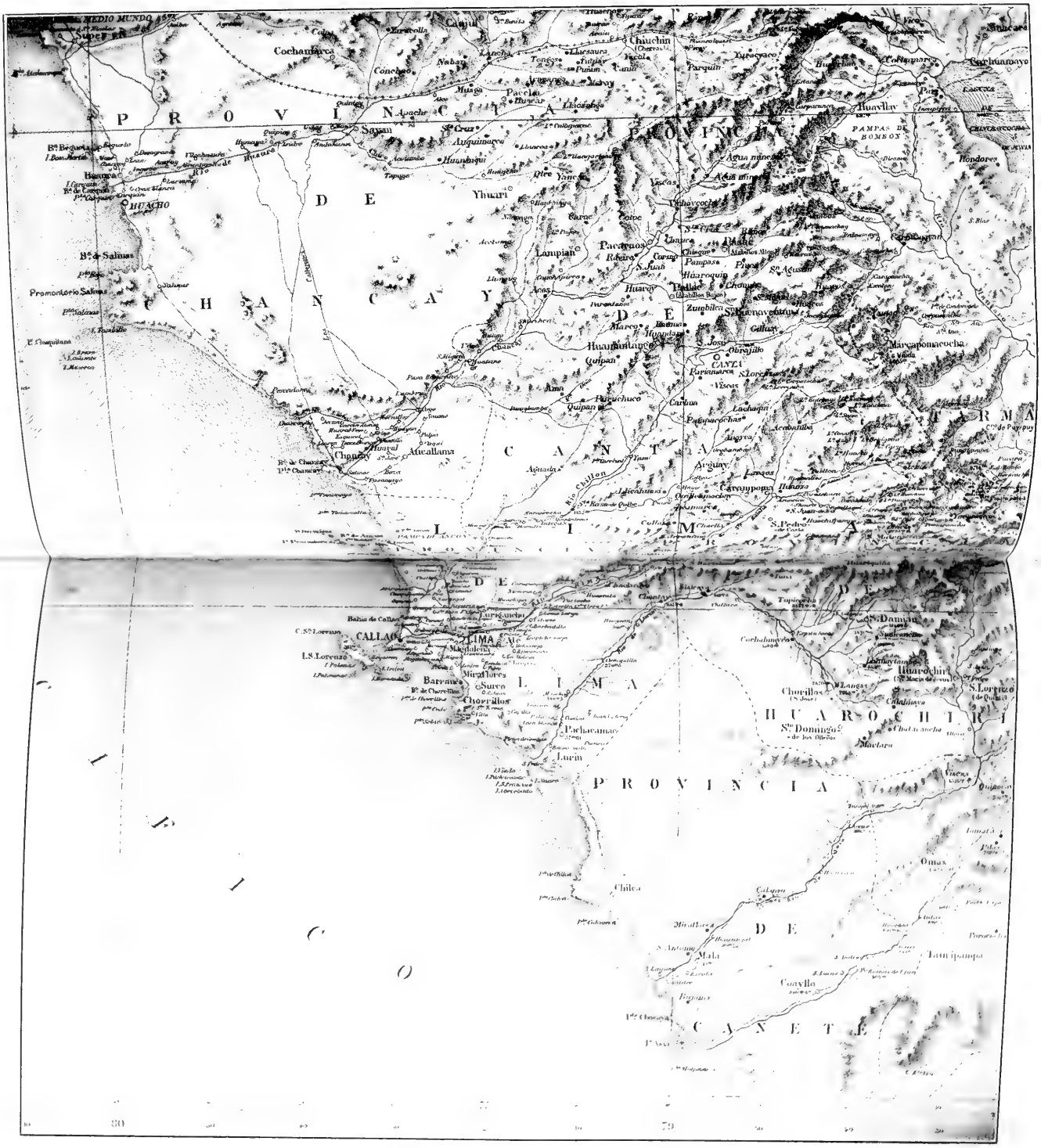
The Huarochirí region has no special historical importance, and, although so near to Lima, it has never been well studied archeologically or anthropologically; but it has long been known to be relatively rich in ruins and in trephined crania. Some of the trephined skulls found their way into the remarkable collection described 15 years ago by Muñiz and McGee,[1] and two years ago the Harvard Medical School purchased a large number of similar specimens from Dr. Julio C. Tello, a native of the town of Huarochirí. The latter collection, as yet undescribed, was made by Dr. Tello, with the assistance of Dr. Clemente Palma and some of the natives, entirely in the district of Huarochirí, and when seen by the writer was found not merely to present highly interesting conditions from surgical and pathological standpoints, but also to show crania of a remarkably uniform type such as occurs only exceptionally in the coast regions. These facts and the problems they offered made a personal investigation of the burial places of this district very desirable. After duly obtaining permission from the Peruvian authorities, the writer therefore started at once toward Huarochirí.

Preceded by a brief visit to the ruins of Cajamarquilla, the route chosen was that by way of Matucana, whence a perilous and long day's journey took the writer, with a soldier-companion and a native, to San Damian, the center of a difficult but archeologically

[1] Muñiz, M. A., and McGee, W J: Primitive Trephining in Peru, 16th Ann. Rep. Bur. Amer. Ethnol., Washington, 1897.


PROVINCIA DE CHANCAY
PROVINCIA DE CANTA
LIMA
TARMA
Cochamarca
Sayan
HUACHO
Chancay
Huaral
Aucallama
Huamantanga
CANTA
Obrajillo
Huayllay
PAMPAS DE BOMBON
Marcapomacocha
Chiuchin
Promontorio Salinas
Rio Chillon

MAP (AFTER RAIMONDI), SHOWING THE CENTRAL PARTS OF THE PERUVIAN COAST, AND THE PROVINCE OF HUAROCHIRI.




MAP (AFTER RAIMONDI), SHOWING THE CENTRAL PARTS OF THE PERUVIAN COAST, AND THE PROVINCE OF HUAROCHIRI.

rich region, from which shorter trips were undertaken in several directions. At San Damian, Dr. J. C. Tello, who had been appointed by one of the ministries as a companion, met the writer, who with him proceeded to Huarochirí, whence again a number of trips were made into the neighborhood. Then, with the rainy season making further travel in the mountains out of question, our small party returned by the more southern route to the coast. The rapid observations made on this journey under difficult climatic and other conditions were as follows:

*Cajamarquilla.*—The extensive ruins known by this name lie in a nook of the foothills rising at the northern limits of the Rimac Valley, approximately 18 miles east of Lima, and about five miles from the little station of Santa Clara on the Peruvian Central Railway. They have not as yet been thoroughly investigated, though partially explored by Squier,[1] Middendorf[2] and Uhle[3] and visited by Dr. Charles W. Currier,[4] Mr. M. H. Saville and other archeologists. According to Squier's estimate, the ruins cover nearly a square league. The structures are all of adobe, and have suffered considerably from climatic conditions and earthquakes. They are not very imposing, but their extent shows that the city must have harbored at one time a very numerous population. Contrasted with this is the relative scarcity of cemeteries. Burial grounds, one large and one small, have been located just south of the ruins on the plain and one exists on the top of a hill to the north. There seems but little chance that any extensive burial grounds have thus far escaped notice, and these cemeteries together are so disproportioned to the probable population of the town, that, as cremation or distant burials were not practiced, there seems to be only one explanation for these conditions, namely, a rapid building and a brief occupation of the town. No historical mention of the place is known; a vague tradition in the valley ascribes the town to the "reconcentrados" during the early part of the Spanish dominion, while Uhle found that the archeological contents of the graves represent several cultures. The writer led by the *dueño* of the hacienda Nieveria, to which these lands belong, visited the two cemeteries on the plain, found numerous skulls

[1] Squier, E. George: Peru, etc., 8vo, New York, 1877, pp. 91-97.

[2] Middendorf, E. W.: Peru, Vol. 2, Berlin, 1894, p. 74.

[3] Uhle, Max: Ueber die Frühculturen in der Umgebung von Lima. Trans. Intern. Congr. Americanists, Wien. 1909, p. 362; also a map (No. 2, Distribution de las Varias Civilisaciones en el Valle de Lima), Lima, 1907.

[4] Currier, Charles Warren: The Dead City of Cajamarquilla. Bull. Pan-American Union, Washington, August, 1912, pp. 301-308.

and other skeletal remains on the surface and also some open graves in the form of deep adobe-lined cists, resembling considerably the stone cists encountered farther south, in the Nasca and Acarí valleys. The bones indicated a homogeneous population of medium stature and strength. The skulls were almost invariably brachycephalic, of the coast type, and usually free from the characteristic artificial antero-posterior deformation so common in prehistoric times on the coast, but which disappeared soon after the coming of the Spaniards. A few that showed the fronto-occipital flattening showed it in a small degree only. These facts would seem to speak for a rather recent, post-Columbian, period for these ruins and burials.

Fifteen miles eastward of Cajamarquilla, in the now rough and narrowing valley of the Rimac River, lies the health resort Chosica, and, according to information obtained, skeletal remains of the mountain population, with a few trephined crania, have been found in the hills to the north as well as to the south of this locality.

From Chosica the canyon ascends at an increasing grade to Matucana, passing through what is probably the most dangerous verruga region in Peru. Signs of ancient occupation in the form of terraced fields on the slopes of the mountains appear in many localities, and the natives tell of ruins and burial caves in the sides and especially on the tops of the scarcely scalable great rocky hills. Here for the first time the rather puzzling fact was met with—seen later on to be the general rule in these regions—that the ancient settlements and burials are found not in the scanty lowlands, but near or at the summits of the less extreme mountains.

Opposite and north of the village and station of Surco, 56 miles from Lima, a huge mountain rises, known as the "Cerro Wacapuna," the summit of which is reported to show remnants of a large, ancient fortification, and a subterranean cavity with burials.

*Matucana* itself is a small town situated 64 miles east of Lima at an elevation of 7,800 feet, in a narrow part of the "quebrada," of the Rimac, and is surrounded on all sides by mountain masses that reach several thousand feet higher. In the great elevation which dominates Matucana on the south there were said to exist some burial caves, and a number of apparently more important localities with ruins and burial caves were reported to exist in the rough country to the northeast of Matucana. Due to the presence of the verruga in this region, personal exploration of the various remains was not undertaken, but an arrangement was made with

Sr. Lizardo Montes, an ex-prefect of the district of Huarochirí and a 20-year sufferer from the dread "wart" disease, for a collection of skeletal material. The results were about 30 crania and a box of other bones of the skeleton. Sr. Montes reported that all the sites examined have been found despoiled by those who hunted for valuables, and in many instances the skeletal remains had been thrown out from the caves and were found broken and more or less decomposed on the side of the mountain. Of the 30 crania collected, one showed trephining. None of them presented any deformation, and a large majority belong to the same oblong type as that represented in the Huarochirí collection at Harvard.

*San Damian* was found to be a fair-sized and picturesque village situated on the shoulder of a mountain, at an elevation greater than that of Matucana and probably not far short of 9,000 feet (pl. 2, fig. 1). The place is surrounded on all sides by mountain masses and peaks, separated by more or less deep "quebradas." Washing the foot of the promontory on which the village stands winds a branch of the Rio Lurin. The summits of the mountains rise from 10,000 to over 13,000 feet in height, and many of the lower ones show ruins, ancient fortifications, or burials. The canyons are for the most part so narrow, unhealthy and difficult of penetration, that the ancient inhabitants of these regions were obliged to search for more favorable spots on the heights; they terraced the fertile mountain sides for fields; they fortified some of the more inaccessible summits; and they buried in caves, crevices or rock shelters, which were walled up when no more used, or in peculiar long low stone houses, constructed near the settlements and on high elevations in the neighborhood. The present inhabitants (pl. 5, fig. 1), all of whom are of mixed blood, but some of whom doubtless descend from the former Indians of these regions, have taken the terrace fields as a heritage and continue their cultivation in what is probably the old manner (pl. 2, fig. 2; pl. 5, fig. 2). Such "andenes" are found in all parts of the district of Huarochirí, at various localities in the canyon of the Rimac, and in all neighboring territory as well as in a great many other parts of the mountainous regions in Peru. They are often exceedingly picturesque, with their well-made supporting walls, green-lined acequias, rich black earth, and fresh crops of corn, alfalfa, wheat, or potatoes.

There are indications that at the time of the conquest, or just before, the population of this territory was larger than at the present time. The cultivation of the difficult terraines, it is seen, was more

extensive and the region is full of ruins. The latter can be found on or near all the summits where water could be had and where some of the steep slopes in the neighborhood could be terraced.

The writer's stay at San Damian was too brief for a thorough survey of the ruins and he can only report upon them collectively. The nearest are known as Pueblo Viejo. They top a hill less than two miles northeast of San Damian, tapering toward the east and northeast. Farther on in the same direction, on the steep slope on both sides of the road to Toctococha, are numerous burials in shallow caves and under the rocks. On a large hill to the north of that of Pueblo Viejo and across a canyon, is another ruin; on the mountain beyond that still another, and the same applies to the great ridge that extends northwestward. To the south and southeast, there are several ruins, one, like Pueblo Viejo, partially in view from San Damian. Directly to the east a huge mountain blocks the way, but to the westward appear the "Cinco Cerros" or Five Peaks, a remarkable stone fortress and an important burial ground (pl. 2, fig. 2), while still farther west, near Tupicocha, are the ruins of Sunaikaka (recently visited by Dr. Tello), and to the south there are said to be remains of still other old settlements.

The region would well repay a three or four months exploration in a favorable season. The writer had only ten days and most of this time it was a work of traveling in clouds or chilly drizzle. He did not suffer from the soroche, or mountain sickness, which incapacitates so many in these altitudes; nevertheless the climbing of the steep slopes, to reach the ruins or burials, was attended by considerable difficulty in breathing and a continuous effort for more than three or four minutes was impossible. A piece of the rough ground would be scaled, until the lungs would threaten to burst, when it would be necessary to lean on some rock for several minutes until more normal respiration was reestablished; then the procedure would be repeated. Nor were these the only difficulties. Serious obstacles were encountered on the part of the natives, ignorant, superstitious, unwilling, and enfeebled by alcohol. Reliable information or help was out of question; and due to the general poverty and the season, it was almost impossible to secure the necessary animals, or food for them when secured. Notwithstanding, visits were made daily to ruins and fair collections were obtained from the Pueblo Viejo, Ulculla, and especially from the "Cinco Cerros." And the exploration would have been prolonged had it not been found that the majority of the more approachable ruins had been

Fig. 1. San Damian, with the clouds rising from the "quebrada" just beyond

Fig. 2. "Cinco Cerros" ("five peaks") from just beyond San Damian. On the steep slopes in the foreground to the left, some "andenes" or terrace fields

THE VILLAGE OF SAN DAMIAN AND THE OLD FORTRESS "CINCO CERROS"

Fig. 1. Ruined stone burial houses on a rocky promontory opposite the ruins known as Pueblo Viejo, near San Damian

Fig. 2. Stone burial houses higher up on same rocky ridge as those shown above

OLD STONE BURIAL HOUSES NEAR SAN DAMIAN, DISTRICT OF HUAROCHIR

visited by Tello or his native friends, who secured whatever seemed more valuable of the skeletal remains for the collection that was later sold to Harvard. The "Cinco Cerros" have fortunately escaped, though, like nearly all such locations in Peru the remains were despoiled by the treasure hunters; and the writer found here some precious cases of trephining as well as some interesting anthropological material.

The results of the exploration about San Damian cannot be fully given before the elaboration of the collections. A number of the most evident facts, however, are as follows:

The region was settled predominantly by people with a more oblong type of skull, the same as has been found in the neighborhood of Matucana and which has before been seen in the Tello collection from the district of Huarochirí. Besides this, however, there were also found remains of what may have been clans in some of the settlements, with a more brachycephalic type of crania approaching those of the coast. At the "Cinco Cerros" ruin, the remains of the individuals of this type, who were in minority, occupied one separate burial house.

The long and other bones showed that throughout the region the people were well-built and of fair stature. Also they were a people remarkably free from such constitutional diseases as would leave marks on the bones, for pathological specimens among the latter were very scarce. Injuries of the various parts of the skeleton were also rare, but on the other hand wounds of the skull were common. These wounds were evidently due in a large majority of the cases to sling shots and clubs, and often when the injury was not immediately fatal, the subject would be operated on by trepanation.

The peculiar burial houses met with in this region and later on in other parts of the district of Huarochirí, deserve a special mention (pls. 3 and 4). They are structures from 8 to over 30 feet long, about three feet inside and five and one-half feet in outside diameter, with walls approximately four feet high, and a flat or a low A-shaped roof rising from one to two and one-half feet higher. Few of those seen may have exceeded somewhat these dimensions. The walls where finished are generally seen to have been quite well-built of unhewn stones. They were covered by big slabs reaching from side to side, and on these were placed flat stones in an offset manner in such a way as to form sort of eaves on each side and rise to a convex or a bi-sloped roof. The interstices among the roof

stones were filled with earth, and sometimes the whole surface of the stone roof was evidently covered with earth or sod. In some instances the roof was left very low and quite flat, but in others the A-shape is well marked. In one of the sides there would be, at the level of the ground, one, two or even three doorways, according to the size of the house, through which a man could just crawl. Some of the longer houses were divided into two and even three compartments by a secondary stone wall on the inside, and the floor was generally lowered below the level of the outside ground.

These burial houses, as well as burial caves, often served for secondary communal burials, but besides this, individual bodies were also placed in them in the contracted position, and in some instances, as later seen near Huarochirí, all of the burials in a given mortuary house might be of this nature. The bones or bodies were placed close together and scantily covered with earth up to the level of the outside ground; above this they were evidently laid in without any covering.

Some of the largest burial houses seen at the Five Peaks each contained the remains of over one hundred individuals, while the smallest ones might not shelter the bones of more than two or three bodies. None were found filled to their capacity, and a few were almost empty. Their position and arrangement seldom showed anything noteworthy; at the "Cinco Cerros" however, there existed in the midst of a group of such houses a moderate-sized square, which may have served for ceremonies, and one isolated burial house at the same place was found surrounded by a circle of single larger stones. When a burial house was no longer used—and the same is true of the burial caves—the doorways (or mouth in the case of the caves) were walled up.

These stone houses seem to the writer to be nothing but modifications of the well-known chullpas found in the highlands farther eastward, and this opinion was corroborated by what has since been found by Drs. Tello and Cl. Palma in another part of the district of Huarochirí (pl. 4). They show various modifications in different parts of Peru (pl. 18) and, modified by environment, they become the stone or adobe burial chambers or pits found in some parts of the coast region.

*Huarochirí* (pl. 5, fig. 2).—From San Damian the writer proceeded, through a territory less rich in and in some parts wholly devoid of ancient remains, to the valley of Huarochirí. This with the neighboring elevations was found to be a beautiful and picturesque

BURIAL TOWER, BURIAL HOUSE, AND WALLED-IN ROCK-SHELTER FOR BURIALS; RUINS IN THE SIERRA DE HUACHUPAMPA, DISTRICT HUAROCHIRÍ, NORTH OF MATUCANA

(From a drawing by Dr. C. Palma, furnished by Dr. J. C. Tello)

Fig. 1. Natives, all mixed bloods, of San Damian, Dept. of Huarochirí

Fig. 2. The town of Huarochirí, with San Pedro and the Cerro de San Pedro in the rear. Andenes on the slope of the mountain

NATIVES OF SAN DAMIAN AND THE OLD TOWN OF HUAROCHIRÍ

region, even richer in ruins and other remains of the past than San Damian. The ruins exist in every direction from the present town, and several of them represent large ancient settlements. This is especially true of those on the hill overlooking Huarochirí on the north, those occupying the surface of a low, long mesa about three miles down the valley, and some to the southeast, at some distance from San Pedro. A number of the ruins on the north side of the river were examined by the writer in company either with Dr. Tello or the gobernador of Huarochirí. Those of the two large settlements mentioned above, that to the north and that down the valley, showed the remains of numerous stone walls of houses, enclosures and terraces, with a series of formerly walled-up burial caves (pl. 6), and of half ruined and now empty burial houses. The habitations were built throughout of moderate-sized uncut stones, and with a few exceptions the workmanship was rather mediocre.

More interesting conditions were found at a locality known as Lupo, situated on the northern slopes of the valley about 10 miles up the river Rio Mala from Huarochirí. There were no ruins of dwellings, but numerous burials existed under some huge bowlders strewn over the slope; and farther up, at a distance of a few hundred yards, in a range of scarcely approachable rock shelters, there were over a score of burial houses, looking very much like cliff dwellings.

A most interesting group of these houses was encountered on the second visit to the locality. After a perilous descent, before which the natives provided themselves with ample quantities of coca and cigarettes, supposed to antagonize the injurious effects resulting from the showing and especially handling the old human remains, we reached, partly with the help of a lasso, a long narrow shelf in the nearly vertical rock cliff, and there in the shallow shelter found a row of nine burial houses. The fundamental characteristics of these were the same as in the case of those about San Damian, but they were shorter, higher, divided by cross slabs into two stories, and with flat roofs made of stone slabs and earth. The walls were well constructed of uncut stone. Between the three more proximate and the six more distant houses, there was an interval behind and above which the wall was much blackened by fire; and on the wall above the house, well out of reach, were seen large marks in red, plainly made by the aborigines. Under these unintelligible marks in one place was a cross, with a lower branch longer than the three others, as among the Catholics, traced by pigment like that used in the large painted symbols or figures above the

houses, and probably contemporaneous. This makes it possible that these particular burials date from the early era after the Spanish invasion. Nothing was found with the bodies that would demonstrate a contact with the whites, but this cannot be regarded as a proof that the burial place was pre-Columbian. There can be no question but that numerous burial places, both in the mountains and along the coast, are post-Columbian, for the natives did not disappear immediately after the whites came, nor did they at once give up their old cemeteries or methods of burial; and a large majority of them doubtless died in the earlier times after the Spanish invasion without any chance to acquire such articles of white man's manufacture as would be interred with them and persist to the present time.

The burial houses now visited, though in better condition than those of similar nature seen lower in the Huarochirí Valley, nevertheless also showed the effects of marauders. Not one was intact. The walls and especially the ceilings were in many places broken down, and many of the bones and mummies that originally, according to all accounts, existed here, had doubtless been thrown over the cliff and lay broken in fragments below. Nevertheless, a number of naturally preserved mummies with crude wrappings were still encountered, as well as a considerable quantity of bones and upward of 30 crania, one of the latter showing a remarkable example of trepanation by scraping. This ruin yielded, besides the skeletal remains, a few gourds, some decorated by burning; several rawhide sandals, almost identical in style with those still used by the common people in these regions; and a "liburi" or "bola," a lasso with three irregular and rather small but heavy metal balls, a weapon much like that used by the Patagonians. Among the bones was a humerus showing a clean amputation, which, as amputation of bones was unknown to the prehistoric Indian, strengthens the supposition that these burials were post-Columbian.

On the whole the exploration in the environs of Huarochirí, which regrettably was soon terminated by the advancing rainy season, showed the following:

In pre-Columbian and probably the early Spanish times the region was thickly peopled. But the inhabitants were evidently for the most part poor and had not made much advance in architecture or in other lines of material culture.

Anthropologically, the people of this region show again two cranial types, the more oblong one, which seems to be characteristic of a

Fig. 1. Burial hole; ruins above

Fig. 2. Burial cavern, amidst ruins

BURIAL HOLES AND CAVERNS AMONG AND IN THE VICINITY OF RUINS COVERING A LARGE PART OF THE TOP OF A MOUNTAIN JUST NORTHWEST OF HUAROCHIRI

large part of the central western sierra, and a more rounded one, related and possibly identical with the prevailing type on the coast. In some of their ruins, one of these types is seen to predominate and in others the other, but in most instances there is also present some mingling and probably intermixture.

Artificial deformation of the head has not been practiced by any of the people of the Huarochirí Valley; rarely, however, a skull will be found showing the circular or "Aymara" compression and one specimen was brought from some distance with a typical fronto-occipital flattening such as met with along the coast.

As in the neighborhood of San Damian, the people were rather well built, with good though not excessive musculature. Remains of very tall and again very short individuals were not met with. Diseases, at least such as would leave marks on the skull or bones, were very scarce and the same is true of injuries, except those of the head. In regard to the latter, fractures of the skull ranging from small impressions to a complete fragmentation were quite common, as about San Damian. There doubtless had been considerable fighting in the entire district of Huarochirí. Some broken skulls also indicate falls down the precipices.

Wounds of the head frequently were treated by trepanation, and this was often successful; but the local medicine men were evidently not well versed in the treatment of fractures of the long bones or other surgical procedure.

The exploration in the entire district of Huarochirí demonstrates, on the whole, the prevalence in these mountains of a type of Indian differing physically as well as culturally from that common to the coast. The identity and the connections of this interesting, handsome, oblong-headed type remain to be determined. As will be seen later on, there are indications that this type reached much farther to the north as well as to the south. These people may have been related to but were not tribally identical with the "Aymara" as we know them from Bandelier's collections.

Besides the above, there is found at some points in this district a small, and at others a moderate intrusion of more round-headed people, probably related to the coast people, but not practicing head deformation. The skulls of this type cannot be regarded merely as modifications of the more oblong variety, because they are not infrequently found in a burial cave or house where none or but a few skulls occur of the other type. Exactly what they represent is another problem for the future.

## III. EXPLORATIONS ALONG THE COAST

### NORTH OF LIMA

*Ancón.*—Due to its accessibility from Lima, the large cemetery of Ancón has been visited, explored, and described more than any other single burial ground in Peru. Notwithstanding this it is still fairly rich in material, some of which throws additional light on the people and conditions of the region.

The first effects of the view of this cemetery on the writer, who was led from the report of the place to expect something extraordinarily extended and interesting even for Peru, were rather disappointing. It cannot compare with the burial grounds of Pachacamac, Chan-Chan, and other localities. Also there are no ruins near by. There are in fact no signs of any settlement in the vicinity with the exception of the refuse heaps within and near the present small town.[1]

The surface of the cemetery was rather poor in material, especially such as would be fit for examination. A good many of the skulls, were found broken by stones—one of the amusements of the Ancón excursionists. On close examination and repeated visits, nevertheless, a number of interesting specimens were discovered.

The refuse heaps are composed mainly of shells and contain an occasional burial. There seems no reason why they should be regarded otherwise than as contemporaneous with the cemetery, for they are neither so great nor so diversified as to indicate a different age.

As to the cemetery itself, there are indications that some parts of it are older than others, and the graves nearer the railroad tracks to Lima seem post-Columbian. The older burials yield bones that are freer from remains of the soft parts and skulls that generally show a marked fronto-occipital flattening. In the more recent and generally more superficial graves, more flesh remains on the bones, the skulls are frequently undeformed or show but moderate antero-posterior flattening, and the bones on the whole are fresher and more resistant. Notwithstanding the differences in age of the burials, however, the Ancón skulls are all or very nearly all the same type. They are the brachycephals of the coast; the rare exceptions belong to the oblong type such as found in the mountains. Also, the bones of all ages at Ancón indicate about the same stature of the people, which was rather moderate, and, for the men at

[1] See in this connection Uhle, M.: Die Muschelhügel von Ancón, Peru. Trans. 18th Int. Congr. Americanists, 1913, Vol. 1, p. 22, et seq.

least, a very good development in strength. There was at no time any intrusion of foreign people. The cemetery is evidently that of the fishermen of the Ancón Bay and has in all probability been used from the time of their coming to the locality up to historic times.

A number of peculiarities worthy of special mention were met with in this burial ground. The very first skull picked up showed a small impressed lesion and an unfinished trephining by the rare method of boring. Curiously, no other case of trephining was discovered at Ancón. In a superficial grave near the middle of the cemetery and wrapped in native articles of clothing, lay the still partly connected skeleton of a young woman, who was killed from behind by being struck on the back of the head with a club or a large stone, and with her lay uninjured the body of her infant, possibly put to death in some manner because of the decease of the mother.[1] Finally, there were found here relatively numerous cases of exostoses in the meatus auditorius, of symmetric osteoporosis of the skull,[2] and of "mushroom head" femora (arthritis deformans).[3]

*Huaral.*—A little over a year ago an extension of the railroad line was constructed from Ancón to Huacho and Sayan. The line, after passing over the arid and sterile pampa of Ancón and the sandy hills farther on, descends to the fertile low flats of Chancay and Huaral. This region contains numerous remains of aboriginal population, including some cemeteries. The villages were of adobe, worked in the form of large, heavy blocks; but there are also remains of habitations made of reeds or totora (cat-tails).

One of the more important ruins was examined. It is situated about eight kilometers southwest of Huaral, at the base of a rocky hill. The structures were all built of big adobe blocks, resembling in this respect very closely those of some of the ruins in the Lima Valley, especially in the neighborhood of Chorillos. The ruin is in a poor state of preservation and has been much excavated by the peons of the neighboring haciendas. Notwithstanding the usual reports of "montones" of bones, only a small number of skeletal remains were discovered. The skulls showed antero-posterior compression, as usual along the coast, and evidently represent the same people as those of Ancón. Two similar skulls were seen in other localities of the valley.

[1] Among the North American Indians, as well known, a child at breast was not infrequently buried with the dead mother.

[2] See Appendix.

[3] See Appendix.

*Kilometer* 98.—After passing Huaral, the railroad line soon enters again the desert depressions and hills, which extend to the valley of Huacho. In constructing the line over a barren elevated flat facing the sea, 98 kilometers from Ancón, the workmen struck an old graveyard, which they promptly set to excavate, and which yielded quantities of pottery with many human bones. Due to the kindness of Mr. Otto Holstein, the chief of traffic of the railroad, the writer and his companion for the time being, Dr. Tello, were "dropped" off at this hot and desolate place one Saturday noon, and stayed there until the afternoon of the following day. The place was found littered with pottery as well as human bones (pl. 7). Probably more than 200 burials had been excavated. There were no ruins nor any signs of habitation in the neighborhood, with the exception of three or four mealing stones among the sands a little to the south and some shell accumulations; nor were there any ruins within a considerable distance in any direction. The place was evidently a settlement of fishermen, and was occupied only during certain portions of the year. The cemetery, which is not completely exhausted, was very rich in pottery, from two to as many as ten or more vessels being found with each body, as we learned later on. The earthenware represented in the main kitchen utensils and tall water jars, but there were also other types. It was well made and in numerous instances quite artistic in shape or decoration, though scarcely comparable with the better class of Peruvian pottery.

The vandalism in this place was appalling. Hundreds of vessels which could not readily be sold or transported, lay broken and even entire over the surface, and skulls and bones, in many instances damaged by the diggers, lay in every direction. A busy afternoon was spent in examining the remains and selecting what was worth saving; a cache was made of the entire or better preserved pieces of pottery (pl. 8, fig. 2), and a valuable selection of skulls and bones were packed in sacks and eventually brought to Lima.

That night we were to be taken away by a "train," but the train proved to be only a machine and this passed serenely by leaving us where we were. We, therefore, slept on the sands. The next morning, Sunday, our first occupation was a dangerous descent down a steep slope to the sea, more than 200 feet below, for a bath. When we returned an hour later, we found to our astonishment five men busily engaged in digging in the graves (pl. 8, fig. 1), and at the same time saw a railroad hand car on which they came. They

Fig. 1. Waste of pottery, skulls and bones. A party of peons excavating farther on

Fig. 2. Another part; the pottery is that of less salable grades and therefore broken or abandoned by the diggers

CEMETERY, IN ALL PROBABILITY PRE-COLUMBIAN, AT KILOMETER 98 ON THE R.R. FROM ANCÓN TO HUACHO, DESPOILED BY PEONS. THE CONDITIONS SEEN ARE QUITE TYPICAL OF MANY SIMILAR SITES IN PERU

Fig. 1. The diggers and their spoil (mainly in the bags)

Fig. 2 Some of the abandoned pottery

SAME CEMETERY AS SHOWN ON PLATE 7, SHOWING A SUNDAY PARTY OF THE VANDALS AND SOME OF THEIR WORK

proved to be a party of railroad laborers, who came out under the direction of their foreman, to engage in their usual Sunday recreation of digging for pottery. Upon our questions as to who permitted them to do such work, the foreman met us only with indignities[1]; but later on, from apprehension, he became more civil and eventually, in the afternoon, finding that after he had loaded his men and his spoil some room was left on the car, he transported us, at a break-neck rate, to one of the wooden shacks built by the railroad for the accommodation of the laborers. Here my companion was taken ill; however, we spent another night on the sands and the next morning were taken back to Huaral.

The skeletal material recovered at "Kilometer 98" proved to be in all important respects like that from Ancón. An interesting specimen, the first of the kind met with by the writer along the coast, was one skull with the Aymara type of deformation. A large majority of the remaining crania presented a more or less marked fronto-occipital flattening. The few that were not deformed or were deformed to only a small degree, showed the ordinary brachycephalic type of the coast people. In regard to pathology about the same conditions prevailed as at Ancón.

*The Valley of Huacho.*—This extensive well-watered valley or rather low plain, was doubtless quite as thickly peopled before and early after the arrival of the white man as it is at this day. The proofs of this are seen in the numerous ruins, mounds or *huacas*, and old cemeteries. The ruins, of the adobe-block type, are found generally on the deserts outside of the cultivable grounds. The more important ones are located at the Pampa Industria, along the northwestern border of the valley in the direction of Begeta, and in the neighborhood of the hacienda of Vilcahuaura. Huacas, which as a rule enclose adobe structures, are especially in evidence in the vicinity and to the east of Huaura. The cemeteries finally are located in numerous places along the edge of the sandy deserts surrounding the valley, especially to the southward, and some are of considerable extent.

The burial grounds examined were, one just south of the railroad line at Km. 140; one just to the east of the last curve of the railroad line before it enters Huacho; three or four extensive ones to the southeast of the valley in the direction of Agua Dulce and San

[1] It is only just to the railroad authorities to state that when they found what happened, they promptly stopped the wanton destruction.

Lorenzo; one large and one small one near Huaura; three moderate-sized ones near Mazo and between this and Begeta; two at Pampa Industria; two at Vilcahuaura; and two burial caves at Quintay, north of Sayan.

Some of these cemeteries, especially that at Km. 140, are in all probability post-Columbian. The mummified bodies there are in a relatively fresh condition, preserving considerable odor of mummified and even decomposing flesh. Also the dead were buried here in the extended position as at the present time.

All of these cemeteries have been, of course, despoiled by the peon, the bones being left scattered over the ground. Due to damage during excavation and to disintegration of the longer exposed specimens by the elements, a large proportion of the skeletal remains, particularly on the sandy slopes to the southeast of Huacho, were already in poor condition. It was possible, nevertheless, to examine, with the cooperation of Dr. Tello, about 600 crania and a large quantity of other bones with the following results:

It was evident that the valley was peopled at all times by natives of good physique and of very fair, though not strictly tall, stature. The natives of the present day in this region, though largely of mixed blood, are still perceptibly more robust and look healthier than similarly mixed natives along other parts of the coast. The explanation of these facts is probably that the fertile valley has always afforded ample and good nourishment to the people; it was seemingly not as badly infected with malaria as other valleys along the coast; and the natives have never been reduced to peonage on a large scale. Many to this day possess a piece of rich land of their own and are practically independent.

Besides being sturdy the people of this valley were also remarkably free from diseases such as would leave their marks upon the bones. "Mushroom" femora were about as frequent as at Ancón, but symmetric osteoporosis of the skull was less common, nor were any extreme forms of it encountered, and other bone diseases as well as injuries were rare.

Anthropologically, the large majority of the Huacho Valley people of all times belonged to the coast brachycephals; two or three of the cemeteries, however, showed a very noticeable admixture of the more oblong skulls of the mountain type.

Most of the crania presented a more or less pronounced fronto-occipital flattening, but some percentage of little deformed or unde-

formed skulls, showing clearly the cranial type of the people, were encountered in every cemetery. An interesting fact is that there were found dispersed in the valley seven skulls, mostly of women, with a typical Aymara deformation. Whether these were slaves or individuals introduced in other manner among the Huacho people, and whether pre-Columbian or post-Columbian, could not be determined. None the less the occurrence shows that the Huacho Valley people came into contact with individuals of the Aymara culture.

Several specimens of special or collateral interest were found in this valley. One was a clearly syphilitic skull, and four evidently tuberculous bones. The period, however, to which these bones belonged could not be ascertained and it is quite possible that they were fairly recent. The rarity of fractures was very remarkable. Some of the skulls showed injuries by stones or clubs, but there were no trephinings. And there existed, doubtless due to strong development of the occipital tendons and muscles, an unusually large percentage of impressions (physiological) in the occipital at the inion.

So far as cultural objects are concerned, the pottery of the Huacho Valley, outside of some specialties, seems well to represent the more ordinary pottery common to the coast. There are, however, cemeteries which yield a better class of earthenware than others, and a few forms were seen which may be peculiar to this region. Besides pottery the people also made oblong moderate-sized palm baskets, which were occasionally buried with the dead, filled with utensils and materials for sewing and weaving. There were evidently few, if any, high class fabrics; but the ordinary weaving presented some local peculiarities, one of which was the frequency of network stuffs.

The caves at Quintay, distant about 50 kilometers from the coast and already well in the mountains, showed still a predominance of skulls with the fronto-occipital deformation, but about one-fourth of the crania presented undeformed oblong forms, such as those met with in the Huarochirí highland district farther south.

According to information obtained from various sources, considerable quantities of skeletal material lay exposed in the vicinity of Supe, about 32 kilometers in a straight line north of Huacho, and especially on the grounds of the hacienda Paramonga, in the neighborhood of Supe, but these regions could not be visited on this occasion.

## SOUTH OF LIMA

*Chorillos.*—Twelve kilometers south of Lima, on the coast, lies the watering place and town of Chorillos. Following the road which leads from this town eastward and then southward, toward Lurin, the traveler passes rather extensive adobe ruins, and at least two burial grounds. Curiously enough, though so near to Lima, these ruins and cemeteries have not as yet been properly explored. Uhle, on his archeological map of the Lima Valley (4to, Lima, 1907), marks them as belonging to the "last civilization of the valley before the Incas," but they are probably more recent. They show excellent construction from huge blocks of adobe, formed doubtless in situ, in frames. The burial grounds were examined by the writer in 1910, and were seen again on this occasion. At the former date a quantity of skulls and bones lay over the surface; these have since then almost entirely disappeared. The crania showed a prevalence of the antero-posterior deformation, and were evidently of the ordinary coast type, though occasionally an oblong skull was present. The bones indicated people of moderate stature and moderate muscular development.

A considerable number of burials probably still exist in this neighborhood and they, as well as the ruins, deserve attention before it is too late.

*Pachacamac.*—About 18 kilometers southeast of Chorillos, within a few hundred feet from the sea and just north of the Rio de Lurin, on and about a number of moderate elevations, lie the great ruins of Pachacamac (pls. 9, 10) well known from Uhle's description.[1] The writer has referred to this old city, to which he made two brief visits in 1910, in another publication.[2] Although the present owner of the land on which the important ruins stand forbids the peons to excavate for themselves and is opposed to wanton destruction of the remains, still they are in a perceptibly worse state than three years ago.

The abundant skeletal material found here by the writer in 1910, and from which 2,200 skulls with several thousand other bones were at that time secured for the U. S. National Museum, has in a large measure disappeared, mainly through the influence of the elements. New excavations, however, have been carried on for a person of high standing in Lima, and it was possible to examine

[1] Uhle, M.: Pachacamac. University of Pennsylvania Publications, fol., Philadelphia, 1903.

[2] Hrdlička, A.: Some Results of Anthropological Exploration in Peru. Smithsonian Misc. Coll., Vol. 56, No. 16 (Publication 2005), Washington, 1911.

PACHACAMAC FROM THE NORTHWEST. THE WHOLE RANGE OF LOW ELEVATIONS IN THE FOREGROUND IS ONE VAST STRETCH OF RUINS AND CEMETERIES. THE HILL OF THE "TEMPLE OF THE SUN" IS SEEN ON THE RIGHT

THE UPPER VIEW SHOWS THE HILL OF THE TEMPLE OF THE SUN AT PACHACAMAC, THE LOWER A RECENTLY TAPPED GROUND AT PACHACAMAC, FULL OF BURIALS

the skeletal material left from these (pl. 10, fig. 2). They have not changed the conclusions reached during the former visit, which, for easier reference, are with slight modifications here repeated.

The people of Pachacamac as well as those who did not live but were buried there, were of moderate stature and physical development, with shorter and weaker individuals rather frequent.

The crania belong largely to the brachycephalic coast type. A fair percentage is fortunately free from deformation and shows the type clearly.

With the more rounded skulls were mingled in some of the burial sites a smaller or higher percentage of more oblong skulls, occasionally attaining pure dolichocephaly. These skulls, it is now seen, are of a very similar type to those found in the mountain district to the east (the district of Huarochirí), and doubtless represent visitors, invaders, or an intrusion of these people. The majority of these narrower skulls were without any deformation, while a few showed some occipital compression probably of intentional origin. It was seen in the former part of this report that the oblong skulls from the mountains are generally free from deformation.

The majority of the Pachacamac skulls of the more round-headed variety and some of the narrower specimens, present a fronto-occipital artificial compression which, however, is seldom excessive. In some instances the frontal flattening is scarcely detectable, and there are cases in which, though they probably belong to the same class as the preceding, only an occipital flattening can be discerned. The pressure on the frontal must in these instances have been very weak. Deformed crania were particularly frequent in the large burial ground in front, that is just to the north, of the old temple of Pachacamac.

No specimen was met with at the former nor at the present visit to Pachacamac, which would show the "Aymara" type of deformation. This indicates that the highland people where such deformation was in vogue neither visited nor invaded the town or its temples.

A number of submicrocephalic and even microcephalic, but otherwise normal, adult crania were found in the vast cemeteries of this locality. They have nothing in common with the small skulls of idiots, being normal in every respect except size. They doubtless belonged, as shown by occasional small bones of the rest of the skeleton, to diminutive individuals. They range in capacity from 1,050 to 910 c.c.

The long and other bones from Pachacamac afford many features of interest, especially to pathology. Fractures, as elsewhere along the coast, were very rare. Symmetric osteoporosis of the skull and the "mushroom-head" femur, were fairly frequent, about as at Ancón. One plain case of trephining was found, one was discovered among the specimens collected on the first visit to these ruins, and three or four other specimens in the total collection show partly cicatrized lesions which may have been due to such an operation.

The Pachacamac burial grounds are still far from exhausted (pl. 10, fig. 2).

*Chilca.*—From Pachacamac, the main road south leads to the cultivated valley of Lurin and then follows the coast deserts to the large but, due to aridity of the region, now half-abandoned town of Chilca, 70 km. south-southeast of Lima. The visit to this place was due to information obtained from Sr. José Bravo, Chief of the Bureau of the Engineers of Mines of Peru, and was facilitated by kind aid from Sr. Bravo and Engineer C. W. Sutton.

Upon arrival at Chilca, it was found that one large and one small burial ground with a number of shell and refuse heaps existed to the north of the place, and that ruins with numerous burials were located on and about a hill three miles to the northwestward.

The main cemetery, which commences a short distance beyond the outskirts of the town, was found to have been in part recently excavated, for another a high dignitary of Lima; but the larger part of it is fortunately still intact (pl. 11). This burial ground proved on examination to be uncommonly interesting, for it was found to represent in a large measure a wedge-like intrusion among the coast population of the oblong-headed mountain people. The ground so far as dug over was strewn with bones and fabrics. The majority of the bones and skulls showed well-developed people of the type met with in the not far distant district of Huarochirí. Besides these there existed a moderate admixture of the more round-headed coast elements. As in the mountains, the oblong skulls were generally free from deformation, while those of the coast type showed mostly the intentional antero-posterior flattening, though not in a high degree. Two or possibly three cases of trephining were discovered in this burial ground, and there were a number of interesting pathological specimens, though on the whole the people have evidently been very healthy. There was no well-defined case of "mushroom-head" femur, and symmetric osteoporosis of the

THE CEMETERY AT CHILCA.

skull was rare—both features in which the population represented in the cemetery concurred more with the mountain tribes than with those of the coast.

The age of this cemetery could not be determined. The bodies showed many remains of the soft parts, which were not entirely dry. Also there was still considerable odor to some of the remains. The burials, however, were all in the contracted position, the fabrics were strictly of native material, design and manufacture, and no objects indicating contact with whites were encountered.

The burials farther to the north lay in the path of a shallow stream in which there is seldom any water; nevertheless we were informed that after a late freshet a number of the skulls and bones that lay on the ground had been washed away or covered. The skulls that remained, though mostly imperfect, showed the ordinary coast type of people. On and beyond the northern bank of the wash are various refuse heaps.

The ruins on the hill three miles to the northwest of Chilca are evidently the remains of a settlement, and possibly a fortification, of the people who cultivated the lowlands among the dunes which surround the hill from the southwest to the southeast. They buried principally in and at the foot of the slopes of the hill, and in the dunes. The skeletal remains resemble those of Pachacamac in every respect, including the admixture with the more oblong-headed type. Considerable fighting must have taken place about this hill, judging from the number of skulls showing wounds. Of 11 skulls found at the foot of the slope to the southeast, nine presented traumatic lesions which must have been mortal. The excavations in these localities were not recent and the exposed skeletal material was in general in a poor state of preservation.

No other ruins or cemeteries were heard of in the near neighborhood of Chilca, but important archeological remains are reported to exist to the southeast, on the Rio Mala, in the vicinity of Calango. These, as well as other ruins on that river and on the one a few miles farther south, were indicated on his map by Raimondi (see pl. 12). Still farther to the southward, about Cañete, other ruins exist, including the "Incahuasi" described by Larrabure[1]; and these are followed, farther southward, by the ruins and *huacas* of the region of Chincha and Tambo de Mora, beyond which one enters the region of Ica and Nasca.

[1] Larrabure y Unanue, E.: Incahuasi. 8vo, Lima, 1912, pp. 1-10.

## IV. EXPLORATIONS IN THE LOMAS AND RIO ACARÍ REGIONS

*Lomas.*—The rather insignificant port of Lomas lies about 280 miles southeast of Lima, and between 80 and 90 miles south-southwest of Nasca. It is formed by a small rocky barren peninsula, on which nestles the little sombre town of Lomas. The peninsula as well as the surrounding country is desert, but a sandy depression just to the north and northeast contains some moisture which gives rise to a sparse growth of vegetation; in the midst of this depression is a well which supplies a poor quality of water, used mainly for animals, while a better class of water must be brought from springs nearly three leagues to the north.

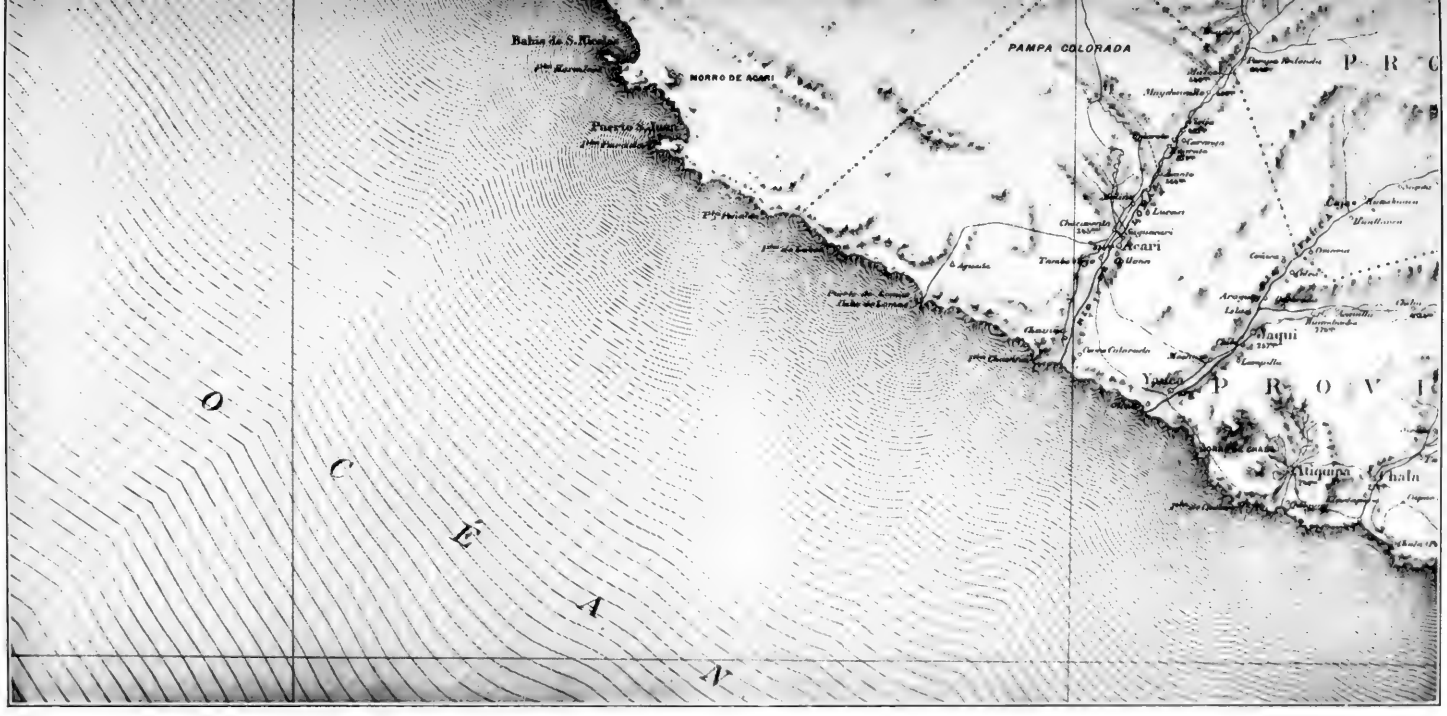
The sandy wastes just to the north of the road between the peninsula and the above-mentioned well, contain a number of old cemeteries. These as usual have been to a large degree dug over and despoiled by the peons. Judging from their extent, they represent a prolonged occupation of the spot by a fairly numerous people, reaching probably to post-Columbian times. Ruins, with the exception of a few remnants of walls on the northern border of the peninsula, are wanting. The region was in all probability peopled by fishermen, who for the most part built easily perishable habitations.

At Lomas the writer was fortunate enough to find an excellent friend in the wealthiest and most cultured man of these regions, a Piemontese, Sr. Enrique Fracchia, and whatever success attended the explorations between here and Ica is largely due to the generous assistance given by this gentleman.

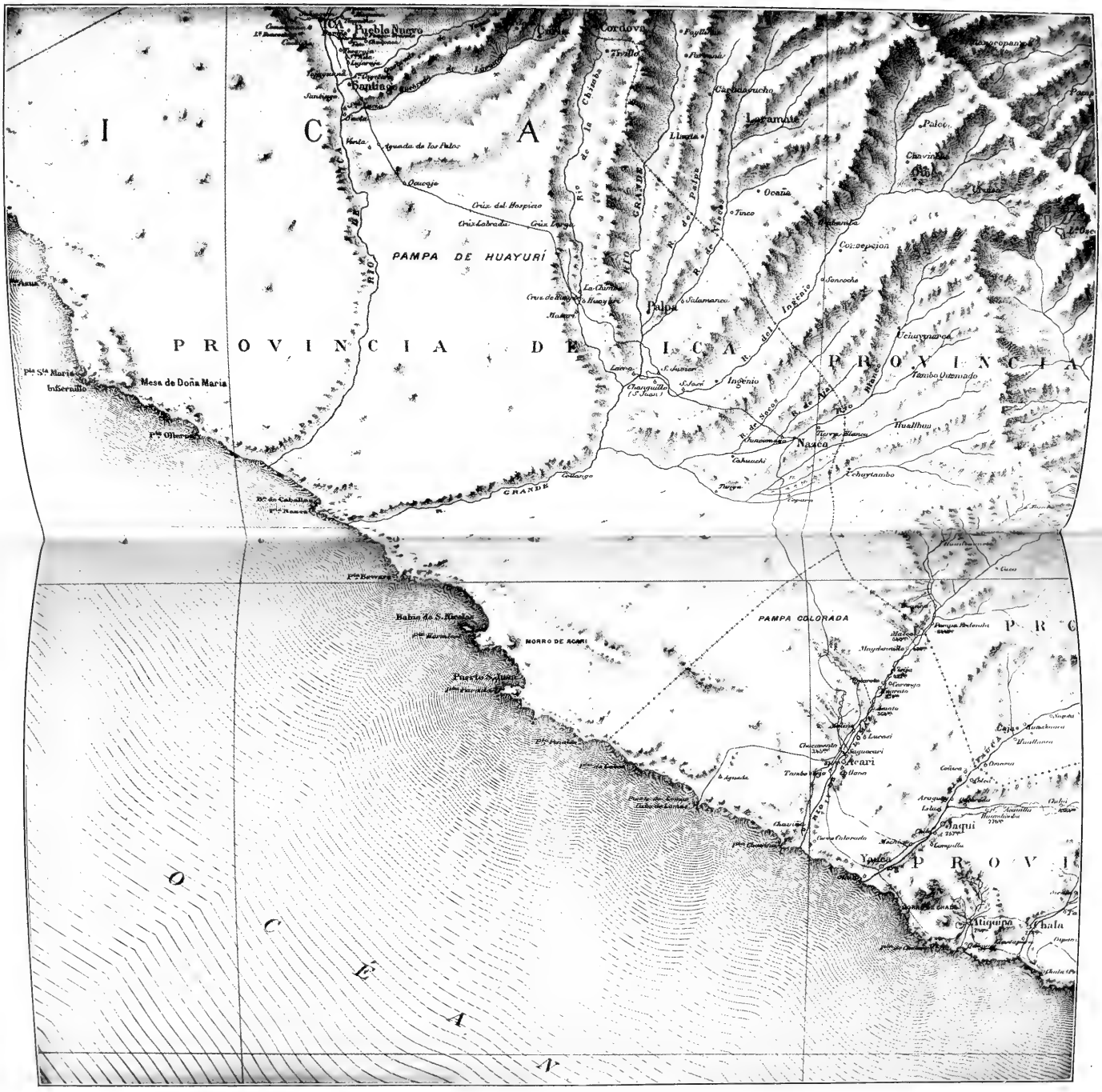
The skeletal material exposed in the cemeteries about Lomas represented the remains of between 400 and 500 bodies. Much however is doubtless still left in the ground.

The Lomas cemeteries date plainly from different periods and do not represent exactly the same people. One of the small burial grounds is probably post-Columbian, though no articles of white man's manufacture lay exposed. In this cemetery the bodies were not only in fresher condition but the burials were extended, while in all the other cases the body was interred in the usual contracted position. An interesting ethnological detail is that all the bodies in this region, including even those in the most recent burials, were sewn and bound into bundles, and the clothing with other fabrics was more abundant than in any of the more northern cemeteries that were examined. These fabrics were predominantly of wool,

I C A
PROVINCIA DE ICA
PROVINCIA
PAMPA DE HUAYURÍ
Pueblo Nuevo
Santiago
Cordova
Palpa
Nazca
Ingenio
Ocaña
Concepcion
Huallhua
Tambo Quemado
Mesa de Doña Maria
Infiernillo
Río de la Chimba
Río Grande
Río Blanco
Río de Nazca
Río Grande
Cruz del Hospicio
Cruz Labrada
Cruz Larga
Agua de los Palos
Ocucaje
Cruz de Huayuri
Huayuri
Sulamanca
Tinco
Llauta
Carhuacucho
Cahuachi
Cuchuytambo
Tunga
Cotango
Lacra
Chanquillo (S. Juan)
S. Juan
S. José
Tambo
Palos
Chavinillo
Ocho
Pta Sta Maria
Pta Ollera




MAP (AFTER RAIMONDI), SHOWING MORE SOUTHERN PARTS OF THE PERUVIAN COAST, WITH THE NASCA REGION.




MAP (AFTER RAIMONDI), SHOWING MORE SOUTHERN PARTS OF THE PERUVIAN COAST, WITH THE NASCA REGION.

from the llama, but there were also those made of cotton. Besides the fabrics, there is occasionally discovered in these graves a palm fiber basket in character much like those of the Huacho Valley, filled with thread balls and various feminine utensils. Pottery, judging both from the reports and from the great scarcity of potsherds, is met with much less frequently than in the cemeteries of the Nasca Valley, but the varieties are on the whole similar. A specialty of these burial grounds, though later found over the whole Nasca region, was the frequency of the *huarakas* or slings, and of small round stones which were thrown from these. One or two of these slings were apparently buried with every grown male, while smaller ones were found with the male children. Some of the slings were beautiful examples of workmanship, and it was interesting to note that the design and colors on the strings near the central part generally imitated a serpent.

Physically, most of the people buried in the Lomas cemeteries belonged to the coast type of moderate brachycephals. Besides this predominant strain, there were varying proportions, according to cemeteries, of oblong-headed individuals, but the percentage was never very high. None of the people were very robust, comparing in this respect most closely with the inhabitants of Pachacamac. Also, the stature was very seldom above medium.

The usual coast fronto-occipital deformation was practiced extensively. But there were no extreme cases, and in numerous instances the frontal flattening was but little marked. Evidently none of the Peruvian coast people used planks to produce the deformation, such as have been in vogue, for instance, in the Columbia River valley. More probably they employed a pressure by a pad or a double pad over the forehead, the bandage fastening the head to something which simultaneously, by counter pressure, flattened the occiput. It was frequently seen that the more oblong-headed individuals have also suffered from the antero-posterior deformation, showing that they were already inherent units of these tribes and followed the same culture. Only a small proportion of both the brachycephalic and the more oblong crania in the older cemeteries of Lomas were undeformed. No example of "Aymara" deformation was discovered.

From the pathological standpoint, the symmetric osteoporosis of the skull was found to have been frequent but generally rather mild. Not even one fracture of any of the long bones nor dislocation was noted; but wounds of the head by sling projectiles or clubs

were very common. In one of the small cemeteries, every subject, men, women, and children, was thus killed; and in the majority of cases the wounds were in the posterior half of the skull, indicating that the people were probably slain while running away from those who attacked them.

Trephining was very rare, if practiced at all. Two specimens were recovered which show a partly healed lesion that may have been a trephining, but the diagnosis is not certain.

Not one really pronounced "mushroom-head" femur was found, and even moderate grades of the disease were quite rare, which seems to justify the conclusion that this peculiar disease was more prevalent among the coast people farther north. Signs of more ordinary arthritis, on the other hand, especially on the vertebræ, were not infrequent. Dental caries, curiously, was rather common in this locality.

*Chaviña.*—About 20 miles, by the road, southeast of Lomas is found the mouth of a fair-sized river, known on maps as the Rio de Lomas, but locally called Rio Acarí. The cultivated lowlands on both sides of the river at this place constitute the hacienda Chaviña (fig. 1). The dwelling of the overseers is situated at the edge of the high ground which bounds these lowlands to the northwest, and a short distance to the east of this building, among low sandy hillocks, exists an extensive and highly interesting old cemetery. Three other burial grounds, or rather one cemetery in three parts, are situated about two miles to the west of the dwelling on the lower sandy ground near the sea and not far from a hill fortified by the ancients, the locality being known as Conventillo; while several small to fair-sized burial grounds are found in the sandy slopes on the south side of the river, opposite the headquarters of the hacienda.

The scattered cemetery east of the house showed exposed the skeletal remains of about 200 individuals. So far as it was possible to judge, the brachycephalic element was predominant, but there were also longer skulls. A highly interesting feature was the prevalence of extreme forms of fronto-occipital compression, produced evidently by tying the head very firmly to a plank or cradle-board (pl. 13). This was the first cemetery in Peru where such pronounced deformations were seen, but another one was heard of to the south of the river, one was found later on in the valley of the Rio Grande de Nasca, and still another was seen about 60 miles to the north of the valley at the hacienda Ocucaje, near

A SKULL WITH AN EXCESSIVE AND PECULIAR FRONTO-OCCIPITAL OR "FLAT-HEAD" DEFORMATION, FROM CHAVIÑA, ON THE RIO DE ACARI (S. "R-DE LOMAS") PERU

Fig. 1. Remains of walls, made of waterworn stones, on the plateau

Fig. 2. Part of the plateau and the slope towards the river

TWO VIEWS AMONG THE ANCIENT RUINS KNOWN NOW AS TAMBO VIEJO, NEAR ACARÍ

Ica. They doubtless represent a special clan or tribe of the coast people.

In contrast to the cemeteries of Lomas and also to those at Conventillo, the burials in this locality were poor in fabrics, including slings, but there were present wooden clubs made of the heavy huarango (a variety of mesquite). Another interesting condition was that some of the burials at least were made in stone-lined pits. The bodies were buried in the contracted position.

Pathologically, the bones of this cemetery showed a prevalence of arthritis; but there were no well-developed "mushroom" femora, and only traces of osteoporosis. Otherwise the conditions agreed with those of the rest of the coast people in this vicinity.

The cemeteries of Conventillo have yielded glass beads, copper pins made in the European style and some other objects indicating contact with the whites, and must therefore be classed as post-Columbian; but they date probably from the early part of that period. The burials, as at Lomas, were rich in fabrics and especially in slings, and the fabrics in general were identical in material, colors and designs with those of Lomas. The skeletal remains also, physically as well as pathologically, presented identically the same conditions as those from the Lomas burial grounds. There can be no doubt but that these remains belong to the same tribe of people as do the majority, at least, of those of Lomas, and their date is also a valuable index for the antiquity of those from the more northern locality.

*The Acarí Valley.*—The narrow valley of the Rio Acarí, from Chaviña to Otapara (a distance of about 30 miles), is dotted and in some places overspread with the relics of the aboriginal population, both ruins and cemeteries (fig. 1). Of these remains, those on the south side of the river could not be examined closely on account of the impassable condition of the stream at this time.

Along the north side of the river ruins and cemeteries are found in the vicinity of all sites where cultivation of the lowlands was possible. The ruins show low walls or foundations, made of water-worn stones, without any cement. Evidently the remainder of the dwellings was of more perishable nature and has completely disappeared. The enclosed spaces are rectangular and generally of moderate dimensions.

Burial grounds, merely tapped or excavated only in part, exist near all the ruins. The skeletal remains exposed are fairly abundant, but often in poor condition. Moderate fronto-occipital

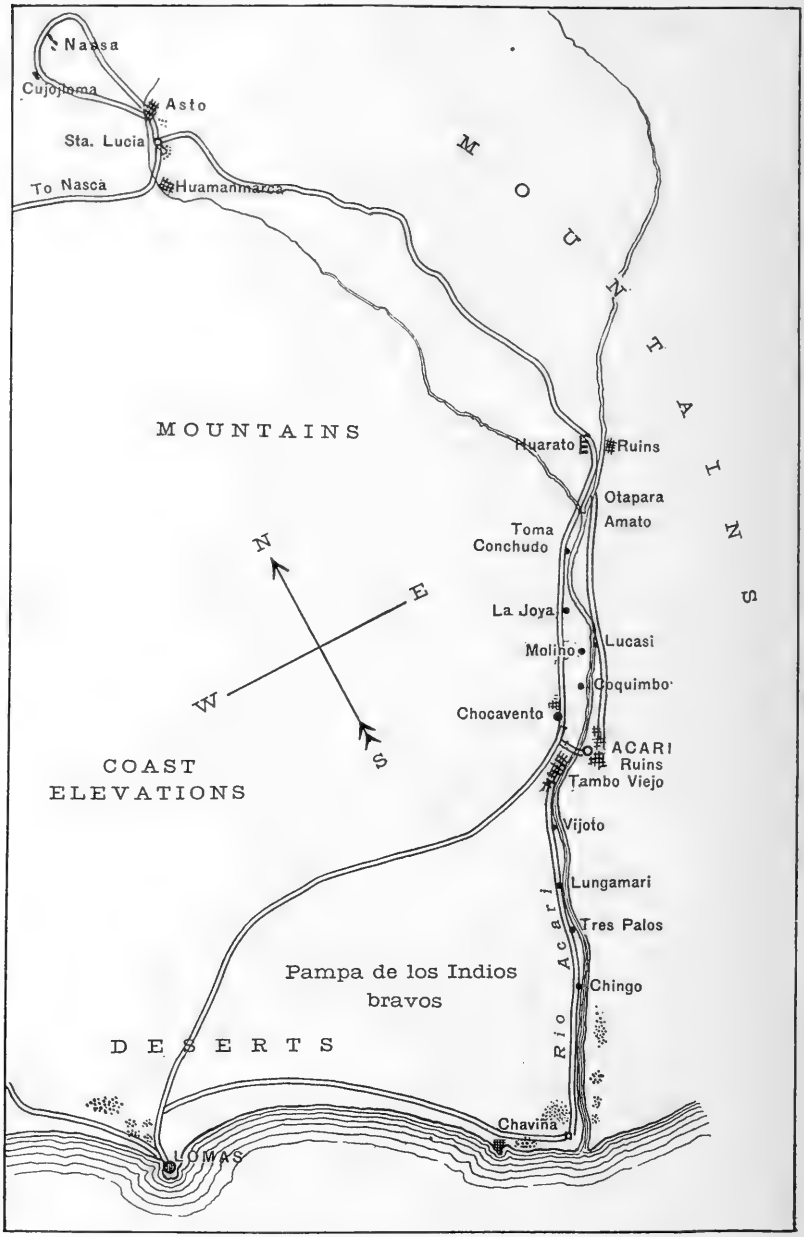



FIG. 1.—Sketch map of the Lomas, Rio Acarí, Sta. Lucia Region.
(Cross lines indicate ruins; groups of dots are cemeteries.)

deformation of the skulls is general. The coast type of people predominates; in some of the cemeteries however there is a marked admixture with the more long-headed and less deformed element, and in one moderate-sized burial ground the latter type existed almost to the exclusion of the former. The culture of these different groups was, however, very similar. The architecture is the same: there are everywhere traces of cylindrical or oval stone-lined burial pits; and the fabrics, as well as pottery (neither abundant), are, as far as could be learned, also alike. It therefore seems safe to conclude that the valley was settled by people of only one cultural group, which however included sub-tribes or clans physically more or less distinct and which perhaps did not occupy all the sites that now bear archeological remains contemporaneously.

The skeletal remains show that the people, while not very robust, were remarkably free from such diseases as affect the bones. The very few fractures found indicate a lack of surgical knowledge in treatment. As on the coast, numerous skulls showed lesions produced by stone projectiles or clubs. No instance of trepanation was discovered. Also there was no case of the "Aymara" head deformation. All the burials were in the contracted position and the body, covered with one or two fabrics, was tied up in a pack. In rare instances there were large, more elaborate, cotton-padded mummies, surrounded by some fabrics, resembling closely those of the Nasca Valley. Pottery, not very common, approximates the Nasca type.

*Tambo Viejo.*—About 16 miles from Chaviña and almost opposite the present town of Acarí, the flats to the north of the river are covered with extensive and interesting ruins known as Tambo Viejo (pl. 14). The ruins consist of many foundation walls, walls of houses, and two *huacas*. The dwellings were, as a rule, quadrilateral, often square, with frequently a stone-lined pit in the center of the floor. In general, they were of moderate size. The upper parts, above the stone foundation, were doubtless of reeds or other perishable material of which no trace now exists. The stone walls were made of moderate-sized cobblestones, laid with mud mortar, and notwithstanding the fact that the material does not yield itself readily to high-class results, the constructions show very good workmanship. In a few instances the low stone wall was heightened by adding small adobes. The base and southern slope of the *huacas* facing the river were carefully paved with larger cobblestones, while their interior disclosed adobe constructions. To the north of the

*huaca* adjoining the river is a large square surrounded by houses and the other mound. In a northeasterly direction, across the square, is an elevated compound of constructions which were apparently of some special importance. To the east of the ruins extend the burial grounds, which, on account of the difficulty of excavation (the ground being full of water-worn stones), have as yet hardly been touched by the peon. At a few spots where excavations have been made the skeletal remains show the usual coast type of population.

*Acarí, and Eastern Part of the Valley.*—A short distance from Tambo Viejo is a primitive ferry which transports one across the raging river (in the rainy season), to Acarí. This is a small town with mixed-blood population, situated on a moderate-sized flat made in previous times by the river, and extending close to a rocky hill, lying in the shadow of the high slopes behind. The lower part of this hill is covered with many remnants of ancient stone constructions. Just to the east of the hill, following the valley, in sandy nooks between smaller elevations, are found burials, which again show the usual characteristics of the coast people.[1]

A little over a mile northeast from Acarí, to the north of the river, is the hacienda Chocavento, belonging to the brothers Orezzoli. Here the writer stopped three days, exploring the neighboring territory.

Some burials of the coast type people were found just to the east of the dwellings of the peons belonging to the hacienda. Crossing the river once more and following the valley eastward for approximately four miles, a small burial ground was found on the low sandy slope, not far from the stream, opposite the little settlement of LaJoya; and about four miles farther east, near the abandoned haciendo of Amato, another burial ground was examined. A short distance northeast of Amato on the north side of the river is a small rocky hill, known as Otapara, with numerous remains of walls of ancient habitations; this will be described subsequently. Traces of irrigation were seen on the south side of the river, but no ruins with the exception of those near Acarí.

On the north side of the river in this vicinity there are also no ruins of any account, but at two spots in proximity to the road some uncovered skeletal remains indicated burials. A regular

[1] It is worthy of remark that the first native in this region who could be regarded as a full-blood Indian was seen at Acarí; he was, however, only a visitor of the place, coming from the sierra.

cemetery was not found until near the above-mentioned hill of Otapara.

*Otapara* (pl. 15) was evidently in the past a place of some importance. Now it is uninhabited, with the exception of three huts of Quechua-speaking mixed-breeds, recently erected. The hill was found to be a rocky elevation less than 100 feet in height, but difficult to scale, and, on the land side full of ruins of stone walls. Some of these doubtless represent habitations, while others may have served more for defence. The workmanship was mediocre throughout. Many potsherds of common kitchenware lay about, and strewn over the hill, especially at the summit, were numerous bones of the llama. At the foot of the hill to the north several chambers were excavated by the peons, yielding a little pottery, a few copper implements and a number of burials. The skulls and bones showed a more or less brachycephalic population, of moderate stature, with frequent fronto-occipital head deformation, hence the type of the coast.

*Acarí Valley as a Whole.*—On the whole, the skeletal remains seen in the Acarí Valley, from Chaviña to Otapara, were found to represent predominantly the now well-known coast type of the Peruvian Indian, with more or less admixture of the more oblong heads, some intrusion of which occurs in so many other localities along the coast. All the principal characteristics of the skulls and bones of the people of this region are exactly like those from the Pachacamac and Chimu cemeteries in the north. The resemblances are so close, even in regard to the admixture with the more oblong-headed elements, that the three groups cannot be considered otherwise than as parts, and that contemporaneous parts, of the same people. Throughout the valley there were many evidences of warfare in the numerous wounds found on the skulls. In the majority of cases these wounds were made by rather small stones, doubtless sling shots; in others the skull was crushed by a club. As to diseases, no very advanced case of symmetric osteoporosis of the skull was discovered in these regions, nor any pronounced case of "mushroom-head" femur. The majority of the scarce pathological specimens seen consisted of arthritic changes, and rarely a variety of osteoperiostitis attacking some of the long bones, especially the the tibia. The dead, as a rule, had been buried in the contracted position and bound in a bundle. Such a bundle or pack regularly showed some thin fabric about the loins of the body, a cotton or woolen shirt, or a blanket, and occasionally a *faja* (sash), a *telega* (woven bag), or a *huaraka* (sling). The bundle would be tied sometimes, in a wide-meshed network, with a rope

made of the wool of the llama—exactly similar to the rope used at this day by the more primitive mountaineers just to the east of this region. Such a pack would be buried in a pit three and a half to six feet deep, sometimes without, sometimes with, a piece of decorated pottery.

*Huarato.*—Three miles from Otapara, farther up the valley, is a locality known as Huarato, now occupied by a moderate-sized hacienda. From this place the roads divide, one leading farther up into the narrow valley, while another ascends a high mountain and leads to Sta. Lucia, Puquio and Andamarca.

In the past, the neighborhood of Huarato was evidently well peopled. On a low sandy elevation across the river are seen the ruins of a moderate-sized old town, with rectangular pebble-stone foundations, as at Tambo Viejo. This belongs doubtless to the valley and coast culture. On the north side of the river, however, and just beyond the hacienda—in fact including a part of the ground of the present buildings—is found a large and highly interesting earthwork rather than a ruin, unlike anything seen elsewere in the valley (fig. 2). It consists of a low artificial ridge, not unlike a breastwork, made of earth and adobes and running for about 300 feet from west to east. From this run at right angles four or five similar though less distinct ridges, 200 feet down the slight slope in the direction of the river. Within the two enclosures formed by the more eastern ridges are seen the remnants of adobe foundations of the dwellings, and also low elevations the nature of which could only be determined by excavation.

One of the more western transverse ridges of these curious remains of antiquity contained a number of superficial burials which were dug out by the peons from the hacienda, and, most unexpectedly, the crania from these showed without exception a typical "Aymara" deformation. This was the first instance of such an occurrence met with on the coast—nor was anything like it seen in the further explorations to the west of the mountains.

Having secured with considerable difficulty the help of a man and a single heavy spade, the writer chose, more within the ruin, a spot which looked as if it might contain a burial and made excavation. We passed through a layer of sandy earth, then through one of earth and ash, through another layer of earth, and through an accumulation of chunks of adobe and numerous fair-sized cobblestones. Finally, at the depth of four feet, lay a bundle containing a skeleton. The body was buried in the contracted posture,

and was tied up in a single piece of ancient cotton cloth of natural color and poor quality. The bones were those of an adult male. Again the skull showed the "Aymara" deformation. No earthenware or other articles were buried with the body. A decorated moderate-sized jar of dark brown color was shown to us later at the

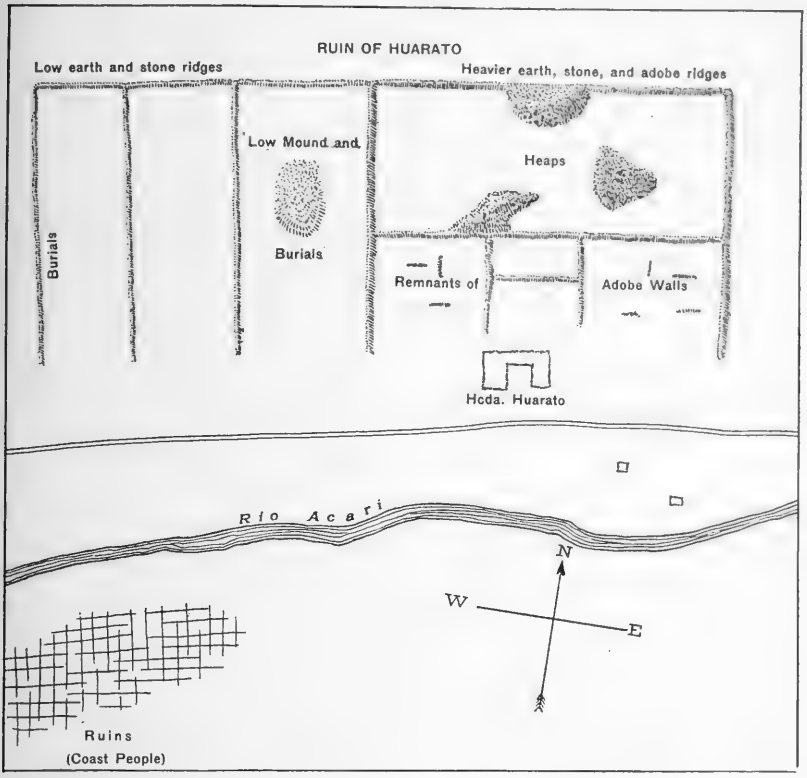



FIG. 2.—Sketch of Huarato, showing approximately the lay and ground-plan of the peculiar ruins of the people with the Aymara head deformation (to the north of the river).

hacienda and was said to have been dug out from another burial in these ruins.

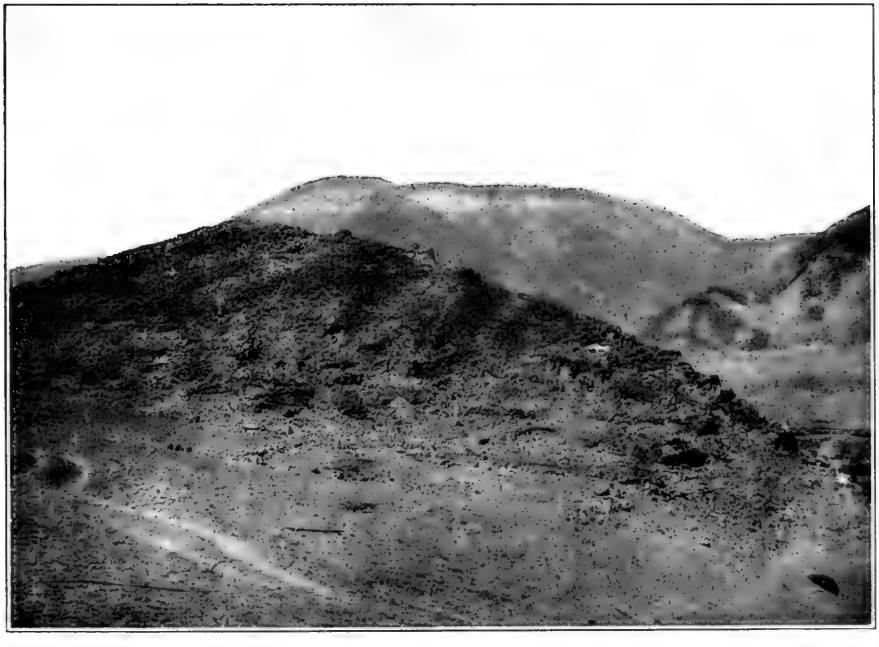
It is evident that these ancient remains of Huarato present a very interesting intrusion into the coast region of people from somewhere in the mountainous country farther to the east, and the burials at this place, hardly touched as yet, deserve a careful excavation.

## V. EXPLORATIONS IN THE MOUNTAINS TO THE NORTHEAST OF THE ACARÍ RIVER

*Santa Lucia.*—After a day's stop at Huarato, the writer set out once more for the sierra, which holds a key to many of the anthropological problems of Peru. The parts of the district of Lucanas now entered have never before been visited by a scientific explorer. They were reported to contain numerous ruins as well as burial caves, and as a further inducement the writer was informed that a three days journey from Huarato, in the old town of Andamarca,[1] there could be found many full-blooded Indians, speaking scarcely anything except Quechua and preserving their ancient dress as well as many old customs.

The writer, unfortunately, was to be guided and assisted by a merchant from Puquio. For the convenience of this merchant, the start from Huarato, on the 17 leagues (over 40 miles) journey to Sta. Lucia, was not made until five o'clock one afternoon. The main ascent of the mountain occupied over four hours. Long before that the sky became overcast, the darkness was almost impenetrable, and our animals stumbled on the perilous path. After we reached the top we were in addition overtaken by the usual cold drizzle of the rainy season in the hills, and this accompanied us the remainder of the journey. After midnight, the hitherto sandy upper country became more rocky and the darkness quite black. The animals could no more be guided, and we labored down and up, slipping and climbing, not knowing where we were or where the next step might land us, until three o'clock in the morning. That we this time escaped serious injury was a marvel and wholly due to the sagacity of the animals. When we emerged we were on the freer ground near Sta. Lucia. The miserable village itself was reached about three quarters of an hour later. Approaching, still in the rain, the hut where there were to be accommodations for us, we found first that it was very inadequate in size; second, that the yard was a pool of ill-smelling mud and water; and third, that the roof of the addition, more a shed than a part of a dwelling, which was to be our quarters, leaked so badly that there was no place inside where one could lie down or even crouch to sleep and escape the dropping water. It was raw and chilly. Two of the burros with loads had been lost in the darkness. But we were weary, and so the merchant took a corner of the floor, while the

[1] This is not to be confounded with the Andamarca farther north reported upon by Raimondi and Barrailler. Bol. Soc. Geog. Lima, Vol. 2, 1892, p. 121.



THE HILL OF OTAPARA, IN THE VALLEY OF THE RIO ACARÍ, COVERED WITH ANCIENT RUINS

Fig. 1. The fortified hill of Huamanmarca

Fig. 2. Despoiled stone-lined burial pits at Huamanmarca, with decomposed bones to the right

THE FORTIFIED HILL OF HUAMANMARCA, NEAR STA. LUCIA

writer rested on a primitive improvised narrow platform, a few sticks on four green forked poles, and the rest of the night was passed in wet oblivion.

At this place, with people too indolent to make even a ditch to carry the water away from their yards, with the baby of the family ill with bronchitis and the mother with tuberculosis, it was necessary to stay several days; and each day from four or five to 16 hours of cold drizzle. All this is mentioned merely to show some of the difficulties under which, at this season at least, the explorer labors in the Peruvian mountains, and some of the reasons why Andamarca was never reached by the party. The other reasons were, impossibility of obtaining native help and animals, and limits of personal endurance. The promises of the merchant proved to be just so much "palangana," an expressive Peruvian word, meaning the saying of a great deal that is never meant, or known.

Notwithstanding the untoward climatic conditions, the stay at Sta. Lucia was well utilized for examination of the region. The village doubtless lies on the site of an old native settlement. A number of large stone-lined burial pits, unfortunately almost wholly despoiled, exist in the slope of the hill opposite to the northeast. On the higher ground more to the north are stone ruins and the remains of a small row of partly subterranean, more or less oval burial chambers, plainly modifications of the burial houses of the more northern regions in the sierra. Farther to the north, on still higher ground, are other burial houses of the same nature and numerous remnants of low stone walls of habitations, as well as some beautifully preserved terraced fields or andenes; this locality is known as *Asto*. Across the valley of the stream that flows by Sta. Lucia on the west, there are other ruins and burial houses; and on the high plateaus to the north are ruins of dwellings, remnants of enclosures, and other evidences of ancient occupation. Finally, three miles southwest of Sta. Lucia down the valley, is a remarkable fortified rocky hill, with various burial houses, and with clear outlines of extensive slightly terraced fields about the base, known as *Huamanmarca* (pl. 16).

Most regrettably the more easily found burials in all the above places were thoroughly excavated many years ago and nothing was found left of the remains beyond small piles of decomposed bits of bone. However, in the burial houses between Sta. Lucia and Asto were seen several damaged skulls which indicated a type of people like those of the coast, with moderate fronto-occipital deformation.

After the ruins nearer to Sta. Lucia had been examined, an excursion was undertaken, with two of the mixed-blood natives, to the much higher and rougher regions about 15 miles north-northeast of the village,[1] where burial caves were reported.

The region now reached was found to consist of more or less parallel granite ridges or long narrow mesas, separated by canyons—in no case probably over 300 feet deep, but with slopes rather steep and full of bowlders. A curious geological feature, not seen elsewhere in the writer's travels, was that in a large proportion of the greyish granite bowlders there were nicely shaped rounded or oval cavities, in some instances amounting to good-sized caves, evidently blasted out by the winds. It was in two such cavities that, wet to the skin, cold, with soaked horse blankets beneath, wet poncho for a cover, and nothing more for supper than a box of sardines with a handful of parched corn, there was passed another night to be remembered.

In the morning it developed that my guide, besides being afraid through superstition, was not any too sure of the location of the burial caves, which by this time were reduced from several to "one or two," and we therefore set out to find some shepherds. In this, due to some native instinct of my companions, we were successful. We found an old woman with three daughters, of somewhat mixed blood, but speaking nothing but Quechua; had a royal breakfast of hot goat's milk with fresh parched corn; even found some tough grass for our animals; and then set out for the cave—only one now remaining. But it so happened that one of the young women, with a child, had an inflammation of the breast and in reward for the little help which it was possible to give her, her old mother volunteered not merely to locate exactly the cave we sought, but also to show us another one, unknown to anyone except herself, though at some distance.

We started for the first cave, while the old woman promised to meet us later on. Descending from the hut down one of the canyons through which was running a small stream, we saw on one of the slopes the remnants of crude stone walls; and about 15 minutes later, in a second canyon, we came to the burial cave. It was a good-sized rock shelter in the slope, and had been closed by a stone wall. Now it lay about two-thirds open, with its floor strewn with stones, skulls, and bones. Not far from 100 skulls and a large

[1] These directions and distances must be taken as only approximately correct.

quantity of corresponding bones were found here. They belonged to healthy, strong and rather tall people, with evidently normally meso- to brachycephalic skulls, but which in every case presented more or less the "Aymara" deformation.

This cave is known as *Nassa,* which is said to be a Quechua word, but the signification of the term was not known to the writer's informers. The accumulation of human remains in the cave represented plainly a secondary burial. There were no traces of pottery, nor any metal objects, but shreds of fabrics were present, some of which showed handsome colors and weaving. For the first time also since the writer touched at Lomas, there was an absence of wounds of the skull.

Just as the exploration of the cave and the selection of specimens were finished, the old shepherdess was seen descending with her dogs from the opposite ridge among the bowlders. She was soon with us, and then led us up ridge and down canyon, over native trails and again where there were no roads, until we reached, still surrounded on all sides by bowlders, an elevated V-shaped nook on the slope not far from the top of one of the mesas, in one side of which was seen an oblong, black crevice, closed except for a small opening by stones. Through the opening, the writer could see a large, dark cavern, the floor of which was covered to about two-thirds of its extent with human skulls, pelves, spines with ribs and bones of the limbs.

That forenoon, fortunately, we for once had no rain and the light was quite bright, so that, removing the stones, it was possible to crawl in and examine the inside without a fire. Upon entering it was evident that, for the first time since the writer's work in Peru, he was in a burial cave which had not been visited or disturbed by anyone. The skulls and bones lay exactly as placed there by the Indians, not even showing any damage by rodents or carnivores. The hollow of the cave was filled with droppings—probably of the guanaco which still abounds in this region, and a large number of the bones and skulls were buried entirely or partly in this substance. About 40 skulls, however, and numerous other parts of the skeleton lay, as before stated, uncovered. As in the first cave so here all the crania, with one exception, showed a typical "Aymara" deformation. As to the undeformed specimen and several of those where the deformation was of slight degree, they showed not the small oblong type of skull which we thus far have associated with the term "Aymara," but more rounded and in instances quite large

crania, which could be more directly compared with the better developed type of the coast skull, or with the shorter, undeformed crania found mingled to some extent with the prevailing longer type in the sierra of Huarochirí.

Again as in the Nassa cave, the burials were plainly secondary, and it was evident that in many instances a body only partly decomposed had been forcibly disjointed to a greater or lesser extent, before being placed in its last resting place.

Although the sun was shining when the writer entered the cave, before he was through with the examination of the skeletal remains lying on the surface, thick mists began to envelop everything about, and were soon followed by the " aguacero " or cold drizzle. A large quantity of skeletal material still remained buried in the refuse with which the cave was filled, but it was necessary to hurry and only the more accessible parts could be examined. The total number of skulls inspected was more than 100, and according to the indications there were possibly as many more in the cave. Besides the skulls numerous other bones were looked over. Among this mass of material not a single pathological skull or bone was discovered. Also, there were neither pottery nor fabrics, but a number of various sized undecorated gourds lay on the floor, probably representing vessels that contained food and drink offerings.

The native name for this cave is *Cuxoxloma,* which again is said to be a Quechua term, but of unknown signification. It is not impossible, however, that these names are derived, in common with some others met with later on in these regions, from some other language.

While the cave was being examined, the old woman and also the writer's companion kept carefully at some distance away, for fear of the dead. The limit of daring was shown by the younger man in taking the selected specimens from before the opening of the cave, out of which the writer pushed them, and placing them with grass in bags.

No cultivable grounds and no ruins exist in the proximity of this cave or in the nearer neighborhood, and the remains must have been brought here from some distance. Exactly who these people were remains to be determined. The Aymara deformation may have been only an extension of that habit from the real Aymara people southeast of this region.

*Sta. Lucia to Nasca.*—Having done what was possible in the vicinity of Sta. Lucia and not being able to go farther inland, the

writer started for his original goal, the valley of Nasca. The journey by the route chosen occupied, not counting the stops, two and a half days, and showed a number of interesting conditions.

The first stop was made at the old fortress Huamanmarca. The fortifications were primitive but extensive and before the introduction of firearms must have been quite effective. In and about the fortifications, especially on a hill to the northwestward, were found quantities of quartzite chips and rejects, indicating a considerable stone industry. A somewhat similar condition had been seen at and above Asto. No finished implements were discovered, but, according to the natives, arrow points, larger worked blades, star-shaped club heads and other articles of stone are occasionally found by the children, or in working the fields. The writer saw no traces of stone manufacture along the coast, or in the mountains of Huarochirí.

Late in the afternoon of the same day, a narrow but at this time of the year dangerous river was passed, the most southern affluent of the Rio Nasca. On the subordinate elevations just to the north of the river were seen crude stone ruins, evidently untouched, of a moderate-sized settlement, with some burials; and that night another remarkable fortified hill was reached, known as Llaxwa.

The *Llaxwa* ruins (pl. 17) consist of stone remains of terraces, fortifications, and dwellings. The hill which they cover is easily approached from the east, but dominates the lower mountainous land on all other sides. The ruins are in a poor state of preservation; it is seen however that they have not yet been thoroughly despoiled and contain some untouched burials. The stone masonry, while showing care, is not of high order. No cement was used, and there are no imposing edifices. At the distance of about half a mile to the east from these stone structures, on high sloping ground, exist two groups of burial houses, not as long, but otherwise considerably like those described before from the district of Huarochirí (pl. 18). Unfortunately, these houses have been visited long ago by the treasure hunters, who have left little except fragments of the bones; nevertheless by excavation numerous specimens could probably still be discovered. The remains of the crania show without exception the "Aymara" deformation. A few huts about the Llaxwa ruins are now occupied by Quechua speaking mixed breeds, who seem to know nothing about the history of the locality.

## VI. EXPLORATIONS IN THE NASCA REGION

From Llaxwa, a hard day's journey brings one to the Hacienda de Las Trancas, on a river of that same name but which later on joins the Rio Nasca. It is from this road that one appreciates best the dominating nature of the fortress. The country traversed is dry and no other remains of ancient settlements are met with until one reaches the narrow rocky valley of the river. There in numerous localities are seen stone foundations of ancient dwellings, made of large water-worn stones; despoiled burial pits lined with stones; and on a few large blocks of stone there are petroglyphs resembling remarkably those common to North America.

The above remains are, however, rather unimportant; the archeological wealth of the Nasca region commences at the Hacienda de Las Trancas. The main road of this large estate passes in several spots across remnants of ancient habitations and burials, and numerous cemeteries that have yielded quantities of fine pottery are in the vicinity. Skulls, bones, fabrics, and other objects are strewn in patches over the desert outside of the arable lands of the shallow valley. A group of these cemeteries at a locality known as *Poroma,* about three miles southwest of the hacienda, were examined later.

From Las Trancas the writer proceeded to *Majoro,* one of the haciendas of his friend from Lomas, Sr. Enrique Fracchia, and located only a short distance below the town of Nasca. From this place limited excursions were made farther up and down the valley of Nasca, and also to the above-mentioned Poroma. Subsequently the river was followed to considerably below where it merges into the Rio Grande. What was learned during the rapid survey of these regions was briefly as follows:

Ruins of importance are found in the vicinity of Nasca, but remains of small settlements exist at many spots along the edges of the sandy plains bordering the arable lowlands. In a number of instances posts of the hard and enduring huarango (mesquite) indicate the presence of habitations, while other posts of the same wood, standing in rows, subserved functions not yet determined.

Along the various branches, as well as by the main stream of the Rio Grande de Nasca, in the deserts, beyond the cultivable ground, there are numerous old cemeteries, some quite extensive, but the majority of small size. A great deal of excavation has been done in these cemeteries, particularly during the recent period of drouth, when, according to local reports, they proved a "god-send" to the poor people.

Fig. 1. The hill from the northeast

Fig. 2. The hill from the southeast. Native hut, for the moment the writer's quarters, in the foreground. The inhabitants are mix-breeds, speaking Quechua

THE FORTIFIED HILL OF LLAXWA, ABOUT 50 MILES (BY THE PATHS) S. E. OF NASCA

BURIAL HOUSES A SHORT DISTANCE EAST OF THE ANCIENT FORTIFIED HILL OF LLAXWA, IN THE WESTERN CORDILLERA, S. E. OF NASCA

Throughout these regions there are found with the burials not only excellent potteries of the Nasca type, but also, though to a less extent, nicely decorated fabrics, even feather work, and now and then articles of gold. It was the indiscriminate digging for and the sale of such articles, that sustained for two years the poorer part of the Nasca population. Since the law was enacted prohibiting such exploitation it has been greatly reduced, but irreparable damage to scientific investigation has already been done. The objects taken from the graves have been distributed broadcast, in the main to private curio collectors. And there are at the present time individuals who keep on excavating the remaining graves and hunting for whatever may be salable, some of them periodically and a few daily. Good pieces of pottery bring on the spot as much as a pound ($4.90); the gold objects are sold usually by weight, and the fabrics for whatever they will fetch. A great deal is broken or torn and left, so that the total loss is enormous. Some of the more recently excavated burial places were found, as at Lomas, almost covered with remnants of fabrics, slings, ropes, and even scalps with peculiar braids, of all of which it was still possible to secure a good-sized collection; but it would be very costly at this day to make anything like a first-class representative gathering showing the Nasca culture.

The burials of the Nasca region are of several varieties, which however are in the main closely connected and do not indicate separate periods or cultures, or different types of people. The tombs seen over the 40 odd miles of territory between the haciendas Majoro and Coyungo and in the valley of the Las Trancas River, included some low mounds, with chambers built of moderate-sized adobes; ordinary, stone, or sand-block lined pits; subterranean chambers constructed of poles of the hard wood, or of wood and adobes; besides which there were simple graves in the sand or gravel, and finally, in several localities, burials in large, stout, undecorated, earthenware urns, especially made for that purpose. The huarango poles in the graves or burial chambers, as well as in the remnants of the habitations, had generally been reduced to the proper length by burning, but instances also occur in which they had been cut.

The bodies have as a rule been buried in the contracted position, and bound in bundles; and those of important personages were made up, with the aid of abundant raw cotton, into huge mummy-packs.

Physically the population of the entire Nasca region was remarkably homogeneous, which is a fact of considerable interest; and,

what is important, it was possible to determine conclusively that it represents merely a portion of the brachycephalic, moderately developed, coast type of people (pls. 19, 21).

Deformation of the head, fortunately, was much more rare than closer to the coast. What was present was exclusively of the same fronto-occipital variety. Not a single instance of the "Aymara" type came to notice, but it was learned that two or three skulls of that nature were found in one grave at some distance down the main valley. In one case, just above the dwellings of the hacienda of Coyungo, a moderate-sized cemetery was met with in which all the crania were marked by the pronounced fronto-occipital deformation such as was met with in the burial ground to the east of the house at Chaviña.

The oblong type of the skull (pls. 20, 22), which was found frequently in the valley of Acarí, was seen only rarely in the region of Nasca. There was less admixture of this type among the people of the Nasca than among those of most of the localities along the coast. However, at *Coyungo* (over 40 miles west of Nasca), two moderate-sized burial grounds were examined in which this oblong type was again in greater evidence.

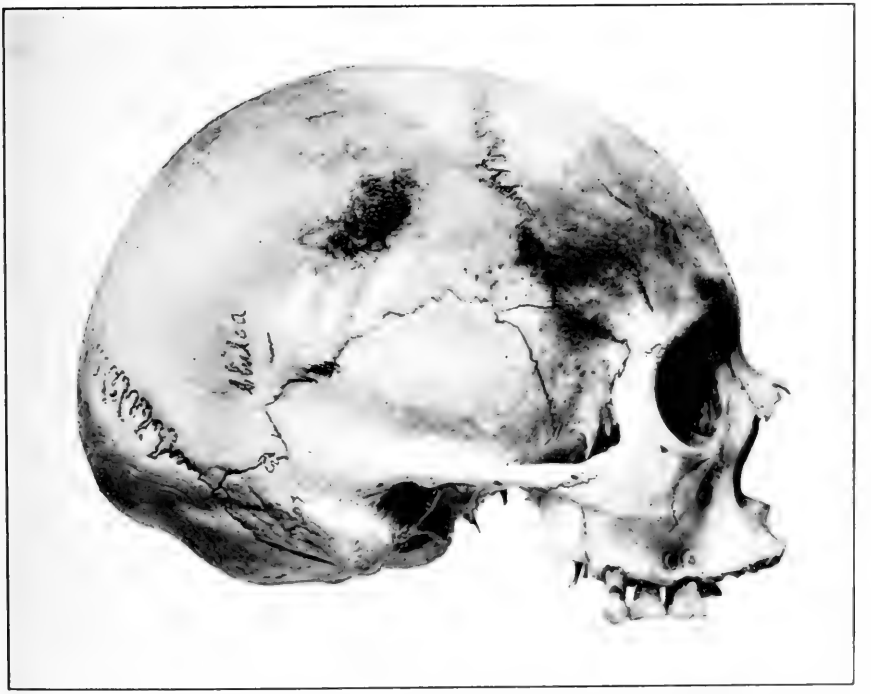
As regards pathology, the Nasca region compares closely with that of Lomas and the Acarí Valley. Fractures were equally rare; symmetric osteoporosis of the skull occurred seldom and not in extreme form; and there were but few "mushroom-head" femora. A number of cases of more ordinary arthritis and a small number of inflammations exhaust the finds in this direction.

In the deeper burials of the Nasca Valley, the skeletal material, either from age or moisture, is generally in a poor state of preservation, and is almost invariably reduced by those who excavate into fragments, many of which are then reburied. So far as it was possible to examine this class of remains they were seen to be of the same type as those from the more superficial graves, but the fronto-occipital deformation of the skull was more common.

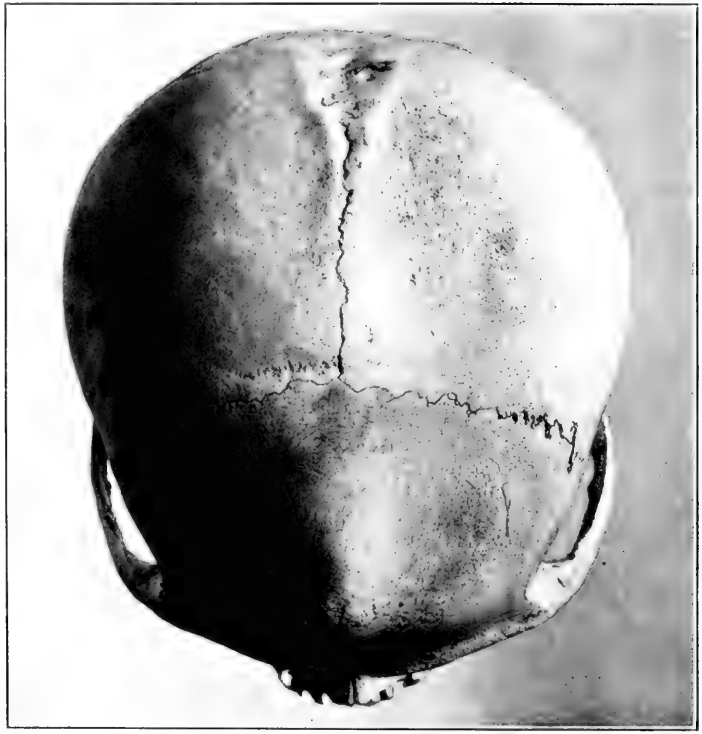
The uneven size of the various cemeteries in this region will be appreciated from the following records:

Of the four well-excavated cemeteries at Poroma, six leagues south-southwest of Nasca, the first showed exposed 156 crania and a corresponding quantity of bones; the second 63 crania; the third 101, and the fourth 200 crania. Five smaller burial places at Coyungo gave, the first 72 skulls, the second 34, the third 78, the fourth 9 (with perhaps as many in fragments or reburied), and

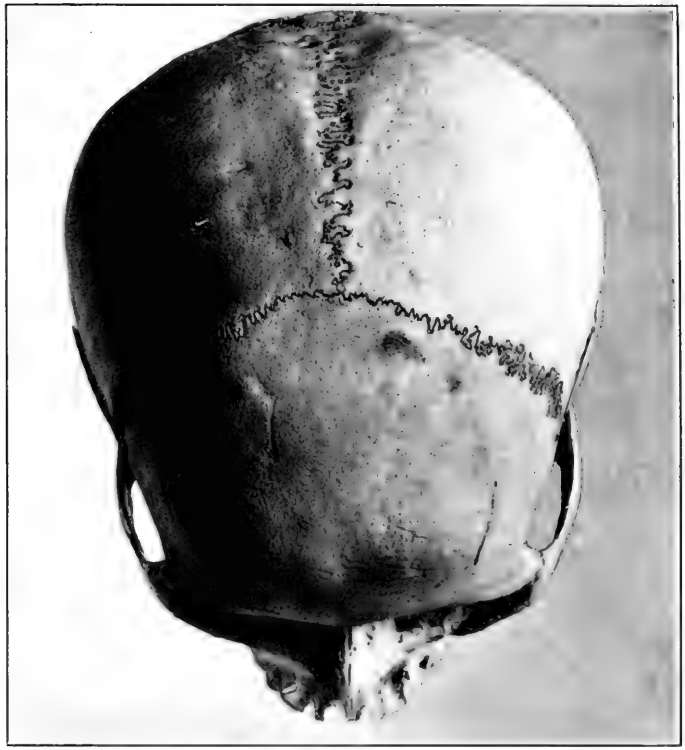
THE TWO TYPES OF SKULLS SECURED IN ANCIENT CEMETERIES ON THE COAST OF PERU: A MALE AND A FEMALE SKULL OF NASCA, SHOWING THE PREDOMINANT BRACHYCEPHALIC COAST TYPE



A MALE SKULL (TOP) FROM CHAVIÑA, AND A FEMALE SKULL FROM CHILCA, SHOWING THE MORE OBLONG TYPE OF PERUVIAN CRANIA, WHICH OCCURS IN MINORITY ALONG THE COAST BUT PREDOMINATES IN THE WESTERN PARTS OF THE MOUNTAINS

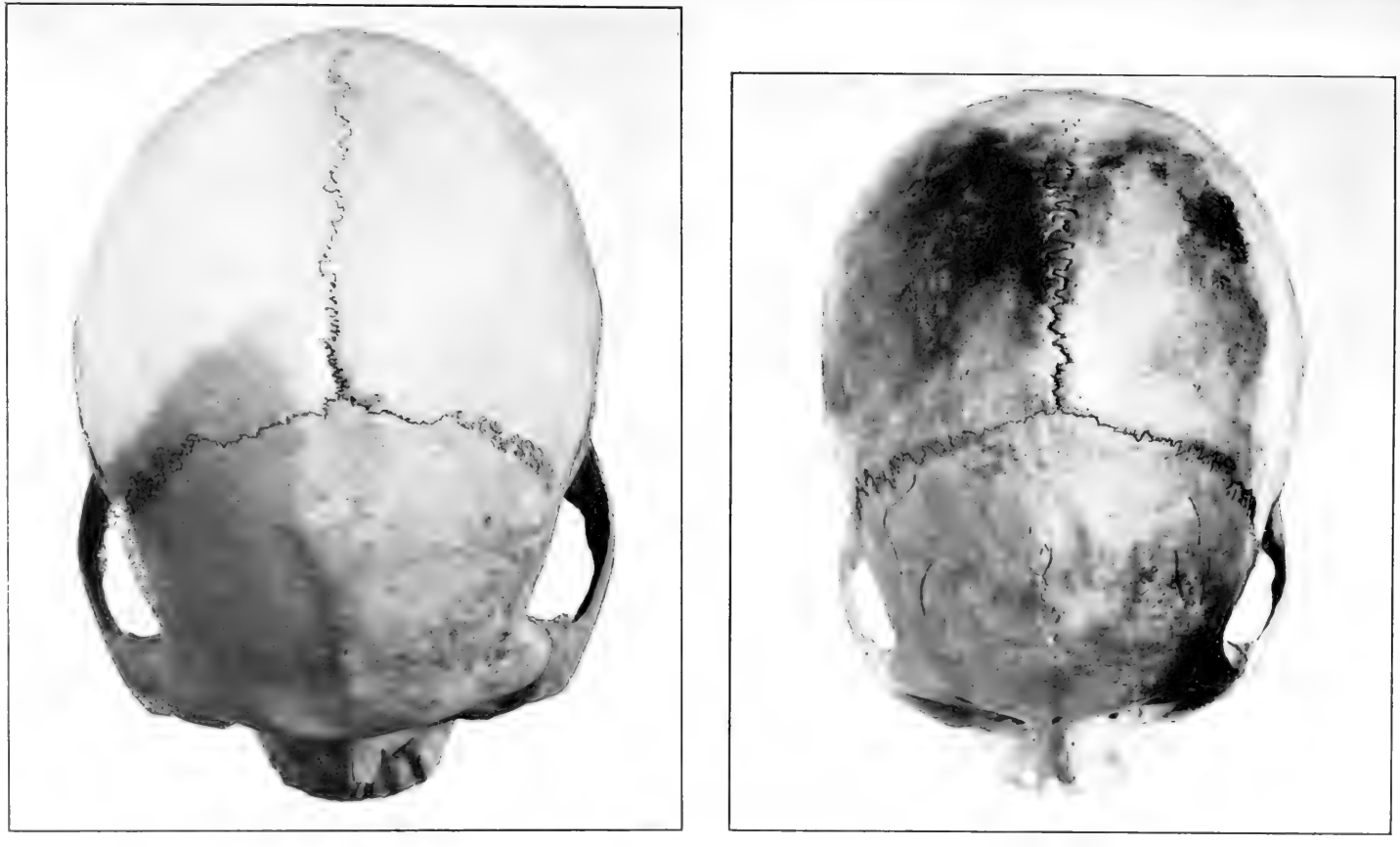


Male



Female

THE TWO BRACHYCEPHALIC SKULLS SHOWN IN PLATE 19 FROM ABOVE



Male Female

THE TWO DOLICHOCEPHALIC SKULLS SHOWN IN PLATE 20 FROM ABOVE

the fifth 23. But in each case some addition must be made for skulls accidentally reburied and for a few that may have escaped discovery.

Owing to lack of time, the shorter more eastern part of the Nasca Valley could not be visited, and the same is true about the watersheds of the northeastern branches of the Rio Grande, all of which are said to contain cemeteries as well as other remains of antiquity.

The burial grounds on the lands of the hacienda of Coyungo represented, as indicated above, in a large measure the Nasca people and Nasca culture. The pottery at the hacienda, of which a collection was seen, was also in the main of the Nasca type, with some aberrations. Finally the cotton-bale mummies were rather common (pl. 23, fig. 2).

*Coyungo-Ica-Pisco.*—The distance from Coyungo to Ica is estimated at over 80 miles, and up to about 25 miles from Ica the road passes over hot barren deserts, which show few traces of the ancient population. At the point just indicated, the road reaches the hacienda of *Ocucaje,* a large, shallow, green depression. At a number of sites on the outskirts of this depression are seen mound-like elevations which possibly contain remains of habitations and show burials. At one such place a number of defective skulls on the surface were found to present the interesting highly deformed "flat-head" variety, such as seen before in one of the cemeteries at Chaviña and in two near Coyungo. The bones belonging to these skulls showed also the same moderately developed people as were found in the other cemeteries just cited, and as were general along this part of the coast.

A brief stop was made at this hacienda and one of the owners demonstrated to the writer a collection of various objects recovered from the local burial grounds. These specimens, while showing in many points a relation to the Nasca culture, presented a number of differences. Thus for the first time on the coast there were seen bows and arrows. Both were of large size. The bows were simple. The arrows were made of reeds and had long wooden points barbed on one side. A kind of a colored palm-fiber basketry was seen, representing possibly parts of a head gear. The pottery, while showing numerous resemblances to the more ordinary types of the Nasca region, differed from the latter by the absence of certain shapes and in decoration. Furthermore there were signs of wood carving, which is only rarely met with about Nasca. Feather work

was present, but of simple design, and even this was said to be rare in this vicinity.

From Ocucaje the road leads over a swell in the ground to the valley of Ica. Just where the road enters that valley, a low artificial elevation was seen and the ground in the neighborhood was strewn with skulls and bones, for the most part very defective due to long exposure. The type of the crania and bones was that of the ordinary coast population, and the majority of the skulls presented more or less of a fronto-occipital flattening.

In the valley of Ica, thickly overgrown by the huarango, a number of localities were heard of at which there were old burial grounds, and traces of ruins, or huacas; but evidently none of these are of great size or much importance. On the day following his arrival at Ica, the writer, with the kind assistance of the prefect of the district, made an excursion to a rather large mound and cemetery located at *Chalcaca* (or *Chulpaca*), near Pueblo Nuevo, about five miles southeast of Ica. The place was found thoroughly dug over by the peons, and the work was evidently completed a number of years ago, for the skeletal remains were in poor condition. The burials, or at least some of them, were made in large cylindrical earthenware jars or urns, about two and a half feet high and nearly the same in diameter. A number of these jars, not unlike the sections of a huge sewer-pipe, lay about one of the neighboring huts, apparently too substantial to be broken and too large to be made any use of by the present people. The skeletal remains showed a prevalence of the ordinary coast type people, with moderate fronto-occipital deformation of the skull; but there was a very perceptible admixture of the more oblong-headed element, well known from other places referred to in this report. At the house of one of the wealthier men of the neighborhood was seen a collection of pottery and other objects, showing the ancient culture of this vicinity. The specimens resembled closely those of Ocucaje, the pottery, however, showing decoration still more at variance in designs from that of Nasca. A large percentage of the vessels were more or less globular water jars of different sizes, with a narrow neck. The collection embraced very few fabrics, but included 20 or more stout staffs with well-executed carvings at one extremity, and set in the ground in front of the house was a carved post showing an attempt at a representation of a human figure. The bows and arrows were like those at Ocucaje.

Fig. 1. Some recent excavations in one of the old Nasca cemeteries, showing the abandoned skulls and bones

Fig. 2. Excavations at Coyungo, showing a subterranean burial chamber and debris of the cotton-padded mummies

ANCIENT CEMETERIES IN PERU, SHOWING THE RESULTS OF THE PEON'S WORK. THE SKULLS, BONES, FABRICS ETC., ARE LEFT TO DESTRUCTION

A noteworthy condition in regard to the human bones at this locality was the relative frequency of various pathological conditions of inflammatory nature, and a rather poor development of many of the bones in strength.

The above was the only burial ground within easy reach of Ica that offered any fair prospects for finding skeletal material; and according to information obtained from various sources, no cemeteries or other remains of antiquity of any account exist on the deserts between Ica and Pisco. None are, in fact, said to be found before one reaches the Rio de Pisco, and especially the vicinity of Tambo de Mora and Chincha, which localities the writer was also unable to examine.

## VII. GENERAL REMARKS ON THE LOMAS, ACARÍ, NASCA AND ICA REGIONS

The explorations along these parts of the Peruvian coast and especially those in the Nasca region, have demonstrated beyond any possible doubt that the population of this territory and to the west of the high mountains, was an integral and inseparable part of the coast people. In every respect, even in the occasional admixture of the longer-headed element, this population was identical with that of more northern districts of Pachacamac, Rimac, Ancón, Huacho and Chan-Chan. Its culture differed, however, from that of these districts in many particulars; but it was not homogeneous, differing more or less from spot to spot and even from cemetery to cemetery. The Nasca group, physically the purest, seems to represent the oldest part of this southern coast population.

## VIII. EXPLORATIONS IN THE DISTRICT OF LA LIBERTAD

From Pisco the writer took a steamer northward and, after rapidly arranging matters at Lima, left for Salaverry, 300 miles to the northwestward of Lima and nearly six hundred from Nasca. After reaching Salaverry, he proceeded immediately to the hacienda de Roma in the valley of the Chicama (fig. 3).

It was in the *Chicama Valley* and from the same hacienda, that the writer was able in 1910 to visit 29 old native cemeteries and to make an important collection. Over 1,200 crania and a large quantity of other bones of the skeleton were secured on that occasion; nevertheless the region had by no means been exhausted of specimens, or

scientifically. In particular, a number of pathological problems remained to be settled and made further investigations very desirable.

Fortunately for the work, the writer gained the friendship of the most influential as well as enlightened man of the Chicama Valley, Senator Victor Larco, and the aid of this gentleman, with that of those who have charge of his estates, made it possible to accomplish what otherwise would have required much more time, and might even have been impracticable. On this occasion at the writer's wish and before his arrival, Sr. Larco detailed a number of his employees to collect everything in the line of skeletal remains that was exposed from one of the large prehistoric cemeteries, not before examined, near the hacienda of Chiquitoi, and from several other localities. As a result when the writer arrived, he found the floor of a spacious hall in the local hospital piled with skulls and bones, a material on the whole in a rather poor state of preservation, but making possible some statistical determinations, particularly in regard to pathological conditions, for which there was formerly no occasion. The results of these are given in the appendix to this paper.

The work at Roma concluded, the writer made an interesting visit to a large huaca and a cemetery on the Casa Grande hacienda, and then proceeded toward the seashore, where a number of burial sites were investigated. He came unexpectedly across an exceptional burial ground near Huanchaco; examined once more the cemeteries about the Cerro de la Virgen; found another remarkable cemetery on the edge of the slightly elevated Chan-Chan plateau about two miles south of Huanchaco; examined two large and one small cemeteries at Chan-Chan; passed over the burial grounds in the edge of the desert from Moche to the huacas of the Moon and the Sun; and finally nearly completed the circle about Trujillo by making a journey to the eastward and northeastward of the town, following the ancient acequias and walls. A more detailed visit than was formerly possible was also made to the great Chan-Chan ruins.

The results of these explorations in the La Libertad district may be briefly summarized as follows:

Since the writer's visit to many of these places three years ago, a very perceptible change for the worse was observed to have taken place in the state of preservation of the old remains. Also, where formerly were seemingly inexhaustible quantities of skeletal material,

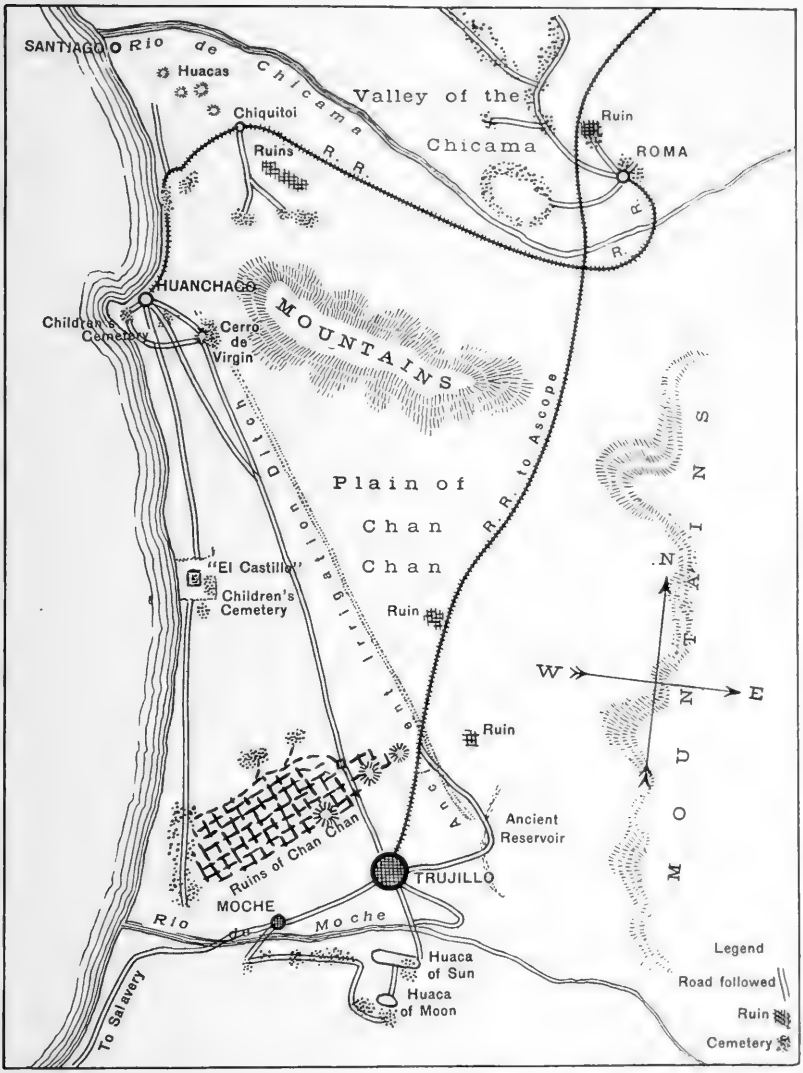



FIG. 3.—The environs of Trujillo and the Valley of the Chicama. Sketch showing the territory examined by the writer and approximate location of a number of the ruins and cemeteries.

there is now a dearth of the same. No such collection as that made in 1910 will ever again be possible from these regions, and had the material not been gathered at that time, it would be to-day for the most part unavailable, due to atmospheric destruction.

As on the occasion of the former visit, so now, the major part of the ancient population of the Chimu region was found to belong to the more or less brachycephalic coast type, of moderate stature and moderate to (close to the coast line) strong muscular development. The valley of the Moche River, the cemeteries about and on the huacas of the Sun and Moon, and Chan-Chan itself, show a population identical with that of the Chicama Valley; and this population is of precisely the same type as that of Huacho, Ancón, the Rimac Valley, Pachacamac, Lomas, Acarí Valley, and of the Nasca and Ica regions. These conclusions it is now possible to state definitely.

As elsewhere along the coast, the Chimu people were wont to practice, though not with equal frequency or intensity at all periods of time or among all their subdivisions, the antero-posterior head deformation. Even those cases which formerly appeared to the writer as being simple occipital flattenings are, he has now reasons to believe, merely lighter varieties of the "flathead" type; they are cases in which the pressure on the forehead was inadequate to cause enduring changes in that region, nevertheless was sufficient, coupled with the weight of the head of the infant, to produce a flattening of the occiput.

As many other localities along the coast, so also the Chicama and Moche valleys, as well as the Chan-Chan region, show more or less admixture, the proportion differing from cemetery to cemetery, of a more oblong-headed element of the same type as that met with in the mountain region of Huarochirí. But it seems very probable that this type was in the main of a relatively late appearance. It is rare among what appear to be the oldest burials; and it manifests itself in mingling, or living side by side, rather than admixture. This type evidently brought with it differences in culture, including the absence of the habit of head deformation, which however was in part adopted later. The occurrence of this type, which can represent no local variation and which is very scarce among or absent from the oldest Chimu as well as Nasca burials, indicates late prehistoric relations, more or less extensive according to locality, with the highland people who carried it, and a considerable subsequent intrusion of these people into the coast settlements. Quite likely exploration in

the mountains will show all along the line similar intrusions of the people of the coast type into the hills.

A number of especially interesting particulars resulting from these later studies in the Trujillo and Chicama regions, were as follows:

At the cemetery near a large huaca on the lands of the hacienda *Casa Grande,* while a larger part of the burial ground yielded nothing but the coast type of people, a small collection showed a taller and better developed strain with large and beautifully oblong skulls, free from all deformation.

On a promontory of the elevated flats rising a short distance south of *Huanchaco,* a moderate-sized burial ground was found which, with the exception of one or two adult individuals, yielded nothing except the skulls and bones of children and young adolescents, and the crania of these belong without exception to the fine, oblong, undeformed type, such as was found near the above-mentioned Casa Grande ruin. The cemeteries north and east of Huanchaco showed the usual coast type of people.

A little over two miles south from Huanchaco, at the edge of the elevated and in the olden times cultivated, but now desert, plain of Chan-Chan, a double, quadrilateral, isolated enclosure exists, which has been regarded by some as the remains of an old castle or fortification (see fig. 3). Instead, this relatively simple structural unit was a convent, school, or a shelter for more grown-up children and young adolescents, and was occupied by people other than those of the valley, for just outside the walls of the inner enclosure, to the east, exists a cemetery which again, as at Huanchaco, yielded nothing but the bones and skulls of the young and the skull in every instance was found to be of the oblong, undeformed, fine variety. Just outside of the wall to the south of this compound were some burials of adults which gave the usual coast crania.[1] No other

[1] It is doubtless this compound to which Squier (Peru, etc., N. Y., 1877, pp. 122-123) refers as *El Castillo.* But Squier must have written of this structure from recollections that had become somewhat unreliable. The quotation is introduced below. It is certain that the burials mentioned by Squier were not those of young women, but of children and young adolescents of uncertain sex; such skulls, however, can easily be taken for skulls of women by one who is not an anatomist. Also, there are no traces of the "several acres stuffed with skeletons"; the large exposed Chan-Chan cemeteries exist farther southward. Finally, skulls showing traumatic lesions are common in many parts of the coast. It is certain that nothing now indicates that any battle has taken place in this locality. Of course, the skeletal

occurrence of a similar grouping of the oblong-headed type was met with in these regions, nor anywhere else along the coast.

The *Cerro de la Virgen* cemeteries and neighborhood were again examined and it was definitely determined that this small rocky eminence has never been fortified; that the cemeteries about it are just ordinary burial grounds of rather poor people of the coast type; and that the neighborhood was in olden times irrigated and cultivated, the remains of a large, deep ditch leading for miles to the eastward and terminating in a reservoir, now dry, east of Trujillo.

The cemeteries of *Chan-Chan,* to the north and northwest, are still to a large extent unexplored; however, digging by the peon goes on. Those immediately to the west of the ruins have by this time been quite dug over. There are stores at Trujillo, including the principal pharmacy, which openly buy and in some instances sell the "wares."

It is strange that this great ruin, the center or rather culmination of the Chimu culture and as such one of the most important archeological remains of ancient Peru, also one of the sites most dug

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remains exposed 35 years ago have in all probability completely disappeared, but the peons generally keep on excavating in such localities turning up new specimens. Squier's note reads: "We took a long sweep past La Legua to an eminence near the sea, on which stands an extensive work with a *huaca* and other monuments inclosed, called, from its position and assumed purpose, El Castillo. The sandy soil in front of its principal entrance, over an area of several acres, is stuffed with skeletons, buried irregularly, as if after a great battle; a supposition supported by the fact that the bones which had been exposed by excavation or laid bare by the winds were all of adult men, and that a large part of the skulls bore marks of violence. Some were cloven as if by the stroke of a battle-axe or sabre; others battered in as if by blows from clubs or the primitive hammer to which the French have given the appropriate name of *cassetête;* and still others were pierced as if by lances or arrows. I picked up a piece of a skull showing a small square hole, precisely such as would be occasioned by the bronze arrow-heads found here and there among the ruins.

"I could not resist thinking, in spite of tradition, that perhaps on this very spot had been fought the last decisive battle between the Inca Yupanqui and the Prince of Chimu, and that here were mingled the bones of the slain of both armies: a notion supported by finding mixed together the square, posteriorly compressed skulls of the peoples of the coast, the elongated skulls of the Aymaras, and the regular, normal heads of the Quechuas of the sierra.

"Inside the Castillo we found a terraced cemetery, containing, however, only the skeletons of young women, carefully enveloped in a fine cotton cloth. These skeletons were apparently of persons that had died at between 15 and 18 years of age."

over by treasure hunters, has to this day received scarcely any scientific attention.

While visiting the ruins of Chan-Chan themselves, one is struck by the enormous labor and expense undergone by the excavators hunting for gold; and the fancies of many an inhabitant in the valley still dwell upon hidden treasure. Also, to one who has seen them before, the fact is sadly apparent that these ruins are undergoing a gradual decadence. The bas-relief palace was revisited. The figures on its walls, stamped in resistant adobe, and which were still beautifully clear three years ago, are to-day already blurred by the action of the elements; a few years more and they will be so much shapeless dry mud, and not a cast or a fragment of them exist anywhere in a museum. Similar examples of the ravages of time could be multiplied in this great city.

The cemeteries of the *Moche Valley* are now evidently almost exhausted; but burials are said to still occur in the sand hillocks from Moche to Salaverry. The burial grounds about the huaca of the Moon have been thoroughly dug over and seem also to be quite exhausted. The excavations in the huge adobe pile which began a few years ago under the direction of the then prefect of Trujillo and another high public official, Dr. Portugal, have evidently been carried somewhat further, but so far as learned without adding much to the results of the first digging. The great huaca of the Sun has been injured no further. Undisturbed burials doubtless still exist about and on, as well as in, this immense structure. A skeleton of a woman, which the writer secured, has been recently dug out from a small flat near the top.

The skeletal material examined or gathered from all these places duplicates, as already indicated, that from the valley of the Chicama, and offers similar pathological conditions. The four principal classes of lesions found in the Chan-Chan region include symmetric osteoporosis in the young; the "mushroom-head" femur; other signs of arthritis; and exostoses in the external part of the auditory meatus. Besides these there were met with a few cases of more or less localized periostitis or osteoperiostitis, one of a destructive bone lesion or tumor, and a few fractures and dislocations.

## IX. GENERAL CONCLUSIONS

During his late expedition to Peru, the writer examined approximately 4,800 crania and a very large quantity of other bones of the skeleton. This material belonged in a large part to the coast region,

but to some extent also to two of the more western districts of the highlands. The investigations were an extension of those of 1910, when, besides the considerable quantity of specimens examined, 3,400 skulls and a large number of bones were collected.

The investigations on both these trips to Peru followed, as already stated in part, three main objects, namely:

(1) The determination of the anthropological characteristics of the pre-Columbian Indian of the coast as well as of the highland regions, so far as these could be covered;

(2) The study of the diseases of the pre-Columbian Peruvian, with a collateral inquiry as to trephining and other possible surgical practices; and

(3) The gathering of any indications that might be found relating to man's antiquity in that country.

The results of the work are not ideal, nevertheless a number of points of value, have been determined. Important parts of the territory could not be reached, and even within the regions attained the exploration had to be limited to what lay exposed on the ground or in the caves. Furthermore, it was difficult to determine the age of many of the burial grounds. Except where clear signs of a contact with Europeans were present the age of the cemetery could only be surmised. Yet it is certain that a large majority were pre-Columbian; and the problems seriously affected by the uncertainty are few in number, and belong only to the realm of pathology and surgery.

*Anthropologically,* the opinions ventured after the conclusion of the first expedition are in the main confirmed. While a few links in the chain of evidence are still wanting, it can now be regarded as quite certain that the Peruvian coast from Chiclayo at least, in the north, to Yauca in the south—a distance of over 600 miles—was peopled predominantly before the advent of the whites by one and the same physical type of Indian. This type was characterized by brachycephaly, moderate stature, and moderate to strong musculature according to localities. The most important facts ascertained in this connection are that both the Chimu and the Nascas were innate and, on physical grounds, inseparable parts of this people.

These coast people were fishermen, or agriculturists, according as they were settled close to the sea or farther inland. Evidently they were organized into numerous political groups, which developed smaller or greater cultural differences according to environment and other influences. It may be permitted to introduce here a few

generalizations, however imperfect, in regard to their cultural life, based on the extensive knowledge obtained of their remains.

They built dwellings of reeds, as well as larger structures of small uncut stones, of moderate-sized sun-dried brick, or of great blocks of adobe, and they constructed of adobe, stones, and earth characteristic larger edifices, and mounds of various sizes, known as *huacas*. The latter probably served partly for ceremonial purposes and partly for burials.

These people were remarkably well acquainted with the arts of weaving, pottery making, and decoration. They wove from the native cotton and from llama wool. The color and decoration of the fabrics, and the shapes, artistic value and variety as well as the symbolism of the decoration of the pottery, differed from place to place, in accordance with time and other influences.

The pre-Columbian Peruvians of the coast knew copper, silver and gold, with some of their combinations, and worked these metals to a limited degree. They dressed principally with a poncho shirt, a loin cloth, and sandals, with little head-gear; what there was of the latter was often decorative or symbolic. They made considerable use of gourds. They made few or no stone implements. They utilized wood in their houses and for ceremonial purposes, in the latter case developing more or less carving. Their weapons were a metal or stone mace, a wooden club, a copper axe, a variety of copper knife, the sling, and in some regions also the bow and arrow. Their implements were the whorl, weaving sticks, looms, cactus-spine or bone needles, bone needle holders, sharpened sticks, copper knives, copper axes, hoes; and in the case of the fishermen, nets, sinkers, reed-bundle boats or balsas, and peculiar rafts, with paddles. In pottery they made frequent use of molds and stamps, and were masters at imitating natural objects and animals as well as man. They knew no precious stones, except possibly, in rare instances, the emerald and the turquoise; and they had no pearls. They used beads, claws, seeds, feathers, multicolored yarn, and metal objects for personal decoration. Nose and ear ornaments, though probably in use, have not been found by the writer in the many cemeteries examined. Their musical instruments were the drum, the pan-pipe, the flute, and the rattle.

Throughout the extent of the territory which they occupied, the coast people deformed the heads of their infants by applying a pressure, probably by means of a bandage and pads, to the forehead, and this practice flattened at the same time by counter pressure the

occiput. The oldest parts of the population, except perhaps at Nasca, seem to have deformed less generally than those just before the arrival of the whites. The frequency and intensity of the deformation differed according to groups and possibly clans, of the people. They practiced no filing, cutting or chipping of the teeth, and no other mutilation which would leave marks on the skeleton. In the Chimu region, there may have been something like the nose-cutting among the Apache and other tribes.

These people of the coast have spread along the valleys to the foothills of the Cordillera, and have probably in some instances penetrated into the mountains. Meanwhile, however, they became in many though not all localities more or less mixed, or rather mingled, with dolicho- or near dolichocephalic elements, which must have come from or across the mountains. In a few instances a cemetery will be found near the coast in which this oblong-headed type predominates or is almost the only one present.

*Pathologically,* so far as shown by the bones, the people of the coast were decidedly freer from diseases than would be an average white population of such numbers. Some systemic diseases well known to us were seemingly entirely absent before the advent of the Spaniards. On the other hand, there existed several morbid conditions which may not be known or are very rare among the whites. The absent diseases were rachitis, osteomalacia, and probably syphilis, tuberculosis, and cancer. The diseases peculiar to the coast, were symmetric osteoporosis of the skull, in infancy and early childhood; a strange progressive arthritic process affecting the head of the femur and the cotyloid cavity in the adult or rarely the adolescent, called here from its most characteristic feature the "mushroom-head" femur (arthritis deformans); and characteristic exostoses in the distal part of the auditory meatus, tending toward its occlusion. There was a great scarcity of fractures, but on the other hand there were everywhere numerous traumatic lesions of the skull, showing fighting and perhaps executions.

Notwithstanding the frequency of wounds of the skull such as would lend themselves to operation, trephining was very rare on the coast, if practiced there at all. The instances found were all at places within easy reach of the mountainous districts where trepanation is known to have been common. As to other operations, in the valley of Chicama two lower limbs were seen, both in the possession of Dr. Velez Lopez, now of Trujillo, in which the foot had been

disjointed from the leg and the limb fitted with a cylindrical wooden pedestal with a cup-shaped cavity for the stump. But no assurance can be had that these specimens are pre-Columbian. As to the treatment of fractures, too few of these were met with to justify any conclusion; in some cases the very good results suggested the use of splints, in others, if any aid was given, it was unsuccessful.

Only a very few crania were found along the coast showing the "Aymara" deformation, hence the people who practiced this must have had a very limited contact with those of the coast, and the possibility is not excluded that such contact was post-Columbian.

As to the *mountain people*, conditions differ between the two territories visited, namely, that of the district of Huarochirí, and that southeast of Nasca. The Huarochirí district, and doubtless the neighboring parts of the sierra, were peopled predominantly by the oblong-headed type of the Indian, such as found mingled in various proportions with the coast population. Besides this, there was also a proportion of broader-headed people, possibly derived from the coast. The material culture was relatively poor, except as regards agriculture and to some extent weaving; and with the exception of a few examples of the fronto-occipital flattening, there was no head deformation. In the region southeast of Nasca, on the other hand, while some burial places showed apparently the coast people, others gave exclusively those with the "Aymara" deformation, though probably not of "Aymara" descent.

In both regions the mountain people were characterized by a good average development of the body as well as of the skull, and by a great freedom from disease. Facts of especial interest are that there was a complete absence of the symmetric osteoporosis, of the "mushroom-head" femur, and also of the auditory exostoses, in both territories. In the Huarochirí district, where injuries to the cranium were not fatal they were followed in many cases by the operation of trepanation. This, though often large and quite crudely done, was evidently in many cases successful. The practice in all probability persisted to and even after the coming of the Spaniards. In the mountains southeast of Nasca, wounds of the head were scarce and no clearly recognizable instances of trepanation were discovered; one such instance was, however, reported from a place a day's journey to the southeast of the farthest point reached by the writer. Of other surgical procedures there were no traces either in the hills to the north or those to the south.

*Antiquity.*—As to the third main object of the expedition, namely, the search for evidences of man's antiquity, the results were wholly negative. Aside from the cemeteries or burial caves of the common coast or mountain type of people, and their archeological remains, there was no sign of human occupation of these regions. Not a trace suggesting even distantly something older than the well-represented pre-Columbian Indian was met with or heard of anywhere; and the coast or mountain population itself cannot be regarded as very ancient in the regions which it occupied, so far as these were studied. There are no signs that any group has been in any of the sites for even as much as, say, 20 centuries; nor does it seem that any of these people have developed their culture on these spots, except in some particulars due to environmental opportunities or requirements.

As to the density of the pre-Columbian population in Peru, there are plain indications that in numerous localities it was greater than at the present time, while in others it probably was less. However, the burial grounds as well as the ruins offer everywhere plain evidence that they are not contemporaneous, though the differences in their age may often not be very great. The population changed, new groups superseding others. Some of the ruins were doubtless such long before the advent of white man, while others, including the great Chan-Chan, were probably in decline, if not fully abandoned, when the country was entered by the Spaniards. In one word, as among the North American Pueblos, nowhere was the aboriginal Peruvian population at any time as great as the relatively numerous cemeteries or ruins might lead one to suppose, for these burial grounds and ruins date from different, though not far distant, periods.

*Future work.*—In closing this report, the question naturally presents itself as to what remains to be done in Peru in the lines followed by the writer. The answer is—the work recorded here, while to some extent establishing a foundation, is far from sufficient. Similar investigations and collections wait urgently on the anthropologist in the districts of Piura, Eten, and Moquegua, on the coast; in the western sierras from the neighborhood and latitude of Cajamarca to those of Arequipa; and in the eastern highlands from Tiahuanaco to Moyobamba.

The four most important problems in Peruvian anthropology that await their solution are (1) The derivation of the coast brachycephals; (2) The extension and connections of the mountain type or types;

(3) The extension and exact physical characteristics of the Aymara; and (4) The physical identity of the Quechua. Besides this it will be of great importance to determine archeologically the exact relations of culture to the physical type of the people. The writer must repeat again what he wished to accentuate in his former report, that, due to the lack of scientific supervision of the vast majority of the excavations practiced in Peru to the present date, the actual archeological collections from that country in the museums are little more than so many curiosities, which for the most part it is impossible to refer either to any definite people or period. For some time there was hope that the work of the National Museum at Lima would throw light on these subjects; but that work has stopped and lately the museum, so far as anthropological and archeological interests are concerned, has much retrograded. It is earnestly to be wished that the Peruvian Government might assist anthropological investigations in its extensive territories, and especially that it might itself do everything in its power, before it is too late, to gather the data and material which are of fundamental importance to the American anthropologist.[1]

## X. APPENDIX A. SPECIAL NOTES ON SOME OF THE PATHOLOGICAL CONDITIONS SHOWN BY THE SKELETAL MATERIAL OF THE ANCIENT PERUVIANS

### SYMMETRIC OSTEOPOROSIS OF THE SKULL

A peculiar disease, or a manifestation of a disease, occurring quite commonly in infancy among the prehistoric Peruvians of the coast (pl. 24). Found by the writer in 1910 at Pachacamac and Chicama, and at all other parts of the coast that were examined in 1913. It was absent in the mountains, and along the coast its frequency and perhaps its grade differed from locality to locality.

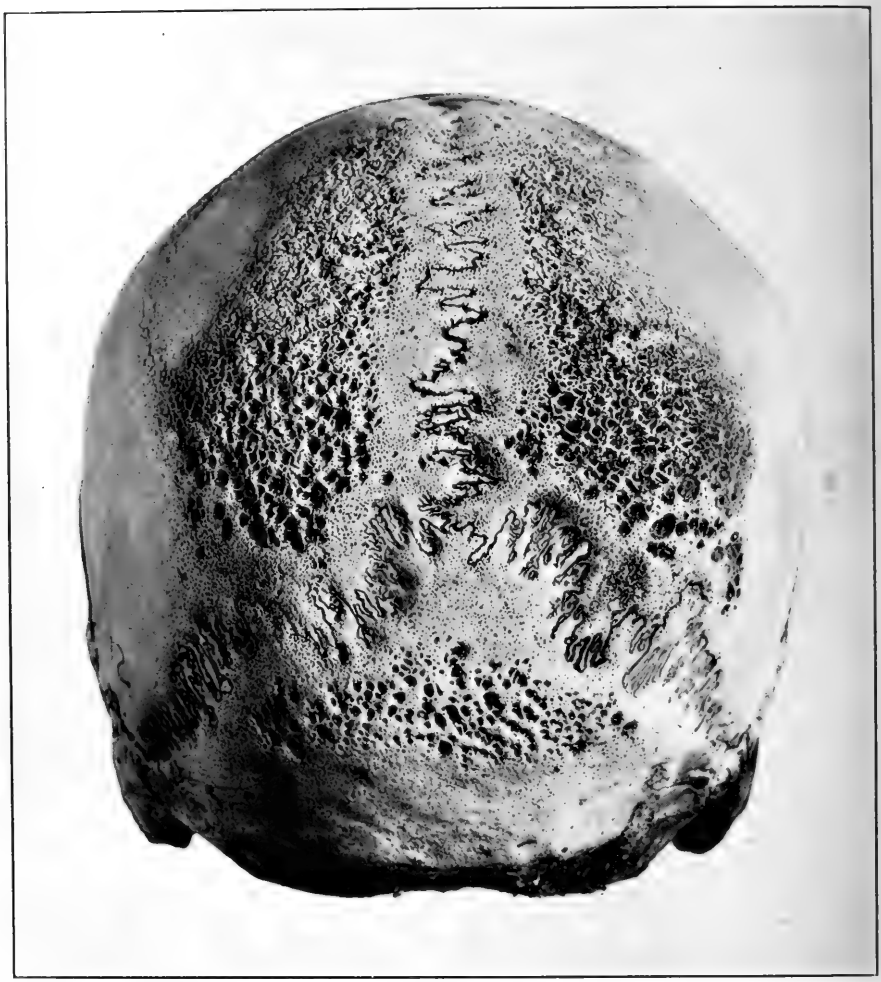
This condition of the skull began to manifest itself in infancy or early childhood. The osseous changes were, so far as could be determined, limited to the cranium, all other parts of the skeleton remaining normal. In all probability they represented not a local

[1] Since the above was written the welcome news has reached the writer that by a decree of the President of Peru, the Anthropological and Archeological parts of the Museo Nacional have been separated from the Historical and placed in charge of the energetic young Dr. Julio C. Tello.

disease, but an indication of some systemic disorder, and this was more likely of toxic than of nutritive or degenerative nature. The disorder was often fatal and that mostly before the changes in the skull reached their maximum; but in a fair percentage of cases the subject recovered. The changes on the skull were characterized by considerable symmetry, by limitation to a very large extent to the outer surface, by invasion of only those parts which do not give attachment to muscles, and by the avoidance of the sutures as well as the facial portions, thus differing radically from such diffuse osteoporoses as described in apes by v. Hansemann. The process began, as can well be seen from the numerous specimens, in the roof of the orbits, or on each side of the frontal squama, between the frontal tuberosity and the coronal suture. In the orbits it began by an increase of vascularity, followed by deposition of porous tissue, which in extreme cases came to look exactly like a low growth of coral. On the frontal the first changes were more like those of localized periostitis, but eventually led also to more or less surface osteoporosis. Following the frontal, more exclusively osteoporotic manifestations developed on the posterior portion of each parietal, between the temporal crest and the sagittal suture, and on the occipital above the crest (see pls. 24, 25). If the condition still advanced, then the wings of the sphenoid, parts of the temporals and parts of the base with the palate began to show signs of proliferation and fine osteoporosis, while localized breaking down of the altered tissue may have taken place in one or more of the older lesions. These were evidently the limits of the bone changes. If recovery took place, there was some thickening of the affected parts of the skull, disappearance of all overgrowths, and a persistence of more or less of a sieve-like condition of the altered surfaces (pl. 25). The rest of the skeleton, as already stated, was either unaffected or affected but slightly.

The condition here briefly described was not rachitic, for rachitis did not exist in the pre-Columbian Indian. It cannot be assumed to have been syphilitic, for in no case were there any other manifestations present that would point to that disease, and its clinical picture does not correspond to that of hereditary syphilis in the infant—there were no nodes nor any intracranial lesions on any infant's or child's head among the many examined, whether with or without osteoporosis, and the recoveries left results unknown in syphilis. Nor was it a part of a tuberculous affection, for the lesions differ greatly from those of this disease. The only conclusion the writer can

PARTS OF THREE SKULLS OF INFANTS, SHOWING LESIONS OF SYMMETRIC OSTEOPOROSIS. THE MIDDLE SKULL IS FROM AN ANCIENT BURIAL NEAR HUACHO, PERU WHILE THE TWO FRONTALS ON SIDES ARE FROM PREHISTORIC PUEBLO CEMETERIES IN ARIZONA



ADULT PRE-COLUMBIAN MALE SKULL FROM THE VALLEY OF THE CHICAMA, SHOWING RECOVERY FROM AND THE REMAINS OF SYMMETRIC OSTEOPOROSIS IN INFANCY

reach in regard to this symmetric osteoporosis is that it represents a process not well known in the pathology of the white race, though perhaps not limited to the ancient Americans.[1]

## EAR EXOSTOSES: OSTEOMÆ OF THE TYMPANIC RING

A relatively large proportion of the pre-Columbian people of the more central parts of the Peruvian coast suffered, as shown by the skulls, from a greater or lesser occlusion of the external auditory canals by bony tumors. These are generally hard osteomata, from one to three in number, ranging in size from those like a minute drop to those of several millimeters in diameter, mostly rounded or pearl-shape, but occasionally irregular, frequently with enamel-like surface, and situated just within, or perhaps protruding slightly from, the orifice of the osseous meatus. These little tumors, which are associated with no signs of any inflammatory nature, develop invariably from the tympanic ring and particularly from its extremities. They were in no case seen to coalesce, and though they may almost close the meatus they were never seen to do this entirely. Similar osteomata occur, though far less frequently, among the whites; they have been mentioned by Virchow from Peru; and they are found occasionally in the skull of a North American Indian.

## "MUSHROOM-HEAD" FEMUR: ARTHRITIS DEFORMANS OF THE HIP-JOINT

Never seen in the young, and only once met with in an adolescent.

Evidently always of gradual development.

Occurs unilaterally (more frequently) or bilaterally (due to nature of material exact data in this respect not possible).

Sex influence?

Never found advanced to synostosis.

As a rule, without any exception, there were no accompanying changes in the shaft or lower extremity of the same bone, barring an occasional slight to moderate arthritis.

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[1] In 1909 the writer brought two infant skulls with a coral-like osteoporotic development in the roof of each orbit from a XIIth dynasty cemetery in Egypt; while Virchow reported (Verh. Berl. Ges. Anthr., 1874, 61-62) similar lesions in a skull of a Pampa Indian from Argentina, and mentions of having seen much the same in the cranium of a young Berliner. It is, of course, possible that such isolated orbital lesions are not homologous pathogenetically with the process described above, but they are of identical character.

Was absent or exceedingly rare in the mountains.

Was less frequent in the south (Nasca region) than in the north (Chimu).

The condition showed many variations. The form changes of the head and neck may reach a fairly advanced stage without a trace of inflammation. Of the more affected specimens there were two principal varieties, one characterized by a great shortening of the neck and a pronounced flattening of the head of the femur, with a shallowness and roughness of the acetabulum; while the other was marked by a deepening of the cotyloid cavity, with less roughness, and the assumption by the head of the femur of a shape much resembling the *caput penis* (see pl. 26). The changes in the acetabulum include in advanced cases the bridging over of the cotyloid notch by irregular masses of bone and a conversion of it into a cavity. Characteristic changes are also observable just above the acetabulum.

Three specimens of the humerus were collected in which the head of the bone underwent similar transformation, *i. e.*, pronounced flattening, spreading and roughening.

## ARTHRITIS

*Arthritis, Arthritis senilis, A. deformans (ordinary type), Spondylitis deformans*

Conditions not separable in the Peruvian skeleton, differing only in grade and individually.

Found thus far only in adults, and especially in the aging.

Commenced in the Indian generally, first in some of the vertebræ and at the same time, or soon after, on the lower articular surface of one or both femora.

In the vertebræ the process commenced generally in the lower joints, very rarely in the upper. In the majority of instances it remained restricted to the lowest joint.

First signs: one or two "abrasion" spots on the posterior part of the surface of one or the other condyle. There may also have been early in the process slight concretory deposits on the surface of the condyles. These conditions were soon followed by a slight, uneven marginal redundancy (as if the end of the bone turned into less solid consistency and articular surface was being forced out along the margin), which gradually extended and increased until it assumed the character of a marginal, continuous, more or less irregular exostosis. As a rule it was the posterior part of one or the other

ARTHRITIS DEFORMANS OF THE HIP-JOINT AMONG THE ANCIENT PERUVIANS. PELVIC BONE AND FEMUR ON RIGHT FROM ONE SUBJECT. FEMUR ON LEFT SHOWS EARLY STAGE OF ALTERATIONS; THAT IN MIDDLE REPRESENTS A VERY ADVANCED CASE OF FLAT "MUSHROOM-HEAD", THAT ON RIGHT A PRONOUNCED caput penis CONDITION. ALL FROM THE CHIMU REGION

articular surface of the condyles that showed the first lesions. The initial lesions were gradually followed by more roughness of the articular surface, associated with an augmentation of the marginal exostosis; and then, in the case of the condyles, followed the gradual development of an abrasion-surface, grooved antero-posteriorly, with more or less wearing off of the compact layer of the bones so that some of the bone cavities beneath became visible, and with a polishing of the abraded portion.

Exostoses about the head of the femur came generally much later than those about the condylar articular surfaces, if at all.

In the tibia, changes corresponding to those in the femur developed simultaneously on and about the upper articular surface; and about the same time, or later, the process began to manifest itself also in other bones, especially the vertebræ and the humerus (lower end). Not seldom the first and occasionally the only manifestation of the disorder was manifest in the vertebræ, particularly those of the lumbar, lower dorsal and cervical regions. The material examined seemed to show plainly that the cause which gave rise to the manifestations was constitutional.

## "TENDON LESION"

This was evidently an inflammatory lesion, of varying extent, on the posterior surface of the lower end of the femur, at and about the insertion of the medial head of the gastrocnemius.

It was quite frequent in the Chimu region on the coast, but was not noticed in the mountains, though lighter grades may have escaped attention.

Not accompanied (except accidentally) by other pathological conditions.

Present occasionally in the adolescent, but not in children.

Traumatic origin?

# XI. APPENDIX B. STATISTICAL DATA ON PATHOLOGICAL CONDITIONS OF THE SKULLS AND BONES EXAMINED IN 1913 IN THE CHICAMA VALLEY

## SKULL

Number of crania examined in this lot: adults or near ..... 262
children ..... 16

Total ..... 278

Of which:

*Ear exostoses* (generally bi-lateral) including in one adolescent ..... 19

*Osteoporosis*, signs of ..... children 3, adults[1] 8

*Osteoma*, on frontal, small ..... 1

*Erosive perforation*, frontal ..... 2

*Arthritis*, slight, in one glenoid fossa ..... 1

*Cicatrix* on left inter-maxillary (cause?) ..... 1

## LOWER JAWS

Number of bones examined (adults) ..... 160

Pathological: No lesions at all except those due to teeth, and even those rare.

*Caries* decidedly infrequent; of 708 teeth in the 160 jaws only 16, and of the 788 teeth present in all only 17 were more or less diseased. The absent teeth were mostly lost post mortem.

## HUMERI

Number of adult bones examined ..... 593
Number of children bones examined ..... 57

Total ..... 650

Of these:

*Fractures* ..... adult 1

*Dislocations* ..... 0

*Exostoses* ..... adult 1

Moderate, above deltoid ridge.

*Arthritis* ..... adults 12

6 slight, lower joint.
3 moderate, lower joint.
3 pronounced, lower joint.

[1] The cases in the adults represent merely remnants of the lesions of childhood.

*Osteoperiostitis* .....adult 1
whole shaft affected;
bone light.

*"Mushroom head"* humerus .....adult 1

*Specimens showing more than one lesion* (included in the above):

a. Head fractured and deformed, and shaft bent (not rachitic).

b. "Mushroom" head, and moderate arthritis lower joint.

*Special*

Number of adult bones with aperture in septum..... 123=21%
Number of children bones with aperture in septum..... 4= 7%

Total ..... 127

RADII

Number of adult bones examined..... 255
Number of children bones examined..... 32

Total ..... 287

Of these:

*Fractures* .....adults 2
both broken just above distal end.

*Dislocations* ..... 0

*Arthritis* .....adults 7
3 moderate, upper joint.
3 slight, upper joint.
1 moderate, lower joint.

*Special*

In two, a pair, a congenital deformation of lower articular surface.

*Combinations of lesions on same bone*..... none

ULNÆ

Number of adult bones examined..... 301
Number of children bones examined..... 16

Total ..... 317

Of these

*Fracture* .....adults 2
1 fracture of shaft.
1 of coronoid process.

*Dislocations* ..... 0

*Arthritis* .....adults 16
9 slight, upper joint.
7 moderate, upper joint.

*Combinations of lesions on same bone*..... none

## FEMORA

Number of adult bones examined.....1,210
Number of children bones examined..... 133

Total .....1,343

Of these:

*Fractures* ..... 0
*Dislocations* .....adults 2[1]
*Exostoses* .....adults 4

1 button-exostosis or osteoma.
1 small outgrowth of bone postero-inferiorly, just below the bifurcation of the linea aspera.
2 moderate excrescences on the great trochanter.

*Arthritis* .....adults 36

22 slight, lower joint.
12 moderate, lower joint.
1 pronounced, lower joint.
1 slight, head as well as lower joint.

"*Mushroom head*".....adults (including 1 adolescent) 16

*Periostitis* ..... adults (with 1 adolescent) 9
children ..... 1

7[2] slight and localized (one or more spots or patches).
3 moderate (one or more spots or patches).

*Osteoperiostitis* .....adults (including 1 adolescent) 6

3 localized inflammatory enlargements.
1 moderate, generalized.
1 pronounced, generalized (in adolescent, bone light).
1 exostotic, lower half of bone.

*Other inflammatory:*

Small ulcer-like lesion on neck.....adult 1

*Miscellaneous* .....adults 3
infantile paralysis..... 2
lesion, destructive, lower two-fifths..... 1

*Specimens showing more than one lesion* (included in the above):

a. Moderate osteoperiostitis, and slight arthritis both joints.
b. "Mushroom" head, and destructive lesion lower two-fifths.

[1] See also under "ossa innominata."
[2] Including the adolescent and the child.

## TIBIÆ

Number of adult bones examined..... 781
Number of children bones examined..... 99

Total ..... 880

Of these:

*Fractures* ..... 0
*Dislocations* ..... 0
*Exostoses* .....adults 6

1 pronounced exostosis popliteal ridge.
1 spine beneath medial condyle.
1 traumatic exostosis at middle.
1 traumatic exostosis lower third, ant. surf.
2 moderate excrescences above fibular groove.

*Arthritis* .....adults 12

8 slight superior arthritis.
4 pronounced superior arthritis (of which 1 with abrasion-surface).

*Periostitis* ..... { adults 12 / children 1

adults 9 } slight, in patches.
children 1 }

2 moderate, localized.
1 advanced, localized.

*Osteoperiostitis* .....adults 5

4 moderate, localized.
1 pronounced, general.

*Specimens showing more than one lesion* (included in the above):

a. Pronounced exostosis of popliteal ridge and moderate arthritis upper joint.
b. Moderate excrescences about fibular groove and slight arthritis upper joint.

## FIBULÆ

Number of adult bones examined..... 266
Number of children bones examined..... 24

Total ..... 290

Of these:

*Fracture* ..... 1
*Dislocations* ..... 0
*Arthritis* .....adults 2

1 moderate, both ends.
1 moderate, lower end.

*Periostitis* .....adults 3

1 slight, localized.
2 moderate, localized.

*Combinations of lesions on same bone*..... none

## OSSA INNOMINATA

Number of adult bones examined..... 694
Number of children bones examined..... 30

Total ..... 724

Of these:

*Fractures* ..... 0
*Dislocations of femur, unreduced*.....adults 8

all early, with an irregular, shallow new joint above the cotyloid cavity.

*Exostoses* .....adult 1

moderate, just above acetabulum.

*"Mushroom" cavity* .....adults 25

10 well-marked.
14 shallowing of cotyloid cavity and defects or lesions antero-superiorly in and above the border of the cavity.
1 moderate, in an adolescent.

*Combinations of lesions on same bone*..... none

## SACRUM

Number of adult bones examined..... 199

Of these:

*Arthritis* ..... 29

29 arthritic exostoses, upper border.
2 of the above also joined to pelvis both sides.

*Other lesions:* erosion-like defects, anterior surface..... 1

*Combinations of lesions on same bone:*

2. Arthritis upper border, and of both the iliac articular surfaces.
1. Arthritis upper border, and erosion-like defects anterior surface.

*Special*

*Sacral segments:* 4—0; 5—79 (58%); 6—56 (41%); 7—1 (0.7%); 63 undeterminable because of damage.

## ATLAS

Number of bones examined..... 31

Of these:

*Arthritis* ..... 1

about condylar and odontoid facets.

*Exostoses* ..... 1

a process for articulation with a paroccipital process.

*Special*

Congenital union with axis..... 1

## AXIS

Number of bones examined..... 36

Of which:

*Arthritis* ..... 3

2 about lower surface of body.
1 probably arthritic synostosis with third.

## OTHER VERTEBRÆ

Number of bones examined..... 822

Of which:

*Arthritis* (superiorly or inferiorly)..... 92

mostly lumbar; synostosed: 2 lumbar; 5 lumbar with 6 dorsal (in one).

*Other lesions:* body moderately flattened..... 1

*Special*

Five of the lowest lumbar, and one of the upper lumbar, show a separation (congenital) of the posterior part of the arch.

Two cervical vertebræ are congenitally joined.

## STERNA

Number of bones examined..... 26

*Pathological* ..... 0

*Special*

In 4 manubrium attached; in 22 manubrium separate; in 3 the body shows an aperture in lower third.

## SCAPULÆ

Number of adult bones examined..... 229
Number of children bones examined..... 9

Total ..... 238

Of these:

*Fractures* ..... 0
*Dislocations* ..... 0
*Arthritis* .....adults 11

9 slight, glenoid cavity.
2 pronounced, glenoid cavity.

## RIBS

Number of adults (an adolescence).....2,410

Of these:

*Fractures* ..... 14
*Dislocations* ..... 0
*Exostoses* ..... 1

a flat exostosis ventrally at angle.

*Arthritis* ..... 36

4 of articulation on head.
32 about articulation on tubercle.

*Periostitis* ..... 1

slight, external surface.

### *Remarks*

First ribs show occasional arthritic conditions at sternal end.
No case seen of ossified cartilage or of synostosis with a vertebra.
No ulceration.
One instance of anomalous juncture of two long ribs by a broad process near the spinal extremity of the bones; not traumatic.

## CLAVICLES

Number of adult bones examined..... 117
Number of children bones examined..... 12

Total ..... 129

*Fractures* ..... 0
*Dislocations* ..... 0
*Exostoses* .....adult 1

moderate, under surface, distal end.

*Arthritis* ..... adult 1
at sternal joint.
*Periostitis* ..... adult 1
moderate, under surface, distal end.
*Combinations of lesions on same bone* ..... none

PHALANGES

Number of bones examined (adults or adolescents) ..... 213

Of which:

*Fracture* ..... 1
*Arthritis* ..... 3

A brief analysis of the preceding figures shows that among 3,406 long bones only 157, or 4.6 per cent, presented one or at most two pathological conditions; while among the remaining 4,777 other bones, such bones numbered 231, or slightly less than 4.9 per cent. These are exceedingly small proportions of diseased specimens, far smaller than among the modern whites of any class. The distribution of the lesions was as follows:

| | Long Bones | Other Bones |
|---|---|---|
| *Fractures* | 6 or one in 567 bones | 15 or one in 318 bones (14 in ribs). |
| *Dislocations* | 2 | 8 (all at hip-joint). |
| *Exostoses* | 11 | 4 |
| *Arthritis* | 85 (48 at knee joint) | 176 (92 in vertebræ). |
| *"Mushroom-head"* femur or humerus (arthritis deformans) | 17 (16 femora) | 25 (acetabulum). |
| *Periostitis* | 24 (12 in tibia) | 2 |
| *Osteoperiostitis* | 12 | ... |
| *Miscellaneous* | 6 | 3 |

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# New Races of Carnivores and Baboons from Equatorial Africa and Abyssinia

BY
EDMUND HELLER
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# NEW RACES OF CARNIVORES AND BABOONS FROM EQUATORIAL AFRICA AND ABYSSINIA

By EDMUND HELLER

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Further systematic study of the collection of African mammals in the U. S. National Museum has led to the discovery of the new races described in the present paper. The material was received from the Smithsonian African Expedition under the direction of Col. Theodore Roosevelt, and the Paul J. Rainey Expedition, unless otherwise noted.

### AONYX CAPENSIS HELIOS, new subspecies

Nyanza Clawless Otter

*Type* from the Sotik District, 40 miles southwest of Kericho Station, British East Africa; adult female, Cat. No. 175750, U. S. Nat. Mus.; collected by H. J. Allen Turner, Oct., 1912; original No. 1181.

*Characters.*—*Aonyx capensis helios* resembles *meneleki* of Abyssinia closely in coloration, having the top of the snout as far as the interorbital region and the tip of the ears white as in that species, but it differs by its much smaller body size. *Hindei* of the Tana River drainage differs by the absence of white on the top of the snout and the tips of the ears, by smaller or shorter mastoid processes and narrower or more slender zygomatic arches, but resembles it closely in body size.

*Coloration* of the body and limbs dark seal-brown, deepest on back and palest on underparts, where it is burnt umber in color. Top of head seal-brown like the body. Underfur on body pale drab-gray. The throat, sides of head to the level of the eyes and ears, lips and top of snout, patch above eye and tip of ear, silky white in striking contrast to the general dark brown color. The lips at angle of mouth and the sides of the snout are dusky brown in color.

*Measurements.*—No flesh measurements are available. The tanned skin measures in length of head and body 700 mm. and in tail 470 mm. Skull: condylo-basal length, 127; basal length, 117; zygomatic breadth, 91; mastoid breadth, 84; interorbital constriction, 30; breadth across interorbital processes, 38.5; post-orbital constric-

tion, 27; length of palate, 57; width of narial opening, 18; width of mesopterygoid fossa at suture, 11; greatest diameter of $M^1$, 16.5; condylo-basal length of mandible, 85. Skull old, with the sutures all obliterated, but the teeth show well defined cusps.

*Remarks.*—The type is the only specimen in the National Museum. A female topotype of *hindei* from the Thika River, however, is in the collection also collected by H. J. Allen Turner. The skull of this specimen is practically the same age and size as the type, but differs from it by the possession of the first upper premolars, narrower narial opening, heavier zygomatic arches and longer mastoid processes. The race here described is doubtless confined to the Nile drainage and is the Uganda or Nyanza representative of the giant Abyssinian otter, *menelcki*, the largest known race. From typical *capensis* of South Africa it differs by the presence of white tips to the ears, but is otherwise quite identical to it in color and size of body, and is perhaps best considered an intermediate race between *capensis* and *menelcki*.

**FELIS LEO ROOSEVELTI, new subspecies**

Abyssinian Lion

*Type* from the highlands of Abyssinia near Addis Ababa, presented by Emperor Menelik to President Roosevelt in 1904; old male, Cat. No. 144054, U. S. Nat. Mus.; original (Nat. Zoöl. Park) No. $\frac{1151}{5307}$

*Characters.*—*Felis leo rooseveltl* is readily distinguishable from the other described races by the greater breadth of the skull, the wider mesopterygoid fossa and the smaller size of the cheek teeth. The zygomatic arches are bowed outward to so great an extent that the outline of the skull is quite triangular. Externally this race is characterized by large body size, dark tawny coloration and heavy black tipped mane.

*Coloration.*—The dorsal coloration is tawny, lined over the middle of the back with black tipped hairs; sides of body tawny-ochraceous without, darker spots and merging gradually into the lighter ochraceous underparts. Mane heavy, extending from the forehead to behind shoulders and over the whole throat and chest areas to the forelegs and tuft on back of elbows; length of individual hairs on nape 14 inches; color effect distinct blackish, but mixed considerably by tawny hair; shoulders darkest, the hair chiefly black with short terminal tawny tips; front of mane about head and forethroat lightest,

without black, the hair uniform tawny; flanks without any evidence of a mane. Tail like the back in color, except the terminal four inches which are furnished with a heavy black tuft in which the hair is black to the roots. Outside of legs like the back in color, inside ochraceous-buff like the underparts; hair on underside of toes black in conformity with the black footpads. Head tawny black lined like the back in color, the black ear patches and the deep black eyelashes alone showing contrast; whiskers mixed black and white; ears tawny, marked on the back by a broad band of black occupying the middle half of the ear, the base and tip tawny; inner side of ears ochraceous.

*Measurements.*—Measurements of tanned skin: head and body, 1,780 mm.; tail, 760; hindfoot (bone still in place), 350. Skull old, the sphenoidal and occipital sutures anchylosed and the sagittal and lambdoidal crests well developed. Greatest length from occipital crest to tip of premaxillæ, 333 mm.; condylo-basal length, 297; zygomatic breadth, 255; interorbital constriction, 69; post-orbital constriction, 60; width across post-orbital processes, 104; nasals, 92 x 62; upper cheek teeth series, 73; length of upper carnasial, 35; width of mesopterygoid fossa at suture, 45; distance between bullæ across basi-occipital, 26; condylo-basal length of mandible, 230.

*Remarks.*—The type was received alive March 19, 1904, and deposited in the National Zoölogical Park at Washington where it lived until November 14, 1906. Owing to its short stay in captivity it may be taken as a normal specimen of the lion inhabiting the Abyssinian highlands. Neither the hair covering nor the condition of the skull shows any abnormalities due to its life in the Zoölogical Park. Judging by its skull it was an old animal well along in middle life at its death, and was doubtless fully adult when captured by the Abyssinians. Another adult male specimen from Abyssinia, also from the National Zoölogical Park, is in the National Museum. This specimen agrees with the type in the broad character of the skull and small size of the teeth. A specimen received from the Sudan, sent by the Sirdar, Sir Reginald Wingate, to the National Zoölogical Park, is also a member of this race. The skull of this specimen is even wider than in the type and exceeds in this dimension the record lion skull from Delago Bay, South Africa, now in the Berlin Museum. The two Abyssinian and the Sudan skulls are easily distinguishable by their great width, wide mesopterygoid fossa and small cheek teeth, from a series of 30 male skulls of *massaica* of equal age in the National Museum from British East Africa, shot by Colonel and Kermit Roosevelt, Paul J. Rainey, John Jay White, and Dr. W. L.

Abbott. Specimens have also been examined at the British and Berlin museums from south and west Africa. The west African skulls are easily distinguishable from east or south African specimens by their small size, great breadth and large carnasial or cheek teeth. The Abyssinian lion approaches this western type in the breadth of skull, but the teeth are of the small eastern type, and the large skull also distinctive of the east coast lions. Distinctly the largest of all is the South African lion, now quite extinct. The skull averaged at least an inch longer in length than any of the equatorial races, but was relatively quite narrow. In coloration the Cape race resembled the Abyssinian, being tawny bodied with a black mane. The Somali lion, the nearest geographical ally of the Abyssinian, is a light-buffy colored desert race, closely resembling and doubtfully distinct from the Masai lion. It is much shorter maned and smaller in body size than the Abyssinian. The characters assigned by Noack in the original description of *Felis leo somaliensis* of larger ears and longer tail are not applicable to the race, these parts having the same proportionate size as in other members of the group. Noack's description was based on a pair living at the Berlin Zoölogical Gardens, and the characters he assigned to the race, are merely such as appeared upon casual observation and are not founded upon actual measurements of a specimen. Doctor Matschie has informed me that the types have been exchanged by the Berlin Zoölogical Gardens with animal traders and their present abode is unknown. The unfortunate condition of these types is a good illustration of the loss and confusion to systematic work so often attendant upon the pernicious custom of naming species from living specimens. In the present case we have no exact characters and no knowledge of the skull structure of the race described, merely a few casual observations to which are attached a general locality of doubtful value. Several of the types of African big game mammals are to-day living in various zoölogical gardens. Special efforts should be made by such institutions to keep trace of these types and upon their death deposit the specimens in the largest available public museum where they may be preserved and accessible to zoölogists for comparison.

**FELIS LEO NYANZÆ, new subspecies**

Uganda Lion

*Type,* a flat skin, from Kampala, Uganda, gift of the European residents to Colonel Roosevelt; adult male, Cat. No. 164551, U. S. Nat. Mus.; received Dec. 30, 1909; original (Heller) No. 580.

*Characters.*—*Felis leo nyanzæ* differs from *massaica* of British East Africa by its darker tawny coloration and short mane. In coloration it closely resembles the Abyssinian lion, but lacks the heavy black mane of that species and the large body size. The skull is smaller and narrower than *massaica,* but resembles it in the relative size of the cheek teeth and mesopterygoid fossa.

*Coloration.*—Dorsal coloration ochraceous-tawny vermiculated slightly with black on median line; sides ochraceous without darker spots; belly buffy-ochraceous. Mane short, not extending on shoulders except on median dorsal line where it forms a narrow ridge of hair 2 inches wide by 10 inches long; length of hair on middle of neck only 3 inches; color tawny throughout, only showing dark brownish color at tips of hair on crown and shoulders. Limbs like the back in color, the thighs posteriorly with a blackish stripe; underside of toes seal-brown. Head tawny like back. Ears chiefly tawny, the black area being reduced to a narrow line.

*Measurements.*—Measurements of the flat skin: head and body, 1,990 mm.; tail, 890; ear, 100. Skull missing, only the premaxillaries, canine and incisor teeth and nasal bones preserved with the skin. These indicate a fully adult animal. An adult male specimen in the British Museum from Mulema, Uganda, collected by Colonel Delme-Radcliffe is quite identical with the type in color and may be taken as reperesenting the race here described. This specimen has a narrow, short skull with rather small teeth. The dimensions are: greatest length, 363 mm.; condylo-incisive length, 324; zygomatic width, 230; interorbital width, 74; post-orbital constriction, 66; width across post-orbital processes, 111; length of upper carnasial tooth, 37; nasals, 116 x 69; condylo-basal length of mandible, 237.

*Remarks.*—The Uganda race of the lion does not apparently share the close approximation to its west African representative that is exhibited by much of the mammal fauna of the region. The broad skulled, large-tooth form of west Africa is strikingly different from the narrow skulled, small-tooth *nyanzæ* which is a close ally of *massaica.*

**FELIS PARDUS FORTIS, new subspecies**

Highland Leopard

*Type* from the Loita Plains, Southern Guaso Nyiro district, British East Africa; adult male, Cat. No. 181600, U. S. Nat. Mus.; collected by Mr. Aggate in the bush country bordering his farm, and purchased by Paul J. Rainey, May 31, 1911; original (Heller) No. 2309.

*Characters.*—*Felis pardus fortis* is a large race which attains the maximum size, the skull exceeding in length that of any other African or Asiatic race. The skull is further distinguishable by its narrowness, the small size of the tympanic bullæ and the absence of the first upper premolar. Body size large, with long pelage, dark coloration, and numerous small rosetted spots, the central color of which it not differentiated in shade from the general ground color. *Fortis* in color most resembles *suahilica*, but is easily distinguishable by the darker ground color which is uniform in shade with the central portion of the rosetted spots. Male skulls of *suahilica* differ in their much smaller size, the largest being seven-eighths of an inch less in length than the type of *fortis*, decidedly larger bullæ, and presence of a well developed first upper premolar. The bullæ in *fortis* do not rise to the level of the mastoid process, the skull when placed on a level resting upon the bullæ, but in *suahilica* they extend well beyond the mastoid.

*Coloration of the type.*—Ground color on median line of back cinnamon-brown, paling on sides to ochraceous-tawny, and on underparts and inside of limbs to whitish or pale buff. The rosetted spots on the back are small and broken into two or three sections, the central portion being uniform in color with the cinnamon-brown ground color; on the sides of the body the central portion is darker than the ground color as usual among leopards. The underparts, legs, head, and basal part of tail are marked by solid black spots. The terminal portion of the tail is solid blackish with a narrow median whitish band on the underside. Ears tawny like the ground color of the head and marked by a broad band of black across the middle of the back.

*Measurements.*—The type is without flesh measurements. The skull measures: greatest length, 260 mm.; condylo-basal length, 236; zygomatic width, 157; interorbital width, 43; width across post-orbital processes, 75; post-orbital constriction, 37; nasals, 75 x 39; length of upper carnasial, 27; width of mesopterygoid fossa at suture, 20; condylo-basal length of mandible, 172. Skull old, the sphenoidal and interparietal sutures fully anchylosed. The type is unique in skull characters and large size among a series of 25 leopards from east equatorial Africa in the National Museum.

### FELIS PARDUS CHUI, new subspecies

Nile Leopard

*Type* from Gondokoro, Northern Uganda; adult male, Cat. No. 164764, U. S. Nat. Mus.; collected by Edmund Heller, Feb. 26, 1910; original No. 653.

*Characters.—Felis pardus chui* is characterized by its widely isolated spots, which are few in number and separated from one another by wide interspaces of the ground color. From the leopard of British East Africa, *suahilica,* it is distinguishable by the wide interspaces between the spots, the white ground color of the upper surface of the hindfeet, the more extensive white surface to the underside of the tail and the larger body size and skull. The west African leopard, *leopardus,* has actually and relatively much larger cheek teeth, more numerous spots and smaller body size than *chui.* Pelage very short.

*Coloration.*—The dorsal body color is ochraceous, paling on the sides to buffy, and on the belly and underside of legs to pure white. Spots black, rosetted, the center usually darker ochraceous than the ground color, the margin in some forming a complete ring without any breaks, and distinctly ocellated in character. Spots on underside of body and on legs generally solid black without a lighter central portion. Spots on head and sides of face broken up into numerous small blotches. The tail basally with rosetted spots which become lengthened into solid streaks on the middle portion, the terminal portion having a ringed appearance with much white from the underside showing on the sides and nearly separating the black into rings.

*Measurements.*—Measurements of the type in the flesh: head and body, 1,240 mm.; tail, 840; hindfoot, 255; ear, 90. Skull: greatest length, 243; condylo-basal length, 225; zygomatic breadth, 150; interorbital constriction, 37; width across post-orbital processes, 64; post-orbital constriction, 38; nasals, 77 x 35; length of upper carnasial, 24.5; width of mesopterygoid fossa at suture, 26. Skull old, the sphenoidal and interparietal sutures fully anchylosed. First upper premolar minute and rudimentary.

*Remarks.*—Another specimen, an adult male from Rhino Camp, Lado Enclave, is in the National Museum which agrees in color characters and large size of skull with the type. *Chui* is a lowland race occupying the Nile Valley, and characterized by the reduced number of spots, some of which are ocellated, large body size and short pelage. A large series of *suahilica* from British East Africa have been compared with the two Nile specimens representing this race and in this series the color differences are well marked and constant.

**ACINONYX JUBATUS VELOX, new subspecies**

African Highland Cheetah

*Type* from the Loita Plains, British East Africa; adult male, Cat. No. 163096, U. S. Nat. Mus.; shot by Kermit Roosevelt, June 12, 1909; original (Heller) No. 107.

*Characters.*—The African highland cheetah, *Acinonyx jubatus velox,* is characterized by its large, close set black spots which predominate over the ochraceous tone of the ground color, the boldly spotted hind legs, long pelage, and large body size. From *jubatus* of the Cape region of Africa it may be recognized by its larger dorsal spots, lighter ground color and larger body size. It may be distinguished from *raineyi* by the absence of pinkish suffusion to the coat, the larger and more numerous spots, and longer pelage.

*Coloration.*—The dorsal ground color of the type is ochraceous, deepest on midline of back and palest on sides and belly, where it shades into cream-buff. Black spots on back circular in outline, three-quarters of an inch in diameter, interspaced with numerous smaller black spots causing the black color to predominate over the ground color on the back. The spots on the sides are larger but less numerous and cover a smaller area than the ground color. The legs and underparts are marked by oblong black spots. The feet are marked by irregular black spots, the forefeet more numerously than the hind ones, and the base of the toes also show spots above, but the hair on the underside is dusky-brown. Tail marked by large black spots above and black rings below, with the terminal portion ringed all around with black and pale buffy rings, the tip whitish. The crown of the head and the nape are marked by small black spots as far forward as the interorbital region. The whole snout from the eyes is uniform ochraceous and banded on the sides by the heavy black tear band from the eyes to the mouth. The sides of the head from eye to ear base are marked irregularly by small black spots without any suggestion of a line from eye to base of ear. The chin and the upper throat are whitish or cream-buff in color. The back of the ears are chiefly black, only the tips and the inner side being buffy. Hair of nape longer than on rest of body and forming a short mane from head to behind the shoulders. Hair on median line of breast and belly long and mane-like in character. The ventral surface of the tail is marked along its whole length by a broad mane or ruff of longer hair, tip of tail long haired, and somewhat tuft like.

*Measurements.*—The flesh measurements of the type are: head and body, 1,300 mm.; tail, 740; hindfoot, 300; ear, 80. Skull: greatest length, 179; condylo-basal length, 163; zygomatic breadth, 136; nasals, 56 x 31; interorbital width, 40; post-orbital constriction, 59; width across post-orbital processes, 82; length of upper carnasial, 23; width of mesopterygoid fossa at suture, 25.5; condylo-basal length of mandible, 124. Skull aged, the sphenoidal and occipital sutures obliterated by anchyloses.

*Remarks.*—Twelve adult specimens of this race are in the National Museum, nine from the Loita Plains, two from Laikipia Plateau north of Mount Kenia and one from the Uasin Gishu Plateau. The latter specimen has an extremely long skull measuring in greatest length 200 mm., and exceeding in size any other cheetah skull examined. One other male skull from the Loita Plains attains a length of 190 mm. These dimensions would indicate that the British East African or highland cheetah is the largest of the races. The series is quite uniform in coloration and distinguishable from *raineyi* by the darker color and more numerous spots on the back which predominate in area and give the whole a general dark coloration.

**ACINONYX JUBATUS RAINEYI, new subspecies**

Rainey African Cheetah

*Type* from Ulu, Kapiti Plains, British East Africa; adult male, Cat. No. 182321, U. S. Nat. Mus.; shot by Paul J. Rainey, Oct. 13, 1911; original (Heller) No. 2639.

*Characters.—Acinonyx jubatus raineyi* is a pale colored, short haired race of the African cheetah having a light pinkish-buff dorsal ground color and large blackish spots. It resembles most closely in characters *soemmeringii* of Kordofan and the Lake Tchad region, but may be distinguished by its much larger dorsal spots, lighter ground color and the spotted hindfeet. From its nearest geographical ally, *velox,* it may be distinguished by the light dorsal ground color with its pinkish suffusion, fewer dark spots and less distinctly spotted hindfeet.

*Coloration of the type.*—The ground color is pale pinkish-buff, darkest on midline, where it is ochraceous-buff, and paling on the underparts to cream color. Body and legs marked uniformly by round black spots three-quarters of an inch in diameter, interspersed by occasional small spots or dots. Spots on legs and belly elongate in shape; legs spotted to the toes, the forefeet much more conspicuously than the hind ones in which the spots are small or indistinct near the toes. The toes are much spotted above and pinkish-buff like the ground color, but below they are clothed by dusky-drab hair. Tail spotted like the back with the terminal one-fourth marked by five black rings, the extreme tip whitish. Top of head and nape marked by numerous small black spots, but the snout is uniform ochraceous-buff without spots and sharply defined on the sides by a black tear stripe extending from the eye to the mouth, just behind whiskers, and passing backward to the angle of the mouth. The sides of the

head behind the eye and below the ear are marked by a few black spots, but no evident line between the eye and the base of ear is thus formed. The ears are pinkish-buff marked by a wide black band covering lower half of back. The chin and upper throat are white. Pelage short on dorsal surface, seven-eighths of an inch on the rump; nape with a short mane three inches wide from head to behind shoulders. The midline of breast and belly and the whole length of the ventral surface of the tail is furnished by a ruff or short mane of longer fluffy hair.

*Measurements.*—No flesh measurements of the type are available. The skull measures: greatest length, 180 mm.; condylo-basal length, 162; zygomatic breadth, 122; nasals, 55 x 31; interorbital width, 39; post-orbital constriction, 53.5; breadth across post-orbital processes, 72.5; length of upper carnasial, 22; width of mesopterygoid fossa at suture, 25; condylo-basal length of mandible, 122. Skull, young adult, the sphenoidal and parietal sutures still evident.

There are six specimens of this race in the National Museum collection, four of which are adult females and two adult males. Five of the specimens are from the Kapiti Plains near Ulu station, and one from Juja Farm. This series shows little variation in color, all being quite light colored with a distinct pinkish suffusion to the buff ground color. They differ from *velox* of the higher plateau region by the lighter ground color which predominates over the black of the spots which are in this race more widely separated. *Raineyi* represents the coast race of the cheetah which inhabits the lower slopes of the plateau region and the edge of the coast desert region about the slopes of Kilimanjaro and in the vicinity of the Tana River. The Athi and Kapiti Plains are the farthest inland point reached by this race.

### PAPIO ANUBIS LESTES, new subspecies

Athi Baboon

*Type* from the Ulukenia Hills, Athi Plains, British East Africa; adult male, Cat. No. 164633, U. S. Nat. Mus.; collected by J. Alden Loring, Nov. 19, 1909; original No. 8234.

*Characters.—Papio anubis lestes* differs from *furax* of the Rift Valley region by the much narrower and longer rostral portion of the skull, longer tooth row, less blackish feet, shorter tail and smaller body size. From *vigilis* it may be distinguished by its darker body color, presence of black on the hands, and smaller body size.

*Coloration.*—General color of the type olive; hair annulated, basally hair brown with a broad subterminal band of buffy and a black tip. Skin of face quite blackish with a scattered growth of downy grayish hair. Forefeet showing a mixture of black and olive; hindfeet without blackish cast, being vermiculated like the body. Chin and throat blackish, rest of underparts vermiculated like the upperparts, but the hair of the chest and belly basally seal-brown or black.

*Measurements.*—Measurements in the flesh: head and body, 723 mm.; tail, 439; hindfoot, 215. Skull old, with the incisors much worn. Greatest length, 198; basilar length, 135; zygomatic breadth, 115; rostral width midway between orbit and nares, 30; length of snout from orbit to tip of premaxillæ, 110; length of upper cheek teeth series, 55. The snout in *furax* is equal in length to that of *lestes,* but it is fully a third wider measuring usually more than 40 mm.

*Remarks.*—Three old males of this race are in the National Museum collection from the Ulukenia Hills. They agree in having the rostrum long and narrow as in the type and are easily distinguishable by this character from skulls of *furax.* The race described as *neumanni* from the Rift Valley of German East Africa is decidedly smaller and lighter colored.

### PAPIO ANUBIS VIGILIS, new subspecies

North Kenia Baboon

*Type* from the Lakiundu River near its junction with the Northern Guaso Nyiro, British East Africa; old male, Cat. No. 182033, U. S. Nat. Mus.; collected by Edmund Heller, July 10, 1911; original No. 2337.

*Characters.*—*Papio anubis vigilis* is a very long, slender snouted race of large body size. The snout has the same proportions as *lestes,* but the body size is much larger, the general coloration paler, the face grayish rather than blackish, the tail longer and the forefeet or hands without any blackish coloration. From *furax* it differs by its more slender and longer snout, lighter coloration and absence of black on the hands.

*Coloration.*—General color of the type light grayish olive on the shoulders, the back and rump buffy brown lightly vermiculated by black. Forelimbs like the shoulders to the finger tips, the hands not differentiated by darker color. Hindlimbs more buffy like the rump in color, but without black vermiculation, the feet uniform in color with the rest of the limb. Tail like the hindlimbs, the terminal por-

tion lighter and grayer. Skin of face mouse-gray with a downy growth of short grayish hair. Whiskers and hair on lips blackish.

*Measurements.*—Measurements in the flesh: head and body, 700 mm.; tail, 540; hindfoot, 190; ear, 50. Skull very old, the canines worn down level with the premolars and the molars worn down level with the gums. Greatest length, 212; basilar length, 151; zygomatic breadth, 125; width of rostrum midway between orbit and nares, 44; length of rostrum from orbit, 118; length of upper cheek teeth series, 52.

*Remarks.*—There is besides the type another adult male from the Northern Guaso Nyiro which agrees in length and slenderness of rostrum with the type. These two specimens are readily distinguishable by the rostral characters from a series of *furax* and *lestes* in the National Museum.

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# Descriptions of Ten New African Birds of the Genera Pogonocichla, Cossypha, Bradypterus, Sylvietta, Melaniparus, and Zosterops

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# DESCRIPTIONS OF TEN NEW AFRICAN BIRDS OF THE GENERA POGONOCICHLA, COSSYPHA, BRADYPTERUS, SYLVIETTA, MELANIPARUS AND ZOSTEROPS.

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Four of the forms herein described are from the collection made by the Childs Frick African Expedition, 1911-1912; three are from the collection made by the Paul J. Rainey Expedition, 1911-1912; one is from the Smithsonian African Expedition 1909-1910 collection, made under the direction of Col. Theodore Roosevelt; and two were collected by Dr. W. L. Abbott in 1888.

The names of special tints and shades of colors used in this paper conform to Robert Ridgway's "Color Standards and Color Nomenclature," issued March 10, 1913. All measurements are in millimeters.

### POGONOCICHLA CUCULLATA HELLERI, new subspecies

Mount Mbololo Bush-Robin

*Type-specimen.*—Adult male, Cat. No. 217720, U. S. Nat. Mus.; collected on Mount Mbololo summit, altitude 4,400 feet, British East Africa, November 8, 1911, by Edmund Heller. (Original number, 416.)

*Characters.*—Most closely related to *Pogonocichla cucullata cucullata* (Blyth) and *P. c. keniensis* Mearns. From the former it differs in the paler blue of the head and wings, and in the clearer yellow of the under parts; from the latter in the darker blue of the head and wings; from these and all other known forms it differs in the pattern of the tail-feathers, which, as usual, have the central pair of rectrices entirely brownish black, the remaining feathers being yellow, narrowly tipped with black, except the outer feather, on which the black occupies the terminal two-thirds of the outer web; tail with terminal black band only seven millimeters in breadth.

*Description of type and only specimen* (adult male).—Head with a small white brow-spot on each side, otherwise entirely green-blue slate, darkest on the lores and at base of maxilla; mantle dark citrine; rump and upper tail-coverts apricot yellow; wing-coverts and pri-

maries brownish black, with outer webs broadly bordered with the same, or slightly paler, color as the head; outer webs of secondaries washed with the same color as the mantle; tail light cadmium, squarely tipped with black, which runs down the outer web of the terminal two-thirds of the outer feather, and with the central pair of rectrices entirely brownish black; upper throat with a round black spot enclosing a white one five millimeters in diameter; remaining under parts light cadmium; axillars and lining of wings lemon chrome; inner webs of quills edged with grayish white. In the dry skin the bill is entirely black, the feet and claws grayish brown.

*Measurements of type* (adult male).—Length of skin, 150; wing, 80; tail, 67; culmen (chord), 13.5; tarsus, 25.

**COSSYPHA NATALENSIS GARGUENSIS, new subspecies**

Mount Gargues Robin-Chat

*Type-specimen.*—Adult female, Cat. No. 217681, U. S. Nat. Mus.; collected on Mount Gargues (South Creek, altitude 3,600 feet), in north-central British East Africa, September 4, 1911, by Edmund Heller. (Original number, 297.)

*Characters.*—This is an extremely pale form from an isolated range of mountains surrounded by desert plains.

*Description of type and only specimen* (adult female).—Head and entire under parts ochraceous-orange; feathers of crown edged at base with green-blue slate, producing wavy lines; mantle green-blue slate, mixed with ochraceous-orange in middle of upper back, contracted to a point posteriorly; wings grayish black, all the feathers bordered by green-blue slate; lower rump cadmium yellow; upper tail-coverts ochraceous-orange; tail raw sienna, with middle pair of rectrices, entire outer webs of external rectrices, and sub-apical markings on inner webs of intermediate rectrices brownish black; axillars and under wing-coverts ochraceous-orange. In the dry specimen the bill is brownish black; feet and claws grayish brown.

*Measurements of type* (adult female).—Length of skin, 155; wing, 86; tail, 71; culmen (chord), 15; tarsus, 28.

**COSSYPHA NATALENSIS INTENSA, new subspecies**

Intensely-colored Robin-Chat

*Type-specimen.*—Adult male; Cat. No. 118105, U. S. Nat. Mus.; collected by Dr. W. L. Abbott, at Taveta, British East Africa, April 26, 1888.

*Characters.*—This is a saturated coast form, characterized by intensity of coloration.

*Description of adult male and female from Taveta and Mombasa.*—Head sudan brown, with feathers of crown edged at base with blackish slate; entire under parts mars yellow; mantle dark green-blue slate, mixed with sudan brown, cleft by a wedge-shaped area of mixed blackish slate and sudan brown; wings slaty black, the feathers bordered by dark green-blue slate; rump and upper tail-coverts mars yellow; tail mars yellow, the middle rectrices, outer web of outer rectrices, and very narrow edging to next to the middle rectrices slaty black; axillars and under wing-coverts mars yellow. In the dry specimen the bill is black; feet and claws brown.

*Measurements of type* (adult male).—Length of skin, 170; wing, 90; tail, 76; culmen (chord), 16; tarsus, 27.5.

*Average measurements of two adult males from Mombasa, British East Africa* (Carnegie Museum).—Length of skin, 172.5; wing, 96.5; tail, 82; culmen (chord), 16.5; tarsus, 28.25.

*Geographical range.*—Coast region of British East Africa (Taveta and Mombasa).

*Remarks.*—The typical form *Cossypha natalensis natalensis* from Port Natal, South Africa, is slightly larger than the subspecies *garguensis* and *intensa*.

**BRADYPTERUS BABÆCULUS FRATERCULUS**, new subspecies

Escarpment Reed-Warbler

*Type-specimen.*—Adult male, Cat. No. 244935, U. S. Nat. Mus.; collected at Escarpment, altitude 7,390 feet, on the Uganda Railway, British East Africa, September 10, 1912, by Edgar A. Mearns. (Original number, 24190.)

*Characters.*—Most closely resembling *Bradypterus babæculus babæculus* (Vieillot), but darker brown above and less spotted below.

*Description of type* (adult male).—Entire upper parts natal brown; a narrow superciliary stripe of grayish white; cheeks and ear-coverts mouse gray; chest, sides, flanks, and thighs yellowish hair brown; throat and abdomen dirty white; feathers of throat and upper chest with obsolete dark spots; iris brown; bill brownish black, paler at base of mandible; feet and claws brown.

*Description of adult female.*—Similar to the adult male, but more drabish above, and paler on the abdomen (almost white), with the throat more spotted, and with the pectoral band narrower and less uniformly brown.

*Measurements of type* (adult male).—Length of skin, 150; wing, 62; tail, 68; culmen (chord), 13; tarsus, 25.

*Average measurements of two adult females* (from Mount Kenia at 8,500 feet).—Length of skin, 150; wing, 62.5; tail, 62; culmen (chord), 12; tarsus, 24.

**SYLVIETTA WHYTII ABAYENSIS, new subspecies**

Abyssinian Crombec

*Type-specimen.*—Adult male, Cat. No. 245199, U. S. Nat. Mus.; collected on the Gato River, near Gardulla, at the south end of the Abaya lakes (altitude 4,000 feet) in southern Abyssinia, April 6, 1912, by Edgar A. Mearns. (Original number, 21057.)

*Characters.*—Most closely related to *Sylvietta whytii jacksoni* and *S. w. loringi,* from northern and southern British East Africa, respectively. These three subspecies are closely similar in size, *loringi* having slightly larger feet and a smaller bill than the others. *S. w. jacksoni* has the darkest coloration throughout, and *S. w. abayensis* the palest. *S. w. loringi* has the upper parts purer, less olivaceous, gray than *S. w. abayensis,* while *S. w. jacksoni* has the upper parts more plumbeous.

*Sylvietta whytii abayensis* has the iris yellowish brown; bill olivaceous brown above, pale reddish brown below; feet and claws light brown.

*Measurements of type* (adult male).—Length of skin, 85; wing, 61.5; tail, 25; culmen (chord), 12; tarsus, 18.

The salient difference in coloration of three closely-related forms of *Sylvietta* may be expressed as follows:

| *Sylvietta whytii loringi* | *Sylvietta whytii jacksoni* | *Sylvietta whytii abayensis* |
|---|---|---|
| Upper parts neutral gray. Under parts nearly uniform aveilaneous. | Upper parts dark gull gray. Under parts nearly uniform fawn color. | Upper parts light grayish olive. Under parts vinaceous-buff, fading to whitish on abdomen and crissum. |

COMPARATIVE MEASUREMENTS OF THREE SUBSPECIES OF *SYLVIETTA WHYTII* SHELLEY

| Name | Sex | Number of specimens | Wing | Tail | Culmen (chord) | Tarsus |
|---|---|---|---|---|---|---|
| *Sylvietta whytii loringi* | ♂ | 1 | 61.0 | 25.0 | 11.7 | 19.6 |
| *Sylvietta whytii loringi* | ♀ | 2 | 56.5 | 25.5 | 11.5 | 19.0 |
| *Sylvietta whytii jacksoni* | ♂ | 4 | 60.5 | 28.3 | 12.3 | 18.8 |
| *Sylvietta whytii jacksoni* | ♀ | 4 | 57.3 | 24.4 | 11.9 | 17.8 |
| *Sylvietta whytii abayensis* | ♂ | 3 | 60.8 | 24.7 | 12.0 | 17.7 |
| *Sylvietta whytii abayensis* | ♀ | 6 | 57.4 | 23.3 | 11.9 | 17.3 |

**SYLVIETTA LEUCOPHRYS KENIENSIS, new subspecies**

Kenia White-eyebrowed Crombec

*Type-specimen.*—Adult male, Cat. No. 215605, U. S. Nat. Mus.; collected at 8,500 feet altitude on Mount Kenia, British East Africa, October 13, 1909, by Edgar A. Mearns. (Original number, 17130.)

*Characters.*—Differs from *Sylvietta leucophrys leucophrys* from Mount Elgon in being paler, more olivaceous, and with the supra-orbital area reduced to a narrow whitish stripe, obsolete behind the orbit.

*Measurements of type* (adult male).—Length of skin, 80; wing, 58; tail, 25; culmen (chord), 10; tarsus, 22.5.

**SYLVIETTA BRACHYURA TAVETENSIS, new subspecies**

Taveta Crombec

*Type-specimen.*—Adult female, Cat. No. 118155, U. S. Nat. Mus.; collected on the plains of Taveta, in southeastern British East Africa, August 13, 1888, by Dr. W. L. Abbott.

*Characters.*—Most closely related to *Sylvietta brachyura leucopsis* (Reichenow), but smaller, with the upper parts browner, less grayish, the whitish of the abdomen more contracted and contrasting less with the rufescent sides and chest, with the chest more intensely tawny-olive, and with the white confined to the chin and not extending to the upper throat.

*Measurements of type* (adult female).—Length of skin, 75; wing, 46; tail, 20; culmen (chord), 9; tarsus, 17.

*Measurements of adult female of Sylvietta brachyura leucopsis* (from Lakiundu River, near the type locality).—Length of skin, 75; wing, 47; tail, 20; culmen (chord), 10; tarsus, 17.

*Remarks.*—In the subspecies *leucopsis,* from Lakiundu and the northern Guaso Nyiro rivers north to Dire Daoua, Abyssinia, the only variation noticeable is a slight increase in size to the northward.

**MELANIPARUS AFER FRICKI, new subspecies**

Frick's Titmouse

*Type-specimen.*—Adult male, Cat. No. 245844, U. S. Nat. Mus.; collected at Dire Daoua, Abyssinia, December 9, 1911, by Edgar A. Mearns. (Original number, 19581.)

*Characters.*—Most closely related to *Melaniparus afer barakæ* (Jackson), from the region around Lake Baringo, British East Africa, from which it differs in having a larger black spot on the

middle of the upper chest, deep gull gray sides and flanks, with a broad buffy-white collar separating the dark colors of the sides and chest from the black of the throat, and a darker general coloration. From *M. afer thruppi* (Shelley), from northern and central Somaliland, it may be readily distinguished by the absence of a decided tinge of buff to the cheeks, ear coverts, and under parts.

*Description of adult male and female.*—Head glossy black, with a white patch below the eye beginning as a narrow line from the angle of the mouth to below the eye, expanding to occupy the upper cheek and all of the ear-coverts, this rounded white spot surrounded by the black of the neck; mantle, rump, and least wing-coverts smoky slate-gray; a nuchal spot of dirty white, ten millimeters in diameter, between the black crown and gray mantle; upper tail-coverts black; wings black, or brownish black, the median and greater coverts and all of the quills edged with grayish white; edge of wing white with a black spot at base of feathers; rectrices black, the outer ones edged and tipped with white; the black of the lower throat, which is pointed below, separated from the deep gull gray of the sides by a continuous collar of dirty white, obscurely continued around the sides of the neck to unite with the whitish nuchal patch; a black spot occupies the middle of the upper chest below the whitish collar; center of abdomen washed with rusty white; thighs and crissum soiled grayish white; axillars, under wing-coverts, and inner edge of quills soiled grayish white. In dry specimens the bill, feet, and claws are blackish.

*Measurements of type* (adult male).—Length of skin, 108; wing, 65; tail, 46.5; culmen (chord), 10.5; tarsus, 17.5.

*Measurements of adult female topotype.*—Length of skin, 111; wing, 64; tail, 48.5; culmen (chord), 10.5; tarsus, 17.5.

### ZOSTEROPS SENEGALENSIS FRICKI, new subspecies

Frick's White-eye

*Type-specimen.*—Adult male, Cat. No. 245874, U. S. Nat. Mus.; collected on Bowlder Hill, Thika River, British East Africa, August 28, 1912, by Edgar A. Mearns. (Original number, 23936.)

*Characters.*—Most closely related to *Zosterops senegalensis stuhlmanni* (Reichenow), from which it differs in being considerably smaller, with less yellow on the forehead. The back is greener and the under parts yellower than in *Z. s. smithi* of southern Abyssinia; and it may be easily separated from *Z. s. flavilateralis,* from the coast region at Mombasa, by its more yellow coloration throughout.

*Description of adult male and female.*—Forehead, throat, and middle of under parts, including under tail-coverts, citron yellow; sides yellowish citrine; top and sides of head, upper side of neck, mantle, and outer edges of wing-coverts and quills serpentine green, becoming yellowish citrine on rump and upper tail-coverts; wing- and tail-feathers mouse gray; axillars, lining of wings, and inner edge of quills yellowish white; edge of wing pale yellow, a narrow eye-ring pure white.

*Measurements of type* (adult male).—Length of skin, 92; wing, 54; tail, 39; culmen (chord), 10; tarsus, 15.

*Average measurements of four adult males.*—Wing, 53.25; tail, 36.5; culmen (chord), 10; tarsus, 15.25.

*Average measurements of two adult females.*—Wing, 50.75; tail, 34.5; culmen (chord), 10; tarsus, 14.25.

*Geographical range.*—Upper Thika and Tana rivers, north to Endoto Mountain, British East Africa.

### ZOSTEROPS VIRENS GARGUENSIS, new subspecies

Mount Gargues White-eye

*Type-specimen.*—Adult male, Cat. No. 217736, U. S. Nat. Mus.; collected on the summit of Mount Gargues (altitude 7,100 feet), north of the Northern Guaso Nyiro River, in British East Africa, August 25, 1911, by Edmund Heller. (Original number, 225.)

*Characters.*—Most closely related to *Zosterops virens jacksoni* (Neumann) from Mau, British East Africa, and *Z. v. kaffensis*, from Kaffa, southern Abyssinia, having an equally narrow white eye-ring, but a darker, more grayish, coloration. From the form *garguensis, Z. v. kikuyuensis* (Sharpe) from Kikuyu and Mount Kenia, and *Z. v. eurycricota* (Fischer and Reichenow) from Mount Kilimanjaro, may be instantly distinguished by the very broad white eye-ring as well as by a quite different coloration.

*Description of adult male and female.*—Upper parts light yellowish olive, not perceptibly yellower on the crown or upper tail-coverts, but slightly yellowish on ear-coverts and sides of face; the very narrow eye-ring is white; lores black; throat and a narrow band bordering upper bill olive-yellow; quills and upper wing-coverts grayish brown, edged with the same color as the back; chest, sides, flanks, and outer side of thighs pale olive-green; abdomen, under tail-coverts, inner aspect of thighs, and edge of wing olive-yellow; axillars primrose yellow; under wing-coverts yellowish white; under

surface of quills bordered with grayish white. In the dry specimen the bill is black and the feet grayish olive.

*Measurements of type* (adult male).—Length of skin, 110; wing, 58; tail, 48; culmen (chord), 12; tarsus, 17.

*Average measurements of two adult male topotypes.*—Wing, 59; tail, 47; culmen (chord), 12; tarsus, 17.5.

*Average measurements of two adult female topotypes.*—Wing, 58.5; tail, 46; culmen (chord), 11.6; tarsus, 17.3.

*Material.*—Four specimens from Mount Guargues (also written Garguez on some maps).

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# FIFTY-ONE NEW MALAYAN MAMMALS

BY
GERRIT S. MILLER, JR.

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# FIFTY-ONE NEW MALAYAN MAMMALS

By GERRIT S. MILLER, Jr.

Under the auspices of the Smithsonian Institution Mr. H. C. Raven has been engaged, during the past eighteen months, in collecting specimens of the vertebrates of Dutch Southeast Borneo. His explorations are made possible by the generosity of Dr. W. L. Abbott. Identification of the mammals included in the first shipment of material has led me to the re-examination of the related parts of the collections previously made by Dr. Abbott himself elsewhere in the Malay region. This work has resulted in the detection of the fifty-one new forms here described.

### PARADOXURUS PARVUS, new species

1903. *Paradoxurus hermaphroditus* Miller, Proc. U. S. Nat. Mus., vol. 26, p. 471. February 3, 1903. (Not of Pallas.)

*Type.*—Adult male (skin and skull), No. 114175, United States National Museum. Collected on Simalur Island, off coast of west Sumatra, December 15, 1901, by Dr. W. L. Abbott. Original No. 1385.

*Diagnosis.*—Like *Paradoxurus hermaphroditus hermaphroditus* of the Sumatran mainland, but smaller; condylobasal length of skull in male with well developed sagittal crest 100.2 mm., as compared with 106.2 and 106.4 in two males of similar age from Aru Bay; condylobasal length of skull in female with basal suture closed 96.0, as compared with 107.3 and 107.5 in two of similar age from Aru Bay, and 104 and 108.6 in two from Siak River.

*Measurements.*—Type: head and body, 485 mm.; tail, 390; hind foot (dry), 71 (70); condylobasal length of skull (basal suture visible, teeth moderately worn), 100.2 (96.0);[1] zygomatic breadth, 59.6 (53.8); breadth of braincase, 31.6 (32.0); interorbital breadth, 16.5 (15.2); breadth of rostrum over canines, 19.5 (17.8); mandible, 74.0 (70.9); maxillary toothrow exclusive of incisors, 37.6 (37.8); mandibular toothrow exclusive of incisors, 42.3 (42.0).

*Specimens examined.*—Six, all from Simalur Island.

[1] Cranial measurements in parenthesis are those of a female *P. hermaphroditus* (No. 114172) of same age as the type.

*Remarks.*—On re-examining the specimens of *Paradoxurus* from Simalur I find that Dr. Abbott was right in considering the island form distinct from that of Sumatra.[1] In color the two animals appear to be indistinguishable, but in size the differences are very noticeable, as shown by the following table of maxima and minima:

| | Head and body | Tail | Weight (kg.) | Condylobasal length of skull | Number of specimens |
|---|---|---|---|---|---|
| *hermaphroditus* | 490 to 595 | 420 to 520 | 2.25 to 3 | 104 to 108.6 | 6 |
| *parvus* | 465 to 483 | 380 to 420 | 1.5 to 2 | 96 to 100.2 | 5 |

**PARADOXURUS HERMAPHRODITUS RAVUS, new subspecies**

*Type.*—Adult female (skin and skull), No. 84429, United States National Museum. Collected at Trong, Lower Siam, March 5, 1897, by Dr. W. L. Abbott.

*Diagnosis.*—Like *Paradoxurus hermaphroditus hermaphroditus* of Sumatra and the southern portion of the Malay Peninsula,[2] but ground color of upperparts noticeably paler (about pale-ecru-drab) instead of a brownish ochraceous-tawny), so that the black spots and hair-tips are thrown into greater contrast.

*Measurements.*—Type: head and body, 580 mm.; tail, 470; hind foot (dry), 83 (81); condylobasal length of skull (basal suture closed, teeth slightly worn), 104.5 (108.0);[3] zygomatic breadth, 58.2 (58.3); breadth of braincase, 35.4 (35.0); interorbital breadth, 18.0 (18.2); breadth of rostrum over canines, 18.6 (20.0); mandible, 76.8 (81.4); maxillary toothrow exclusive of incisors, 38.1 (42.0); mandibular toothrow exclusive of incisors, 41.2 (47.0).

*Specimens examined.*—Two, both from the type locality.

*Remarks.*—This animal is readily distinguishable from true *Paradoxurus hermaphroditus* by the gray, not brown, ground color of the upperparts and sides. As in the typical form the black markings are well developed, and the tail has no conspicuous light area on basal third. From *P. minor,* represented in Dr. Abbott's collections

[1] See Proc. U. S. Nat. Mus., vol. 26, p. 471. February 3, 1903.

[2] The United States National Museum contains specimens of true *hermaphroditus* from the following localities:

Sumatra: Little Siak River, 3; Aru Bay, 9; Tarussan Bay, 2; Engano Island, 1.

Malay Peninsula: The Dindings, 1; Rumpin River, Pahang, 2; Endau River, Johore, 1; Jambu Luang, Johore, 1.

[3] Cranial measurements in parenthesis are those of a male topotype with basal suture visible and teeth unworn.

by specimens from Trong and Tenasserim, it differs in its paler color, more sharply defined black markings, larger skull, and much more robust teeth.

### PARADOXURUS HERMAPRODITUS SENEX, new subspecies

*Type.*—Immature male (skin and skull), No. 124171, United States National Museum. Collected on Domel Island, Mergui Archipelago, January 26, 1904, by Dr. W. L. Abbott. Original No. 3074.

*Diagnosis.*—Like *Paradoxurus hermaphroditus ravus,* but ground color of upperparts and sides with less distinct trace of yellow; auditory bullæ more reduced than in any other known race.

*Measurements.*—Head and body, 525 mm.; tail, 465; hind foot, 77.4 (77.4); condylobasal length of skull (basal suture open, teeth slightly worn), 99.0; zygomatic breadth, 58.9; breadth of braincase, 54.6; interorbital breadth, 17.2; breadth of rostrum over canines, 20.0; mandible, 75.2; maxillary toothrow exclusive of incisors, 38.6; mandibular toothrow exclusive of incisors, 44.0.

*Specimen examined.*—The type.

*Remarks.*—In color the Domel Island race is probably not always distinguishable from that of Trong, though the ground color in the type more nearly approaches a clear grizzle of black and white. The auditory bullæ are slightly inflated, and only 10.5 mm. in length from border of paroccipital process to front of bullæ proper.

### PARADOXURUS HERMAPHRODITUS FUSCUS, new subspecies

*Type.*—Adult female (skin and skull), No. 124075, United States National Museum. Collected on James Island, Mergui Archipelago, January 2, 1904, by Dr. W. L. Abbott. Original No. 2982.

*Diagnosis.*—Ground color as in *Paradoxurus hermaphroditus senex,* but black markings on head, neck and shoulders more extensive, and entire underparts suffused with sooty brown, darkest on throat, chest and inner surface of legs.

*Measurements.*—Head and body, 500 mm.; tail (imperfect), 370; hind foot (dry), 77 (73); condylobasal length of skull (basal suture closed, teeth moderately worn), 101.2; zygomatic breadth, 53.6; breadth of braincase, 34.6; interorbital breadth, 16.8; breadth of rostrum over canines, 17.8; mandible, 73.2; maxillary toothrow exclusive of incisors, 37.4; mandibular toothrow exclusive of incisors, 41.6.

*Specimen examined.*—The type.

### PARADOXURUS HERMAPHRODITUS PALLENS, new subspecies

*Type.*—Adult female (skin and skull), No. 124201, United States National Museum. Collected on Kisseraing Island, Mergui Archipelago, February 4, 1904. Original No. 3106.

*Diagnosis.*—Like *Paradoxurus hermaphroditus ravus* but tail distinctly brownish instead of essentially black, its basal third, both above and below, concolor with corresponding surfaces of body in conspicuous contrast with uniformly dark terminal portion.

*Measurements.*—Head and body, 538 mm.; tail, 425; hind foot (dry), 84.5 (79); condylobasal length of skull (basal suture closed, teeth much worn), 103.2; zygomatic breadth, 58.4; breadth of braincase, 33.7; interorbital breadth, 18.0; breadth of rostrum over canines, 19.4; mandible, 76.2; maxillary toothrow exclusive of incisors, 39.0; mandibular toothrow exclusive of incisors, 42.6.

*Specimen examined.*—The type.

### PARADOXURUS HERMAPHRODITUS PUGNAX, new subspecies

*Type.*—Adult female (skin and skull), No. 124100, United States National Museum. Collected on Sullivan Island, Mergui Archipelago, January 5, 1904, by Dr. W. L. Abbott. Original No. 2999.

*Diagnosis.*—Like *Paradoxurus hermaphroditus pallens* but size slightly less and dark markings slightly more extensive, particularly on thighs, upperarms, nape and cheeks.

*Measurements.*—Type: head and body, 520 mm.; tail, 420; hind foot (dry), 83.5 (81); condylobasal length of skull (basal suture closed, teeth much worn), 99.5; zygomatic breadth, 56.8; breadth of braincase, 33.5; interorbital breadth, 17.5; breadth of rostrum over canines, 18.6; mandible, 74.1; maxillary toothrow exclusive of incisors, 39.1; mandibular toothrow exclusive of incisors, 41.8.

*Specimens examined.*—Two, both from Sullivan Island.

### PARADOXURUS HERMAPHRODITUS SACER, new subspecies

*Type.*—Adult female (skin and skull), No. 124032, United States National Museum. Collected on Saint Matthew Island, Mergui Archipelago, December 27, 1903, by Dr. W. L. Abbott. Original No. 2934.

*Diagnosis.*—Like *Paradoxurus hermaphroditus pallens* but black markings so reduced that dorsal stripes are broken up into lines of spots; skull smaller than in any of the other known Mergui forms, scarcely exceeding that of *Paradoxurus minor.*

*Measurements.*—Type: head and body, 520 mm.; tail, 420; hind foot (dry), 75.8 (71.4); condylobasal length of skull (basal suture closed, teeth much worn), 99.3 (101.0);[1] zygomatic breadth, 56.8 (60.0); breadth of braincase, 33.3 (33.7); interorbital breadth, 17.6 (17.2); breadth of rostrum over canines, 18.8 (19.2); mandible, 75.1 (73.2); maxillary toothrow exclusive of incisors, 39.0 (37.9); mandibular toothrow exclusive of incisors, 42.1 (41.6).

*Specimens examined.*—Three from Saint Matthew Island and two from St. Luke Island.

### PARADOXURUS HERMAPHRODITUS PULCHER, new subspecies

*Type.*—Adult female (skin and skull), No. 124142, United States National Museum. Collected on Clara Island, Mergui Archipelago, January 11, 1904, by Dr. W. L. Abbott. Original No. 3033.

*Diagnosis.*—Like *Paradoxurus hermaphroditus pallens* but ground color both above and below between cartridge-buff and cream-buff, more yellowish than in any of the other known races.

*Measurements.*—Type: head and body, 485 mm.; tail, 460; hind foot (dry), 83.5 (80.5); condylobasal length of skull (basal suture closed, teeth much worn), 101.3 (103.2);[2] zygomatic breadth, 56.6 (61.2); breadth of braincase, 34.8 (33.0); interorbital breadth, 16.5 (16.8); breadth of rostrum over canines, 18.8 (20.2); mandible, 75.3 (78.3); maxillary toothrow exclusive of incisors, 38.0 (38.3); mandibular toothrow exclusive of incisors, 42.2 (43.4).

*Specimens examined.*—Two, both from Clara Island.

*Remarks.*—The peculiar yellowish hue of the pale areas in this animal is unique among the members of the genus that I have seen.

### PARADOXURUS HERMAPHRODITUS CANUS, new subspecies

*Type.*—Adult female (skin and skull), No. 123976, United States National Museum. Collected on Pulo Terutau, off west coast of Lower Siam, April 7, 1904, by Dr. W. L. Abbott. Original No. 3209.

*Diagnosis.*—Like *Paradoxurus hermaphroditus pallens* but light element in markings faintly though perceptibly less yellowish than in *P. h. ravus;* throat blotched with buffy white; size somewhat less than in *pallens* or *ravus.*

*Measurements.*—Type: head and body, 510 mm.; tail, 440; hind

[1] Measurements in parenthesis are those of a male (basal suture closed but visible, teeth moderately worn) from the type locality (No. 124033).

[2] Measurements in parenthesis are those of a male (No. 124141) of same age as the type.

foot (dry), 80.6 (76.6); condylobasal length of skull (basal suture closed, teeth moderately worn), 99.3 (103.1);[1] zygomatic breadth, 54.0 (61.5); breadth of braincase, 31.8 (31.4) interorbital breadth, 18.6 (18.8); breadth of rostrum over canines, 18.0 (20.0); mandible, 73.5 (77.0); maxillary toothrow exclusive of incisors, 35.7 (38.3); mandibular toothrow exclusive of incisors, 40.3 (43.5).

*Specimens examined.*—Six, all from Pulo Terutau.

*Remarks.*—The white blotch on throat, though variable in size, is present in each of the six individuals. In other members of the genus it is indicated in less than ten per cent of the specimens that I have seen.

### PARADOXURUS HERMAPHRODITUS SIMPLEX, new subspecies

1906. *Paradoxurus hermaphroditus* Lyon, Proc. U. S. Nat. Mus., vol. 31, p. 597. December 18, 1906. (Not of Pallas.)

*Type.*—Adult male (skin and skull), No. 124902, United States National Museum. Collected at Klabat Bay, Banka, June 26, 1904, by Dr. W. L. Abbott. Original No. 3443.

*Diagnosis.*—Size and general appearance as in *Paradoxurus hermaphroditus hermaphroditus* of the Sumatran mainland, but dark markings reduced to a minimum, one specimen like the least spotted individual among twenty of the typical race, the other (type) with no spots whatever and with the dorsal stripe barely indicated.

*Measurements.*—Type: head and body, 540 mm.; tail, 450; hind foot, 88; hind foot, dry, 85.5 (81.5); condylobasal length of skull (basal suture closed, teeth much worn), 105.8; zygomatic breadth, 65.4; breadth of braincase, 35.5; interorbital breadth, 18.8; breadth of rostrum over canines, 20.8; mandible, 78.4; maxillary toothrow exclusive of incisors, 39.2; mandibular toothrow exclusive of incisors, 43.8.

*Specimens examined.*—Two, both from Banka.

### ARCTOGALIDIA MACRA, new species

*Type.*—Adult female (skin and skull), No. 124172, United States National Museum. Collected on Domel Island, Mergui Archipelago, January 26, 1904, by Dr. W. L. Abbott. Original No. 3075.

*Diagnosis.*—Like *Arctogalidia leucotis* from Tenasserim but condylobasal length of skull about 10 mm. less than in the mainland form.

[1] Cranial measurements in parenthesis are those of a male (No. 123972) with excessively worn teeth.

*Measurements.*—Type: head and body, 475 mm.; tail, 545; hind foot (dry), 81 (76.5); condylobasal length of skull (basal suture closed, teeth slightly worn), 96.6 (104.2);[1] zygomatic breadth, 55.6 (58.5); breadth of braincase, 33.8 (35.1); interorbital breadth, 17.1 (20.0); breadth of rostrum over canines, 19.2 (19.3); mandible, 75.4 (80.0); maxillary toothrow exclusive of incisors, 36.0 (38.0); mandibular toothrow exclusive of incisors, 40.5 (42.5).

*Specimen examined.*—The type.

### ARCTOGALIDIA BICOLOR, new species

1911. *Arctogalidia stigmatica* Lyon, Proc. U. S. Nat. Mus., vol. 40, p. 116. April 25, 1911. (Part.)

*Type.*—Adult female (skin and skull), No. 151875, United States National Museum. Collected at Klumpang Bay, Dutch Southeast Borneo, January 1, 1908, by Dr. W. L. Abbott. Original No. 3745.

*Diagnosis.*—A small species related to *Arctogalidia simplex* of Linga and Singkep, and *A. inornata* of the Natuna Islands; upperparts, as in *A. simplex,* grayish brown with faint median dark stripe; underparts clear buff, even paler than in *A. inornata* (near the cartridge-buff of Ridgway but with less yellow); contrast between color of dorsal and ventral surfaces more noticeable than in any other known member of the genus; skull as in *A. inornata,* the rostrum and palate narrower than in *A. simplex.*

*Measurements.*—Head and body, 473 mm.; tail, 495; hind foot (dry), 78 (73.5); condylobasal length of skull (basal suture closed, teeth slightly worn), 94.1; zygomatic breadth, 51.0; breadth of braincase, 32.9; interorbital breadth, 14.8; breadth of rostrum over canines, 17.4; mandible, 70.9; maxillary toothrow exclusive of incisors, 35.1; mandibular toothrow exclusive of incisors, 38.4.

*Specimen examined.*—The type.

### ARCTOGALIDIA MIMA, new species

1907. *Arctogalidia simplex* Lyon, Proc. U. S. Nat. Mus., vol. 31, p. 655. January 16, 1907. (Not of Miller.)

*Type.*—Adult female (skin and skull), No. 142153, United States National Museum. Collected at Semimba Bay, Battam Island, Rhio Archipelago, September 16, 1905, by C. Boden Kloss. Original No. 10. Presented by Dr. W. L. Abbott.

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[1] Cranial measurements in parenthesis are those of a female *A. leucotis* (No. 124228), with moderately worn teeth, from Red Point, Tenasserim.

*Diagnosis.*—Like *Arctogalidia simplex* of Linga and Singkep but skull not so large, auditory bullæ more reduced, and posterior lower molar smaller than in any of the other known species, *A. minor* not excepted.

*Measurements.*—Head and body, 448 mm.; tail, 502; hind foot, 77 (dry, 76.5, 72.5); condylobasal length of skull (basal suture closed, teeth moderately worn), 91.7 (97.8);[1] zygomatic breadth, 51.2 (53.1); breadth of braincase, 31.1 (33.3); interorbital breadth, 17.2 (16.6); breadth of rostrum over canines, 18.2 (18.3); mandible, 68.0 (73.7); maxillary toothrow exclusive of incisors, 33.8 (36±); front of canine to back of $m^1$, 30.6 (33.4); mandibular toothrow exclusive of incisors, 34.5 (40.6); antero-posterior diameter of $m_2$ at base of crown, 2.5 (4.1).

*Specimen examined.*—The type.

### ARCTOGALIDIA DEPRESSA, new species

1909. *Arctogalidia fusca* LYON, Proc. U. S. Nat Mus., vol. 36, p. 490. June 1, 1909. (Part.)

*Type.*—Adult female (skull only), No. 115600, United States National Museum. Collected on Pulo Bintang, Rhio Archipelago, August 18, 1902, by Dr. W. L. Abbott. Original No. 1896.

*Diagnosis.*—Skull like that of *Arctogalidia fusca* but larger (that of female slightly exceeding the largest of four males of the Kundur animal); frontal region more depressed (depth immediately behind last molar, 23.6 as compared with 28.1 in a male *A. fusca* with condylobasal length of 96.4), so that orbits are directed more upward; auditory bullæ larger and broader but less elevated. External characters not known.

*Measurements.*—Condylobasal length of skull (basal suture closed, teeth slightly worn), 97.6; zygomatic breadth, 52.8; breadth of braincase, 33.2; interorbital breadth, 17.3; breadth of rostrum over canines, 17.8; mandible, 73.5; maxillary toothrow exclusive of incisors, 35.6; mandibular toothrow exclusive of incisors, 39.3.

*Specimen examined.*—The type.

### EPIMYS PANNELLUS, new species

1900. *Mus pannosus* MILLER, Proc. Biol. Soc. Washington, vol. 13, p. 190. December 21, 1900. (Part.)

*Type.*—Adult male (skin and skull), No. 104121, United States National Museum. Collected on Pulo Rawi, Butang Islands, December 19, 1899, by Dr. W. L. Abbott. Original No. 175.

[1] Cranial measurements in parenthesis are those of a slightly older female (No. 123103) *A. simplex* from Singkep.

*Diagnosis.*—A member of the *rattus*-group similar to *Epimys pannosus* of Pulo Adang, Butang Islands, but skull less robust, incisive foramina distinctly narrowed anteriorly, and teeth usually not so large.

*Measurements.*—Type: head and body, 205 mm.; tail, 175; hind foot (dry), 38 (36); condylobasal length of skull (teeth much worn), 42.3; zygomatic breadth, 20.2; interorbital constriction, 6.7; mastoid breadth, 16.9; depth of braincase, 10.9; nasal, 16.6; diastema, 12.1; mandible, 26.5; maxillary toothrow (alveoli), 8.0; mandibular toothrow (alveoli), 7.2.

*Specimens examined.*—Five (three skulls without skins), all from Pulo Rawi.

*Remarks.*—Though in external appearance not appreciably different from *Epimys pannosus,* this species is distinguishable from its ally by the cranial characters shown in the series of five skulls.

### EPIMYS TINGIUS, new species

*Type.*—Adult male (skin and skull), No. 112723, United States National Museum. Collected on Pulo Tinggi, off east coast of Johore, August 5, 1901, by Dr. W. L. Abbott. Original No. 1201.

*Diagnosis.*—A member of the *rattus*-group similar to *Epimys tambelanicus* of the Tambelan Islands and *E. pannosus* of the Butang Islands, but skull more slender than in the latter and auditory bullæ smaller than in the former.

*Measurements.*—Type: head and body, 217 mm.; tail, 204; hind foot (dry), 40.5 (38); condylobasal length of skull (teeth moderately worn), 44.1; zygomatic breadth, 21.9; interorbital constriction, 7.2; occipital breadth, 18.0; depth of braincase, 12±; nasal, 17.0; diastema, 12.2; mandible, 27.2; maxillary toothrow (alveoli), 7.2; mandibular toothrow (alveoli), 7.1.

*Specimens examined.*—One skin and six skulls, all from Pulo Tinggi.

### EPIMYS FULMINEUS, new species

*Type.*—Adult female (skin and skull), No. 112349, United States National Museum. Collected on St. Barbe Island, South China Sea, May 27, 1901, by Dr. W. L. Abbott. Original No. 950.

*Diagnosis.*—A member of the *rattus*-group, in general like *Epimys tingius,* but skull still more slender, with braincase both narrower and less deep.

*Measurements.*—Type: head and body, 205 mm.; tail, 220; hind foot (dry), 37 (35); condylobasal length of skull (teeth much worn),

42.7 (43.2);[1] zygomatic breadth, 19.6 (21.5); interorbital constriction, 7.2 (7.4); occipital breadth, 15.8 (17.6); depth of braincase, 10.1 (11.3); nasal, 17.0 (17.4); diastema, 13.3 (13.0); mandible, 26.0 (27.4); maxillary toothrow (alveoli), 6.7 (7.4); mandibular toothrow (alveoli), 6.5 (7.2).

*Specimens examined.*—Three, all from St. Barbe Island.

### EPIMYS ROA, new species

*Type.*—Adult female (skin and skull), No. 112444, United States National Museum. Collected on Pulo Aor, off east coast of Johore, June 8, 1901, by Dr. W. L. Abbott. Original No. 1025.

*Diagnosis.*—A member of the *rattus*-group resembling *Epimys pannosus,* but color paler and with a decided tinge of drab; skull with rostral portion more robust than in the Butang animal.

*Measurements.*—Head and body, 203 mm.; tail, 187; hind foot (dry), 37.5 (36); condylobasal length of skull (teeth much worn), 42.8; zygomatic breadth, 21.2; interorbital constriction, 6.8; occipital breadth, 7.2; depth of braincase, 11.1; nasal, 16.5; diastema, 12.8; mandible, 26.0; maxillary toothrow (alveoli), 7.1; mandibular toothrow (alveoli), 6.6.

*Specimens examined.*—The type and an immature individual, both from Pulo Aor.

*Remarks.*—Though nearly related to the form occurring on Pulo Tinggi this animal is easily distinguishable by the lighter, drab-tinged color of the upperparts. In the dry state the ears appear to be smaller than the Tinggi form.

### EPIMYS MARA, new species

*Type.*—Adult female (skin and skull), No. 196751, United States National Museum. Collected on Maratua Island, Dutch Southeast Borneo, August 28, 1912, by H. C. Raven. Original No. 187. Presented by Dr. W. L. Abbott.

*Diagnosis.*—A large member of the *rattus*-group resembling *Epimys pannosus* of the Butang Islands, but color darker, skull larger, and teeth smaller; nasals distinctly spatulate anteriorly.

*Color.*—Upperparts seal-brown mixed with isabella-color, the mixture inconspicuous along median region but gradually increasing laterally until the lighter element predominates on sides of body and outer surface of legs. Underparts and inner surface of legs vina-

[1] Cranial measurements in parenthesis are those of a female *Epimys tingius* of about the same age (No. 112728).

ceous-buff dulled by the light-neutral-gray bases of the hairs, the contrast between belly and sides not conspicuous. Ears and feet sprinkled with fine hairs of an indefinite brownish color. Tail uniform dark brown, the minute blackish hairs not producing any effect of color.

*Skull and teeth.*—The skull is larger than in *Epimys neglectus*, closely agreeing with that of *E. pannosus* in size and general appearance. It differs from that of the Butang form in more depressed braincase, larger interparietal (area about equal to that of one parietal instead of decidedly less than that of parietal), narrower interorbital region, smaller auditory bullæ, and in the spatulate form of the nasals caused by the very abrupt narrowing at middle.

Teeth as in *Epimys pannosus* but noticeably smaller, the transverse diameter of $m^1$ about 1.8 mm. instead of 2.4 mm.

*Measurements.*—Head and body, 208 (212) mm.;[1] tail, 215 (228); hind foot, 42 (42); hind foot without claws, 40.8 (40.5); condylobasal length of skull (teeth much worn), 46.1 (45.0); zygomatic breadth, 23.0 (22.3); interorbital constriction, 7.1 (6.9); mastoid breadth, 17.1 (16.9); depth of braincase, 11.0 (11.8); nasal, 17.5 (17.0); diastema, 13.7 (13.6); mandible, 27.1 (27.1); maxillary toothrow (alveoli), 6.8 (6.8); mandibular toothrow (alveoli), 6.9 (6.4).

*Specimens examined.*—Two, both from Maratua Island.

*Remarks.*—The section of the *Epimys rattus* group containing this species and the four just described is characterized by large size, coarse fur, and heavy skull, features which cause its members to have a superficial resemblance to the rats allied to *Epimys validus* and *E. firmus*. Two forms, *E. bullatus* (Lyon) from eastern Sumatra and *E. villosus* (Kloss)[2] from Singapore, have in fact been described as small members of the *validus-firmus* series, though in each instance the main character by which the two groups are distinguished—the large normal auditory bullæ of the smaller animal as compared with the much reduced bullæ of the larger species—was made the principal feature of the new race. In addition to the forms already mentioned, the section contains *E. tambelanicus* of the Tambelan Islands, and

[1] Measurements in parenthesis are those of an adult male (No. 196754) of same age as type.

[2] Mr. Kloss now considers the Singapore animal as identical with *E. bullatus* (Journ. Fed. Malay States Mus., vol. 4, p. 245, 1911). A topotype in the U. S. National Museum (No. 105076, adult female) differs from the five adults of the Sumatran form in less yellowish underparts and in the shorter, deeper rostrum. Until more material can be compared I prefer to regard the two as distinct.

*E. simalurensis* and *E. lugens* of the Barussan Archipelago. The Sumatran *Mus mülleri* of Jentink, usually supposed to be a member of the *firmus* group, is probably related to *E. pannosus*. Unfortunately the absence of the auditory bullæ in the type specimen makes exact determination for the present impossible.

### EPIMYS TUA, new species

*Type*.—Adult female (skin and skull), No. 196752, United States National Museum. Collected on Maratua Island, Dutch southeast Borneo, August 28, 1912, by H. C. Raven. Original No. 188. Presented by Dr. W. L. Abbott.

*Diagnosis*.—Like *Epimys rattus neglectus* of the Bornean mainland but upperparts blackish brown and underparts slaty.

*Color*.—The color in one adult and one young is essentially like that of *Epimys mara*. In the other two adults it is similar, except that there is less of the isabella on back and sides and of the vinaceous-buff on underparts.

*Skull and teeth*.—The skull resembles that of *Epimys neglectus*. It consequently differs from that of *E. mara* in its much smaller size and normally formed nasals. Teeth as in *E. neglectus*.

*Measurements*.—Type: head and body, 185 mm.; tail, 170; hind foot, 39 (dry, 36, 35); condylobasal length of skull (teeth moderately worn), 40.1; zygomatic breadth, 19.8; interorbital constriction, 6.1; mastoid breadth, 16.1; depth of braincase, 11.0; nasal, 14.5; diastema, 11.6; mandible, 6.7; maxillary toothrow (alveoli), 25.3; mandibular toothrow (alveoli), 6.8.

*Specimens examined*.—Four, all from Maratua Island.

*Remarks*.—The dark color of the upperparts and the dull, slightly contrasted underparts immediately distinguish the Maratua form from the other local races of the *neglectus*-group represented in Dr. Abbott's and Mr. Raven's Bornean collections.

### EPIMYS RATTUS TURBIDUS, new subspecies

*Type*.—Young adult female (skin and skull), No. 196746, United States National Museum. Collected at Tanggarung, south bank of Mahakam River, Dutch Southeast Borneo, June 21, 1912, by H. C. Raven. Original No. 81. Presented by Dr. W. L. Abbott.

*Diagnosis*.—Like *Epimys rattus neglectus* from southern Borneo but color of underparts a dull drabby gray, inconspicuously contrasted with that of sides.

*Measurements.*—Type: head and body, 189 mm.; tail, 233; hind foot, 40 (dry, 39, 37.5); condylobasal length of skull (teeth slightly worn), 40.7; zygomatic breadth, 19.6; interorbital constriction, 6.8; mastoid breadth, 16.4; depth of braincase, 11.2; nasal, 15.8; diastema, 11.4; mandible, 25.3; maxillary toothrow (alveoli), 6.8; mandibular toothrow (alveoli), 6.4.

*Specimens examined.*—Thirteen, from the following localities in Dutch Southeast Borneo: Lo Bon Bon, 3; Samarinda, 4; Tanggarung, 2; Tanjong Batu, 1; Talisaian Mountain, 1.

*Remarks.*—The thirteen specimens on which this form is based differ conspicuously from the south Bornean races in the dull color of their underparts. In this feature they resemble *Epimys tua*, but they show no tendency toward darkening of the back.

### EPIMYS RATTUS PAUPER, new subspecies

1901. *Mus neglectus* MILLER, Proc. Washington Acad. Sci., vol. 3, p. 121. March 26, 1901. (Part. Not of Jentink.)

*Type.*—Adult male (skin and skull), No. 104828, United States National Museum. Collected on Sirhassen Island, South Natuna Islands, June 4, 1900, by Dr. W. L. Abbott. Original No. 433.

*Diagnosis.*—Like *Epimys rattus neglectus* from southern Borneo but smaller.

*Measurements.*—Type: head and body, 170 mm.; tail, 155; hind foot (dry), 33.5 (32); condylobasal length of skull (teeth much worn), 36.9; zygomatic breadth, 17.2; interorbital constriction, 6.2; occipital breadth, 14.4; depth of braincase, 10.2; nasal, 14.0; diastema, 10.8; mandible, 23.0; maxillary toothrow (alveoli), 6.4; mandibular toothrow (alveoli), 6.1.

*Specimens examined.*—Five, all from Sirhassen Island.

### EPIMYS RATTUS VICLANA, new subspecies

*Type.*—Adult male (skin and skull), No. 123861, United States National Museum. Collected on Pulo Lankawi, off west coast of Malay Peninsula, November 3, 1903, by Dr. W. L. Abbott. Original No. 2800.

*Diagnosis.*—Like the form of *Epimys rattus* occurring in Trong and southern Tenasserim but color of back and sides duller and more finely blended (grizzled rather than "lined"); cheek teeth slightly though evidently larger than in the mainland race.

*Measurements.*—Type: head and body, 180 mm.; tail, 167; hind foot (dry), 34.5 (33.5); condylobasal length of skull (teeth much

worn), 38.6; zygomatic breadth, 19.9; interorbital constriction, 6.2; occipital breadth, 15.6; depth of braincase, 10.4; nasal, 15.3; diastema, 11.0; mandible, 24.5; maxillary toothrow (alveoli), 7.2; mandibular toothrow (alveoli), 6.7.

*Specimens examined.*—Six, all from Pulo Lankawi.

### EPIMYS RATTUS DENTATUS, new subspecies

*Type.*—Adult male (skin and skull), No. 111929, United States National Museum. Collected on Hastings Island, Mergui Archipelago, December 13, 1900, by Dr. W. L. Abbott. Original No. 783.

*Diagnosis.*—Like the form of *Epimys rattus* occurring in Trong and southern Tenasserim but cheek teeth decidedly larger, exceeding those of *E. rattus viclana.*

*Measurements.*—Type: head and body, 180 mm.; tail, 190; hind foot (dry), 36 (34); condylobasal length of skull (teeth much worn), 39.0; zygomatic breadth, 19.8; interorbital constriction, 6.0; occipital breadth, 15.8; depth of braincase, 11.2; nasal, 15.2; diastema, 11.7; mandible, 24.1; maxillary toothrow (alveoli), 7.0; mandibular toothrow (alveoli), 7.0; mandibular toothrow (alveoli), 6.6.

*Specimens examined.*—Eight (one odd skull), all from Hastings Island.

*Remarks.*—The large size of the cheek teeth in this form, as in all those now known from the Mergui Archipelago, is immediately evident on comparison with specimens from the adjoining mainland. In the insular races the width of $m^1$ usually equals and often exceeds half the least palatal width, while in the mainland animals it is usually less than half.

### EPIMYS RATTUS INSULANUS, new subspecies

*Type.*—Adult male (skin and skull), No. 104147, United States National Museum. Collected on Helfer Island, Mergui Archipelago, March 7, 1900, by Dr. W. L. Abbott. Original No. 334.

*Diagnosis.*—Like *Epimys rattus dentatus* but general outline of skull narrowed.

*Measurements.*—Type: head and body, 185 mm.; tail, 185; hind foot (dry), 36.5 (35.5); condylobasal length of skull (teeth moderately worn), 40.6; zygomatic breadth, 18.6; interorbital constriction, 6.3; occipital breadth, 16.1; depth of braincase, 11.2; nasal, 15.4; diastema, 11.3; mandible, 24.1; maxillary toothrow (alveoli), 7.6; mandibular toothrow (alveoli), 6.9.

*Specimens examined.*—Six, all from Helfer Island.

*Remarks.*—The narrow, elongate form of the skull in this race as compared with the normal outline in the other members of the group occurring in the Archipelago and on the neighboring mainland is at once appreciable on comparison of series of specimens.

### EPIMYS RATTUS EXSUL, new subspecies

*Type.*—Adult male (skin and skull), No. 124046, United States National Museum. Collected on James Island, Mergui Archipelago, December 31, 1903, by Dr. W. L. Abbott. Original No. 2958.

*Diagnosis.*—Like *Epimys rattus dentatus* but with auditory bullæ appreciably reduced in size.

*Measurements.*—Type: head and body, 175 mm.; tail, 183; hind foot (dry), 36.5 (34); condylobasal length of skull (teeth moderately worn), 37.4; zygomatic breadth, 18.5; interorbital constriction, 6.0; occipital breadth, 14.7; depth of braincase, 11.1; nasal, 14.0; diastema, 10.7; mandible, 23.1; maxillary toothrow (alveoli), 6.9; mandibular toothrow (alveoli), 7.0.

*Specimens examined.*—Twelve, from the following islands of the Mergui Archipelago: Sullivan, 1; James, 5; Loughborough, 6.

### EPIMYS RATTUS FORTUNATUS, new subspecies

*Type.*—Adult male (skin and skull), No. 104148, United States National Museum. Collected on Chance Island, Mergui Archipelago, December 29, 1899, by Dr. W. L. Abbott. Original No. 191.

*Diagnosis.*—Size somewhat larger and color more yellowish (ground color a clearer chamois and blackish hairs less abundant) than in the other races of *Epimys rattus* known to occur in the Mergui Archipelago. Skull normal, with well developed auditory bullæ.

*Measurements.*—Type: head and body, 205 mm.; tail, 215; hind foot (dry), 38 (36); condylobasal length of skull (teeth much worn), 41.5; zygomatic breadth, 21.2; interorbital constriction, 6.6; occipital breadth, 16.6; depth of braincase, 11.2; nasal, 17.0; diastema, 12.9; mandible, 16.3; maxillary toothrow (alveoli), 7.2; mandibular toothrow (alveoli), 6.7.

*Specimens examined.*—Three, all from Chance Island.

### EPIMYS BORNEANUS, new species

*Type.*—Adult female (skin and skull), No. 196749, United States National Museum. Collected at Telok Karang Tigau, Dutch South-

east Borneo, August 12, 1912, by H. C. Raven. Original No. 157. Presented by Dr. W. L. Abbott.

*Diagnosis.*—A member of the *firmus*-group resembling *Epimys integer* of the Natuna Islands but color of underparts and cheeks less yellowish (between cream-buff and cartridge-buff instead of chamois), and skull with more slender rostrum.

*Measurements.*—Type: head and body, 207 mm.; tail, 262; hind foot, 44 (dry, 43.5, 41); condylobasal length of skull (teeth moderately worn), 46.0; zygomatic breadth, 24.1; interorbital constriction, 6.9; mastoid breadth, 18.5; depth of braincase, 13.1; nasal, 18.9; diastema, 13.2; mandible, 29.2; maxillary toothrow (alveoli), 8.5; mandibular toothrow (alveoli), 8.5.

*Specimens examined.*—Four, from the following localities in Dutch Southeast Borneo: Birang River, 1; Karang Tigau, 1; Lo Bon Bon, 1; Segah River, 1.

*Remarks.*—The slenderness of the rostrum is a character not shared by other parts of the skull. In the type and a female of about the same age from Birang River the breadth of rostrum at middle of nasal is 8.4 mm.; zygomatic breadth, 24.1 and 23.9 respectively. In two similar females of *E. integer* the breadth of rostrum is 9.6, zygomatic breadth 24.0 and 24.2.

### EPIMYS VICTOR, new species

*Type.*—Adult female (skin and skull), No. 115422, United States National Museum. Collected near mouth of Rumpin River, Pahang, May 25, 1902, by Dr. W. L. Abbott. Original No. 1706.

*Diagnosis.*—Largest known member of the *firmus*-group, the skull attaining a total length of about 60 mm., as compared with about 55 mm. in *Epimys firmus* and *E. validus;* color as in *E. firmus;* teeth like those of *E. firmus,* therefore relatively smaller than in *E. validus* and with the elements of anterior crescent in $m^2$ and $m^3$ less developed.

*Measurements.*—Type: head and body, 265 mm.; tail, 291; hind foot (dry), 50 (48.5); condylobasal length of skull (teeth moderately worn), 57.0; greatest length, 59.6; zygomatic breadth, 29.2; interorbital constriction, 8.3; occipital breadth, 20.2; depth of braincase, 14.5; nasal, 23.7; diastema, 17.0; mandible, 35.2; maxillary toothrow (alveoli), 10.4; mandibular toothrow (alveoli), 10.0.

*Specimens examined.*—Seven, from the following localities: Pahang, Rumpin River, 4; Johore, Sembrong River, 1; Ka Kuli, 1 skin and 1 skull.

*Remarks.*—This is a large, south-Peninsular representative of *Epimys firmus*. It is readily distinguishable from *E. validus* of Trong by the relatively smaller teeth with less developed enamel folds. The *Mus muelleri fœderis* of Robinson and Kloss, from Selangor, is described as a much smaller animal with greatest length of skull in adult female only 48 mm.

### EPIMYS POLLENS, new species

1906. *Mus firmus* Lyon, Proc. U. S. Nat. Mus., vol. 31, p. 594. December 18, 1906. (Not of Miller.)

*Type.*—Adult male (skin and skull), No. 124691, United States National Museum. Collected at Tanjong Rengsam, Banka, May 22, 1904, by Dr. W. L. Abbott. Original No. 3250.

*Diagnosis.*—Like *Epimys firmus* of the Rhio-Linga Archipelago, but tail longer and skull differing from that of all the other known members of the group in the very abruptly constricted interorbital region and weak anterior portion of zygoma.

*Measurements.*—Type: head and body, 247 mm.; tail, 307; hind foot (dry), 48.7 (46.2); condylobasal length of skull (teeth moderately worn), 51.7; zygomatic breadth, 26.0; interorbital constriction, 7.7; occipital breadth, 19.9; depth of braincase, 14.4; nasal, 21.0; diastema, 15.0; mandible, 33.3; maxillary toothrow (alveoli), 9.1; mandibular toothrow (alveoli), 9.0.

*Specimens examined.*—Four, all from Banka.

### EPIMYS POTENS, new species

*Type.*—Adult female (skin and skull), No. 114384, United States National Museum. Collected on Pulo Tuangku, Banjak Islands, February 5, 1902, by Dr. W. L. Abbott. Original No. 1516.

*Diagnosis.*—Like *Epimys firmus* but tail shorter (about equal to head and body instead of distinctly longer) and cheek teeth smaller.

*Measurements.*—Type: head and body, 245 mm.; tail, 240; hind foot (dry), 46.5 (43.5); condylobasal length of skull (teeth moderately worn), 48.8; zygomatic breadth, 25.8; interorbital constriction, 7.9; occipital breadth, 18.8; depth of braincase, 14.6; nasal, 19.7; diastema, 14.6; length of incisive foramina, 8.9; mandible, 32.3; maxillary toothrow (alveoli), 8.6; mandibular toothrow (alveoli), 8.2.

*Specimens examined.*—Five, all from Pulo Tuangku.

*Remarks.*—The average length of head and body in the five specimens is 232 mm., that of tail 231 mm. The tail decidedly exceeds the head and body in only one individual (17 mm.). In thirteen adults of

*Epimys firmus* the average excess of tail over head and body is 14.6 mm., while in only one does the head and body decidedly exceed the tail (10 mm.).

### EPIMYS VALENS, new species

*Type.*—Adult female (skin and skull), No. 114285, United States National Museum. Collected on Pulo Bangkaru, Banjak Islands, January 19, 1902, by Dr. W. L. Abbott. Original No. 1430.

*Diagnosis.*—Like *Epimys potens* of Pulo Tuangku but tail decidedly shorter than head and body, skull with noticeably shortened incisive foramina, and teeth more nearly as large as in *E. firmus*.

*Measurements.*—Type: head and body, 232 mm.; tail, 203; hind foot (dry), 34.5 (32); condylobasal length of skull (teeth moderately worn), 48.8; zygomatic breadth, 25.1; interorbital constriction, 7.3; occipital breadth, 18.8; depth of braincase, 13.2; nasal, 21.2; diastema, 14.7; length of incisive foramina, 7.9; mandible, 32.5; maxillary toothrow (alveoli), 8.7; mandibular toothrow (alveoli), 9.0.

*Specimens examined.*—Six, all from Pulo Bangkaru.

*Remarks.*—In all of the specimens the tail is shorter than head and body, the average difference 22 mm. The color of the back and sides in the skins of *Epimys valens* and in those of *E. potens* is more yellowish than in the series of *E. firmus*. They are, however, in fresher coat, so that the difference may be purely seasonal.

### EPIMYS LUTA, new species

1911. *Epimys sabanus* LYON, Proc. U. S. Nat. Mus., vol. 40, p. 104. April 25, 1911. (Part.)

*Type.*—Adult female (skin and skull), No. 151917, United States National Museum. Collected on Pulo Laut, Dutch Southeast Borneo, December 24, 1907, by Dr. W. L. Abbott. Original No. 5682.

*Diagnosis.*—A member of the *sabanus-vociferans* group much smaller than *Epimys sabanus* or than any of the forms of *E. vociferans* except *E. vociferans stridulus*. Differs from *E. vociferans stridulus* in darker ground color of back and sides (about ochraceous-tawny instead of about pale-ochraceous-buff), paler underparts (buffy white instead of cream-buff), and less robust skull with conspicuously weaker anterior base of zygoma, narrower antorbital plate, and longer incisive foramina.

*Measurements.*—Head and body, 210 mm.; tail, 290; hind foot (dry), 42.5 (41); condylobasal length of skull (teeth moderately worn), 45.8; greatest length, 50.2; zygomatic breadth, 22.9; inter-

orbital constriction, 7.6; nasal, 18.8; diastema, 13.0; mandible, 38.2; maxillary toothrow (alveoli), 9.0; mandibular toothrow (alveoli), 9.0.

*Specimen examined.*—The type.

### EPIMYS STENTOR, new species

*Type.*—Adult female (skin and skull), No. 124044, United States National Museum. Collected on James Island, Mergui Archipelago, January 2, 1904, by Dr. W. L. Abbott. Original No. 2983.

*Diagnosis.*—A member of the *Epimys vociferans* group with skull more robust and rostrum deeper in proportion to its length than in any of the previously known forms. Color as in *E. vociferans*.

*Measurements.*—Head and body, 262 mm.; tail, 323; hind foot (dry), 46.3 (43.5); condylobasal length of skull (teeth moderately worn), 53.6 (53.8);[1] greatest length, 56.8 (56.9); zygomatic breadth, 27.1 (24.4); occipital breadth, 19.8 (18.8); interorbital constriction, 9.3 (8.7); nasal, 22.7 (21.2); diastema, 15.8 (14.8); length of rostrum from posterior rim of antorbital foramen, 19.0 (19.6); least depth of rostrum, 11.3 (10.4); depth at front of anterior molar, 14.7 (13.7); mandible, 35.2 (31.6); maxillary toothrow (alveoli), 9.7 (9.6); mandibular toothrow (alveoli), 9.7 (9.7).

*Specimen examined.*—The type.

*Remarks.*—The skull of *Epimys stentor* differs conspicuously from that of the other members of the *vociferans*-group as represented by the large series in the U. S. National Museum.

### EPIMYS VOCIFERANS INSULARUM, new subspecies

*Type.*—Adult female (skin and skull), No. 104167, United States National Museum. Collected on Domel Island, Mergui Archipelago, February 27, 1900, by Dr. W. L. Abbott. Original No. 329.

*Diagnosis.*—Like *Epimys vociferans lancavensis* of Pulo Lancawi but smaller, the greatest length of skull in fully adult individuals rarely exceeding 54 mm.

*Measurements.*—Type: head and body, 248 mm.; tail, 330; hind foot (dry), 45 (43); condylobasal length of skull (teeth moderately worn), 50.1; greatest length, 53.7; zygomatic breadth, 24.6; interorbital constriction, 8.3; nasal, 20.0; diastema, 14.4; mandible, 31.6; maxillary toothrow (alveoli), 10.0; mandibular toothrow (alveoli), 9.7.

[1] Cranial measurements in parenthesis are those of a male *E. vociferans* (No. 112651) from Johore. Teeth moderately worn.

*Specimens examined.*—Thirty, from the following islands of the Mergui Archipelago: Kisseraing, 6 (1 odd skull); Domel, 12 (2 odd skulls); Helfer, 2; Sullivan, 8; Hastings, 2.

### EPIMYS VOCIFERANS CLARÆ, new subspecies

*Type.*—Adult male (skin and skull), No. 124115, United States National Museum. Collected on Clara Island, Mergui Archipelago, January 10, 1904, by Dr. W. L. Abbott. Original No. 3019.

*Diagnosis.*—Size as in *Epimys vociferans lucas* of St. Luke, Hastings and Loughboro Islands (intermediate between that of *E. vociferans insularum* and the very small *E. vociferans stridulus* of Bentinck Island); color duller and less yellowish than in the other Mergui races, but not darkened as in *E. vociferans matthæus.*

*Measurements.*—Type: head and body, 235 mm.; tail, 316; hind foot (dry), 44 (42); condylobasal length of skull (teeth moderately worn), 48.1; greatest length, 52.1; zygomatic breadth, 24.1; interorbital constriction, 8.3; nasal, 20.1; diastema, 13.8; mandible, 30.6; maxillary toothrow (alveoli), 9.6; mandibular toothrow (alveoli), 8.6.

*Specimens examined.*—Five, all from Clara Island.

*Remarks.*—With the exception of *Epimys stentor,* which appears to be specifically distinct from the other members of the group, the forms of *E. vociferans* occurring in the Mergui Archipelago now seem to be best treated as subspecies. The characters on which they are based, though evident when series are compared, do not serve for the positive determination of individual specimens. In a general way the larger, less differentiated forms may be said to inhabit the islands lying nearest the coast, while the smaller races are furthest separated geographically from true *Epimys vociferans* of the mainland. The most noticeable exception to this rule is furnished by the small *E. vociferans lucas,* which occurs on one of the inner islands barely separated from that on which the large dark *E. vociferans matthæus* is found. Specimens scarcely distinguishable from *E. vociferans insularum* were obtained by Dr. Abbott on Pulo Terutau, 350 km. south of the Mergui Archipelago.

### EPIMYS LEPIDUS, new species

1907. *Mus jerdoni* LYON, Proc. U. S. Nat. Mus., vol. 31, p. 654. January 16, 1907. (Specimen from Tenasserim. Not of Blyth.)

*Type.*—Adult female (skin and skull), No. 104127, United States National Museum. Collected at Bok Pyin, southern Tenasserim, February 19, 1900, by Dr. W. L. Abbott. Original No. 315.

*Diagnosis.*—Similar to *Epimys batamanus* (Lyon) but differing externally in the shorter foot, longer tail and more yellowish color (cheeks cream-buff and underparts cartridge-buff instead of a nearly uniform pale drabby gray); skull with shorter rostrum, narrower interorbital region and nearly parallel-sided incisive foramina.

*Measurements.*—Head and body, 140 (148) mm.;[1] tail, 159 (129); hind foot, 27 (32.5); hind foot without claws, 26 (31); condylobasal length of skull (teeth moderately worn), 31.4 (32.0); zygomatic breadth, 16.3 (16.0); interorbital constriction, 5.8 (6.3); occipital breadth, 13.5 (13.7); depth of braincase, 10.0 (9.5); nasal, 13.0 (11.6); length of rostrum from upper rim of antorbital foramen, 11.4; greatest breadth of rostrum, 6.2; diastema, 8.3 (9.2); mandible, 18.8 (19.1); maxillary toothrow (alveoli), 6.0 (5.9); mandibular toothrow (alveoli), 5.7 (5.6).

*Specimens examined.*—One adult and one young, both from the type locality.

### EPIMYS GRACILIS, new species

1892. *Mus jerdoni* THOMAS, Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 10, p. 939. (Not of Blyth.)

*Type.*—Adult female (in alcohol), No. 101520, United States National Museum. Collected on summit of Mount Mooleyit, northern Tenasserim, by L. Fea. Received from Genoa Museum.

*Diagnosis.*—Like *Epimys lepidus* but tail much longer; skull with more slender rostrum. Distinguished from *Epimys jerdoni* of Sikkim, as described by Blyth, in very different size and proportions (head and body about 150 instead of 100; tail 196-220 instead of 85; hind foot about 32 instead of 22).

*Measurements.*—Type: head and body, 145 mm.; tail, 200; hind foot, 31 (30); ear from meatus, 19.5; condylobasal length of skull (teeth moderately worn), 32.5; zygomatic breadth, 15.5; interorbital constriction, 6.0; occipital breadth, 13.5; depth of braincase, 10.6; nasal, 13.6; length of rostrum from upper rim of antorbital foramen, 12.0; greatest breadth of rostrum, 5.9; diastema, 9.4; mandible, 19.6; maxillary toothrow (alveoli), 6.1; mandibular toothrow (alveoli), 5.7.

*Specimens examined.*—Two, both from the type locality.

*Remarks.*—The relationships of this rat appear to be strictly with the group including *Epimys lepidus, E. batamensis* and *E. inas.*

[1] Measurements in parenthesis are those of the type of *Epimys bullatus* (male with slightly less worn teeth).

Blyth's description of *E. jerdoni* indicates that the Sikkim animal, if related to any species occurring on the Malay Peninsula, is like *Epimys asper,* though decidedly smaller.

### EPIMYS SOLUS, new species

*Type.*—Adult male (skin and skull), No. 123944, United States National Museum. Collected on Pulo Terutau, west coast of Malay Peninsula, November 16, 1903, by Dr. W. L. Abbott. Original No. 2902.

*Diagnosis.*—A member of the *Epimys cremoriventer* group agreeing with *E. bukit* from Jalor in large general size, but differing in the longer tail and hind foot; color as in *Epimys gilbiventer* of Sullivan Island, Rhio Archipelago.

*Measurements.*—Head and body, 160 (121) mm.;[1] tail, 220 (148); hind foot without claw, 30 (24.5); ear, 17 (17); condylobasal length of skull (teeth moderately worn), 32.8; greatest length, 36.5 (37); zygomatic breadth, 17.1 (18); interorbital constriction, 6.6 (6); breadth of braincase, 14.5 (15); depth of braincase, 10.0; nasal, 13.0 (15); diastema, 8.7 (9.5); mandible, 19.7; maxillary toothrow (alveoli), 6.3 (6.5); mandibular toothrow (alveoli), 6.1.

*Specimen examined.*—The type.

### SCIURUS ATRISTRIATUS, new species

*Type.*—Half grown female (skin and skull), No. 196670, United States National Museum. Collected at Lo Bon Bon, Dutch Southeast Borneo, June 4, 1912, by H. C. Raven. Original No. 13. Presented by Dr. W. L. Abbott.

*Diagnosis.*—A member of the *notatus*-group resembling *Sciurus bilimitatus* of the Malay Peninsula, but underparts less slaty (between pallid-mouse-gray and white instead of a gray much like the paper on which the colors in Ridgway's "Standards" are mounted), throat with scarcely a trace of rusty wash, light bands on hairs of tail more yellowish, and pencil nearly clear black, its hairs without annulations.

*Measurements.*—Head and body, 127 mm.; tail, 145; hind foot, 34 (dry, 35, 32.5); condylobasal length of skull, 31.7; mandible, 21.4.

*Specimen examined.*—The type.

*Remarks.*—The slaty-bellied squirrels of the *vittatus*-group show

[1] Measurements in parenthesis are those of the type, an adult male, of *Epimys bukit* as given by Bonhote. (Fasc. Malayenses, Zool., pt. 1, p. 27. July, 1903.)

no appreciable differences in color between adult and young. The Bornean species more nearly resembles that of the Malay Peninsula than it does the Javan *S. nigrovittatus*.

### SCIURUS DULITENSIS DILUTUS, new subspecies

*Type.*—Adult female (skin and skull), No. 196712, United States National Museum. Collected at Tanjong Batu, Dutch Southeast Borneo, August 24, 1912, by H. C. Raven. Original No. 177. Presented by Dr. W. L. Abbott.

*Diagnosis.*—Like *Sciurus dulitensis dulitensis* but color of underparts usually more dull and more diluted with white.

*Measurements.*—Type: head and body, 194 mm.; tail, 208; hind foot, dry, 44.5 (41); condylobasal length of skull (teeth not worn), 44.1; zygomatic breadth, 28.1; interorbital breadth, 16.0; nasal, 14.3; diastema, 11.0; mandible, 30.4; maxillary toothrow (alveoli), 8.9; mandibular toothrow (alveoli), 8.9.

*Specimens examined.*—Sixty-three, from the following localities in Dutch Southeast Borneo: Batu Panggol, 22; Birang River, 7; Mahakam River, north bank 13, south bank 11; Karong Tigau, 10.

*Remarks.*—The differences between the 63 specimens of this form and 30 skins of true *dulitensis* may be tabulated as follows:

35 *dilutus* show obviously more white on underparts than any *dulitensis*.
10 *dilutus* without noticeable white are paler than the palest *dulitensis*.
18 *dilutus* are similar to palest examples of *dulitensis*.
10 *dulitensis* are similar to brightest examples of *dilutus*.
20 *dulitensis* are brighter than brightest examples of *dilutus*.

On comparing the 10 *dulitensis* and 18 *dilutus* which are essentially similar it is seen that few if any individuals in either series can be exactly matched by skins from the other. In true *dulitensis* the red tends toward orange, while in *dilutus* it is more ochraceous. It would, however, be impossible to sort out the two lots with any degree of certainty if the skins were thrown together without labels.

### SCIURUS ATRICAPILLUS ATROX, new subspecies

*Type.*—Adult female (skin and skull), No. 19669, United States National Museum. Collected on Talisaian Mountain, Dutch Southeast Borneo, Feburary 6, 1913, by H. C. Raven. Original No. 457. Presented by Dr. W. L. Abbott.

*Diagnosis.*—Like *Sciurus atricapillus atricapillus* from southern Borneo, but dark area on face not extending behind eyes, and feet a grizzled blackish brown instead of clear black.

*Measurements.*—Type: head and body, 236 mm.; tail, 220; hind foot (dry), 52 (48); condylobasal length of skull (teeth slightly worn) 49.9; zygomatic breadth, 34.8; interorbital breadth, 22.3; nasal, 16.2; diastema, 12.5; mandible, 34.8; maxillary toothrow (alveoli), 10.6; mandibular toothrow (alveoli) 10.9.

*Specimens examined.*—Twelve, from the following localities in Dutch Southeast Borneo: Birang River, 5; Segah River, 6; Talisaian Mountain, 1.

### SCIURUS HUMILIS, new species

*Type.*—Immature female ($m^3$ in place, permanent premolars just appearing), No. 123116, United States National Museum. Collected on the Kateman River, East Sumatra, August 20, 1903, by Dr. W. L. Abbott. Original No. 2751.

*Diagnosis.*—A member of the *Sciurus lowi* group agreeing in size with *S. robinsoni* of the Malay Peninsula and *S. seimundi* of Pulo Kundur, Rhio Archipelago, but differing from the former in darker general color (essentially like that of the Bornean *S. lowi* but more dull; feet less grizzled; muzzle and eyering scarcely different from face) and from the latter in the normal extent of the light-buff of underparts and inner surface of legs.

*Measurements.*—Head and body, 114 mm.; tail imperfect; hind foot (dry), 33.5 (31.5); condylobasal length of skull, 28.1; zygomatic breadth, 18.3; interorbital breadth, 10.2; nasal, 7.8; diastema, 7.0; mandible, 19.6; maxillary toothrow (alveoli), 5.8; mandibular toothrow (alveoli), 6.0.

*Specimen examined.*—The type.

### LARISCUS BERDMOREI AMOTUS, new subspecies

*Type.*—Adult male (skin and skull), No. 124152, United States National Museum. Collected on Domel Island, Mergui Archipelago, January 30, 1904, by Dr. W. L. Abbott. Original No. 3081.

*Diagnosis.*—Like *Lariscus berdmorei berdmorei* from southern Tenasserim, but skull with more slender rostrum.

*Measurements.*—Type: head and body, 200 mm.; tail, 130; hind foot (dry), 41 (40); condylobasal length of skull (teeth much worn), 48.1; zygomatic breadth, 27.6; interorbital breadth, 27.5; nasal, 16.0; diastema, 13.2; mandible, 32.3; maxillary toothrow (alveoli), 10.5; mandibular toothrow (alveoli), 10.0.

*Specimens examined.*—Two, both from Domel Island.

*Remarks.*—Though externally similar to *Lariscus berdmorei berd-*

*morei* from Tenasserim the island race is distinguishable by the slender rostrum, a character difficult to describe but readily appreciable to the eye.

### RATUFA MELANOPEPLA PENINSULÆ, new subspecies

*Type.*—Adult male (skin and skeleton), No. 83478, United States National Museum. Collected at Lay Song Hong, Trong, Lower Siam, September 23, 1896, by Dr. W. L. Abbott.

*Diagnosis.*—Larger than *Ratufa melanopepla melanopepla* of Telibon Island, Trong, the skull with auditory bullæ normal in size, not reduced as in the island form.

*Measurements.*—Type: head and body, 400±; tail, 420±; condylobasal length of skull (teeth moderately worn), 67.0 (63.1)[1]; zygomatic breadth, 45.2 (44.3); interorbital breadth, 29.5 (28.2); nasal, 23.3 (23.4); diastema, 17.4 (15.1); length of inflated portion of auditory bulla, 14.9 (13.3); mandible, 47.0 (41.6); maxillary toothrow (alveoli), 13.9 (14.0); mandibular toothrow (alveoli), 14.8 (14.4).

*Specimens examined.*—Seven, from the following localities: mainland of Trong, no exact locality, 1; Lay Song Hong, Trong, 2; Ty Ching, Trong, 2; Rumpin River, Pahang, 2.

*Remarks.*—Examination of the original records shows that the type and three other specimens of *Ratufa melanopepla* were collected on Telibon Island, not on the mainland of Trong. The four specimens from the island differ so noticeably from those taken on the neighboring mainland that it is necessary to recognize two races. From Trong to the southern limit of the group *R. melanopepla peninsulæ* appears to be very constant in its characters. Whether or not in the region north of Trong it intergrades with *R. phæopepla* is not indicated by the material that I have seen.

### RATUFA PHÆOPEPLA, new species

*Type.*—Adult male (skin and skull), No. 124235, United States National Museum. Collected at Sungei Balik, Tenasserim, February 25, 1904, by Dr. W. L. Abbott. Original No. 3141.

*Diagnosis.*—Like *Ratufa melanopepla peninsulæ* but larger (hind foot without claws 80 to 89 mm. instead of 71 to 83 mm., greatest length of skull in individuals with distinctly worn teeth 74 to 78 mm.

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[1] Measurements in parenthesis are those of the type of *R. melanopepla melanopepla*, also a male with moderately worn teeth.

instead of 69 to 72 mm.); color of upperparts in fresh pelage a rich dark brown (near the chestnut-brown of Ridgway) instead of black.

*Measurements.*—Type: head and body, 405 mm.; tail, 500; hind foot, 91 (85); condylobasal length of skull (teeth moderately worn), 71.4; zygomatic breadth, 46.2; interorbital breadth, 28.3; nasal, 23.8; diastema, 16.0; length of inflated portion of auditory bullæ, 15.9; mandible, 48.0; maxillary toothrow (alveoli), 14.6; mandibular toothrow (alveoli), 15.0.

*Specimens examined.*—Sixteen, from the following localities in southern Tenasserim: Red Point, 2; Sungei Balik, 7; Telok Besar, 5; Victoria Point, 2.

### RATUFA CELÆNOPEPLA, new species

*Type.*—Adult male (skin and skull), No. 124149, United States National Museum. Collected on Domel Island, Mergui Archipelago, January 26, 1904, by Dr. W. L. Abbott. Original No. 3073.

*Diagnosis.*—Like *Ratufa phæopepla* but color of upperparts in fresh pelage clear blue black; skull with auditory bullæ more inflated.

*Measurements.*—Type: head and body, 415 mm.; tail, 487; hind foot, 95 (88.5); condylobasal length of skull (teeth moderately worn), 73.4; zygomatic breadth, 49.4; interorbital breadth, 31.2; nasal, 24.3; diastema, 17.4; length of inflated portion of auditory bulla, 16.6; mandible, 48.9; maxillary toothrow (alveoli), 14.5; mandibular toothrow (alveoli), 15.4.

*Specimens examined.*—Three, all from Domel Island.

*Remarks.*—The three forms here described increase the known members of the restricted *melanopepla*-group to nine. Their characters are indicated in the following key:

### KEY TO THE SQUIRRELS OF THE RATUFA MELANOPEPLA GROUP

Large forms, greatest length of skull in individuals with distinctly worn teeth usually more than 72 mm.
- Upperparts chestnut brown (never black) Tenasserim.....*phæopepla*
- Upperparts black when not faded.
  - Greatest length of skull about 71 to 74 mm. (Terutau and Lankawi).....*fretensis*
  - Greatest length of skull about 74 to 78 mm. (Domel).....*celænopepla*

Small forms, greatest length of skull in individuals with distinctly worn teeth usually less than 72 mm.
- Skull unusually narrowed (Natuna Islands).....*angusticeps*

Skull normal.
Auditory bullæ reduced in size (Telibon Island).....*melanopepla*
Auditory bullæ normal.
Average excess of length of tail over that of head and body about 95 mm.
Underparts approximately ochraceous-buff (Malay Peninsula from Trong to Pahang).....*peninsulæ*
Underparts approximately tawny (Penang).....*penangensis*
Average excess of tail over head and body less than 70 mm.
Skull usually larger with particularly heavy rostrum (Anamba Islands).....*anambensis*
Skull usually smaller with weaker rostrum (Tioman Island).....*tiomanensis*

### PETAURISTA MIMICUS, new species

1908. *Petaurista nitidula* Lyon, Proc. U. S. Nat. Mus., vol. 34, p. 634. September 14, 1908. (Not of Thomas.)

*Type.*—Adult female (skin and skull), No. 143341, United States National Museum. Collected on Pulo Rupat, eastern Sumatra, March 10, 1906, by Dr. W. L. Abbott. Original No. 4695.

*Diagnosis.*—Like *Petaurista nitidulus* of the North Natuna Islands but ear slightly larger and reddish brown of upperparts somewhat lighter.

*Measurements.*—Type: head and body, 400 mm.; tail, 405; hind foot (dry), 64 (59); condylobasal length of skull (teeth much worn), 60.4; zygomatic breadth, 42.8; interorbital constriction, 12.6; nasal, 18.0; diastema, 13.8; mandible, 42.4; maxillary toothrow (alveoli), 14.4; mandibular toothrow (alveoli), 11.5.

*Specimens examined.*—Four, all from Pulo Rupat.

*Remarks.*—This animal, though very different from the large *Petaurista nitidus marchio* of the Sumatran mainland, closely resembles *P. nitidulus* of Bunguran. The ears in four specimens of each of the small animals (measured in skin after relaxing) give the following extremes (those of *nitidulus* in parenthesis): height from meatus, 31 to 33 (30 to 31); height from crown, 20 to 22 (19 to 21); width, 17 to 18 (16 to 17).

### PRESBYTIS CORVUS, new species

*Type.*—Adult male (skin and skull), No. 123993, United States National Museum. Collected on Pulo Terutau, west coast of Malay Peninsula, November 10, 1903, by Dr. W. L. Abbott. Original No. 2852.

*Diagnosis.*—Like *Presbytis carbo* of Pulo Langkawi but darker,

the difference between the two forms about as great as that between *P. carbo* and the less dark *P. obscura* of the Malay Peninsula.

*Measurements.*—Type: head and body, 520 mm.; tail, 810; hind foot (dry), 160 (155); condylobasal length of skull (teeth moderately worn), 78.5; greatest length, 96.8; zygomatic breadth, 77.4; breadth of braincase, 52.8; breadth of rostrum over canines, 30.0; mandible, 70.6; maxillary toothrow exclusive of incisors, 33.3; mandibular toothrow exclusive of incisors, 39.2.

*Specimens examined.*—Two, both from Pulo Langkawi.

**PRESBYTIS AUSTRALIS, new species**

*Type.*—Adult male (skin and skull), No. 112709, United States National Museum. Collected at Jambu Luang, east coast of Johore, July 31, 1901, by Dr. W. L. Abbott. Original No. 1196.

*Diagnosis.*—Like *Presbytis femoralis* of Singapore Island but size not reduced, the greatest length of skull about 95 mm. as usual in Peninsular, Sumatran and Bornean members of the group.

*Measurements.*—Type: head and body, 465 mm.; tail, 730; hind foot (dry), 160 (160); condylobasal length of skull (basal suture closed, $m^3$ slightly worn), 72.2 (66.3);[1] greatest length, 94.1 (88.3); zygomatic breadth, 74.2 (66.8); breadth of braincase, 57.2 (51.3); breadth of rostrum over canines, 26.7 (26.3); mandible, 65.6 (60.6); maxillary toothrow exclusive of incisors, 30.3 (29.7); mandibular toothrow exclusive of incisors, 33.5 (33.3).

*Specimens examined.*—Five, from the following localities: Rumpin River, Pahang, 1; Jambu Luang, Johore, 1; Sembrong River, Johore, 3.

*Remarks.*—The material in the United States National Museum shows that the Malay Peninsula is inhabited by three forms of the *Presbytis femoralis* group: (a) the very dark *keatii* at the north (specimens from southern Tenasserim), (b) the less dark *australis;* thighs showing a slight though evident grizzle on outer side; and (c) the small true *femoralis* of Singapore Island, indistinguishable from *australis* except by size. In the original description of *Presbytis femoralis,*[2] supposed to equal the "*Simia maura?*" of Raffles, the type-locality is said to be "Sumatra, etc." As the carefully written account of the animal's color is not appropriate to any of the known

[1] Cranial measurements in parenthesis are those of a male topotype (No. 86897) of *P. femoralis* with $m^3$ slightly worn.

[2] 1838. *S[emnopithecus] femoralis* MARTIN, Charlesworth's Mag. Nat. Hist., vol. 2, p. 436. August, 1838.

Sumatran forms of the group, while it exactly applies to the one occurring on Singapore Island, where Raffles obtained much of his material, I have no hesitation in regarding Singapore as the true type-locality. The *neglectus* of Schlegel thus becomes an exact synonym of *femoralis* Martin.

### PRESBYTIS VIGILANS, new species

1901. *Semnopithecus cristatus* MILLER, Proc. Washington Acad. Sci., vol. 3, p. 138. March 26, 1901. (Not of Raffles.)

*Type.*—Adult female (skull only), No. 104840, United States National Museum. Collected on Sirhassen Island, South Natuna Islands, June 2, 1900, by Dr. W. L. Abbott. Original No. 422.

*Diagnosis.*—General characters of the skull and teeth as in other members of the *cristata*-group but region between narial aperture and middle of frontal more sloping, and apparent width of orbit when viewed from directly above about 17 mm. instead of about 12 mm.

*Measurements.*—Type (teeth much worn): condylobasal length, 75.0 mm.; greatest length, 93.5; zygomatic breadth, 73.6; breadth of braincase, 53.9; breadth of rostrum over canines, 23.8; mandible, 67.6; maxillary toothrow exclusive of incisors, 30.9; mandibular toothrow exclusive of incisors, 35.2.

*Specimens examined.*—Two skulls, both from Sirhassen Island.

*Remarks.*—The characters on which this species is founded are very evident on comparison with the series of 34 skulls of other members of the *Presbytis cristata* group in the National Museum collection.

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*Paradoxurus hermaphroditus ravus*, p. 2.
*Paradoxurus hermaphroditus senex*, p. 3.
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# FOUR NEW SUBSPECIES OF LARGE MAMMALS FROM EQUATORIAL AFRICA

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# FOUR NEW SUBSPECIES OF LARGE MAMMALS FROM EQUATORIAL AFRICA

By EDMUND HELLER

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The subspecies of large mammals described in the present paper are based on material in the United States National Museum collected in East Africa by the Smithsonian African Expedition under the direction of Col. Theodore Roosevelt and the Paul J. Rainey African Expedition.

## HIPPOPOTAMUS AMPHIBIUS KIBOKO, new subspecies

East African Hippopotamus

*Type* from Lake Naivasha, British East Africa; adult male, Cat. No. 162979, U. S. Nat. Mus.; shot by Theodore Roosevelt, July 20, 1909; original (Heller) number, 280.

*Characters.—Hippopotamus amphibius kiboko* is characterized by the wide nasal bones, great elevation of the orbits and the lambdoidal crest above the interorbital region which has a deeply concave surface in consequence, and the less constriction of the rostral part of the skull. From typical *amphibius* of the Nile it is further distinguishable by its smaller body size and smaller canine teeth. It may be distinguished from *capensis* of South Africa and the Zambesi river system by its more circular orbit, the lighter body coloration and the more heavily haired ears and tail tuft. The skull differences between *constrictus* of Angola and Naivasha specimens have been shown by Miller[1] to consist of greater rostral constriction, less elevation of the upper rim of the orbits, shorter mandibular symphysis and smaller teeth in the former.

*Coloration.*—Color of the tanned skin grayish-olive deepest on the back and lightest on the underparts where it becomes a pinkish drab on belly, axillae and groins. Hair covering absent except on tip of tail, inside of ears and on muzzle. The tail is furnished by a conspicuous tuft of seal-brown hair 4½ inches long attached like a mane to the ridge of the flattened tail. Ears heavily haired on the inside by olive-brown hair three-fourths of an inch in length. The great lips of the muzzle as far back as the nostrils support a scattered growth

[1] Smith. Misc. Coll., 1910, vol. 54, No. 7, p. 1.

of stiff buffy brown tufts of hair placed at regular intervals apart like the bristles of a clothes brush.

*Measurements.*—The flesh measurements of the type were: head and body, 3,710 mm.; tail, 510; hindfoot, 550; ear, 95. Skull: condylo-basal length, 720; zygomatic width, 442; rostral constriction, 138; nasals, 415 by 48; orbit, 60 by 80; height of orbital rim above median interorbital region, 42; width of crown of $M^2$, 46; length of upper tooth row including $PM^2$, 255; length of mandibular symphysis, 203; height from angular to coronoid process, 380; circumference of lower canine, 173; length of lower canine beyond alveola, 255.

*Remarks.*—A series of eight skulls and four skins from Lake Naivasha in the National Museum show wide nasal bones, ranging in least width from 40-49 mm. as against 27-38 for the Nile and 29-32 for the Zambesi skulls. Naivasha skins compared with two skins from the Zambesi are much lighter in color and heavier haired on the inside of the ears and tip of the tail. The Zambesi skins (tanned) are olivaceous-black on the upper parts and dark-olive gray on the lower with the hair on the muzzel buff in color. A large number of *Hippopotamus* skulls have been examined and measured, some sixty-five in all, from the Nile, Zambesi, Lake Ngami, Congo Basin, Gambia, Liberia, Angola, and Abyssinia in the British, Berlin, Congo and several American museums, including the eighteen in the National Museum. The measurements of this large series of skulls have been available for comparison with the Lake Naivasha material upon which the present race is based. A specimen from the Athi River in the National Museum agrees with the Naivasha skulls in proportions and shape. The range of *kiboko* doubtless extends from the Rift Valley eastward to the sea coast. The hippopotamus in British East Africa is familiarly known among the European residents by its Swahili name, kiboko.

### PHACOCHOERUS AFRICANUS BUFO, new subspecies

Nile Warthog

*Type* from Rhino Camp, Lado Enclave, Egyptian Sudan; immature female skull, Cat. No. 164796, U. S. Nat. Mus.; collected by Edmund Heller, Jan. 25, 1910; original number, 617.

*Characters.*—*Phacochœrus africanus bufo* differs from *æliani* of Abysssinia and East Africa by the greater breadth and length of the post-orbital or parietal portion of the skull, the flatter interorbital region and the greater length of the premaxillæ beyond the bases of the tusks. Other minor differences from *æliani* are the absence

of elevation in the parietal or lambdoidal crests which are on the same level as the interorbital region, the narrowness of the choanæ posteriorly and the smaller size of the tympanic bullæ.

The type, unfortunately, is an immature skull in which the last molar is just erupting and has all of the maxillary sutures still evident. Skulls of this age from the highlands of British East Africa show a much narrower, shorter and more elevated parietal region. In the flatness of the interorbital region and in the general shape of the post-orbital part of the skull the type resembles the skull of *Phacochœrus delamerei* more closely, but differs from this species as do all the *africanus* group by the presence of well-developed upper and lower incisors, and roofed over choanæ. The skull is large for the age it represents which would indicate a large adult size for this race.

*Measurements.*—Measurements of the skull: greatest length from lambdoidal crest to tip of nasal bones, 375 mm.; condylo-basal length, 302; zygomatic breadth, 181; least orbital width, 112; width of parietal constriction, 76; least width of parietal flat area, 45; median length of post-orbital portion of skull from orbit to lambdoidal crest, 68; maxillary constriction of skull across first premolar, 51; length of premaxillæ beyond base of tusks, 57. A series of some fifty skulls of warthogs are in the National Museum from the Loita Plains, Kapiti Plains, and Uasin Gishu Plateau which apparently represent the Abyssinian race, *œliani*. This large series shows considerable variation in shape of the post-orbital portion of the skull, but the extremes in width and length do not equal the specimen from the Lado Enclave described as the type of *bufo*. A specimen of the same age as the type from the Loita Plains has a skull length of 350, width of the parietal constriction 60, and length of post-orbital portion 52.

*Remarks.*—The type specimen was collected on the shores of a small pond near Chief Sururu's village in the vicinity of Rhino Camp. It had been killed by a lion the night previous to the arrival of Colonel Roosevelt's hunting party, and the head was the only portion which remained uneaten. Warthogs were rare in the Lado Enclave, less than a score being seen by the members of the Smithsonian African expedition during a month's sojourn in the upper Nile district.

### EQUUS QUAGGA CUNINGHAMEI, new subspecies

Samburu Quagga Zebra

*Type* from Archer's Post, Northern Guaso Nyiro River, British East Africa; young adult male, Cat. No. 182157, U. S. Nat. Mus.; collected by Edmund Heller, Sept. 23, 1911; original number, 2466.

*Character.*—*Equus quagga cuninghamei* is distinguishable from *granti* by its darker ground color as represented by the light stripes which are pale ochraceous-buff and the lighter color of its dark stripes which are bister-brown instead of black. The skull differs from that of *granti* by the shortness of the rostral portion and the narrowness of the diastema between the cheek-teeth and the incisors and also averages smaller in length with narrower palatal width and wider lambdoidal crest. From *böhmi* of the Kilimanjaro district it differs in color in the same way as from *granti* but is further distinguishable by its much smaller body size.

*Coloration of the Type.*—The ground color as represented by the light stripes is pale ochraceous-buff and shows considerable contrast to the white belly and inner surface of the hindquarters. The dark stripes are uniform bister-brown on the body but darken somewhat on the head where they become seal-brown in conformity with the seal-brown nose patch. The legs below the knees and hocks are marked by lighter stripes than the body, being snuff-brown and fully striped to the hoofs. The tail tuft of long hair is black with the exception of the mixture of a few white hairs in the upper part. The ears are cream-white marked on the back at the tip by a broad area of bister-brown and another brown area near the base. The mane is well-developed, the hair having a length of 6 inches with an extent from the crown of the head to the shoulders and is striped pale-buff and seal-brown in conformity to the stripes of the neck. The body stripes are arranged quite as in *granti* or *böhmi* but there is no indication of shadow stripes anywhere. The widest stripes are the oblique ones crossing the hindquarters which have a width of 2¾ inches at their widest part. The body is crossed behind the shoulders from the last neck stripe to the first oblique stripe by four transverse stripes which completely encircle the body and join the longitudinal ventral stripe. The neck is crossed by nine transverse stripes, the anterior of which are narrow and a few of the posterior very wide. The leg stripes are broken on the inner side on the upper part of the legs, but below the knees and the hocks they completely encircle the leg and on the lower part of the pasterns immediately above the hoof they become fused into a solid dark band.

*Measurements.*—The flesh measurements of the type were: head and body, 1,950 mm.; tail, 460; hindfoot, 500; ear, 170. Skull: greatest length, 487; condylo-basal length, 450; greatest breadth, 175; least interorbital width, 110; rostral length from nasal-premaxillary notch to tip of premaxillæ, 136; least width of postorbital arch, 19;

width of lambdoidal crest, 63; postorbital constriction of skull, 81; palatal width across $M^1$, 109; width of $M^1$, 24.5; width of mesopterygoid fossa, 43. The skull is immature, all the milk molars being still in use and only the first molar being in place. An adult male skull collected with the type from the same herd has been used to determine the tooth dimensions and the length of the diastema. This skull, No. 182156, measures in condylo-basal length, 457; greatest breadth, 188; upper tooth row, 146; diastema between cheek-teeth and incisors, 84.

*Remarks.*—The skin of the adult male having been lost it has been necessary to take an immature specimen as the type. There is in addition to the type skin another skin of the same age taken at the same time. This latter specimen is quite identical in color with the type. There are in the National Museum for comparison a series of 30 skins of *granti* from the Athi and Loita Plains. Specimens of *granti* of the same age differ from the type by their whitish or cream ground color and darker stripes which are seal-brown in color. The stripes of the old adults of *cuninghamei,* however, as observed in the live specimens in the field are darker than the type somewhat but are not deep black as in *granti.* The lighter color of the dark stripes is no doubt due to the arid conditions and intense heat and sunlight to which the Northern Guaso Nyiro race is subject. *Cuninghamei* is a desert race occupying the Northern Guaso Nyiro watershed from its junction with the Guaso Narok eastward to its termination in the Lorian swamp. Northward the race reaches at least as far as the northern slopes of the Lorogi Mountains and southward as far as the north bank of the Tana River. The race is named for R. J Cuninghame, the well-known Safari leader of British East Africa, to whose efforts are due the preservation of many of the big game specimens collected by the Smithsonian African expedition under the direction of Colonel Roosevelt.

### CROCUTA CROCUTA FISI, new subspecies

Marsabit Spotted Hyaena

*Type* from Merille Waterholes, midway between the Northern Guaso Nyiro River and Mount Marsabit; adult male, Cat. No. 182078, U. S. Nat. Mus.; collected by Edmund Heller, July 23, 1911; original number, 2385.

*Characters.*—*Crocuta crocuta fisi* is characterized by its light, pale buff, ground color, the small size of the dark spots on the back and the short pelage. *Germinans* of the highlands of British East Africa has a much darker ground color either ochraceous, cinnamon or drab,

the dorsal spots are larger, the largest fully twice the size of the spots in *fisi* and the pelage is longer and heavier. The Somaliland race *rufipicta* differs decidedly by having reddish rather than blackish spots, darker ground color and smaller body size.

*Coloration.*—Ground color of the type pale buff spotted irregularly over the back by rather small black spots varying in diameter from a quarter to three-fourths of an inch, and covering an area only about one-quarter that of the ground color. Spots heaviest and most distinct on mid line of the back and faintest on the neck, sides of the body, underparts, and shoulders; the head and feet unspotted. The tail is basally like the back in color with a few dark spots, the terminal one-half being covered by a bushy black tuft of longer coarse hair. The feet are uniform olive-brown to the toes in contrast to the spotted upper portions of the legs. The head is grizzled buffy and blackish on the crown and sides, the snout, muzzle, lips and chin being uniform dusky black in contrast. The whiskers and the long hairs above the eyes are black. The throat and sides of the head below the ear are uniform light buff without darker spots. The back of the ears show a grizzled appearance due to the scantiness of the short buffy hair which allows the blackish skin to show through. The ears on the inner side are more heavily clothed by longer whitish hair. The hair is short, the length on the rump being only one-half of an inch. The nape is furnished with a short mane of uniform light buff color in which the longest hairs have a length of two inches.

*Measurements.*—The flesh measurements of the type were: head and body, 1,150 mm.; tail, 295; hindfoot, 225; ear, 100. The skull measures: condylo-basal length, 250; greatest length, 256; zygomatic breadth, 156; breadth of palate across carnasials, 98; length of upper tooth row including canine, 95; length of lower tooth row including canine, 102; length of upper carnasial on outside edge, 35; interorbital width, 58; post-orbital width, 47; width across post-orbital processes, 74; nasals, 54 x 27; width of mesopterygoid fossa at suture, 26; condylo-basal length of mandible, 176. The skull is that of a young adult having the sphenoidal and parietal sutures still evident. No skull difference has been detected between this race and *germinans* owing to the great individual variation to which this structure is subject. Both narrow and wide types of skulls are found in specimens from the same locality and every intermediate stage between these. The female skulls exceed the male decidedly in size.

*Remarks.*—The desert region lying between Mount Marsabit and the Northern Guaso Nyiro River is represented in the National Mu-

seum by a series of ten skins and eighteen skulls of this race collected by the Rainey expedition. The skins show remarkable uniformity in color and relative size of spots and differ in this respect greatly from the variable *germinans* no two skins of which are quite alike in shade or extent of dark spots. They are readily distinguishable from a large series of *germinans* from the Loita Plains and Uasin Gishu Plateau by their lighter ground color and smaller and less numerous dark spots on the back. The young and the immature specimens are much more heavily spotted and have the ground color darker than the adults. They closely resemble in color the young of other races and it is not until they become adult that their color characters become apparent. *Fisi* is a light-colored desert race having the same bodily size as the highland races. The spotted hyaena is known to the Swahili and other coast tribes as fisi.

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# A New Genus of Mallophaga From African Guinea Fowl in the United States National Museum

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# A NEW GENUS OF MALLOPHAGA FROM AFRICAN GUINEA FOWL IN THE UNITED STATES NATIONAL MUSEUM

By JOHN HOWARD PAINE

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In a collection of Mallophaga, or bird-lice, taken from bird skins collected by Dr. E. A Mearns of the Childs Frick African Expedition, 1911-1912, is a form which shows characters different from those of any of the known genera and for which the following new genus is founded.

## SOMAPHANTUS, new genus

Five specimens, including a single male, were taken from two skins of Guinea Fowl, *Numida ptilorhyncha* (U. S. N. M., Cat. Nos. 243182 and 243176; Lakiunda and Tana rivers, British East Africa, August, 1912), collected by Dr. E. A. Mearns. This form, structurally, is most like *Menopon*, but in general appearance is unlike any other Mallophagan; it may be easily separated from *Menopon* in having the sides of the head nearly straight and by the elongate form of the body.

Species small, inconspicuous, with weak chitinization; form elongate, narrow, with sides subparallel, and all parts well furnished with hairs. Head narrow, longer than wide, with sides nearly straight. Antennal fossæ long, narrow, parallel to the sides of the head and reaching back onto the temples. The antennæ are well developed for the Liotheidæ and in all specimens taken are carried exposed. Pharyngeal sclerite (fig. 1 *d*) present, conspicuous, with anterior processes much prolonged forward and but slightly divergent, as in *Menopon* and *Colpocephalum*. Thorax narrow, the prothorax rounded and the metathorax continuous with the narrow, elongated abdomen. Abdomen well clothed with many long hairs; last segment in female somewhat truncate, but in the male rounded and protruding. Genitalia inconspicuous, apparently consisting of two short, curving, flat blades.

**SOMAPHANTUS LUSIUS, new species**

Four females and one male from *Numida ptilorhyncha* Lönnberg (Lakiunda and Tana rivers, British East Africa). An elongate, narrow, pale species with many long hairs (U. S. N. M., Type No. 18182).

*Description of female.*—Head three-fourths as long as broad with sides but slightly convex. Front weakly angled on the meson in some specimens as shown in the figure, or evenly rounded as in others, bearing about four hairs on each side, the lateral one being the longest; these hairs are not all marginal, some of them projecting from the under side. Sides of the head before the eyes but slightly swollen, bearing four hairs, the posterior three being long; eye with a prominent black fleck and a long hair; ocular fringe present, consisting of ten or twelve hairs. Antennæ (fig. 1 *c*) prominent with last segment cylindrical, as long as the other three together, of which the second is the longest. Temples compressed, weakly rounded and meeting the almost straight occiput in an obtuse angle; temple with five hairs, three of which are long, and occiput with four long hairs; a long hair on the dorsal surface near the eye and two more, arising close together, a short distance cephalad. The eye flecks and the right mandible are the only dark portions on the insect, these being black; the general color of the head, as well as the rest of the body, is a pale yellowish-brown, the occipital region being almost clear and the clypeus slightly darker; along the margin of the occiput is a narrow chitinous thickening.

Thorax a little longer than the head. Prothorax broader than long, not quite as wide as the head, rounded, though not as regular as shown in the figure; a series of ten hairs across the posterior margin and two more on each side; sides and posterior portion of same color as the head, anterior central portion clear. Metathorax wider and a little longer than prothorax and lighter in color, being quite transparent; sides divergent, bearing four hairs, while across the straight posterior margin is a submarginal series of about twenty hairs, roughly arranged in three rows. Legs pale, with long tarsi and stout hairs on femora and tibiæ.

Abdomen long and narrow, all segments clothed with many long hairs, consisting of the usual submarginal row of twenty to thirty and many others on the dorsal surface; sutures between all segments are distinct and straight. Width of abdomen gradually increasing to the fifth segment, then narrowing rapidly to the ninth, which is almost truncate; last three segments each with a very long hair on each

side. The color of the abdomen is pale yellowish-brown with no indication of markings in the female. There is considerable variation in size of individuals, as shown in the table below.

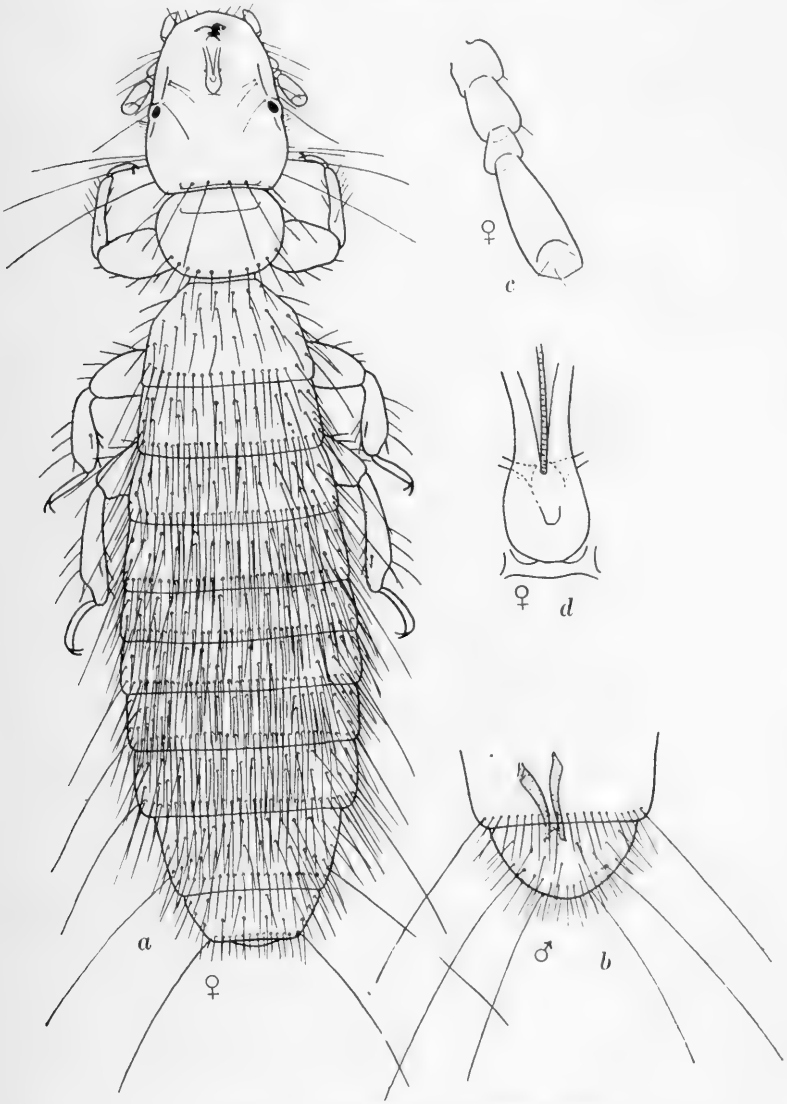


FIG. 1.—*Somaphantus lusius*, Paine.

*a*, female; *b*, last segments of male; *c*, antenna of female; *d*, pharyngeal sclerite of female.

The male is larger than the female, with last segment of the abdomen protruding and rounded (fig. 1 *b*), bearing four very long hairs and numerous short ones. Along the posterior margin of the metathorax and of segments one to eight, inclusive, of the abdomen is a narrow, ill-defined transverse band of about the same shade as the legs; the anterior portion of abdominal segments is almost clear, except the last, which is uniformly colored. The genitalia are small, consisting of two short, curving blades, fairly well chitinized.

MEASUREMENTS

| | | | | | |
|---|---|---|---|---|---|
| Female, length | 1.296 mm. | (1.56 )[1], | width; male, length | 1.60 | mm. width. |
| Head | .240 | ( .256)[1], | .208 | .246 | .216 |
| Prothorax | .132 | ( .104)[1], | .192 | .120 | .176 |
| Metathorax | .144 | ( .144)[1], | .232 | .144 | .256 |
| Abdomen | .784 | (1.050)[1], | .336 | 1.072 | .352 |

[1] Measurements of largest individual.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
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# NEW SAPINDACEAE FROM PANAMA AND COSTA RICA

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# NEW SAPINDACEAE FROM PANAMA AND COSTA RICA

By PROF. DR. L. RADLKOFER, Munich

In a collection of Sapindaceae made chiefly by Mr. H. Pittier during his botanical explorations in Central and South America from 1905 to 1912, but containing also specimens gathered by Messrs. William R. Maxon, of the U. S. National Museum, and R. S. Williams of the New York Botanical Garden, and a few others, there were found several new species which are here described. One collection from Costa Rica supplied the necessary data for determining the true position of a species known only from incomplete material collected by Oersted in 1847, which had been placed provisionally in the genus Dilodendron. On certain special characters of the leaves and structural details of the flower and the fruit, I have established the new genus Dipterodendron, the affinities of which are with the Brazilian Tripterodendron and Dilodendron.

**SERJANIA MICROCEPHALA Radlk., sp. nov.**

Scandens fruticosa; rami 6-angulares, angulis alternis acutioribus magis prosilientibus, juniores sufferrugineo-hirtelli; corpus lignosum compositum e centrali magno et peripheriis tribus parvis angulis acutioribus subjectis; folia biternata; foliola terminalia et lateralia superiora lanceolata, paucidentata, lateralia inferiora abbreviata ovata vel suborbicularia, membranacea, supra ± glabrata subfusca, subtus pilis glandulisque microscopicis adspersa subincana, utrinque opaca, impunctata, attamen cellulis secretoriis staurenchymatis angustis basi dilatatis instructa, epidermide mucigera; petiolus communis nudus, partialium intermedius marginulatus; thyrsi in ramulis axillaribus juxta cirros enascentibus paniculatim congesti, ecirrosi, sat dense cincinnigeri, hirtelli; cincinni breviter stipitati; flores (e sepalis sub fructu relictis) parvi; fructus sectionis XII (Syncoccus), parvus, breviter cordato-ovatus, ad loculos inter alas e summo dorso emergentes quasi immersos trigonus, breviter apiculatus, retrorsum pilosus, ceterum glabriusculus, intus laxe villosus; semen ad basin loculi insertum, obovoideum, spadiceum.

Rami diametro 2.5 mm. Folia 6 cm. longa, 5 cm. lata; foliola terminalia 3.5 cm. longa, 1.5 cm. lata, lateralia minora; petiolus com-

munis 1-1.5 cm. longus; stipulae minutae, ovatae. Thyrsi ad 8 cm. longi; cincinnorum stipes 1 mm. vix superans; bracteae bracteolaeque parvae, lineares, pilosae. Fructus toro glabro insidens ad. 1.5 cm. longus et latus.

PANAMA: Ancon Hill, Canal Zone, fr. Feb. 20, 1908, *R. S. Williams* No. 31 (Type, U. S. Nat. Herb. No. 677877).

*Obs.*—This species belongs in Sect. XII (Syncoccus) and is nearly related to *Serjania rhombea* Radlk., which differs in its larger leaflets and fruits, the rhomboidal shape of the terminal leaflet, and in the cells of the fruit, which manifestly exceed the wings.

**PAULLINIA FIBRIGERA Radlk., sp. nov.**

Scandens, fruticosa, subglabra; rami teretes, juveniles 3-goni, sulcati, cano-tomentelli; corpus lignosum simplex; folia 5-foliolato-pinnata; foliola superiora longius, inferiora brevius oblongo-lanceolata, in acumen curvatum obtusiusculum terminata, basi obtusiuscula, nunc integerrima, nunc latere exteriore vel utrinque supra medium dente singulo obtuso notata, rarius repando-bidentata, subsessilia, membranaceo-chartacea, nervis lateralibus procurvis, supra glabra, subtus in nervorum axillis parce barbulata, glandulis microscopicis malleoliformibus (praesertim supra subimmersis) ornata, insignia diachymate fibris sclerenchymaticis a venulis aberrantibus crebris percurso nec non pneumatenchymatis strato subepidermali secundo crystalla numerosissima fovente, reti utriculorum laticigerorum laxo subtus instructa, epidermide non mucigera, pagine inferioris sparsim crystallophora; petiolus rhachisque mediocriter alata; stipulae parvae, ovatae, acutae, cano-tomentellae; thyrsi ad apices ramorum axillares, sordide tomentelli, a basi sat dense cincinnigeri; cincinni sessiles, contracti; bracteae parvae, subulatae, tomentellae; flores mediocres, subsessiles, sepalis (sub fructu relictis) tomentellis; fructus sectionis I (Neurotoechus) e globoso breviter pyriformis, in stipitem brevem attenuatus, apiculatus, pilis brevibus laxe adspersus; semen ellipsoideum, a lateralibus compressiusculum, testa fusco-spadicea glabra splendida, tota longitudine arillo (sicco) brunneo dorso ventreque usque ad basin fisso obtectum.

Frutex cirrosus, alte scandens, truncis 1.8 cm., ramis 5 mm. crassis. Folia petiolo 8-12 cm. longo adjecto ca. 30 cm. longa, 12-20 cm. lata; foliola superiora 12-16 cm. longa, 3.5-6 cm. lata; petioli alae utrinque 2-4 mm. latae; stipulae 3 mm. longae. Thyrsi 5-8 cm. longi; bracteae 2-3 mm. longae. Sepala interiora 3 mm. longa. Capsula stipite

4 mm. longo incluso 2.4 cm. longa, 1.5 cm. crassa, purpureo-nigra. Semen 1.2 cm. longum, 7 mm. latum.

PANAMA: Cituro, southern Darien, fl. April 14, 1908, *R. S. Williams* No. 672 (Type, U. S. Nat. Herb. No. 678204); Marraganti, southern Darien, fl. April 6, 1908, *R. S. Williams* No. 1014 (U. S. Nat. Herb. No. 678358).

*Obs.*—This species apparently belongs in Sect. I (Neurotoechus) between *Paullinia clavigera* Schlecht. and *P. sessiliflora* Radlk. The leaflets are remarkable on account of their conspicuous sclerenchymatous fibers.

**PAULLINIA FUNICULARIS Radlk., sp. nov.**

Scandens fruticosa, hirtella, mox glabrata; rami 3-angulares, 3-lateri, lateribus costula hirtella notatis, angulis et ipsis pilis crispatis hirtellis dein glabratis denique in costas 3 lamini- vel chordiformes maxime prosilientes cum parte centrali tenui commissuris angustis connexas leviter spiraliter tortas productis et ramos vel truncos profunde 3-sulcatos funiformes efficientibus, cortice fusco; corpus lignosum simplex, triquetrum, 3-sulcatum vel ob costulas partim magis prominentibus inaequaliter 4-5-angulare, 4-5-sulcatum, ramorum adultiorum quasi 3-alatum; folia impari-pinnata, 3-juga, jugo infimo ternato; foliola ex ovali-oblongo lanceolata, terminalia ex obovato subrhombea, omnia acuta vel subacuminata, a medio remote grossiuscule dentata, subsessilia, membranacea, præter marginem nervosque utrinque puberulos glabra, nitidula, saturate viridia, glandulis microscopicis cernuis adspersa, creberrime pellucide punctata et minutissime lineolata, reti utriculorum laticiferorum parum pellucido subtus instructa, epidermide non mucigera; petiolus nudus, rhacheos segmentum superius sat late, interdum inferius quoque angustius alatum; stipulae elongatae, lineares, imo filiformes; thyrsi in ramis juvenilibus axillares, solitarii, perbreves, pubescentes, in ramis adultioribus truncisve glomeratim congesti, glabri, omnes cirrosi (eorum loco vero in ramorum apicibus novellis pedunculi steriles longi, apice elongate bicirrosi); flores parvi, glabriusculi; fructus—(non suppetebat).

Trunci 1.4 cm., rami juniores 3 mm. crassi. Folia ad 30 cm. longa, 18 cm. lata; foliola 5-12 cm. longa, 2.5—4.5 cm. lata; petiolus communis 6-12 cm. longus; rhacheos segmentum superius ad 4 cm. longum alis utrinque 5 mm. latis, inferius ad 6 cm. longum alis (ubi sunt) utrinque 1 mm. vix excedentibus; stipulae 7-10 mm. longae, 0.5-2 mm. latae, puberulae vel hispidulae, mox glabratae. Thyrsi 1-2

cm. longi, sat dense cincinnos stipitatos 2-4 floros gerentes; bracteae bracteolaeque minutae, glabrae vel puberulae; pedicelli 3-5 mm. longi, supra basin articulati. Flores albi. Sepala duo exteriora tertiam interiorum partem aequantia, glabra vel puberula, margine ciliolata, interiora elliptica, 3 mm. longa. Petala tenera obovato-spathulata, intus glandulis laxe adspersa; squamae dimidiam petalorum partem vix superantes, margine ciliatae, superiores crista brevi biloba appendiceque deflexa brevi obtusa barbata, inferiores crista dimidiata dentiformi instructae. Tori glandulae ovatae, puberulae. Stamina ima basi puberula. Germen (floris ♂) rudimentarium puberulum.

PANAMA: Along Rio Fató, Province of Colon, fl. July 9, 1911, *Pittier* No. 3886 (Type, U. S. Nat. Herb. No. 678961); fl. Aug. 16, 1911, *Pittier* 4188 (U. S. Nat. Herb. No. 679289); Hato del Jobo above San Felix, eastern Chiriquí, fl. December 28, 1911, *Pittier* No. 5418 (U. S. Nat. Herb. No. 715641).

*Obs.—Paullinia funicularis* Radlk. is to be incorporated in Sect. XII (Caloptilon) among the species related to *P. cauliflora* Jacq. and *P. hispida* Jacq., from which it differs in its deeply 3-sulcate-funiform stem and the very numerous pellucid dots of the leaflets.

**TALISIA NERVOSA Radlk., sp. nov.**

Arbuscula eramosa, pyramidalis (Pittier), praeter paniculas glabra, trunco tereti, cortice laevi fusco; folia paripinnata, 5-juga, inferiora quam superiora multo majora (Pittier), petiolo mediocri tereti basi incrassato, rhachi supra bisulcata subtus carinata; foliola sat magna, ex oblongo lanceolata, acuminata, basi acuta petiolulis brevibus bulboso-incrassatis insidentia, rigide chartacea, nervis lateralibus approximatis utrinque ca. 13 obliquis strictis supra impressis subtus valde et quidem obtuse prominentibus prope marginem subrevolutum manifeste arcuatim anastomosantibus, utrinque glabra nec nisi subtus ad nervos pilis minutissimis subulatis adspersa glandulisque stipitatis turbinato-capitatis parcis ornata, nitida, e viridi fuscescentia; panicula mediocris, folia dimidia superans, pauciramosa; flores—non visi, nisi partes sub fructu relictae; calyx 5-lobus, lobis anguste imbricatis obtusis, exterioribus leviter carinatis, pulverulento-puberulis intus glabris; petala—?; discus margine et intus hirsutus; stamina pilosula; fructus majusculus, obovoideo-ellipsoideus, obsolete trigonus, sessilis, stylo persistente longiuscule apiculatus, apice (ut et stylus) adpresse puberulus, ceterum glabratus, leviter granulatus, partim suberoso-squamulatus, pericarpio crassiusculo tra-

beculis sclerenchymaticis turbinato-clavelliformibus contiguis in directione radiali percurso, abortu 1-2-locularis, 1-2-spermus, intus in loculorum dorso pilis brevibus adspersus; semina trigono-ellipsoidea, a dorso convexo compressiuscula, ventre obtusangula, testae parte putaminosa crustacea laevi brunnea.

Arbuscula 2 m. alta. Folia superiora petiolo 8-9 cm. longo adjecto ca 40 cm. longa, 25 cm. lata; foliola cum petiolulis 6 mm. longis ca. 20 cm. longa, 5 cm. lata, inferiora plus dimidio minora. Panicula 30 cm. longa; pedicelli vix 2 mm. longi. Fructus 2.5 cm. longus, 1.8 cm. crassus, stylo 2.5 mm. longo, pericarpio 2 mm. crasso. Semen 2 cm. longum, 1.2 cm. latum, 8 mm. crassum.

PANAMA: Loma de la Gloria, back of Fató, Province of Colon, fr. August 23, 1911, *Pittier* 4249 (Type, U. S. Nat. Herb. No. 679350).

*Obs.*—In the absence of the flowers the place of this species in the systematic arrangement is doubtful. In the carinate rachis of its leaves it approaches somewhat *Talisia carinata* Radlk.; in the character of its nervation, *T. clathrata* and *T. dasyclada* Radlk.

**DIPTERODENDRON Radlk., gen. nov.**

Flores—non visi, nisi partes sub fructu juvenili relictae; calycis basis horizontalis, parva, puberula, circumcirciter (lobis decisis) cicatricata; petalorum vestigia nulla; discus annularis, parvus, sufferrugineo- dein canescenti-tomentellus, staminum insertionibus foveolaribus in lobulos 8 partitus; staminum decisorum vestigia 8; pistillum auctum (fructus juvenilis) trigono- (rarius digono-) ellipsoideum vel obovoideum, brevissime sufferrugineo-puberulum, apice in rostrum breve pyramidatum contractum, stylo rostrum aequante subulato sulcis 3 (2) stigmatosis suturalibus exarato terminatum; loculi 3 (2), intus pilis teneris amplis floccoso-villosi; gemmulae in loculis solitariae (vel in germinis septo altero evanido biloccularis loculo majore binae), e loculi basi erectae, campylotropae, apotropae. Capsula sat magna (Aesculi semen magnitudine aequans) tri- (di-) gono-globosa, in rostrum breve dilatato-pyramidatum interdum subevanidum terminata et styli reliquiis apiculata, ad angulos sulco exarata, basi umbilicato-cava, sicca dure crustacea, loculicide 3- (2-) valvis, valvis medio septigeris glabratis granulatis lenticellisque orbicularibus rufis crebris obsitis fusco-brunneis intus tomento sericeo denso pallido vestitis, pericarpio sat crasso trabeculis sclerenchymaticis vasa includentibus crebris radiatim percurso, parenchymate interstitiali e cellulis magnis materia saponino affini (in aqua facile, in alcohol tarde solubili) foetis aliisque tanninigeris conflato. Semina

trigono-ellipsoidea, sat magna, testa crustacea glabra laevi nitida fusco-spadicea, arillo dorso depresso, inde subbilobo scarioso usque ad medium obtecta. Embryo notorrhizus, subcircinato-curvatus; cotyledones crassiusculae, carnosae, amylo farctae cellulisque majoribus saponinigeris persitae, interior transversim subcircinatim biplicata ab exteriore (dorsali) incurva amplexa; radicula a medio seminis dorso intra testae plicam descendens.

Arbores magnae fructicesve. Rami teretiusculi, thyrsigeri sulcati cortice subfusco laevi, adultiores lenticellis orbicularibus longitudinaliter vel exacte cruciatim sulcatis ornati. Folia sparsa, exstipulata, abrupte bipinnata, larga, petiolo supra parum subtus magis convexo, rhachi supra bisulcata, sulcis a pinnarum insertionibus decurrentibus, minutim puberula; pinnae (et ipsae abrupte pinnatae) utrinque 4-9, alternae vel superiores (rarius omnes) suboppositae, oblongae; foliola (pinnulae) pinnarum inferiorium et summarum pauciora, utrinque 4-7, pinnarum reliquarum 10-12, alterna vel subopposita, sessilia, summa interdum in apicem serratum (quasi foliolum terminale) confluentia, proxima quasi decurrentia et rhachin (secundariam) apice marginatum efficientia, ex oblongo-lanceolata vel basi inaequali (latere interiore latiore) in rhomboideum vergentia, acuta et acute serrata chartacea, cellulis secretoriis (ut in Tripterodendro et Dilodendro staurenchymatis ampliatis) saponinigeris crebre minutum pellucido-punctata utriculisque seriatis sub nervis instructa, contrita aqua agitata mox spumam efficientia, epidermide mucigera. Thyrsi e foliorum infimorum axillis vel infra folia supra squamaram (perularum) cicatrices enascentes, petiolos aequantes vel subduplo superantes, a medio remote polychasia 4-flora, dichasia 3-flora vel cincinnos 2-floros (apice ad flores singulos reductos) stipitatos 4-10 saepius per paria approximatos gerentes; bractearum vestigia obsoleta. Flores, ut videtur, parvi, feminei longiuscule pedicellati, pedicellis infra medium articulatis.

Species 2, Costa Rican.

The new genus *Dipterodendron* is closely allied to *Tripterodendron* and nearly intermediate between this and *Dilodendron*. It agrees with the latter in its bipinnate leaves (papillose underneath in the second species), so that once it seemed to me (See Mart. Flora Bras. XIII, 3, p. 597) that the second species, *Dipterodendron elegans*, represented by leaves only in the collection of Oersted, must be referred to the genus *Dilodendron*. The genus *Tripterodendron*, besides its tripinnate leaves, differs in the entire margin of the disc (though this may be undulated on account of the pressure of the stamens),

the oleose-carnose aril, and the greenish embryo devoid of saponiferous cells (and perhaps also in its bisquamulose petals).

### Key to the Species

Leaflets smooth on both sides, bright green. 1. *D. costaricense.*
Leaflets minutely papillose and appressed pubescent beneath, dark green. 2. *D. elegans.*

#### 1. DIPTERODENDRON COSTARICENSE Radlk., sp. nov.

Arbor magna; folia bipinnata; foliola utrinque laevia praeter nervum medianum supra puberulum glandulisque minutis adspersum glabra, saturate viridia, epidermidis paginae inferioris cellulis compluribus (2-4-aggregatis) crystalla singula gerentibus; reliqua ut supra.

Arbor 15-20 m. alta, fere a basi ramosa. Rami juniores (thyrsigeri) teretiusculi, sulcati, glabri vel apice pilosi, innovationibus lanuginosis, cortice laevi subfusco, adultiores teretes, lenticellis orbicularibus longitudinaliter vel nitide cruciatim sulcatis ornati. Folia bipinnata petiolo 8-20 cm. longo adjecto 30-70 cm. longa, 20-28 cm. lata; pinnae 7-20 cm. longae, interstitiis 3-4.5 cm. longis; pinnulae (foliola) intermediae 1.5-3.5 cm. longae, 0.6-1 cm. latae, summae infimaeque minores, interstitiis 0.5-1 cm. longis. Thyrsi 8-15 cm. longi, interstitiis inter ramulorum paria circ. 2 cm. longis, pedicellis 5-10 cm. longis. Capsula diametro 2.5-3 cm., pericarpio (sicco) 2 mm. crasso; semina 1.5-1.8 cm. longa, 1 cm. crassa.

Costa Rica: La Balsa de Rio Grande, Province of Alajuela, young and mature fruits, June 2, 1911, *Pittier* 3645 (Type, U. S. Nat. Herb. No. 678704); El Coyolar, near Santo Domingo, June, 1911, coll. *Wercklé, Pittier* 3681 (U. S. Nat. Herb. Nos. 678748-9), with mature fruits, leaves partly discolored, yellowish green.

#### 2. DIPTERODENDRON ELEGANS Radlk.

*Dilodendron bipinnatum* Radlk., var. *elegans* Radlk. in Mart. Fl. Bras. XIII, 3, p. 597. 1900.

Folia (sola visa, quae vero scribenti mihi ad manus non sunt) bipinnata; foliola subtus minutim papillosa (papillis supra stomata minuta conniventibus, stomatibus aliis majoribus interjectis), pilis

supra basin geniculatis adpressis subsericeo-puberula, utrinque atro-viridia, apicalia saepius confluentia.

COSTA RICA: Near Turrialba, leaves only, May, 1847 (*Oersted* No. 415, in Herb. Havn.).

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# DESCRIPTIONS OF EIGHT NEW AFRICAN BULBULS

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# DESCRIPTIONS OF EIGHT NEW AFRICAN BULBULS

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Four of the forms of African birds here described are from the collection made by the Childs Frick African Expedition, 1911-12; three are from the Smithsonian African Expedition, 1909-10 collection, made under the direction of Col. Theodore Roosevelt; and one is from the Paul J. Rainey Expedition, 1911-12.

The names of special tints and shades of colors used in this paper conform to Robert Ridgway's "Color Standards and Color Nomenclature," issued March 10, 1913. All measurements are in millimeters.

## PHYLLASTREPHUS STREPITANS FRICKI, new subspecies

Frick's Bristle-necked Bulbul

*Type-specimen.*—Adult male, Cat. No. 244836, U. S. Nat. Mus.; collected on the Tana River, below Camp No. 4 of the Childs Frick African Expedition, in British East Africa, August 17, 1912, by Edgar A. Mearns. (Original number, 23716.)

*Characters.*—This subspecies is more closely related to *Phyllastrephus strepitans pauper* (Sharpe) from Schebeli in western Somaliland than to *P. s. strepitans* Reichenow from Malindi in German East Africa. The back, in typical *strepitans* is sayal brown, in *pauper* snuff brown, and in *fricki* drab. In size the three forms are practically alike.

*Description of adult male and female.*—Upper parts, including forehead, crown, mantle, and wings drab; upper tail-coverts cinnamon-brown; tail-feathers mummy brown, obscurely cross-banded with darker; wing-quills externally edged with dresden brown; chest pale drab-gray; sides, flanks, and outer aspect of thighs pale ecru-drab; throat and abdomen grayish white; crissum and inner aspect of thighs pale drab-gray; axillars, under wing-coverts, and inner border of quills tilleul-buff. In a fresh specimen the iris was dark, brownish red; bill olivaceous black, paler below at base; feet and claws plumbeous.

*Measurements of type.*—Length of skin, 175 mm.; wing, 81; spurious primary, 31; tail, 84.5; culmen (chord), 19; tarsus, 23.

*Average measurements of nine adult males.*—Wing, 81.2; tail, 84.8; culmen (chord), 18; tarsus, 22.33.

*Average measurements of four adult females.*—Wing, 75.25; tail, 79.75; culmen (chord), 16.88; tarsus, 21.88.

**PHYLLASTREPHUS CERVINIVENTRIS LÖNNBERGI, new subspecies**

Lönnberg's Bulbul

"*Phyllastrephus cerviniventris?*" Lönnberg, Kungl. Sv. Vet. Akad. Handl., 47, No. 5, 1911, p. 115 (one day's march south of Meru boma, British East Africa).

*Type-specimen.*—Adult male, Cat. No. 244837, U. S. Nat. Mus.; collected on the Government Trail, Tharaka District, British East Africa, August 12, 1912, by Edgar A. Mearns. (Original number, 23569.)

*Characters.*—Most closely related to *Phyllastrephus cerviniventris cerviniventris* Shelley, but with the head more cinereous, the back darker olive, and the under parts more grayish, and more rusty on the middle of the chest and abdomen.

*Description of type* (adult male).—Top and sides of head drab-gray; mantle light grayish olive; wings grayish olive; upper tail-coverts and tail cinnamon-brown; under parts drab-gray, washed with ecru-drab on middle of chest and abdomen, deepening to light cinnamon-drab on crissum; axillars and lining of wings cinnamon-drab; inner border of quills edged with drab-gray. In the dry skin the maxilla and tip of mandible are drab, remainder of mandible yellowish white; tarsi yellowish white; toes and claws pale brown.

*Measurements of type* (adult male).—Length of skin, 165 mm.; wing, 81; tail, 81; culmen (broken); tarsus, 22.

**PHYLLASTREPHUS PLACIDUS KENIENSIS, new subspecies**

Mount Kenia Bulbul

*Type-specimen.*—Adult male, Cat. No. 215281; U. S. Nat. Mus.; collected at the altitude of 8,500 feet, on Mount Kenia, British East Africa, October 10, 1909, by Edgar A. Mearns. (Original number, 17066.)

*Characters.*—More closely resembling *Phyllastrephus placidus placidus* Shelley from Mount Kilimanjaro than *P. p. grotei* from Mikindani. It differs from *grotei* by the redness of its tail, and

darker upper parts. From *placidus* it may be readily distinguished by its more greenish gray upper parts and paler, less brownish, head.

*Description of adult male and female.*—Upper side of head, nape, mantle, and rump grayish olive; eye-ring, grayish white; lores and region below eye grayish olive mixed with grayish white; cheeks and ear-coverts grayish olive, the latter streaked with grayish white; wings light brownish olive, the quills edged with isabella color; upper tail-coverts and tail snuff brown; chin and throat yellowish white; remainder of under parts, light olive-gray, the feathers of the chest centrally streaked with more yellowish gray; thighs olive-gray, axillars light olive-gray; under wing-coverts and inner border of quills drab-gray.

*Measurements of type* (adult male).—Length of skin, 290; wing, 89, spurious primary, 38; tail, 93; culmen (chord), 16; height of bill at anterior border of nostril, 4.7; width of bill at anterior border of nostril, 4; tarsus, 24.

*Average measurements of eight adult male topotypes.*—Wing, 88.5; tail, 86; culmen (chord), 16.25; tarsus, 23.31.

*Average measurements of three adult female topotypes.*—Wing, 78.3; tail, 80; culmen (chord), 15; tarsus, 21.5.

**CHLOROCICHLA FLAVIVENTRIS MERUENSIS, new subspecies**

Meru Yellow-bellied Bulbul

*Type-specimen.*—Adult male, Cat. No. 244777, U. S. Nat. Mus.; collected in the Meru Forest, on the Equator, near Mount Kenia, in British East Africa, August 10, 1912, by Edgar A. Mearns. (Original number, 23546.)

*Characters.*—Most closely related to *Chlorocichla flaviventris mombasæ* (Shelley), from which it differs in having the top of the head much darker, the back more greenish olive, and the under parts much yellower.

*Description of type* (adult male).—Upper side of neck and head, including forehead and lores, sepia; eye-ring yellowish white; cheeks and ear-coverts deep olive; mantle, rump, and upper tail-coverts greenish olive; upper wing-coverts and secondaries sepia, bordered with greenish olive; primaries narrowly edged with yellowish olive; tail-feathers sepia, the central pair more greenish and obscurely cross-banded, the others externally broadly bordered with greenish olive; chin, throat, middle of chest, abdomen, and crissum

deep colonial buff; sides of chest, sides of body, and flanks light yellowish olive; thighs yellow, tinged with buff externally; edge of wing, axillars, under wing-coverts, and inner border of quills yellow. In the dry skin the bill is olive-plumbeous, the feet and claws deep plumbeous.

*Measurements of type* (adult male).—Length of skin, 205 mm.; wing, 101; tail, 98; exposed culmen (chord), 19; tarsus, 25.

**ANDROPADUS FRICKI, new species**

Endoto Bulbul

*Type-specimen.*—Adult male, Cat. No. 244778, U. S. Nat. Mus.; collected at the north base of Endoto Mountain, British East Africa, July 20, 1912, by Edgar A. Mearns. (Original number, 23110.)

*Characters.*—Most closely related to *Andropadus insularis insularis* Hartlaub, but with a stouter bill, darker coloration above, with much more yellow on the under parts, and with a conspicuous yellow eye-ring which is absent in *insularis*.

*Description of type* (adult male).—Top and sides of head, nape, mantle, rump, upper tail-coverts, and upper wing-coverts light brownish olive; quills brownish olive, edged with ecru-olive; rectrices brownish olive, washed with light yellowish olive on outer webs, and with shafts brown above and nearly white below; sides, upper chest, and throat ecru-olive, becoming paler and more yellowish on the chin; lower chest, abdomen, thighs, and crissum deep colonial buff; axillars, under wing-coverts, and inner border of quills colonial buff. In the dry skin the bill is brownish black, paler at base of mandible; feet and claws olive-black. There are three subterminal notches on each side of the maxilla.

*Measurements of type* (adult male).—Length of skin, 175 mm.; wing, 87; spurious primary, 35; tail, 81; culmen (chord), 16; depth of bill at anterior border of nostril, 6; width of bill at anterior border of nostril, 4; tarsus, 20.

**ANDROPADUS FRICKI KITUNGENSIS, new subspecies**

Kitunga Bulbul

*Type-specimen.*—Adult male, Cat. No. 213539, U. S. Nat. Mus.; collected at Sir Alfred Pease's farm at Kitunga, altitude 7,000 feet, British East Africa, May 8, 1909, by Edgar A. Mearns. (Original number, 15711.)

*Characters.*—Similar to *Andropadus fricki fricki* Mearns, but larger, with the upper parts buffy olive; sides and chest grayish olive-yellow, and remaining under parts olive-ocher. In life the iris was white, the bill and feet dark plumbeous. The yellow eye-ring is even more conspicuous than in *A. f. fricki.*

*Measurements of type* (adult male).—Length of skin, 188 mm.; wing, 91; spurious primary, 33; tail, 91; culmen (chord), 16.5; depth of bill at anterior border of nostril, 5.5; width of bill at anterior border of nostril, 3.5; tarsus, 21.

*Average measurements of two adult males* (type and topotype).—Wing, 90.5; tail, 89; culmen (chord), 16.5; tarsus, 21.5.

### STELGIDOCICHLA LATIROSTRIS PALLIDA, new subspecies

Mount Gargues Bulbul

*Type-specimen.*—Adult male, Cat. No. 217670, U. S. Nat. Mus.; collected on the summit of Mount Gargues, altitude 7,100 feet, British East Africa, August 25, 1911, by Edmund Heller. (Original number, 247.)

*Characters.*—Most closely related to *Stelgidocichla latirostris eugenia* (Reichenow), from the Victoria Nyanza region of Equatorial Africa, agreeing with it in the size and shape of the bill, but of a much paler coloration, in the latter respect comparable to *Stelgidocichla latirostris efulensis* (Sharpe), from West Africa. It is as pale as *efulensis* but more greenish, and has a shorter, stouter bill.

*Description of adult male and female.*—Entire top and sides of head deep olive; upper side of neck, mantle, outer wing-coverts, and outer web of inner secondaries citrine-drab; wing-quills deep olive edged with light yellowish olive; upper back citrine-drab, gradually deepening on lower back, rump, upper tail-coverts, and tail to saccardo's umber; rectrices obscurely edged, externally, with yellowish citrine; chin and upper throat citron-yellow; chest, sides, flanks, and thighs light yellowish olive; middle of abdomen olive-buff; edge of wing, axillars, and under wing-coverts marguerite yellow; inner border of quill-feathers very pale olive-buff. In dry specimens the bill is brownish black; tarsi fleshy brown; toes and claws dark, olivaceous brown.

*Measurements of type* (adult male).—Length of skin, 175 mm.; wing, 87; length of spurious primary, 30; tail, 83; culmen (chord), 14; bill from anterior margin of nostril, 8; width of bill opposite posterior border of nostril, 7.2; tarsus, 21.8.

*Average measurements of three adult females.*—Wing, 86; tail, 86.67; culmen (chord), 13.67; tarsus, 21.13.

**STELGIDOCICHLA LATIROSTRIS SATURATA, new subspecies**

Saturated Bulbul

*Type-specimen.*—Adult male, Cat. No. 215274, U. S. Nat. Mus.; collected on the Honi River, south-west base of Mount Kenia, British East Africa, September 17, 1909, by Edgar A. Mearns. (Original number, 16841.)

*Characters.*—Most closely related to *Stelgidocichla latirostris eugenia* (Reichenow), from the Victoria Nyanza region, but larger, more intensely colored, and more yellowish olive above and below.

*Description of adult male and female.*—Entire top and sides of head dark olive; upper side of neck, mantle, outer wing-coverts, and outer web of inner secondaries buffy olive; wing-quills brownish olive edged with ecru-olive; upper back buffy olive, gradually changing on lower back, rump, upper tail-coverts, and tail-feathers to medal bronze; rectrices obscurely edged, externally, with olive-lake; chin and upper throat amber-yellow; chest, sides, flanks, and thighs yellowish olive; middle of abdomen olive-yellow; edge of wing, axillars, and under wing-coverts olive-ocher; inner border of quills yellowish pale smoke-gray. In dry specimens the bill is brownish black; tarsi brownish white; toes and claws dark brown.

*Measurements of type* (adult male).—Length of skin, 193 mm.; wing, 91; length of spurious primary, 32; tail, 91; culmen (chord), 14.5; bill from anterior border of nostril, 9; width of bill opposite posterior border of nostril, 8; tarsus, 23.

*Average measurements of five adult males of Stelgidocichla latirostris saturata.*—Wing, 90.6; tail, 87.2; culmen (chord.) 14.5, tarsus, 22.2.

*Average measurements of three adult males of Stelgidocichla latirostris eugenia.*—Wing, 88; tail, 82.67; culmen (chord), 15.33; tarsus, 20.83.

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