

205. PORZANA CAROLINA (L.); Sci. & Salv. P. Z. S. 1868, p. 450.
V. de Chiriqui.
206. FULICA AMERICANA, Gm.; Sci. & Salv. P. Z. S. 1868, p. 468.
Laguna del Castillo.
207. ÆGIALITES VOCIFERUS (L.).
V. de Chiriqui.
208. GAMBETTA MELANOLEUCA (Gm.).
Chitra.
209. RHYACOPHILUS SOLITARIUS (Wils.).
Castillo; V. de Chiriqui.
210. GALLINAGO WILSONI (Temm.).
Chitra.
211. QUERQUEDULA DISCORS (L.).
Laguna del Castillo.
212. FULIGULA AFFINIS (Forst.).
Castillo.
213. PHALACROCORAX BRASILIANUS (Gm.).
Phalacrocorax, sp.?, Salv. Ibis, 1866, p. 200.
Castillo.
214. PLOTUS ANHINGA (Linn.).
Castillo.
215. PODILYMBUS PODICEPS (Linn.).
Castillo.
216. PODICEPS DOMINICUS (L.).
Castillo; Chitra.

April 28, 1870.

John Gould, Esq., F.R.S., V.P., in the Chair.

The Secretary called the attention of the Society to the following additions to the Menagerie during the month of March:—

1. A male specimen of Sclater's Impeyan (*Lophophorus sclateri*), presented by Major Montagu, Bengal Staff Corps, and received March 12th.

2. A male Blyth's Tragopan (*Ceriornis blythi*), presented by the same gentleman, and received on the same date.

Mr. Slater had already read before the Society his notes on these two interesting birds (see *anted*, p. 162).

3. Four young Hornbills, which had been obtained by Mr. William Jamrach during his recent visit to Malacca and Sumatra, and appeared to be all young birds of the last breeding-season. Two of these Mr. Slater had provisionally determined as being a male and a female of the Plait-billed Hornbill (*Buceros plicatus*), although it appeared possible that the smaller female bird obtained at Malacca might be referable to the nearly allied species *Buceros subruficollis* of Blyth, if, indeed, this were really to be considered distinct from *B. plicatus*. The third Hornbill, from Sumatra, appeared undoubtedly referable to the female of *Buceros gracilis* (Temm. Pl. Col. 535); the fourth to *Buceros bicornis*.

4. Four Burrowing Owls (*Pholeoptynx cunicularia*), presented by George Wilks, Esq., C.M.Z.S., of Buenos-Ayres, and received March 19th, being the only specimens of this interesting species ever received, except the one previously presented by Mr. Wilks in 1868 (*cf.* P. Z. S. 1868, p. 261).

5. A Wood-loving Antelope (*Cephalophus sylvicultrix*), purchased of a dealer March 24th, and believed to be the first specimen of this beautiful Antelope, which was formerly living in the Knowsley Menagerie, ever received by the Society.

Dr. E. Hamilton communicated the following extract from a letter lately received from his nephew, Capt. Francis Hamilton, of the 21st Regt., commanding detachment at Port Blair, Andaman Islands:—

"All of us here have been much amused by the account of the so-called 'Andaman Monkey' (*Macacus andamanensis*) lately received by the Zoological Society*. But in point of fact there are no Monkeys indigenous to the Andaman Islands. One of the superintendents brought some Monkeys to this island (Ross), which got loose; and 'Andaman Jenny' is one of them. There are three others still left; they live among the commissariat sheds. There are two old ones and one young. They were brought from the mainland of Burmah."

The following extract was read from a letter addressed to the Secretary by Dr. J. Anderson, F.Z.S., dated Indian Museum, Calcutta, 15th March, 1870:—

"I have succeeded at last in procuring a specimen of the Irawady Dolphin from Bhamoo, six hundred miles from the sea. I am indebted to my friend Capt. Burns for it. He found it newly stranded on an island opposite Bhamoo, and, according to my instructions, had it packed in salt and arsenic and sent down by a special boat to Mandalay, whence it was forwarded to me by steamer. It arrived in capital condition after a journey of twelve hundred miles.

"It belongs to the genus *Globiocephalus*, and internally has all the characters of *G. indicus* of Blyth; but its skull has certain well-marked features that separate it from the latter.

* See P. Z. S. 1869, p. 467.

"My specimen measured seven and a half feet in length, and, from its much worn teeth and the condition of its skull, appears as if it had attained full growth, whereas *G. indicus* reaches up to from fifteen to twenty feet in length. I have only just received it; so I am not in a position to say much about it.

"Before this specimen reached me I was fully convinced, from my observations on the Irawady, that its Cetacean was a round-headed species."

Mr. Harting exhibited an unusually fine specimen of the Dusky Redshank (*Totanus fuscus*) in summer plumage. This had been stated to have been killed on the Thames, near Surbiton, but was subsequently discovered to have been sent from Holland.

The Rev. H. B. Tristram exhibited two skins of *Luscioniola melanopogon* (Temm.), killed by Mr. Brookes near Etawah (north of Agra) in Central India, being the first instance of this rare species having been obtained in India. Mr. Tristram also exhibited some other rare Indian warblers.

The following papers were read:—

1. Description of a gigantic Amphibian allied to the Genus *Lepidosiren*, from the Wide-Bay district, Queensland.
By GERARD KREFFT, F.L.S., C.M.Z.S., Curator and Secretary of the Australian Museum, Sydney, New South Wales.

The discovery of a species of *Lepidosiren* in Australia will no doubt take the scientific world by surprise—the more so as this newly found amphibian has a dentition different from that of *Lepidosiren*, and closely resembling the teeth of certain fossil Sharks described by Agassiz under the generic term of *Ceratodus* (*Recherches sur les Poissons Fossiles*, tome iii. p. 129). On this ground, and being convinced that the various species of animals classed under the name of *Ceratodus* were not sharks, but amphibians, I shall adopt Prof. Agassiz's name, and describe the Australian amphibian, in honour of its discoverer, the Hon. William Forster, M.C.A., as

CERATODUS FORSTERI.

In general shape the specimen before me (fig. 1), which is somewhat mutilated and without intestines, resembles the *Lepidosiren annectens*. It is nearly 3 feet in length, has a broad flat head, small eyes, and four limbs in the shape of flappers. The body is covered with large cycloid scales, ten rows on each side, the third row from above marked, but not very distinctly, as a lateral line. There is a large gill-opening before each pectoral limb, containing well-developed branchiæ (on account of the state of the specimen, however, a careful examination of them was impossible), and a rather large pair of

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Fig. 1.

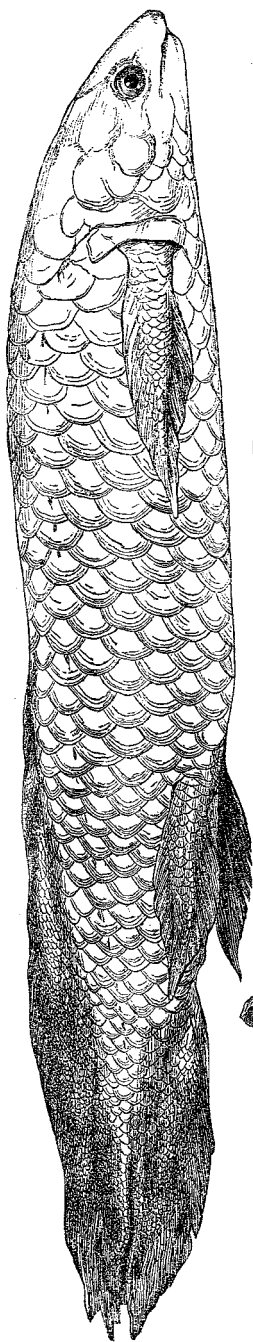


Fig. 2.

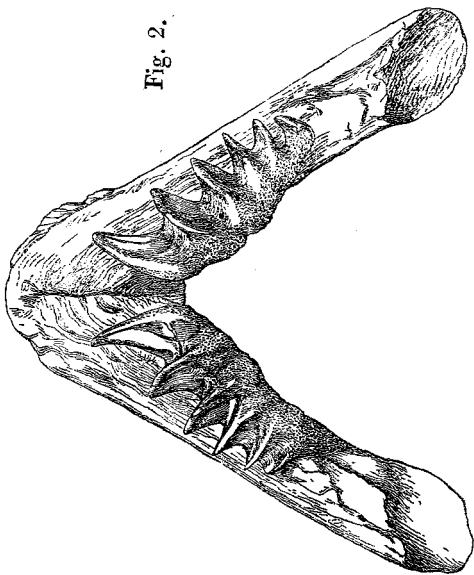


Fig. 2. Lower jaw of ditto, from above.

Fig. 3.

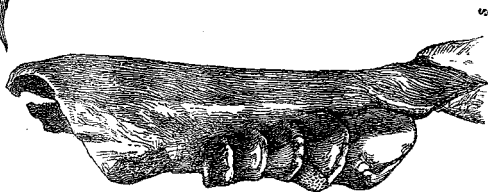
Fig. 1. *Ceratodus forsteri*, side view.

Fig. 3. Left ramus of lower jaw, seen from the front.

s. Symphysis.

nostrils just below the upper lip, communicating by a short tube with the roof of the mouth.

The skeleton is partly ossified, partly cartilaginous, the vertebrae being pure cartilage, and the ribs hollow tubes filled with a cartilaginous substance. The palate and upper part of the skull are bone, and the head is covered with two enormous scales. The tongue is very small, and attached to what I believe to be a large hyoid bone ossified externally. The rays which support the dorsal and caudal fins consist of two or more quill-like hollow tubes filled with and held together by cartilage. Numerous rays branch off from the limbs, forming broad flappers, which have some resemblance to those of a Porpoise, but are covered with small scales. The teeth are very interesting; and the dental plates will be found in form (and substance, probably, also) to approach the teeth of the genus with which I have provisionally classed this animal.

The incisors are two, restricted to the upper jaw; they are flat, slightly bent, with the upper front margin cut away and the hinder one denticulated. A little behind the incisors the first and largest limb of the dental plate appears; it is almost parallel with the palate; the second joint or limb branches outward, being smaller than the first, and so on to the sixth and last, which is only half the size of the fifth. The inner margin of the dental plate is rounded off; and the two together form a triangle (if a line is drawn at their base) with serrated outer sides. The lower jaw (fig. 2) is provided with corresponding plates; the incisor teeth are wanting, and the two rami are only joined by tough skin. The opening of the mouth is not very large; and the jaws appear to work in a curious manner, which is best described by working two sections of a cog-wheel horizontally, one down upon the other, to which motion the flexibility of the lower jaw appears to be well adapted.

This short description of one of the most interesting animals ever discovered in Australia must suffice at present. I have no doubt that many and better accounts will be given of it when well-preserved spirit-specimens have come to hand.

Postscript.—It is strange that a curious creature like this, which was well known to the early settlers at Wide Bay and other Queensland districts, should so long have escaped the eyes of those interested in natural history. I remember that Mr. William Forster mentioned a "fish" with cartilaginous backbone years ago, and that I expressed an opinion that he must be mistaken. This animal is excellent eating, has Salmon-coloured flesh, and at certain seasons will rise to a fly; so that the northern squatters have named it the Burnett or Dawson Salmon, from its habits and from the rivers in which it is principally found. The poor bush-cooks who dressed these "Salmons" could have made a small fortune, had they preserved the heads and sent them to Sydney.

It is only during certain seasons that this amphibian takes bait; at other times it cannot be induced even to nibble. I think, however, that during this latter period the animals are buried in the

mud. The native name is *Baramoonda* or *Baramoondi*. We know as yet nothing about its habits, or the metamorphoses the young undergo; and I have been informed that the specimen from which the present description is taken is by no means a large one. Mr. Forster tells me that he has heard of specimens taken in the Dawson fully 6 feet in length.

2. On the Mammals of Hainan.

By R. SWINHOE, F.Z.S.

(Plate XVIII.)

On the 9th of December, 1869, I had the pleasure of reading before the Society a paper on the Cervine Animals of Hainan. I now desire to give a list of the remaining Mammals that I saw or heard of during my visit to that island.

1. BLACK APE. *Hylobates pileatus*, Gray, P. Z. S. 1861, p. 136, pl. XXI. ? *Wooyuen* of the Chinese of Hainan.

In the Chinese Gazetteer of the Kiungshan district of Hainan I found among the list of Mammal products of the island a species of Gibbon thus described:—"Yuen. Male black, female white; like a Macaque but larger, with the two forearms exceedingly long. Climbs to tree-tops and runs among them backwards and forwards with great agility. If it falls to the ground, it remains there like a log. Its delight is in scaling trees, as it cannot walk on the ground. Those desiring to rear it in confinement should keep it among trees; for the exhalations of the earth affect it with diarrhoea, causing death; a sure remedy for this, however, may be found in a draught made of the syrup of fried Foo-tsze (seeds of *Abrus precatorius*, Linn.)." An extract from the work *Pun Yu liang che* is here inserted, giving the various Yuens known to the author:—"There are three kinds of Yuens—the Golden-Silk Yuen, which is yellow, the Jade-faced Yuen, which is black, and the Jet-black Yuen, which has the face also black. The Golden-Silk and the Jade-face are both difficult to procure." The Gazetteer then continues:—"Hainan has also the Rock-Yuen. It is small, about the bigness of one's fist. If allowed to drink water, it grows in size. This is also called Black Yuen, and is now likewise difficult to obtain."

In a later edition of the Gazetteer the following is added:—"From its love for climbing and its mild disposition it is called *Yuen*" (two meanings of the phonetic part of the character). The work *Pe-ya* remarks, "The Yuen does not usually walk along the ground;" the Gazetteer therefore observes that it cannot walk; but those that have lately kept it in confinement have noticed that it occasionally drops on to the ground of its own inclination, and runs backwards and forwards in as lively a manner as the Meshuy [*Loris gracilis* (Shaw)]. We consequently cannot accept the statement in the Gazetteer.



Du Halde (Description de la Chine, A.D. 1735, tome i. p. 230), in an account of the natural productions of Hainan, writes:—"Among the animals that the island produces is seen a curious species of Great Black Ape, whose physiognomy somewhat approaches the human face; so well are the features marked; but this species is rare."

Having learnt of the existence of this Black Ape in Hainan, I naturally never ceased to inquire after it. Every one knew that such an animal did exist, and many had seen it; but they all spoke of the great difficulty of keeping it alive. At Taipingsze (Central Hainan) the wonderful stories that were told about it showed that the Yuen was not often seen there. The magistrate of that district assured me, with a serious face, that it had the power of drawing into its body its long arm-bones, and that when it drew in one arm it pushed out the other to such an extraordinary length that he believed the two bones united in the body; and he said that the bones of the arm were used for chopsticks. At Lingshuy (S.E. Hainan) the magistrate knew the animal and had kept it alive. His military colleague was in the hill-districts, but he would be back in a few days; and if we could wait, the magistrate thought he could get us a live specimen of the Ape. At all events, he would procure the animal and take it with him for us to Canton, whither he hoped to go before long. We could not, of course, wait, and we never heard of the mandarin or his good intentions again. At Nychow (S. Hainan) the commodore's secretary told me that only a few days previous to our visit he had had one alive, but that it had died, and he had had it buried. At my request he had the remains looked for. The top of the skull was all that was found; the dogs had destroyed the rest. He gave me this fragment, as also a pair of *ulnae* of an older animal, which he was going to turn into chopsticks (the Chinese "knife and fork," so to speak). On our return to the capital of Hainan a rumour reached us that one existed in confinement in the city. The admiral there took the matter in hand and did his best to secure it for us. But the rumour was false; no such animal could be found; so we had to leave Hainan with only the fragments above mentioned of this much desired Wooyuen.

The portion of the skull obtained is that of a very young animal, and is therefore of not much value for determining the species. But the *ulnae* are apparently adult, and are certainly those of a species of *Hylobates*.

Length of *ulna* of adult 11·4 inches.

On the 9th of April, 1861, a paper was read by Dr. J. E. Gray before this Society on a collection of Mammals &c. made by M. Mouhot in Cambodia (P. Z. S. *l. c.*), in which a species of *Hylobates* (*H. pileatus*) was described from an island off Cambodia. There is a fine stuffed group of this in the Mammal Gallery of the British Museum, showing the varieties of colour spoken of by the Chinese author, which, as Dr. Gray points out, are due to age and sex. This species from Cambodia must be closely related to, if not identical with, the Wooyuen of Hainan.

The jet-black Rock-Yuen referred to in the Gazetteer may possibly

be *Presbytes maurus* (Schreber). There is a specimen of this in the British Museum, brought from Canton by Mr. J. Reeves.

2. THE REDDISH-GREY MONKEY. *Macacus erythraeus* (Schreber).

Du Halde (*op. cit.*) says that in Hainan "there are Grey Monkeys, which are very ugly and very common." The Chinese Gazetteer has the following:—"How (or Monkey). The *She-show* (Notes on Animals) states that the Monkey has no stomach, but digests its food by jumping about. According to ancient authors, *Kiungchow* abounds in Monkeys, and its people make a trade by selling young ones."

About the jungles of Nychow (S. Hainan) Monkeys were very common. On our landing, abreast of the ship we saw a large party of them on the beach, which at once retired into a grove above high-water mark. We watched them running along the boughs of the trees and jumping from branch to branch. The discharge of a fowling-piece soon made them scurry away into the thicket; but every now and again their heads would appear from the higher bushes watching the movements of the enemy. At last, when they observed that our presence implied actual danger to themselves, they climbed the hills and posted themselves about conspicuous rocks, where they chattered and grunted out of danger. Their cries were very like those of *Macacus cyclopis*, mihi, of Formosa. In the neighbourhood of Nychow city we found a large number of them in a thick wood that surrounded the hovel of a *Le* native, and one of our party succeeded in knocking over a fine female with a cartridge. Its irides were yellowish brown tinged with green. Eyes somewhat oval. Face long, narrow, with a somewhat projecting mouth; the skin tinged with reddish yellow, and sprinkled with short silky buff-coloured hair, longer and coarser on the lips, chin, and cheeks. A few long black hairs were scattered on the centre of the forehead and on the space beneath the eyes. The ear was well developed, and thinly clothed with hair.

Skull, ♀.—The mouth projects 1 inch in front of the line of the orbital ridge. Height of the skull, from top of frontal bone to angle of the lower jaw, 2·6 inches; from orbital ridge to the same 2·43; length of lower jaw 2·15; hind corner of malar arch to front of incisors 2·45; from ditto to occipital crest 1·5; greatest diameter of rounded orbit ·9; breadth of skull, from one malar arch to the other, 2·6; across base of brain-case 2·25. Nasal aperture shaped like a subverted cone; vertical length ·65, greatest breadth ·42. Central pair of incisors of upper jaw about one-third larger than those of lower. Only fourteen teeth in each jaw; the four hind molars not yet acquired. The frontal bone slopes rapidly backwards from the orbital ridge, rising only a little in its centre, and thus leaves a very inclined forehead.

Vertical length of ear 1·3, breadth ·9; bare palm 1·85 long, 1·1 broad; middle finger 1·2 long; length of sole 3·2, breadth 1·5.

Length of body 15 inches; of entire arm to tips of fingers about

10; of leg about 11; of tail 7, thin, with harsh adpressed hair projecting $1\frac{1}{2}$ inch beyond tip of bone.

The short coarse hair of the head commences from the orbital ridge, leaving no forehead. Head, arms, and back olive-grey, rufescent on the first and last, browner on the arms. Fingers clothed to end of first digits, the rest bare and fleshy-brown in colour, with a few scattered hairs and long brown claw-like nails; basal portions of the hair bluish grey. Under neck, breast, and belly dingy yellowish. Rump, thighs, and base of tail yellowish chestnut; yellowish brown on legs, feet, and rest of tail. Toes covered with longish hairs. Buttocks bare—with a bright red callosity on each side, of an irregular oval form, with the smallest end downwards, 1 inch long by .6 in greatest breadth.

The Chinese General at Nychow (S. Hainan) gave me a live young specimen of this species; but, as it had had its tail chopped off, I did not trouble to have it forwarded to England.

Judging from the single adult female brought home by me, the Hainan Monkey does not appear to be separable from the *Macacus erythraeus* (Schreber) of Bengal, of which there are many examples in the Society's Gardens.

3. HOUSE-BAT. *Vesperugo abramus* (Temm.) [*V. akokomali*], Monograph. de Mamm. t. ii. p. 232.

I only procured one small Bat at Hainan—the species which roosted under the eaves of the house in the city wherein I was quartered. Dr. Peters, of Berlin, has kindly determined the species. It is a common House-bat in Nagasaki, Japan.

The Gazetteer places the Bats at the end of the list of birds, as is usual with Chinese authors, and says, “Peenfoo, or Bat, shaped like a Mouse, has thin flesh-wings uniting the four legs and extending to the tail. In winter stows away; in summer comes out. In daytime lies prostrate; in night flies. One name for it is Foo-yeh, or Belly-wings. It is now called the Feishoo, or Flying-mouse.”

4. ASIATIC CIVET. *Viverra zibetha*, L.

The Indian Civet occurs in China from Canton to Shanghai. I have not detected it in Formosa. In Hainan I procured two flat skins at *Lingmun* (Central Hainan), a place of barter between the Chinese and the independent *Le*. One is that of a full-sized animal, the other of one about two-thirds grown. The younger animal is blacker between the shoulders, with distinct markings on the sides and rump. In the older animal these markings have almost entirely disappeared. This is mentioned in the Gazetteer as the *Heangle*, or Fragrant Fox.

5. THE LITTLE CIVET. *Viverricula malaccensis* (Gmelin).

I obtained a skin of this animal at the same place as the last. Its black markings are somewhat confused. It is a common species in South China, as well as in Formosa. The Gazetteer calls it the *Mao-hwa-le*, or Fox with cat-like markings.

6. THE MUNGOOS. *Herpestes*, sp.?

One evening at Kiungchow I observed a Mungoos running along a bank outside the city wall. Later on I saw a skin of apparently the same species hanging up in a garden at Shuyweisze (Central Hainan) to serve as a scarecrow. Its hair was yellowish grey mottled with black. I cannot from recollection identify the species. I have not noted any species of *Herpestes* in China; but Dr. Gray has described an *Herpestes rutilus* from Cambodia (P. Z. S. 1861, p. 136). The Mungoos is, I think, the *Cha-le* of the Gazetteer.

7. THE CLOUDED TIGER. *Felis macrocelis* (Temm.). *Neofelis macrocelis*, Gray, P. Z. S. 1867, p. 266.

The skin of this Cat was shown to me in the mountains as having been procured in that neighbourhood; and I was told that the true Leopard also occurred in Hainan. The Hainan Gazetteer admits both species. It says, "Pao, or Leopard, resembling a Tiger in form, with white face and round head. Those with spots like cash (Chinese coin) are called the 'Golden-cash Leopard' (*Leopardus varius*); those with spots shaped like the mint-leaf are called 'Mint Leopard' (*L. macrocelis*). They dread Snakes. The poet Hwai Nantsze has the following couplet:—'Snakes command the Leopard to stand: all creatures have their masters.'"

8. THE MUSKY TREE-CIVET. *Helictis moschata*, J. E. Gray, P. Z. S. 1830, p. 94; 1865, p. 153.

I have but one skin from Hainan, which wants the large white spot between the eyes. The white line from between the ears to beyond the shoulders is narrow and indistinct. The dark parts of the head are brown, without any tinge of blackish. Hind neck, front of fore and hind legs plain brown, without the white grizzly appearance; the brown is darker on the hind neck and between the shoulders; the down at the root of these hairs light brownish buff. The under parts, cheeks, and ears are pale buff, deeper-coloured on the down beneath. Whiskers brown; a few of the shorter ones white.

The British Museum has a specimen from Canton, which is coloured like ours and wants the nasal white spot.

9. THE CHINESE OTTER. *Lutra chinensis*, Gray.

Skin of an animal about half-grown. Hair short, with down at roots. Upper parts brown, with down of lighter shade; the brown extending to the muzzle, down the front of the legs over the toes; tail the same colour. Sides of face and underparts generally brownish white, with light-buff-brown down. Ears small and rounded, edged with brownish white; the whiskers about the muzzle and face the same colour. Claws light brown. This seems to be the same as the Otter found throughout South China, which Dr. J. E. Gray has distinguished from the Indian Otter (*L. indica*, Gray).

"Tā, like a Dog, but with a bristly mouth, hair fine; enters water without getting wet; delights in catching fish."—*Gazetteer*.

10. THE CLAWLESS OTTER. *Aonyx leptonyx* (Horsf.). *A. horsfieldi*, Gray, Mag. Nat. Hist. i. p. 580 (1837).

I heard of a second species of Otter in Hainan that lived among the mountains. The Gazetteer speaks of it thus :—"There is a race produced by the mating of the common Otter with the female *Yuen* (*Hylobates*), called the *Cha-kia* (Mountain-Otter). Their bones are found in caverns, and yield an antidote to the poison used on arrow-heads by the savage tribes. People wounded by arrows grind to powder a small quantity and apply it to the wound; the powder at once stops the effect of the poison." I procured three skins of this animal at the trading-station above referred to, and saw at once that it was quite distinct from the common Otter.

Two of the skins are of adults, the third of an animal about two-thirds grown.

There appear to be two groups of Otters with minute pointless claws classed under the genus *Aonyx*, the one to be distinguished from the other by longer and more fully webbed toes. To the former of these belong *Lutra leptonyx*, Horsf., from Java, and *Aonyx horsfieldi*, Gray, from Malacca; which two Dr. J. E. Gray subsequently united as *Aonyx leptonyx* (P. Z. S. 1865, p. 130). To the latter belong the *Lutra indigitata*, Hodgs., from Nepaul, and certain specimens in the Museum from Madras.

My Hainan skins agree in the form of the foot and in the texture of the fur with the fine specimen from Wellesley (Malacca) on which Dr. Gray founded his *Aonyx horsfieldi*; but the tail in the Hainan race is much longer, and it wants the pure white throat of the other, and differs also in the tone of its brown colouring. The skull of the Malacca specimen is in the skin. The Hainan race appears to me to be distinct from this, apparently, its nearest ally; but it is impossible to establish a species of Otter without a comparison of skulls, and I have none of the Hainan kind. I will therefore content myself with giving a description of the appearance of the skins.

Adult. General colour rich brown, except the throat, underneck, and breast, which are whitish, the down of the latter parts being light brown. Hairs shorter and the down more abundant than in *Lutra chinensis*. Down of the upper parts the same rich brown on surface as the hairs, whitish at base. Ears small and oval, the same colour in front and behind as the back, with a pale outer edge. Muzzle and cheek-whiskers stiff and brown. Length from muzzle to root of tail 20 inches; length of tail 13 inches; from ear to eye 2 inches, from eye to nostril 1.25. The hind feet alone are remaining; their claws are without points, and truncated, the toes are well webbed, and there is a broad hollow space between the sole-pads and the ends of the toes. Sole-pad to tip of fourth toe .9; length of sole 1.9, greatest breadth .75.

The young animal is softer and washed with buff throughout. Its ears have no light edging; and its throat, underneck, and breast are light brownish chestnut. Its whiskers are blacker.

From *L. chinensis* the Hainan *Aonyx* differs in the texture and

colour of its fur, in its broader and flatter ear, its minute abrupt nails, and its much smaller size.

By its long well-webbed toes and shape of underfoot it approaches *Lutra*; but in the blunt form of the claws it is a true *Aonyx*. The first toe of the hind foot is proportionally much longer than in *L. chinensis*; its second and fifth are nearly equal, reaching to the middle of the second digit of the third and fourth toes, which are also nearly equal in length. The immature skin has the right hind foot remaining, which shows the same build of toes and nails.

While at Amoy in 1867 I procured a live Otter, from a ship which brought it from Saigon, Cochin China. When alive it was very tame, and followed its keeper about like a Dog. It was handled and caressed without its ever attempting to bite; but when put into a cage, or otherwise confined, it uttered a loud unceasing cry, which was most annoying. From the shortness of its head and its small size it was distinguishable at a glance from the common Chinese species. It would eat almost any thing in the way of food. This specimen has the peculiar short claws of *Lutra leptonyx* of Horsfield, but has a shorter, deeper-brown fur, and diminutive toes. Dr. J. E. Gray has examined the skull, and pronounced it not to differ from that of a specimen from India, figured in P. Z. S. 1865, p. 130; and its external form, I find, agrees with that of skins of the short-toed race from Madras in the British Museum. Dr. Jerdon (Mamm. of India) does not separate the Indian *Aonyx* from that of Java; no more does Dr. J. E. Gray, though the latter considers *A. indigitata* (Hodgs.), of Nepaul, distinct. Unfortunately, there is no skull of the Nepaulese animal in the Museum; but the skin there has a similar foot to that of the Madras Otter above referred to, but differs in being paler with lighter underparts.

Short-toed Otter from Saigon, ♂. Length 26 inches; tail $9\frac{1}{2}$ length of head 4, from ear to ear across head 3, eye (outer angle) to eye across head 1.1; fore leg (shoulder to tip of toes) 7.8, ulnar joint to tip of toes 4.25; hind leg 9, tibial joint to tip of toes 3.4; sole of fore foot 1.25, from sole to tip of fourth toe beyond .4, breadth of sole .75; length of hind sole 1.6, toes beyond .5, breadth of hind sole .65. Toes imperfectly webbed.

Lips, cheeks, sides of neck, throat, and face-bristles buff-white. The rest of the fur dark brown, paler on the underparts, and much so on the chest. Down short and close, yellowish or buff-white on the lighter parts, browner on the upper or darker parts. Pelage very short and glossy. Ears small and rounded, covered with short hair. Hair on fore feet extremely short, on tail short and close.

11. THE THIBETAN BLACK BEAR. *Ursus tibetanus* (F. Cuv.).

A large black shaggy skin was shown me in Hainan as having been taken from an animal in that island. I judged it to be of this species rather than of *Ursus malayanus*, Horsf. Bears are shot with poisoned arrows by the wild tribes of the mountains. The Hainan Gazetteer has the following passage:—"Heung [or Bear] is fond of climbing trees and panting. Its gall in spring is in its heel, in

summer in its belly, in autumn in its left paw, in winter in its right paw. About its heart there is a white fat like jade, the taste of which is extremely fine; this is usually called 'Bear's white.' In winter the Bear lies torpid and does not eat. When hungry it licks its own paws, and thence the goodness in the paws.

"The Gazetteer of Kiungchowfoo says that Hainan produces Pig-bears, Dog-bears, Horse-bears, and Man-bears, alike in the body but differing in the head. Horse-bears are very large. Man-bears are not often seen.

"The old authors say that the Bear has great strength and is given to devouring children. The Le men attack and capture them, a whole tribe uniting in the attack. Where Bears are plentiful the place has no peace. The gall-bladder is of a transparent colour, like rice-grains, and if stuck through with grass-stalks and put into water the best kinds will spin round quite fast. These are good for dissolving all poisons."

12. THE MUSK-RAT. *Sorex myosurus*, Pall.

The Musk-rat was common in the houses in the capital city, and I was often disturbed in my room at night by its clinking note. It is found in all the large towns in South China and Formosa, being transported about in junks with the cargo.

13. SWINHOE'S WHALE. *Balenoptera swinhooi*, J. E. Gray, P. Z. S. 1865, p. 725.

I had heard much of the Whale-fisheries in the Hainan seas, and was in hopes that we should see some of the operations in connexion with them; but the season had passed. We saw, however, one or two large Whales off the west coast of Hainan. We made inquiries about their bones at every fishing-port we touched at, but only succeeded in getting one rib, which is now in the British Museum. It was the only remnant of a Whale that had been captured by some fishermen on the west coast of Hainan. The oil of the animal had been melted down, the flesh eaten, and the rest of the bones chopped up for manure.

This large Chinese Rorqual appears to spend its winter in the seas about Hainan and in the Gulf of Tonquin. It must there produce its young; for in May it is seen with its calf in the Namoa Straits (near the port of Swatow), and remains in that neighbourhood and about the Formosan channel till the north-easters set in at the end of October, when it wends south-westwards again.

A good account of the pursuit and capture of this species is given in the 'Chinese Repository' of November 1843, Art. IV., "Notices of the Whale Fishery in the Chinese Seas, as conducted by the inhabitants of the coasts."

14. RED-BELLIED SQUIRREL. *Sciurus castaneiventris*, Gray, Cat. Mamm. Brit. Mus. 1843, p. 142.

S. erythræus, Pall.; Swinh. Mamm. of Formosa, P. Z. S. 1862, p. 11.

Length of body, from snout to root of tail, $7\frac{1}{2}$ inches; length of

tail to tips of hairs at end 9 inches. Underside of legs, breast, and belly deep chestnut, in some rich and glossy, in others dull and inclined to maroon colour; the chestnut distinctly divided from the upper colour, and not blending with or shading into it. In some the chestnut extends to the throat, in others it is entirely wanting there; others, again, have it in greater or less extent. The amount of chestnut on the underparts also varies. In one of my specimens this colour springs from the pit of the arm and runs to the base of the thigh, thus ranging on either side of the underparts in two broad distinct lines; a second specimen has these lines blending across the belly. The hair of the upper parts is yellowish olive-grey, fretted with black, each hair being banded alternately with black and yellowish olive-grey, having the latter colour at the tip in the hair of the sides, but the black at the tip in the hair of the back. The long hairs of the tail are similarly, but more broadly, banded, the yellowish grey becoming nearly white towards the end of the tail, and the black conspicuous. The tail in all except one of my specimens is bushy. In this one the hairs are worn short, and the apical half of the tail has the appearance of being banded alternately with black and yellowish grey. Ears small and somewhat angular. Moustache-bristles black. Iris deep blackish brown. Toes blacker than the general colour. In the colouring of the upper parts some specimens are blacker and glossier, some greener in the olive tint, and some washed with chestnut-buff.

This Red-bellied Squirrel, which I first got in Formosa, I have since found in the Fokien mountains. In Hainan it was common about the gardens under the north wall of Kiungchow city; and I also met with it in almost every place that we visited, both in the interior and along the coast. In one place, on the 26th of March, I discovered its nest in a small tree near a village. It seemed in every respect like the nest of our Red Squirrel at home. It contained one half-grown young one, which jumped out and escaped.

The Gazetteer calls this Squirrel "The *Too-shoo* (or Poisonous Rat), of a size larger than a Rat, with a bushy tail. Bites the areca-nuts."

15. SMALL STRIPED SQUIRREL. *Sciurus m'clellandi*, Horsf.

Length of body $5\frac{1}{4}$ inches; tail to end of hairs $5\frac{1}{2}$. Rat-like, with hair longer than on the body, an inch long at the tip. Upper fur and tail yellowish brown, lightly freckled with blackish, the black predominating on the tail. Back with a central black line extending from between the shoulders to the bend of the rump; on each side of it a light indistinct yellowish-brown stripe, followed laterally by one of chestnut-brown, then by one of light yellowish buff, and lastly by another of chestnut-brown. Ears small, angular, black on back, and tipped on the hind side of the apical angle with longish white hairs. Underparts dingy whitish buff, with smoke-grey bases to the hairs; the bases to the hairs of the upper parts much deeper grey. Some specimens are washed on the upper parts with chestnut, richly on the rump; others are blacker, with the dorsal stripes

blended. The amount of black on the tail also varies. The underparts of some are duskier, of others tinged with rose-colour, and of others, again, more decidedly buff.

Like the last, this little Striped Squirrel is found in Formosa, in the Tingchow mountains of Fokien, and in Hainan. In the latter island I first detected it in the forests of the interior; but I observed it later in most woody places, especially where the Areca- and Cocoa-nut occurred. It runs with great agility along the ground and up the trunks of trees, but it descends trees slowly and awkwardly. It is, however, quite an arboreal species. Dr. J. E. Gray considers the South China species the same as the Himalayan animal; so that it has rather an extended range.

The Gazetteer calls this the "Hill-rat, shaped like a Rat, but incapable of hurting rice."

16. COMMON RAT. *Mus decumanus*, Pall.

Common at Kiungchow city, and in all the large towns we visited. "Shoo [or Rat], of all hole-frequenting vermin the biggest thief. If it eats salt it gets light in body. If it eats arsenic it quickly dies. The skins of the larger ones are used for furs, which are called 'furs of the Heavenly Deer.'"—*Gazetteer*.

17. RED FIELD-MOUSE. *Mus badius*, Blyth?

I picked up near the capital city the mutilated body of a Field-mouse, with coarse yellowish chestnut hair above, and white beneath. The specimen was too bad to preserve. I refer it, with doubt, to Blyth's species from Burmah.

18. SUBCRESTED PORCUPINE. *Hystrix hodgsoni*, Gray, P. Z. S. 1847, p. 101.

One of our party picked up a Porcupine's quill in the jungle at Nychow (S. Hainan). It is black, with white at tip and base, and answers to the dorsal quills of the Chinese animal which I have brought home from the Fokien province (China), and which appears to be an adult of the Himalayan species, hitherto only known from immature crestless examples. The Chinese specimen shows a small crest on the back of the head.

The Chinese call the Porcupine the *Haochoo* (Bristly Pig) and *Fung-che*. The Hainan Gazetteer says it is "like a Dog, lives in holes in the ground; has the hair black and *sharp*, like awls, 4 or 5 inches long; and a large tail. When attacked, it shoots its thorny bristles at its aggressors."

19. THE HAINAN HARE. *Lepus hainanus*, sp. nov. (Plate XVIII.)

We did not meet the Hare at all in our rambles in Hainan; but a Mandarin's son in the capital city gave me a live specimen taken in the neighbourhood, which I was surprised to find very different from the small species (*L. sinensis* of Gray) that ranges from Canton to Peking. The Hainan Hare is of about the same size as the Chinese, but has a smaller and rounder head, is more brightly coloured and

differently marked, and, instead of having coarse hair, has a soft woolly fur more like that of *L. timidus*. Indeed it is strange that so warmly clad a species should be found in such low latitudes.

Back, shoulders, and rump light yellowish brown, tinged with chestnut and fretted with black, the individual hairs having a band of yellowish and a long tip of black. On the rump the long hairs are closer together, and the black unites to form irregular bands and streaks. Down at root of hairs brownish grey. Round the nose, forehead, between the ears, and cheeks the main colour as above, all fretted more or less with black, the black forming an irregular mark on the cheek in rear of the eye-line. Anterior edge of eyelids and a patch in front of it white. Ear in front brown, with a few of the hairs tipped with yellowish; behind pale buff, blackish brown at tip, with a white margin; front borders of ear white. Throat, breast, belly, under tail, and inner surface of hind legs pure white; inner surface of fore legs less distinctly so. Hind neck light rust-colour, with a broad line of a deeper and richer hue of the same down its centre, making together a conspicuous patch. A broad band of rusty yellowish brown runs across the under neck and chest, sprinkled with a few black hairs; fore legs a richer hue of the same inclining to tile-red. Hind legs brown. Sides of body light chestnut-brown with few black hairs. Soles of feet light dingy brown; nails brown. Tail brownish black on upper surface. Moustache-bristles, some black and some white, and some half and half.

In its coloration this species may be at once distinguished from *L. sinensis*, Gray, by its white throat and much whiter underparts, by its broad nuchal patch and black upper surface of tail, and by the white borders to its ears. The coarse hair on its soles is a dull tawny, and not the bright ferruginous that marks those parts in *L. sinensis*.

Total length about 14 inches; of tail to tip of hairs 3; of fore leg 4.75; of femur 3.75, of tibia to end of toes $3\frac{1}{2}$; of ear 3; breadth of eye .6.

Skull much shorter than a skull of *L. sinensis* of the same age, but of nearly equal breadth, rounding uniformly backwards, and the nasal bones sloping gradually forwards and downwards, giving the head a rounded appearance. Incisive opening above palate narrower at base. Posterior edge of palate with a rounded nasal spine, the same part being smoothly convex in *L. sinensis*. Occipital bone above the foramen magnum nearly flat, with but a slight central ridge. Supraorbital process small and placed back. Molars smaller and narrower, $\frac{5-5}{5-5}$. Anterior upper incisors without the deep groove which characterizes these teeth in the genus *Lepus*, but marked with several narrow indistinct ridges. Lower jaw short and high. Incisors $\frac{4}{2}$.

Dimensions.—Length from front of incisors to projection of occipital crest 2.85; breadth from molar to molar 1.45, between orbits .62; from foremost molar to front of incisors .85; greatest breadth of brain-case 1 inch; height of skull (crown to base of lower jaw) 1.80.

The peculiar form of the upper incisors in the Hainan Hare is worth

noticing. A skull of *L. ruficaudatus*, Geof., from India, in the Museum of the Royal College of Surgeons, has similar upper incisors.

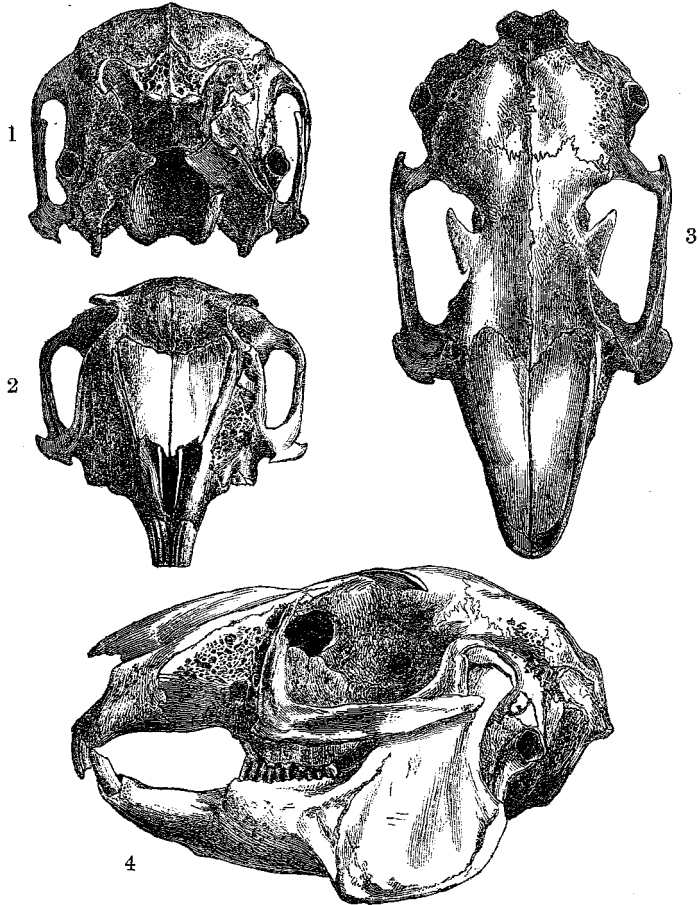


Fig. 1. Skull of *Lepus hainanus*, from behind.
 2. Ditto, from before.
 3. Ditto, upper view.
 4. Ditto, side view.

The nearest ally of our species appears to be *L. peguensis*, Blyth (J. A. S. xxiv. 471, and J. A. S. xxi. 359), "from the east side of the range of mountains dividing Arakan from the valley of the Irrawaddy," which, however, is a larger animal, has "the paws black underneath," "a large blackish terminal patch to the ear," and "towards the tail above a strong tinge of ash-colour." Blyth adds,

in a footnote to the second reference, "Hares are unknown in Arakan and in the Tenasserim provinces, also throughout the Malayan peninsula and archipelago, with the exception of *Lepus nigricollis*, F. Cuv., in Java, which has most probably been introduced from S. India or Ceylon, as it doubtless likewise has in the Mauritius; but we have met with several notices of Hares in the Indo-Chinese countries, even in Cochin-China, the species being as yet undetermined."

The Gazetteer says of the *Too* (or Hare), "In the Buddhist books it is called *Shay-kia*; is as large as a fox and of a brownish colour; its *anus* has nine apertures; the female gets impregnated by licking the bristles of the male."

20. WHITE-WHISKERED WILD BOAR. ?*Sus leucomystax*, Temm. et Schleg. Faun. Japon.

I heard of a Wild Hog occurring in the island, but never got sight of it. The Hainan Gazetteer speaks of it as if it were the ordinary Wild Boar, and merely quotes from the *Puntsao* (the great Chinese Herbal) the following remarks in illustration:—"Yaychoo (Wild Pig), Kow Tungshe says, is in form like the domestic Pig, but has a small belly, long feet, and brown hair; roams about in herds. The hunters dare only shoot arrows at the hindmost animal; if they hit the foremost, or one in the centre of the herd, the rest scatter and wound the sportsmen. The pork of the Wild Boar is red, like horse-flesh, but is more excellent eating than that of tame Pig."

Du Halde (*op. cit.*) tells of the "Cochons-marrons (which are a species of Wild Boar)" being very common there.

At Yu-lin-kan (S. Hainan) the Le people trap the Wild Pigs by clearing a space on the edge of the jungle and enclosing it with a wooden stockade, with an opening on one side. The stockade is angular; and at each angle is built a cone-shaped trap, formed of strips of wood, pointing outwards and downwards. The Pigs that venture inside the stockade are driven, and in their attempt to escape jump head foremost into these wooden pockets, and, not being able to back out of them in their hurry, are easily taken.

At the bartering-place Lingmun (Central Hainan) I picked out two Pigs' skulls from a lot of bones brought in by the Le to dispose of to the Chinese for manuring-purposes. These skulls are evidently not of a wild Pig.

Du Halde must mean by "Cochons-marrons" runaway, or feral, domestic pigs; but it is scarcely probable that a large island like Hainan has been stocked by runaway pigs. I did not see any peculiar Pig in the possession of the Le people, nor did I hear of any.

21. SCALY ANT-EATER. *Manis dalmanni*, Sundevall.

Pholidotus dalmanni, Gray, P. Z. S. 1865, p. 366.

I procured the skins of an adult and of a young Scaly Ant-eater at Hainan, which have much in common with the South-China species.

Adult. Total length 33 inches; tail 12.75 inches. Ears developed much as in the Chinese species. Scales rather darker. Reddish hair on underparts, and between scales much darker. Scales

of the three lowest series on sides of body between fore and hind legs carinated, or with a longitudinal ridge down the centre of each. A few on hind leg also keeled, but less distinctly.

Young. Total length 16 inches; tail nearly 6 inches. Scales very pale, whereas in the young of the Chinese species they are very dark. Lateral scales with prominent keels; those on hind leg more or less distinctly so. Scales small and uniform in adjustment, and with complete edges; those of the adult jagged, and broken at edge. Two small bundles of stiff hair project over each scale on the right and left of the overlapping apex of the scale behind.

I have a series of skins and bones of the *Manis* from Amoy and Formosa, which, together with the two above skins, I have handed over to Dr. Günther of the British Museum, who has offered to make a special study of them.

The Gazetteer gives, "The *Chuen-shan-kia* (or Hill-borer), also called *Ling-le* (or Mountain Carp), like a small Crocodile (Tow), and resembling a Carp with legs. Burrows in the hills, and enters into water. Delights in eating ants."

This closes the list of Hainan Mammals actually seen or procured in whole or part by myself. But to make the paper as complete as I can, I will quote the remaining matter in the Hainan Gazetteer on the subject, taking it in the order of the Chinese work.

"*Wild Cattle.*—These are domestic cattle that have for long had the run of the numerous mountains and peaks of the neighbouring Le. These have originated from cattle that were let loose to pasture and not collected to their stalls each night. Their dispositions have become wild, and they flee from the sight of man. To obtain them it is necessary to shoot them with a gun."

"*Seao kow, or Small Dog.*"—The old edition of the Gazetteer does not describe it. Of the group classed under the character *Le* (or Fox) we are told there are "several kinds." Besides the Heangle (*Viverra zibetha*), the Mao-hwa-le (*Viverricula indica*), the Pe hia le and Chale (which I take to be *Helictis moschata* and the *Herpestes* respectively), it gives the Chih le, or Red Fox. Some of my companions declared they saw a Fox at Nychow; but when cross-examined they were not confident it was a genuine Fox. The Chinese term for *Fulpes* is Hoo le; and I do not think the writer would refer to the true Fox, which is a well-known animal in China, under any other name.

"Tsze-wei (or Hedgehog), shaped like a Rat, with the whole body covered with spines." I found a Hedgehog common in North China (Tientsin and Peking), but I have never seen it in the south.

"The Gold-cash Pao (or *Leopardus varius*, Gray)." See above, under *Felis macrocelis*.

"Chai, resembling a Dog (Kow) with a long tail. Lang, like a (Keuen) Dog, with pointed head and high cheek-bones." Both Chai and Lang are applied to Wolves in books; in speaking it is customary to couple them together. I take the first to imply a species of *Lupus*, and the other *Nyctereutes procyonides*, Gray; but it is very questionable whether either occurs in Hainan.

"*Cattle.*—There are two kinds, called Water-Cow and Yellow
PROC. ZOOL. SOC.—1870, No. XVII.

Cow." The Water-Cow is the ordinary Chinese Buffalo, used for tillage and draught throughout the warmer parts of China. In Central Hainan (Taipingsze) nearly all I saw were *albinoes*—that is, had pink flesh, white hair, and red eyes.

The term Yellow Cow refers in South China to a small, short-horned, straight-backed breed, which used to occur wild in Formosa a century or two ago. I saw few of these, however, in Hainan. Most of the domestic cattle there were more or less humped, and seemed to be a cross between the Yellow Cow and the Indian humped breed. They were of much the same size as the Yellow Cow, but were in many cases brindled and patched like our home cattle. The South-China cattle are generally of a uniform yellowish-brown or black colour, sometimes with more or less white on the head, feet, and belly.

"*Horses*.—There are many white and sorrel-coloured. A work on geography of the former Han dynasty describes Tanurh and Choogai (divisions into which the Chinese possessions in Hainan were then divided) as having neither Tigers nor Horses. The old Gazetteer also says, 'Horses do not count among the natural productions of Hainan.' In the present day Tigers do not exist there, but Horses are produced in abundance." The said Horses are, of course, only Ponies of the small South China breed, with well moulded and compact limbs, rather large head, and long tail. They are not much used, except by officials.

"*Yang (or Goat)*.—There are Hill-goats and Manure-goats. The former are driven out to pasture over the land and find their own food. The latter are shut up when small in floored and covered pens, and fed on cut grass and leaves. Their feet never touch the ground. They grow very fat and are excellent in flavour." All the Goats I saw pasturing on the hills were black, with yellow irides. Their hair was rather short and coarse, their horns about the length of the head; and they had the usual chin-tuft. It is the ordinary breed of South China and Formosa.

"Yu shoo, also called Sêng shoo, with a long body and large tail, is capable of suppressing Snakes and Vipers; is also fond of seizing Rats, birds, and poultry. In the work Kwang ya it is called Shoolang (Rat Wolf). The following verse from the Chuen-tsze refers to this creature:—"Can the Ke-ke (warrior's charger) catch Rats like the Leseng?" This is the *Mustela sibirica*, Pallas. Where the House-rat is abundant in Chinese towns this Weasel is pretty sure to occur also. It is as common in Amoy as in Tientsin.

"*Kow (Dog)*.—These are yellow, black, white, banded, all colours. Those that hang the feet with soles upturned are called Keuen. Those with long muzzles can be used for tilling the fields." The commonest Dog kept by the Chinese in Hainan is the one generally seen in South China, a larger breed of what is known as the "Wolf Dog" in England. There was another race, with shorter and blunter head, short hair usually of a brindled colour, of rather larger make, and bigger-boned. There were also what appeared to be Mongrels between these two. I have noticed the second race as also occurring

about the towns and villages of South China. The Aborigines appear to have no peculiar Dog of their own.

"*Choo (Pig)*.—Ears small, hoofs short. The white-necked variety is looked on with dislike." These small white and pied Pigs are reared in great quantity in Hainan, and a large trade is done in them with Canton, where the larger black race of South China, with long head and drooping ears, hollow back, and hanging belly, is comparatively scarce. It is the Hainan Pig that has been introduced into England, through Canton, as the "small China Pig;" and there is certainly a strong family likeness between the pretty Hainan race and the Berkshire breed at home.

"*Mao (or Domestic Cat)*.—Cannot endure fleas or lice on its skin. Cats that have nine holes inside the mouth will catch Rats the four seasons through." The Cats that I saw in the towns of Hainan were of the small short-haired race reared in Canton and throughout Southern China—very similar to the ordinary London Cat, but rather smaller.

3. List of Reptiles and Batrachians collected in the Island of Hainan (China), with Notes. By ROBERT SWINHOE, F.Z.S.

I. *Sauria*.

1. *VARANUS DRACENA* (L.); Günther, Reptiles of Brit. Ind. p. 65.

This large Lizard appears to be common in the interior of Hainan, and is eaten by the Chinese. I procured the skin of a good-sized specimen, and the foot of a smaller one. Dr. Günther has determined them to be of this species, which before was only known to occur in India, from Nepal to Ceylon. I have not met with it in any other part of China.

2. *MABOUIA CHINENSIS* (Gray); Günth. *op. cit.* p. 83.

The Chinese Skink is common in Hainan, and in China generally south of the Yangtze. It is also abundant in Formosa, and in the dry sandy millet-fields of the Pescadore Islands, where, however, it seems always to remain of a small size. The large Chinese specimens are sometimes richly marked with orange on the sides of the neck.

3. *PERIPIA PERONII* (Dum. et Bibr.); Günth. *op. cit.* p. 110.

The noisy House-gecko, *Gecko japonicus* (Dum. et Bibr.), did not enliven the walls of houses in Kiungchow city; but in its place this small species was occasionally seen. It seems to be silent. The best specimen I have brought was captured on the wall of the Taotai's waiting-hall at night. It was catching the flies attracted by the light of a lamp. Dr. Günther quotes this species as occurring in Mauritius, Penang, and Ceylon; but this is its first occurrence within Chinese bounds.

4. *DRACO*, sp.?

The little Flying Lizard appears only to be found in the jungly district of Nychow (South Hainan), where it is an article of trade. The natives say that it is usually met with during spring in the forests in pairs flying from tree to tree. They are caught with a net; and when one is taken the other falls to the ground and allows itself to be captured without difficulty. They are pinned out like Butterflies and dried for the market. Their chief use is to hasten childbirth, the dried reptile being placed on the forehead of the woman in labour. They are called *Fei-shay*, or "Flying Snake," and sell for one shilling apiece. I bought six of the prepared specimens; but Dr. Günther says that in their dried state it is impossible to determine the species.

5. *CALOTES VERSICOLOR* (Daud.); Günth. *op. cit.* p. 140.

This long-tailed green Tree-lizard, with a combed back, was very common in all the woody parts of the island, and I secured a good series. It is very agile in its movements, running with great celerity along the ground and up trees, and leaping from bough to bough like a Squirrel. The Chinese are very loth to touch it, declaring it to be venomous.

6. *LIOLEPIS GUTTATUS*, Cuv.; Günth. *op. cit.* p. 154.

On the low sandy hill, partly covered with Cocoa-nut trees, that bounds on the south the Lingshuy lagoon (S. E. Hainan) I first met with this large, showy, white-spotted Lizard. They were very numerous, and the sandy soil was riddled with their holes. They lay basking in the sun, and when disturbed would run with great speed to the mouths of their holes, where they would stop short and turn their heads about. If not satisfied with what they saw, they popped at once into their holes. If surprised far from their holes, they spring into the air while running, and, expanding the loose red skin of their sides, skim along the surface of the sand for a considerable distance (say, often twenty yards at a time) and thus reach their retreats at greater speed. Their flight is not continued by flaps, but seems to be merely a long sustained leap, the body being made buoyant by the expanded side skin, and is analogous to the flight of the Flying-fish. They have a peculiar smell about them, which affects the taste of their flesh; and they are in consequence not eaten by the Chinese, except when in great distress for food. I met them again in the Nychow district, and in many warm sandy nooks along the west coast—never in the neighbourhood of woods, and I do not believe that they ever scale trees. We saw hundreds of them, and took great interest in watching their habits.

The British Museum has specimens of this Lizard from the Malayan peninsula, from Mergui, from Cambodia, and from China.

II. *Ophidia*.7. *SIMOTES* or *OLIGODON*, sp.?

A red Snake about $1\frac{1}{2}$ foot in length, Dr. Günther says, belongs

to one or the other of these genera, but its head is so injured that he cannot determine it.

8. *TROPIDONOTUS STOLATUS* (L.); Günth. *op. cit.* p. 266.

This common Indian species, which may be distinguished by the longitudinal white stripe it carries on each side of its back, was abundant in Hainan, as it is elsewhere in South China.

9. *PYTHON MOLURUS* (L.); Günth. *op. cit.* p. 331.

Two large Pythons were exposed in the market for sale at Taipingsze (Central Hainan) in February. They had been taken in the neighbourhood, and I was told that the country people often brought them in. They were confined merely by a straw rope twisted round the neck. The natives declare that they are not hurtful to man; and are easily caught by throwing over their heads a noose of twisted grass, and may with this be led about without danger. They call them Vang, and take them for the sake of their skin, heart, and liver. The skin is used chiefly for making drums, banjos, and other musical instruments; and the heart and liver, when dried and pounded, for stimulative medicine. They offered the live ones to me for 1200 copper cash (5s.) each, provided I would return to them the hearts and livers. This was the day after the market-day, when the countrymen had left, and I could get no one to slaughter the monsters; so I contented myself with the couple of flat skins that I had already purchased at the bartering-station further among the mountains, which were quite sufficient to show the species.

Du Halde, in his great work on China, says of Hainan, "The reptiles cannot be dangerous there, seeing the confidence with which the islanders walk day and night on the plains and in the middle of the thick wood, without arms and with nearly always naked feet. There are, however, Snakes and Vipers of a prodigious size; but as they are very timid, a simple movement or the least cry drives them to a distance."

III. *Batrachia*.

10. *RANA ESCULENTA*, L.; Günth. *op. cit.* p. 408.

Very common about the rice-fields, and offered in most of the Hainan markets as an article of food. I did not preserve specimens.

11. *RANA GRACILIS*, Wiegman; Günth. *op. cit.* p. 409.

A common species in Hainan, and, indeed, all over South China. Found on marshy ground and about the edges of rice-fields.

12. *HYLA CHINENSIS*, Günth. *op. cit.* p. 409.

Occurs in the woods of the island. It is generally observed sitting motionless on a leaf, and, from its green colour, often escapes detection.

In conclusion, I have to record my thanks to Dr. Günther for examining and determining all the species named in this list.

4. Descriptions of some new Genera and Species of Birds belonging to the Families Formicariidæ, Pachycephalidæ, and Sylviidæ. By D. G. ELLIOT, F.L.S., F.Z.S., &c.

(Plates XIX., XX.)

CLYTORHYNCHUS PACHYCEPHALOÏDES, sp. et gen. nov. (Plate XIX.)

Clytorhynchus genus novum Pachycephalinarum; rostrum compressum, subdescendens, ad apicem incurvum; gonyx recurvus, fortiter ascendens; remiges secundus, tertius et quartus fere æquales et longissimi.

♂. *Ex toto brunneus; subtus pallidior vix rufescenti-viridis; rectricibus apice albis; rostro et pedibus plumbeis.*

Hab. New Caledonia.

Upper parts dark rufous-brown, slightly brighter upon the fore part of head and rump. Primaries brownish black; secondaries and tertials like the back, with the edges of the outer webs reddish. Four central feathers of the tail blackish brown for their entire length, the remainder lighter brown, with the ends white, most extensive on the first and second, where it includes both webs, and is about half an inch in length, becoming much less on the third, and is represented on the fourth only by a round spot on the tip of the inner web. Underparts light rufous-brown, slightly darker on the flanks. Bill strong; upper mandible slightly hooked, lower with a decided upward curve, lead-colour at base; the cutting-edges of both mandibles and point horn-colour. Feet lead-colour, claws horn-colour.

Total length $6\frac{1}{2}$ inches; wing $3\frac{1}{2}$, tail 3, tarsus $\frac{3}{4}$, bill at gape $\frac{7}{8}$.

This curious species, which represents an entirely new genus of the family Pachycephalidæ, holds the same relative position to this family as the *Vanga xenopirostris* of La Fresnaye (*Xenopirostris la fresnayus*, Bon.) does to that of the Laniidæ. It is a native of New Caledonia; and the unique specimen from which my description was taken is now contained in the collection of the Museum of Natural History of New York.

CLYTOCTANTES ALIXII, sp. et gen. nov. (Plate XX.)

Clytoctantes genus novum Thamnophilinarum; rostrum magnum, compressum, subrecurvatum; culmen rectum, apex non incurvus; gonyx recurvus, fortiter ascendens; remiges quartus, quintus, sextus et septimus fere æquales et longissimi; pedes graciles, ungues longiores quam in genere Neoctantes.

♂. *Capite et gula nigris, dorso abdomineque plumbeis; alis fusciscentibus; cauda brunneo-nigra; macula magna interscapulari alba; rostro nigro, mandibula inferiore ad basin albicante; pedibus nigris.*

♂ juv. *Niger, rufo-brunneo tinctus; capite saturatius rufo; regione parotica castanea.*

Hab. Rio Napo.



F. G. S. 1870.

M. & N. Hanhart comp.

CLYTORHYNCHUS PACHYCEPHALOIDES



Edinburgh 1870.

W. & A. Nichol & Co.

CENTOCANTES ALIXI

♂. Upper part of head blackish; throat, ear-coverts, and upper part of breast intensely black. Back and lower part of breast very dark slate-colour, almost black. Tail brownish black. A concealed white spot in the centre of the back. The feathers of the rump very long and soft. Primaries blackish brown; secondaries lighter brown. Bill large, very straight on the culmen, black on the upper mandible; under mandible with a very strong upward curve, commencing at the base, and, in the specimen, extending beyond and above the point of the upper mandible, dark lead-colour. The form of the lower mandible in this specimen is probably abnormal, as it shows no indication of protruding in the bill of the young male before me. Legs and feet black; claws very long and slender, black.

Total length $6\frac{1}{2}$ inches; wing $3\frac{1}{4}$, tail $2\frac{3}{4}$, bill at gape 1, tarsus $1\frac{1}{2}$.

A young male, just commencing to throw off the colours of the female has the head and upper of neck and throat rich chestnut-brown interspersed with the black feathers of the adult. Back and underparts lead-colour, the tips of the feathers reddish brown. Tail black. Bill like the male, but slightly broader, the under mandible not extending beyond the upper. Feet and tarsus black, claws long and slender.

Total length 6 inches; wing 3, tail $2\frac{3}{4}$, bill at gape 1, tarsus $1\frac{1}{2}$.

Hab. Rio Napo.

This extraordinary form of Formicariidæ is apparently an exaggeration of Mr. Scater's genus *Neotantes**, to which it seems to be nearest allied. In many respects resembling the members of the genus *Thamnophilus*, it yet differs greatly from them in the form of the bill, and shape and size of the feet and claws. In appearance it resembles *Neotantes niger*, but is more of a plumbeous colour than that species; and the bill is larger, straighter upon the culmen, and the under mandible more decidedly and abruptly curved upward. The feet are larger, and the claws much longer and more curved.

I have named the species after Dr. Alix, of Paris, well known for various scientific publications.

The examples from which my description was taken are contained in the fine collection of the Museum of Natural History of New York.

CALAMOHERPE SUBFLAVESCENS.

Olivaceo-brunneus: subtus flavescens; linea superciliari flava; hypochondriis et pectore superiore olivacentibus; tectricibus alarum et remigibus brunneis; mandibula flava, maxilla brunnea.

Hab. Dahouria.

Entire upper parts olive-brown; a line over the eye yellow; underparts yellow, brown upon the flanks. Wings and tail dark olive-brown. Lower mandible yellow; upper dark brown. Tarsi and feet flesh-colour.

Total length $6\frac{1}{2}$ inches; wings 3, tail 3, tarsus 1, bill $\frac{6}{10}$.

This bird, which is apparently undescribed, comes from Dahouria,

* Described P. Z. S. 1868, p. 572.

in Central Asia, and was received in a collection of other species by Madame Verdey. It seems closest allied to the *C. fumigata* of Swinhoe from China, but differs from it in the following characters, which readily serve to distinguish it from that species. The upper plumage of *C. fumigata* is chestnut-brown, instead of olive-brown as in the present bird, which has no trace of chestnut; the superciliary stripe in *C. fumigata* is white, in this species it is yellow; the throat and underparts of *C. subflavescens* are yellow, while those of its ally are white. These are sufficient to indicate the differences which exist, although others occur*.

The specimen described is the only one I have seen; and I have no information regarding the economy or habits of the species.

5. On some new or little-known points in the Economy of the Common Swallow (*Hirundo rustica*). By R. B. SHARPE, F.L.S. &c., and H. E. DRESSER, F.Z.S. &c.

In examining a large series of the Common Swallow (*Hirundo rustica*) for our proposed work on the Birds of Europe, some peculiar facts have come under our observation, which do not seem to have been previously recorded by other ornithologists; and we therefore lose no time in bringing them before the notice of the public. In order to place the result of our observations in as clear and concise a manner as possible before our readers, we think it best to give the following diagnoses of the specimens on which our conclusions have been based. We take this opportunity of returning our best thanks to Mr. Frederick R. Surtees, to whom we are indebted for the specimens from South Africa, which have been the means of our making the discovery of the curious phases of plumage through which the Common Swallow passes on leaving northern latitudes. The Rev. Dr. Tristram has also, with his usual kindness, sent us his specimens of Swallows collected by him in Palestine.

No. 1. (Taken from a nest at Highgate, near London, on the 22nd of June, 1869.) Frontlet (extending backwards over the eye) and throat very pale sienna; space between the bill and the eye, as well as the cheeks, black; entire upper surface dusky steel-blue; quills blackish, edged externally with greenish blue, as also the tail, which is almost square, the spots on the latter white, tinged faintly with buff; a band extending across the lower part of the throat and chest dusky black with scarcely any blue reflection; rest of the under surface of the body white, tinged with delicate buff, flanks dusky; bill blackish, yellow along the gape; feet dark brown. Total length 4·3 inches; wing 3·1; tail measured to tip of outer-feather 1·3.

* Since writing the above I have been shown by Lord Walden a specimen of *C. fasciolata*, Gray (P. Z. S. 1860, p. 349), from Batchian, which resembles my bird still more closely than *C. fumigata*, but differs in having a much larger bill and in the colour of the upper parts and tail. The two species can readily be distinguished from each other.

No. 2. (*Young, shot near Chichester by R. B. Sharpe on the 23rd of August, 1869.*) Above dusky steel-blue; forehead and eye-brow very pale sienna; least wing-coverts narrowly margined with pale sienna, as also are some of the inner greater wing-coverts; tail forked, the spots tinged with buff towards the shaft; throat pale sienna; band across the breast narrow, very dusky and mixed with sienna, which latter colour is very prominent on some of the feathers; under surface of the body pale buff, flanks a little dusky. Total length 6·2 inches; wing 4·8; tail, measured to tip of outer feather, 2·6.

Another young bird, caught at Highgate on the 24th of September, 1869, differs in having the underparts a little less buff, the throat and frontlet deeper sienna.

No. 3. (*Obtained in the Cape Colony by Mr. F. R. Surtees, and given to us by him; mus. R. B. S.*) Upper surface dusky brown, especially on the head, washed sparingly with steel-blue; quills and tail dusky brown with scarcely any greenish reflection, shafts dirty brownish white; the form of the frontlet marked with pale whitish feathers extending backwards above the eye; throat quite white, with a tinge of rufous, apparently the remains of a red feather, on a few of the feathers on the sides of the neck; below the white throat a band of dusky-brown feathers rather broad and mixed with a few pale rusty-coloured feathers in the centre; rest of the under surface of the body white, with just a tinge of buff on the lower part of the belly. Total length 6·2 inches; wing 4·7; tail, measured as before, 2·65. This bird is probably a late-bred bird; his plumage is thoroughly bleached. He is just beginning to moult and put on his spring plumage; but no signs are apparent of the new feathers on the head and throat, the new feathers having a dark shaft.

No. 4. (*In changing plumage, from the Cape, also obtained by Mr. Surtees.*) Above deep steel-blue, except the head, which is dusky brown, with a cluster of small blue feathers on the nape and sides of the head, and a few scattered over the crown; forehead only indicated by a fulvous mark, as in the preceding bird; cheeks brown, just slightly washed with blue; quills blackish brown distinctly washed with bright greenish steel-blue, the first primaries worn and dull brown with light brown shafts (N.B. These have not been shed, while the other quills are lately donned); tail-feathers blackish brown washed with greenish steel-blue, the spots pure white without a tinge of buff; one outer feather lately put on and having a dark shaft, all the shafts of the others being light brown; chin white with a few red feathers here and there, rest of the throat chestnut; a rather narrow breast-band, dark brown, becoming distinctly glossed with bright steel-blue, a few reddish feathers coming in the centre; rest of the under surface of the body pure white with a suffusion of buff, deepest on the under wing- and tail-coverts. Total length 6·6 inches; wing 4·6; tail, as before, 3·1.

No. 5. (*Also obtained by Mr. Surtees; mus. H. E. D.*) Similar to the foregoing, but shows the coming rufous forehead, distinctly indicated by a frontlet of pale sienna, the upper surface brilliant

steel-blue, but the head all brown, except a few blue feathers coming on the side; first primaries unmoulted, as also are some of the secondaries and tail-feathers; the throat almost entirely rufous, except the chin, which still remains somewhat whitish; breast-band becoming distinct, a few rufous feathers intermixed, washed with deep steel-blue; rest of the under surface of the body deep buff, especially on the under wing- and tail-coverts, which are almost chestnut. The quills and tail are too much abraded to give satisfactory measurements.

No. 6. (*Male, shot at the Knysna by the late Mr. C. J. Anderson on the 2nd of January, 1866; mus. R. B. S.*) Apparently a bird of the previous year putting on its full spring plumage, as it has a trace of the swollen yellow skin at the gape; upper plumage very bright steel-blue, and the red forehead well marked; no trace of white on the throat, and the breast-band dark steel-blue with red feathers intermixed; under surface of the body rich buff, especially dark on the under wing- and tail-coverts; the quills and tail abraded and not thoroughly moulted, though the new feathers are coming rapidly.

No. 7. (*Sent from the Cape Colony by Mr. E. L. Layard; mus. R. B. S.*) Apparently about the same age as the last specimen, but the head brownish, only just beginning to assume the steel-blue appearance, the rest of the upper surface very bright steel-blue; frontlet distinctly marked but very narrow; throat and breast-band as in the last specimen, but the under surface of the body white, with a faint buff tinge on the under wing- and tail-coverts; quills and tail only partially moulted, much worn.

Nos. 8 and 9. (*Male and female, shot at Cookham, in Berkshire, by Mr. J. Ford, on the 19th of April, 1869; mus. R. B. S.*) Above most brilliant steel-blue; quills and tail washed with greenish steel-blue; forehead and throat deep chestnut; band on the breast steel-blue; under surface deep buff, particularly on the under wing- and tail-coverts. Total length 8 inches; wing 5.1; tail to tip of outer feather 4.5. The female is somewhat smaller, the frontlet and throat not quite so deep, the belly white, and the tail shorter, with the spots on the latter smaller. Total length 7 inches; wing 4.9; tail 3.7.

No. 10. (*Female, fully moulted, obtained in Natal by Mr. Ayres; mus. H. B. Tristram.*) Similar to No. 9 (♀), excepting that the head is duller, the feathers of the crown being slightly intermixed with brown, and the frontlet and throat not of such a deep rufous colour.

No. 11. (*Male, shot at Tiberias on the 27th of February, 1864, by Mr. Tristram.*) Differs in no way whatsoever from No. 8 (♂).

From the examination of these specimens the following conclusions are derived; and we earnestly beg our ornithological readers to assist us in the further elucidation of this most complicated question; but we must remark that it will be necessary to have a large series of carefully authenticated specimens before the subject can be approached. We have at the present moment a series of forty-five skins lying before us from all portions of the globe where *Hirundo rustica* is found.

REMARKS.

1. The Common Swallow on leaving the nest has a pale sienna frontlet and throat, the upper plumage very dull, and the entire breast suffused with pale buff; the band on the chest very dusky, but large for the size of the bird. This plumage slightly intensifies as the bird gets older; and on leaving this country the chest-band is more distinct, the upper plumage more suffused with blue, and the throat and frontlet of a darker tinge; the outer tail-feathers and primaries also become more elongated (*cf.* descriptions of spec. 1 and 2, *suprà*, pp. 244, 245).

2. When the young bird arrives in Southern Africa its plumage has undergone a complete change, which may be called the winter plumage of the bird of the year (*cf.* description of spec. 3, *suprà*, p. 245); the throat is white with the very faintest tinge of rufous, abdomen white, breast-band broad, but pale brown, the upper surface dusky brown washed with blue, and the entire head brown, with very slight blue reflections.

There is no doubt that this stage of dress is arrived at by the gradual bleaching of the young feathers, and the full plumage is regained *by an entire moult*. This is shown especially by the quills, those of the old plumage being worn and pale in colour, the shafts being nearly white, whereas the new feathers, some of which, in our specimens above mentioned, are always to be found alongside of the old quills, have black shafts. The long primaries are the last to be shed.

3. The adult specimens of *Hirundo rustica*, which pass the winter in Southern Africa, have the breast white; and as the period of the migration northward approaches, this becomes suffused with buff, and is very distinct when the bird begins its northward journey. On arriving in Europe both sexes (?), the male certainly, have the breast and, particularly, the under tail-coverts buff, the frontlet and throat rich chestnut, the breast-band and upper surface much more brilliant blue than when it leaves the Cape. In the male the buff continues during the summer, getting paler towards the autumn; but the breeding female is always pure white underneath.

4. We may here call attention to the curious fact that though the young on leaving the nest has a frontlet of pale sienna, so complete is the process of bleaching through which the bird passes before reaching the Cape that on its arrival there all traces of the rufous frontlet have disappeared, and there is a mere indication of a frontlet by the presence of a few pale buff-coloured feathers. At the spring moult the red forehead is resumed.

Before concluding the present essay we have a few words to add respecting the supposed variety of the Common Swallow to which the name of *Hirundo riocouri* has been given. We have examined several carefully authenticated specimens of this bird; and we fully believe it to be a distinct species, possessing a very limited range. Indeed we do not hesitate to say that its occurrence in Europe is very doubtful, and that its admission into the European avifauna

has yet to be thoroughly confirmed. The statements of Professor Blasius, which are reproduced in Dr. Bree's 'Birds of Europe' (vol. iii. p. 171), need confirmation as to its interbreeding with the Common Swallow and being generally found in Europe; for we have every reason to believe that the adult spring plumage of *H. rustica*, when the under surface is deeply suffused with buff, has been mistaken for *H. riocouri*. The latter bird may always be distinguished from the Common Swallow by the uniform chestnut tint of the whole under surface below the chest-band, and also by the spots on the tail being of a pale rufous colour and not white. The range of the *H. riocouri* is limited to Palestine and Egypt, extending not further south than Nubia; and in these countries it is not migratory. In confirmation of the above remarks we may quote from the writings of Dr. von Heuglin (Orn. N. O. Afr. p. 152) and Dr. Tristram (Ibis, 1867, p. 361).

"*Hirundo cahirica*," writes the former author, "in mode of nidification and song, as far as I know, hardly differs from *H. rustica*; but it is a resident in Egypt, though not so further south*. It breeds in the months of January to April. In Arabia I have observed the true *H. rustica*, but not in the bright-breasted plumage, which latter, however, I have never found in the breeding-season in company with *H. cahirica*."

We also add his remarks on *H. rustica* (Orn. N. O. Afr. p. 151). "In the beginning of March to early in May, and between August and October, this bird is frequently seen in companies on the migration, often mixing with other species along the Nile and the Red Sea, and even on the true steppes. On the 15th of November, 1857, I even observed on the Somali coast a flight of migrating Chimney-Swallows, and believe that they extend their migrations far to the south of the equator, according to Ayres to Natal. Amongst the Chimney-Swallows which are found during the summer on the Red Sea I have never observed *H. cahirica*."

Dr. Tristram says (*l. c.*)—" *Hirundo cahirica* remains the whole year, and is found both on the coast (in the maritime plains) and throughout the length of the Jordan valley. No one can observe this bird in the Holy Land without being satisfied of its distinctness from *Hirundo rustica*. It is true we can give no other diagnosis than the difference of coloration on the lower parts, these being chestnut instead of white or brownish white; but of the hundreds of Swallows of both sexes to be seen throughout the winter not one of the common sort could be detected. There is neither fading nor intensifying of the chestnut lower plumage at any time of the year. Specimens shot at all seasons are precisely similar. In spring their numbers rapidly increase; and from the middle of March they become distributed over the whole country, the higher as well as the lower grounds, while along with them appear many of our common species. In the higher grounds these perhaps predominate; in the lower certainly the *Hirundo cahirica* is most numerous. I never could detect

* A specimen from Nubia, collected by Rüppell, is in the Leyden Museum.—R. B. S.



C. B. Sawyer, Sc.

M. & N. Macmillan, Del.

NEW SHELLS.



G.B. Sewerky del.

V. & N. Hearn

NEW SHELLS

the two sorts interbreeding, though the nest and eggs are precisely similar."

In conclusion we beg to state that we by no means wish positively to deny the occurrence of the true *H. cahirica* in Europe. On the contrary we believe it very possibly does occur within European limits; but at the same time all the so-called European specimens of *H. cahirica* that we have seen have been *H. rustica* in spring dress. We shall be most glad to receive any authentic specimens of *H. cahirica* from any part of Europe, that we may be certain on the subject before including it in our 'Birds of Europe.'

6. Descriptions of Forty-eight new Species of Shells.

By G. B. SOWERBY, F.L.S.

(Plates XXI., XXII.)

CRASSATELLA SUBQUADRATA.

C. testa oblongo-subquadrata, valde compressa, solida, pallide rubescente, castaneo obscure radiata, ad umbones purpureo biradiata, intus albida, extus concentricè minute striata, liris angulatis subdistantibus, ad angulum quadratis sculpta; latere postico longiusculo, obtuse angulato, post angulum complanato, margine dorsali recto, subdeclivi; latere antico breviusculo; margine dorsali utrinque concavo-complanato; margine interno levi.

Hab. Agulhas Bank, S. Africa.

Mus. Taylor.

CRASSATELLA FOVEOLATA.

C. testa obliqua, crassa, tumida, rostrata, pallida, castaneo maculata, intus partim castanea, extus costellis validis rotundis subdistantibus medio tumidiusculis concentricis lirata, interstitiis profundis; latere postico oblique producto, elevatim angulato, eleganter rostrato, post angulum castaneo; umbonibus elevatis, prominentibus, acutis, margine dorsali utrinque declivi, excavato; margine interno denticulato; epidermide fusca.

Hab. China Seas.

Mus. Taylor.

This shell resembles *C. sulcata*, but differs from it in being more pointedly beaked and more distantly and deeply grooved. All the ridges in this species follow the lines of growth; but in *C. sulcata* they become excentric towards the margin.

CRASSATELLA CREBRILIRATA.

C. testa ponderosa, obliqua, subcompressa, pallide fulvescente, obscurissime radiata, umbones versus rubescente, intus pallidissime rosacea; latere postico oblique producto, angulato, post angulum complanato, margine terminali oblique truncato; latere antico

brevissimo, margine dorsali utrinque valde declivi excavato; margine interno obscurissime denticulato.

Hab. Agulhas Bank, S. Africa. 15 fathoms.

Mus. Taylor.

SOLENELLA SUBÆQUALIS. (Pl. XXI. fig. 5.)

S. testa subovata, subæquilaterali, tumidiuscula, breviuscula, latere postico lato, obsolete biangulato, inter angulos radiatim subdepresso, margine dorsali rectiusculo, margine ventrali abrupte sursum acclivi; latere antico angustiusculo obtuso, margine dorsali subdeclivi, margine ventrali abrupte sursum acclivi.

Hab. Rio Janeiro.

Mus. Leckenby.

This third species of its genus is intermediate between the former two in its lateral proportions. In *S. norrissii* the anterior is much the shorter side; in *S. cumingii* the posterior is the shorter. The present species is equilateral.

LEDA IRRADIATA.

L. testa parva, ovata, radiatim nitente, minute concentrice lirata, tumida, subæquilaterali; latere postico subacuminato, versus terminum radiatim vix depresso; latere antico acuminato, ad terminum arcuatim elevato; lunula lata.

Hab. China Seas.

Mus. Taylor.

A pretty little species, showing a brilliant irradiation resembling that of the cat's-eye jewel.

DOLABRIFERA BRAZIERI.

D. testa recta, planiuscula; apice elevato, recto, crasso, intus rotundato, convexo, extus concavo; margine postico declivi, concavo, margine labiali rectiusculo, antice incurvo, sinuato; margine sinistrali rectiusculo.

Hab. Northhead, Botany Bay (*Mr. Brazier*).

Only two specimens of this, the first species of the genus found on the south-west coast of Australia, were taken by Mr. John Brazier. No note seems to have been made of the character of the animal; but the shell, which is large, differs from that of other known species.

HELICINA MANGOENSIS.

H. testa pallide lutea, supra aurantia, trochæformi; anfractibus convexis, infra medium carinatis, supra carinam spiraliter liris, infra carinam subplanulatis, læviusculis; carina lata, declivi, subtus vix crenulata; apice obtuso; apertura trigona; margine basali convexiusculo.

Hab. Mango Island, Fijis (*Mr. Brazier*).

Unfortunately only one specimen of this remarkable *Helicina* has been taken. It is similar to *H. josephinae*, but much more convex above.

AMATHINA TRIGONA.

A. testa parva, solida, superne complanata, medio carinis duabus distantibus divergentibus, et infra medium costellis tribus spiraliter radiata, infra costas planata; apice parvo, acuminato; apertura magna, trigona; margine basali declivi, oblique producto.

Hab. Tongataboo, Friendly Islands (*Mr. Brazier*).

This new *Amathina* has two widely diverging principal keels or ribs, above which is a broadly flattened, depressed area, and below which are several small ribs and a plain space.

ELENCHUS DILATATUS.

E. testa brevi, subcinerea, spiraliter subdistanter lirata; spira brevi; anfractibus quatuor, ultimo lato; apertura dilatata, viridi-cæruleo iridescente.

Hab. New Zealand (*Mr. Brazier*).

Remarkable for the expansion of the last whorl.

SOLARIELLA UNDATA.

S. testa subdepressa, umbilico rotundo usque ad apicem perforata, margaritacea, pallide rubescente, spiraliter tenuiter lirata, supra prope suturam angulata; medio anfractuum carina rotundato-angulata, angulis distanter rubro maculatis; interstitiis rubro undato-lineatis.

Hab. Agulhas Bank, S. Africa.

Mus. Taylor.

CYLLENE RUBRO-LINEATA.

C. testa ovato-acuminata, albido-fulvescente, ad dorsum pallide purpurea; spira breviuscula, acuminata; anfractibus numerosis, longitudinaliter oblique liratis; apertura longitudine spiram superante, intus castanea, labio columellari late reflexo linea rubra circumscripto; labio externo intus striato, extus post marginem incrassato; sinu antico parvo.

Hab. —?

Mus. Taylor.

TYPHIS DUPLICATUS. (Plate XXI, fig. 1.)

T. testa ovato-acuminata, inter varices castanea, varicibus arcuatim recurvis cum tubis interstitialibus junctis, tubas latas complanatas duplicatas efformantibus; spira acuminata; apertura subrotunda; canali elongato, clauso.

Hab. China Seas.

A second example of the peculiar form first presented by *T. arcuatus*, Hind., in which the varix is bent back towards the interstitial tube so as to form a double varix with a single opening. In the present case the union is less complete, and the opening part of the tube is broad, flattened, and contracted in the middle, so as to appear duplicate.

RAPA BULBIFORMIS.

R. subglobosa, albido-subviridi, infra spiraliter imbricato-lirata; spira producta; anfractibus 6, rotundis; apertura pyriformi, angustiuscula; labio infra crenulato.

Hab. Tongataboo, Friendly Islands.

This shell was found by Mr. Brazier in a large hole in a coral-reef, on a piece of sponge, in five-feet water. It has a much more produced spire than the known species, with rounded whorls.

FUSUS RUBRO-LINEATUS.

F. testa breviuscula, pallide rubescente, castaneo bifasciata, distanter spiraliter rubro lineata, tenuiter striata; spira breviuscula; anfractibus septem, costis longitudinalibus subdistantibus rotundis spiraliter liratis ornatis, superne fascia castanea lata cinctis; apertura subovata, in canalem subelongatum terminante.

Hab. Agulhas Bank, S. Africa.

Mus. Taylor.

TEREBRA TENUISCULPTA.

T. testa angustissima, elongata, fusca, saturatiore flammulata, vel albida castaneo pallide flammulata; anfractibus compressis, supra prope suturam liris spiralibus inæqualibus prominentibus granoso-moniliformibus cinctis, infra cancellatis, ultimo infra angulum tenuiter sculptis.

Hab. China Seas.

Mus. Leckenby.

EBURNA PERFORATA. (Plate XXI. fig. 2.)

E. testa rotundato-pyramidata, maculis magnis fulvidis undatis, medio anfractuum truncatis, infra medium in series duas dispositis, subrotundis, brevibus picta; spira breviuscula, apice purpureo; anfractibus breviusculis, rotundis; canali suturali lato, profunde, excavato; umbilico latissimo, usque ad apicem spiraliter excavato, medio spiraliter calloso; apertura parva; labio columellari leviter arcuato.

The deep, wide canal and short rounded whorls, an arrangement of spots differing from all the other species', and a spiral groove at the lower part of the whorl, resembling only that in *E. formosæ*, Sowb., render this a very remarkable shell. It has a very wide and perforating umbilicus, in which it is only nearly approached by *E. spirata*, Linn., and a spiral umbilical callus resembling that in *E. canaliculata*.

TURRITELLA EXCAVATA. (Plate XXI. fig. 3.)

T. testa attenuata, acuminata, tenuiuscula, sublævigata, albida, medio anfractuum castaneo, spiraliter fasciata; anfractibus subelongatis, medio excavatis, supra prope suturam angustatis, tumidis, infra latis, inflatis, rotundatis; apertura subpyriformi, labio profundissime et late supra medium emarginata.

Hab. Agulhas Bank.

This shell is figured in Reeve's Monograph as a variety of *T. exoleta*, from which species, however, it is quite distinct.

TURRITELLA PUNCTICULATA.

T. testa robusta, pallide fulva, liris spiralibus numerosis validis, rotundatis, minute punctato-maculatis, et interstitiis sulcatis sculpta; anfractibus rotundatis, numerosis, flammulis fuscatis ornatis, ultimo subangulato, infra angulum planiusculo.

Hab. Agulhas Bank, S. Africa.

Mus. Taylor.

PLEUROTOMA LATIFASCIATA.

P. testa attenuata, albida, fasciis latissimis fumeo-castaneis duabus cincta; spira elongata; anfractibus numerosis, brevibus, spiraliter striatis, medio albifasciatis, supra ad suturam granoso-uniliratis, tum excavatis, medio angulatis, costellis longitudinalibus numerosis ornatis, ultimo infra granoso-lirato; apertura brevi, angustiuscula, sinu haud profundo.

Hab. Hongkong.

Mus. Taylor.

PLEUROTOMA LATERCULATA.

P. fusiformi, solida, lævigata, longitudinaliter costata, maculis quadratis rubris tessellata; spira pyramidata; anfractibus medio angulatis, ad angulum carinis duabus, ad costas tuberculatis; apertura subpyriformi, labio extus incrassato, prope suturam emarginato.

Hab. China Seas.

Mus. Taylor.

PLEUROTOMA ALBICARINATA.

P. testa angusta, scabriuscula, fusca, supra medium acute carinata, ad carinam alba; anfractibus supra et infra carinam acute uniliratis, ultimo medio subcarinato, infra carinam liris acutis et interstitiis longitudinaliter crenulatis sculpto; columella rectiuscula; labio ad carinam albam acute emarginato.

Hab. Manzanilla.

Mus. Taylor.

This shell differs from *P. oxytropis* in being laterally much more compressed, in being much shorter above the keel, which is sharp and white, and in being altogether more closely sculptured.

CLAVATULA TUMIDA.

C. testa crassa, subfusiformi, pallide rubescente, epidermide tenui subviridi induta; spira mucronata, convexiuscula, aperturam longitudine superante; anfractibus declivibus, medio concavis uniliratis, supra prope suturam tuberculatis, infra oblique tuberculato-costatis; ultimo obtuse angulato, infra angulum tumidiusculo, lævigato;

apertura alba, castaneo picta, postice acuminata, antice lata, truncata; labio supra medium subacutè emarginato.

Hab. Agulhas Bank, S. Africa.

Mus. Taylor.

CLAVATULA GRACILIOR.

C. testa elongata, pyramidata, crassa, sub epidermide fulva, prope suturam albo fasciata; spira pyramidata, attenuata; anfractibus 12, leviter angulatis, ad suturam tumidiusculis, posticis 6, ad angulum oblique tuberculatis, anticis oblique undulatis; apertura brevi, antice et postice alba, medio fulva, termino obtuso, sinu labii postico profundo, subquadrato.

Hab. —?

Mus. Taylor.

The spire in this species is more elongated than in the preceding, and it has no tumid part anterior to the obtuse and not very prominent angle. Also it has no convexity in the spire. From *Cl. turus* it differs in the much greater elongation of the spire, and also in not having the tumid varix at the top of each whorl which characterizes that species.

DEFRANCIA SECTA.

D. testa albida, fusiformi, acute cancellata; apertura ovata, canali subelongato; labio ad suturam sinu angusto elongato secto.

Hab. China.

Mus. Taylor.

MANGELIA CLAVATA.

M. testa elongate fusiformi, pallida, supra et infra fulvo fasciata; spira elongata, acuminata; anfractibus angulatis longitudinaliter costatis, spiraliter striatis; apertura clavata; labio externo post marginem valide unicastato, canali caudali elongato.

Hab. China Seas.

Mus. Taylor.

In general appearance resembling *Mangelia gracilis* of our seas, but more elegantly fusiform, with longer and more tapering canal.

METULA TRIFASCIATA.

M. testa angusta, mitriformi, minute cancellata, pallidissime fulva, fusco pallido trifasciata; apertura spiram longitudine æquante; labio minute crenulato.

Hab. Bay of Bengal.

Mus. Leckenby.

MARGINELLA OBTUSA.

M. testa ovato-oblonga, grisea, longitudinaliter inconspicue strigata; spira planulata, marginata; anfractu ultimo prope terminum anticum marginato; apertura angusta; columella serpicata, plicis crassis, albis, tribus posticis elevatis, horizontalibus, tribus anticis

obliquis; labio crasso, intus subcrenato, extus reflexo, planato-marginato.

Hab. —?

MITRA MEDIOMACULATA.

M. testa columbelliformi, rubra, supra et infra late castaneo fasciata, medio anfractuum fascia alba, rubro undatim maculata; spira breviuscula, acuminata; anfractibus brevibus, superne longitudinaliter crebriliratis, ultimo infra sulcato.

Hab. Mauritius.

Mus. Taylor.

CONUS LATERCULATUS. (Pl. XXII. fig. 3.)

C. testa elongato-subcylindracea, liris complanatis duplicatis, maculis quadratis ornatis cincta et maculis magnis latis trifasciata; sulcis intermediis albis; spira concavo-acuminata, anfractuum angulo acute unilirato, punctis fuscis, parvis, regularibus ornato; anfractibus spiræ concavis, spiraliter striatis, minutissime cancellatis, flammis fuscatis maculatis.

Hab. —?

Beautifully tessellated with square, regular brown spots, and sculptured with white grooves between duplicate ridges.

CONUS SUBMARGINATUS. (Pl. XXII. fig. 6.)

C. testa parva, angusta, albida, nitida, antice attenuata, sulcis acutis numerosis cincta; lateribus vix convexis; anfractibus ad angulum lira unica marginatis; apertura angusta, labio medio convexiusculo.

Hab. —?

Mus. Taylor.

CONUS PLANILIRATUS. (Pl. XXII. fig. 1.)

C. testa subturbinata, usque ad angulum spiraliter subdistanter sulcata (infra profundius), maculis oblongo-quadratis et macularum undatarum fasciis tribus cincta, infra angulum tumidiuscula, angulo acuto; spira subconvexa, prope apicem acuminata, flammis fuscis subspiraliter continuis ornata, spiraliter striata et minutissime cancellata.

Hab. —?

CONUS SUFFUSUS. (Plate XXII. fig. 9.)

C. testa turbinata, solida, pallida, roseo pallidissime suffusa et obscurissime fasciata, spiraliter striata; spira lata brevi, angulo obtuso, undulato.

Hab. New Caledonia.

This shell has no very remarkable characters, yet is quite unlike any other Cone on the whole. Its colour is a delicate rose-blush on a creamy ground.

CONUS MITRÆFORMIS, var. PUPÆFORMIS. (Pl. XXII. fig. 2.)

C. testa angusta, cylindrica, albida, obscurissime striata.

Hab. Mauritius.

The more cylindrical form and more produced spire of specimens recently brought from the Mauritius, as compared with the original and subsequently published figures, led at first to the belief that they represented a distinct species. Most of the old specimens in cabinets agree with Bruguière's figure, being thick at the upper part and granulated. The new variety is finely striated, with the colouring more continuous.

CONUS TURRITUS. (Pl. XXII. fig. 14.)

C. testa elongata, tenui, utrinque eleganter pyramidata, rosea, flammulis rubescentibus infra medium interruptis ornata, ad basim acuminata, striata; spira producta, gradata, acuminata; anfractibus obscurissime undatis, acutissime angulatis, concavis, apice mamillato; apertura rosea, labio postice profunde sinuato.

Hab. Agulhas Bank, S. Africa.

At first sight, this Cone is slightly suggestive of *C. papillaris*, but it has straight sides, a much more elevated and turreted spire, of which the sharply angulated whorls are not coronated, only very obscurely undated.

CONUS FLORIDENSIS. (Pl. XXII. fig. 11.)

C. testa solida, subfusiformi, alba, lævi, ad angulum lata, infra angulum fascia latissima subaurea longitudinaliter flammulata et maculis fuscis lineatim dispositis cincta; spira pyramidalis, gradata, producta, flammis castaneis brevibus ornata; apertura angusta, labio postice profunde sinuato.

Hab. Florida (Mr. Waters).

A beautifully coloured shell, with moniliform markings, somewhat resembling *C. delessertianus* in general appearance.

CONUS TEGULATUS. (Plate XXII. fig. 12.)

C. testa subangusta, distanter et æqualiter sulcata, inter sulcos planilirata, super sulcos maculis linearibus in fasciis duabus majoribus longitudinaliter flammulata, sulcis concentrice sculptis; spira concavo-acuminata, angulo acuto; anfractibus spiraliter striatis et concentrice cancellatis.

Hab. China Seas.

The chestnut linear spots, arranged in longitudinal flame-like bands, and thickened in two spiral bands, give a tessellated appearance to this pretty little sulcated shell.

CONUS TENUISULCATUS. (Pl. XXII. fig. 10.)

C. testa parva, acuminata, medio et infra tenuiter et distanter sulcata, albida, griseo fasciata, maculis castaneis seu fulvis medio et infra bifasciata; spira acuminata; anfractibus angulatis, maculatis.

Hab. —?

Differing from other shells of similar general appearance in the narrow sulci of the middle and lower part of the last whorl.

CONUS CORRUGATUS. (Pl. XXII. fig. 7.)

C. testa parva, acuminata, liris duplicatis, subrugosis, granulatis et interstitiis minutissime sculptis cincta; supra et infra medium pallide griseo fasciata, strigis minutis fuscatis variegata; spira acuminata; anfractibus cancellatis, acute angulatis, angulis concinne fusco punctatis.

Hab. —?

A more slender and much more finely sculptured shell than *C. verrucosus*, with the edges of the whorls neatly spotted with brown.

CONUS SOWERBYI, var. SUBÆQUALIS. (Pl. XXII. fig. 5.)

C. testa utrinque subæqualiter acuminata, medio acutangulata.

Hab. China Seas.

Described at first for this paper as a new shell, being remarkable for the length of its spire. It resembles *C. præcellens* in form, but with less numerous ribs, and having the interstices very beautifully sculptured. The spire nearly equals the body of the shell in length. In *C. acutangulatus* the sulci are few, and the intervening spaces flat.

CONUS SEMISULCATUS. (Pl. XXII. fig. 13.)

C. testa parva, utrinque acuminata, lævigata, fumeo-fuscata, infra medium distanter plano-sulcata, versus extremitatem acuminatim coarctata; spira acutissime angulata, concavo-acuminata; anfractibus plano-concavis, versus apicem moniliferis.

Hab. —?

A little brown shell with whorls beaded near the apex.

CONUS GEMMULATUS. (Pl. XXII. fig. 8.)

C. testa parva, albida, utrinque subæqualiter acuminata, costellis rotundis subrugosis lirata, interstitiis profundis, striis tenuibus longitudinaliter sculpta; spira exserta, producta, valde acuminata; anfractibus numerosis, papillis rotundis regularibus gemmuliformibus coronatis; apertura angusta, labio postice profunde sinuato.

Hab. China Seas.

A most wonderful fusiform little Cone, with a very produced spire, the whorls of which are beautifully beaded with gem-like papillæ.

CONUS RARIMACULATUS. (Pl. XXII. fig. 4.)

C. testa albida, acute angulata, lævigata, hic illic castaneo maculata; spira obscure cancellata, acuminata, flammulis castaneis picta.

Hab. China Seas.

A whitish smooth shell, with very few spots of chestnut.

STROMBUS MIRABILIS. (Pl. XXI. fig. 4.)

S. testa elongato-fusiformi, ad spiram et anfractum ultimum casta-

neo fasciata, inter fascias fusco angulatim et undatim strigata, ad dorsum castaneo saturatiore et magis suffuso picta; spira elongata; anfractibus 12 circa, quorum 7 apicalibus subrotundis longitudinaliter costatis, spiraliter inter costas striatis, 3 ad 4 ultimis lævibus, angulatis, ultimo in canalem caudalem attenuatum valide retrorsus tortuosum terminante; columella lævigata, arcuata, labio albo, late expanso, alato, ad canalem anticum emarginato, prope canalem unilobato, inter lobum et alam sinu maximo emarginato, ala lævigata, rectiuscula, incrassata, in lobum superne elevata, tum profunde emarginata, ad anfractum ultimum elevata.

Hab. Ceylon.

This very magnificent shell has at first sight the appearance of a gigantic *S. vittatus*, being similarly marked and of a similar general form. In that species, however, the whorls of the spire are sulcated close to the suture, and the slightly winged outer lip is striated and bent inwards at the upper angle, showing nothing like the smooth broad-lobed wing seen in our *S. mirabilis*. Our shell is further characterized by a very large sinus, between the lower part of the wing and the terminal lobe of the outer lip next to the canal, which is curiously curved backwards. The specimen is now in the possession of Mr. G. B. Sowerby, jun.

MITRA INTERSCULPTA.

M. testa attenuata, alba, flammis longitudinalibus rubro-fuscis picta, costellis spiralibus angulatis basi crenulatis subdistantibus et liris minutis interstitialibus crenulatis cincta; ultimo anfractu oblongo; spira breviuscula; anfractibus 6, moderate convexis.

Hab. Mauritius.

Mus. Taylor.

MITRA PRÆTEXTA.

M. testa oblongo-ovata, æqualiter liris longitudinalibus crebris et costellis spiralibus cancellata, albido-subcærulea, zonis fuscatis tribus distantibus margine punctatis et maculis interstitialibus distantibus majoribus ornata, anfractu ultimo spiram longitudine æquante; spira producta; anfractibus 10, convexis, prope suturam rotundis prominentibus; apertura fumeo-fusca, intus lirata.

Hab. —?

Mus. Taylor.

MITRA CORBICULA.

M. testa breviuscula, turrita, costellis subrugosis spiralibus et liris irregularibus, frequenter duplicatis cancellata, albida seu pallide fulvo-rubescens, ad angulum anfractuum distanter nigro ocellata, ad medium anfractus ultimi fascia frequenter bipunctata cincta, infra medium subirregulariter punctata; spira elongata; anfractibus angulatis, anfractu ultimo brevi.

Hab. Mauritius.

Mus. Taylor.

This species resembles *M. rugosa*—a Tankervillean shell, believed

to be unique; but it differs materially in form, the spire being much longer than the body-whorl. It also has longitudinal ridges, and is much more neatly and regularly marked.

MITRA INTERSTRIATA.

M. testa fusiformi, acuminata, costis distantibus lævigatis longitudinalibus et striis spiralibus interstitialibus sculpta, albida; anfractu ultimo in medio aureo latifasciata, supra et infra fasciam inter costas rubro maculato.

Hab. China Seas.

Mus. Taylor.

MITRA DIMIDIATA.

M. testa brevi, liris distantibus, lævigatis, rotundis, longitudinalibus, et striis elevatis spiralibus interstitialibus sculpta; spira et anfractu ultimo usque ad medium albis, infra aurantiacis.

Hab. —?

Mus. Taylor.

MITRA UMBONATA.

M. testa brevissima; spira anfractum ultimum longitudine æquante, alba, turrita; anfractibus supra medium angulatis, costis acute bituberculatis armatis; anfractu ultimo ad medium rubro late cingulato, costis paucis supra acute bituberculatis infra crenulatis et supra canalem costa spirali tuberculata armato.

Hab. —?

Mus. Taylor.

DESCRIPTION OF THE PLATES.

PLATE XXI.

- Fig. 1 *a, b. Typhis duplicatus*, Sowb., p. 251.
 2. *Eburna perforata*, Sowb., p. 252.
 3. *Turritella excavata*, Sowb., p. 252.
 4. *Strombus mirabilis*, Sowb., p. 257.
 5. *Solenella subæqualis*, Sowb., p. 250.

PLATE XXII.

- Fig. 1. *Conus planiliratus*, Sowb., p. 255.
 2. — *mitriformis*, Brug., var. *pupæformis*, Sowb., p. 256.
 3. — *laterculatus*, Sowb., p. 255.
 4. — *rarimaculatus*, Sowb., p. 257.
 5. — *sowerbyi*, Rve., var. *subæqualis*, p. 257.
 6. — *submarginatus*, Sowb., p. 255.
 7. — *corrugatus*, Sowb., p. 257.
 8. — *gemmulatus*, Sowb., p. 257.
 9. — *suffusus*, Sowb., p. 255.
 10. — *tenuisulcatus*, Sowb., p. 256.
 11. — *floridensis*, Sowb., p. 256.
 12. — *tegulatus*, Sowb., p. 256.
 13. — *semisulcatus*, Sowb., p. 257.
 14. — *turritus*, Sowb., p. 256.

7. On the Axial Skeleton of the *Urodela*.

By ST. GEORGE MIVART, F.R.S.

In this communication I shall confine my observations to the spinal column, neglecting for the present the skull, together with the mandibular, hyoidean, and branchial arches*.

* In a communication read before the Linnean Society on the 21st of April of the present year, I stated my views as to the general and serial homologies of the vertebrate skeleton.

I said that the axial system in its most developed form might be considered as consisting of three longitudinal series of parts, continued for a greater or less extent along each side of the vertebral axis.

The upper longitudinal series of parts on each side together form the system of *epaxial* parts.

The middle longitudinal series of parts on each side together form the system of *paraxial* parts.

The inferior longitudinal series of parts on each side together form the system of *hypaxial* parts.

Epaxial parts were defined as "parts embracing the cerebro-spinal axis, or parts serially homologous with parts which embrace that axis."

Paraxial parts were defined as "parts external to and more or less tending to embrace the pleuro-peritoneal cavity, or parts serially homologous with parts which are so situated in the trunk."

Hypaxial parts were defined as "parts placed between the skeletal axis and some part of the pleuro-peritoneal cavity, or serially homologous with parts so situated.

By *epaxial* parts I denote the neural arches and lateral walls of the brain-case.

By *paraxial* parts I denote transverse processes, ribs (both upper and lower of fishes), and sternal bones or cartilages.

By *hypaxial* parts I denote both hypapophyses, whether exogenous or auto-genous, and also visceral arches, however complex.

By "visceral arches" I mean the system of arches forming the hyobranchial apparatus, and also the mandible, the palato-quadrate arch, and the trabeculae cranii.

In this latter respect I follow the happy and original suggestion of Professor Huxley, as far as regards the resemblance of the trabeculae cranii to the other visceral arches; but I venture to differ from him as far as regards the general homology of these visceral arches, which I regard not as ribs (*i. e.* paraxial parts), but as hypaxial elements of the skeleton. The position of the heart and aortic roots, with regard to the branchial arches, is, I submit, fatal to their costal character.

The external branchial cartilages of Sharks, and the branchial basket of the Lamprey, however, may really represent costal elements.

In the paper referred to, I gave my reasons for considering the subcaudal arches of fishes to be generally of more or less mixed paraxial and hypaxial nature, differentiation, in this respect, being, I believe, less complete in that class.

This radiating system of skeletal parts of the trunk corresponds to the radiating system of spinal nerves, first pointed out by Professor Huxley in his last course of Hunterian Lectures, the *epaxial* parts corresponding with the ascending nerves, the *hypaxial* parts with the nerves of the inner ventral laminae of the embryo (*i. e.* with the sympathetic), and the *paraxial* parts corresponding with the nerves of the outer ventral laminae. Moreover, as there are nerves passing directly outwards (above the abdominal nerves), so it was suggested that there may be an upper and lower series of paraxial parts, perhaps coalescing to form the ribs of the higher vertebrata.

If this view of the visceral arches be accepted, then the nerves accompanying

All the species of the order agree in possessing a spine made up, in the adult condition, of more or less similar vertebræ varying in number from 45 to 112, according to the species or individual. These vertebræ increase slightly and very gradually in size from the second vertebra till about the middle of the body. Thence they decrease again, at first gradually and slightly, but afterwards rapidly, and to such a degree that the last ones are only minute rudimentary ossicles. With the exception of the genus *Siren*, these vertebræ may be arranged in four categories.

1. *Cervical*.—This includes only one vertebra, namely that which articulates with the skull.

2. *Dorsal*.—This includes almost all the trunk-vertebræ, *i. e.* all the vertebræ behind the cervical vertebra, and anterior to the sacral vertebra or vertebræ.

3. *Sacral*.—This includes the vertebra or vertebræ to which the pelvis is attached.

4. *Caudal*.—This includes all the vertebræ posterior to the sacral vertebra or vertebræ.

In the exceptional genus just mentioned (*Siren*) there is no sacral vertebra, and a cervical, and more or less arbitrarily divided dorsal and caudal regions are all that can be distinguished.

Very rarely two contiguous vertebræ will more or less completely anchylose together. I have observed this in the large species *Cryptobranchus japonicus*, where sometimes the last two presacral are fused together, and sometimes the sacral and the first caudal. In a skeleton in the British Museum both these unions occur, so that the four originally distinct vertebræ form actually but a pair, though each shows evident signs of its complex nature.

Every vertebra, except the abortive ones towards the end of the tail, consist of a body (*centrum*), and of a neural arch ossified, I believe, continuously with it. The neural arches constitute *epaxial* parts.

Every vertebra, except the cervical one and the very last caudal vertebræ, is furnished with lateral prolongations, never uniting below and forming complete arches, except by the intervention of the limb

those arches (the vagus &c.) seem to be serially homologous with that portion of the spinal nervous system which is called sympathetic.

The chevron bones of Mammals, Reptiles, and Amphibia I stated to be, in my opinion, hypaxial parts, and serially homologous with those hypapophysial processes which are so largely developed in the Pelican and the Great Auk, and which, in their azygos condition, are evidently situated in the line of suspension of the inner laminae of the ventral plates of the embryo. According to this conception, in vertebrates generally we have, at the anterior end of the axial skeleton, hypertrophied epaxial and hypaxial parts, *i. e.* the brain-case and visceral arches. Further back we have hypertrophied paraxial parts with much diminished hypaxial ones. Finally, towards the hinder end of the body (except in tailless forms) we have, in vertebrates above fishes, a reappearance of hypaxial elements generally accompanied by coexisting but distinct paraxial parts. In fishes, in the same region, we have generally paraxial parts in union with more or less of the hypaxial element, or we have paraxial parts only, or, much more rarely, only hypaxial parts.

girdles, and by means of membrane. These lateral structures constitute *paraxial* parts.

These paraxial parts, unlike the neural arches, are not only always incomplete below, but they are not usually ossified continuously with the centra respectively supporting them, but generally consist of two parts—a transverse process and a rib—the rib being somewhat moveably articulated to the distal end of the transverse process. The ribs end freely, except those articulated with the pelvic bones, which are intercalated parts of the appendicular skeleton. Certain vertebræ have transverse processes only, their free ends more or less widely diverging. This is the case with the caudal vertebræ, except the first two or three of them (which sometimes support ribs), and also occurs in many trunk-vertebræ of *Amphiuma*, *Proteus*, and *Siren*.

The caudal vertebræ, except the first one or two and the very last, have almost always inferiorly extending processes and arches, continuously ossified like the neural arches above them, which moreover they resemble, more or less closely, in shape and proportions. They are probably serial homologues of subcentral processes of the trunk-vertebræ; and the whole of these inferior structures belong to a system of *hypaxial parts**, and are the hypapophyses. That such subcentral processes really do answer serially to the caudal hypapophyses behind them, is well shown in *Siren*, where the vertebra in front of that which bears large hypapophyses is furnished with a pair of small backwardly projecting processes exactly like those of *Spelerpes rubra*, but at the same time developed from the posterior end of the ridges, which unquestionably represent the hypapophyses of the vertebræ next behind (fig. 14).

Sometimes instead of, or besides, lateral processes, the inferior surface of a centrum will develop a median longitudinal bony ridge. Such a structure is to be seen in the third and fourth vertebræ of *Siren* (fig. 13, *Hy*), the second and third vertebræ of *Menobranchus*, and in many of the trunk-vertebræ of *Proteus* and *Amphiuma*. This ridge is hypaxial, and may also be spoken of as hypapophysial†, as sometimes in *Siren* and *Menobranchus* it seems, by becoming medianly grooved, to divide into a pair of hypapophyses. The propriety of regarding the subcaudal arches and processes as distinct from paraxial parts is justified by the frequent coexistence of the latter together with subcaudal arches in the tail. Moreover these arches are undoubtedly the representatives of the “chevron bones” of the Crocodile; and these latter were found by Professor Goodsir‡ to be, at the root of the tail, enclosed within the backwardly continued peritoneal folds and abdominal cavity, thus removing them altogether from the

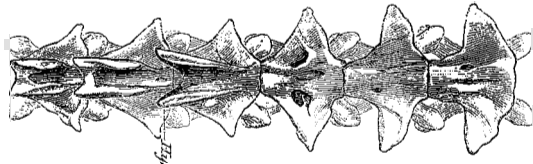
* As before said, I believe the hyobranchial apparatus, jaws and trabeculæ, to also belong to the system of hypaxial parts.

† The way in which the osseous extension (of the under surface of the centrum) related to the great arterial channels is represented by a single process, by a pair of processes, or by a triple development, is well shown by Professor Owen (Memoir on the *Megatherium*, Phil. Trans. 1851, part 2, plate lii. figs. 48–51).

‡ Edinb. New Phil. Journal, January 1857, p. 128.

category of paraxial parts. Were they really hæmal arches (*i. e.* representatives of the membranous connexions between the distal ends of the two series of ribs), we should have to adopt the somewhat violent conception that the lower parts of the hæmal arches of the tail are detached from their proximal portions, and fixed directly to the under surface of each supporting centrum. For if the caudal vertebræ from before backwards are examined, it will be seen that the first hypapophysial arch is not formed by the bending down of the transverse processes, or by an extension of ossification along the membrane, connecting the distal ends of such transverse processes, but that it arises suddenly beneath the centrum. This is well shown in the sixty-fourth vertebra of *Amphiuma* (fig. 1). In this vertebra

Fig. 1.



Under view of last trunk- and anterior caudal vertebræ of *Amphiuma* (No. 579 A in College of Surgeons' Museum*).

Hy. Hypapophysis.

the caudal hypapophysis first makes its appearance as a long process on each side, the two processes being medianly disunited below, and distinct from the transverse process, which exists as completely in this vertebra as in the one preceding it.

The three systems of parts, epaxial, paraxial, and hypaxial, are variously united together respectively.

The epaxial parts, or neural arches, are serially connected together by means of special articular processes, *zygapophyses*. Each vertebra is provided with two of these in front and two behind, the posterior pair of which have their articular surfaces directed downwards, and somewhat obliquely outwards (fig. 16), reposing on the upturned and somewhat inwardly directed surfaces of the anterior zygapophyses of the vertebra next behind. The cervical vertebra forms an exception, inasmuch (fig. 19) as it has no anterior zygapophyses, but has special modifications for articulation with the skull.

The paraxial parts are never serially connected together, but by muscular or connective tissue, except the occasional coalescence of such parts in the sacral region.

The hypaxial parts in the tail form with each other serial connexions more or less simulating those existing between the successive neural arches.

* The figures of specimens in the Museum of the College of Surgeons have been drawn by the kind permission of the authorities of that institution.

CENTRA, OR VERTEBRAL BODIES.

The bodies of the vertebræ unite together by the entire circumference of each of their juxtaposed surfaces, and sometimes by those surfaces also, according to the form and condition of the latter. Each vertebral body consists of a small bony cylindroidal structure, the antero-posterior extent of which considerably exceeds its transverse diameter, which latter about equals its vertical dimension. The length is generally less than twice the breadth; it is about that in the mid trunk-vertebræ of *Menobranchus*, more than that in those of *Amblystoma*, and very much more in those of *Proteus*. Sometimes, as in *Amblystoma* and notably in *Proteus*, the centrum is greatly constricted towards its middle, so as to appear to consist of two cones joined together at their apices, like an hour-glass. The posterior end of each vertebral body is always unossified, and presents a bony concavity filled with gelatinous tissue. Very often the anterior surface of each centrum, except that of the cervical vertebra (hereafter described), is also similarly conditioned, the vertebræ being *biconcave*. Such vertebræ are found in *Siren*, *Proteus*, *Menobranchus*, *Menopoma*, *Amphiuma*, *Amblystoma*, *Plethodon*, *Aneides*, &c. On the other hand, in *Salamandra*, *Triton*, *Pleurodeles*, *Chioglossa*, *Taricha*, *Spelerpes rubra*, &c. the part answering to the anterior cup is not only ossified, but ossification extends continuously and more or less thoroughly into the soft structure filling the cup of the centrum next in advance; so that each vertebral body comes to have a rounded convexity projecting from its anterior surface, and thus to articulate with its neighbour's by an opisthocœlous ball-and-socket joint.

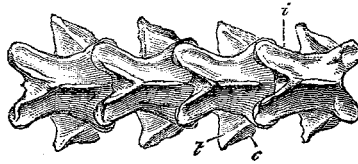
Procœlous vertebræ do not exist in any species of Urodele.

The most posterior centra are sometimes in the form of small rings, the central part of each being unossified and filled with a softer tissue. The centra are commonly (fig. 14) perforated below by small openings for blood-vessels. A centrum may be continuously ossified with a neural arch above, a transverse process on each side, and hypaxial processes in an hypaxial arch below.

NEURAPOPHYSES.

The laminæ which ascend on each side to embrace the spinal cord always, in the fully adult condition, unite together above and form a complete neural arch. In the Axolotl, however, the neural arch of the first vertebra (the cervical vertebra) long remains medianly cleft; and in the Urodela generally a more or less deeply extending median notch very frequently divides the posterior part of each neural arch; this is particularly marked in *Siren* (fig. 2). At the point of junction of the neural laminæ (that is, along the summit of each neural arch) a more or less marked antero-posteriorly directed ridge is usually to be detected. This ridge is sometimes very little developed, as in the trunk-vertebræ of *Salamandra*, *Proteus*, and most others. On the other hand, it is a very elevated process in the trunk-ver-

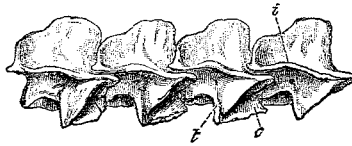
Fig. 2.



Dorsal view of four trunk-vertebræ of *Siren* (No. 576 B in Museum of College of Surgeons).

c. Capitular process. t. Tubercular process. i. Interzygapophysial ridge.

Fig. 3.

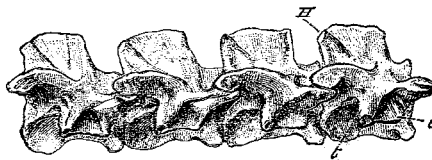


Lateral view of four trunk-vertebræ of *Siren* (No. 576 B in Museum of College of Surgeons).

c. Capitular process. t. Tubercular process. i. Interzygapophysial ridge.

tebræ of *Siren* (figs. 3 & 8), *Amphiuma* (fig. 4), *Pleurodeles*, *Triton palmatus*, and some other forms. Very often the neural ridges of the caudal vertebræ are lofty in species which have the neural ridge of their trunk-vertebræ quite inconspicuous. This is the case, *e. g.*, in *Triton cristatus*, *Chioglossa*, &c. Processes from the margins of

Fig. 4.



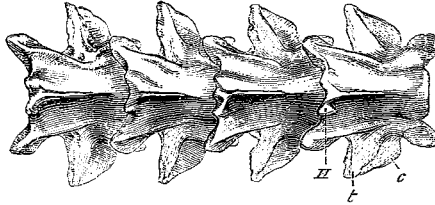
Side view of 23rd, 24th, 25th, and 26th vertebræ of *Amphiuma* (No. 579 A in College of Surgeons' Museum).

H. Hyperapophysis. c. Capitular process. t. Tubercular process.

the posterior median notch of the neural arches of the trunk-vertebræ often project backwards and more or less conspicuously upwards, preeminently so in *Proteus* (in spite of the low neural crest of that form), also in *Amphiuma* (figs. 5 & 17, H) (where the processes are very distinct though short) and *Spelerpes rubra*, and more or less so in *Triton palmatus*, *Pleurodeles waltlii*, &c. This condition is always still more marked in the caudal region, where in *Spelerpes rubra*

these conspicuous productions of the neural arch* ascend almost vertically, as they do in some of the posterior caudal vertebræ of *Siren* (fig. 8), and tend to do in those of *Amphiuma*. The summit of the neural arch in *Urodela* is never produced into a long bony

Fig. 5.



Dorsal view of 23rd, 24th, 25th, and 26th vertebræ of *Amphiuma*.
H. Hyperapophysis. c. Capitular process. t. Tubercular process

pointed process, as it is in so many higher vertebrata; but sometimes the middle of its hinder margin projects slightly backwards, as in *Menobranchus*; and sometimes, as in *Menopoma*, *Cryptobranchus*, and *Menobranchus* (fig. 10), the posterior part of the caudal neural arches are produced into long processes inclined obliquely backwards over the succeeding vertebræ; but they are hollow and open at the summit, and are no doubt continued in cartilage. Sometimes again the posterior part of each neural arch, whether of the trunk or of the tail, is marked by a vacuity, pit, or depression, as if for the implantation of the end of a cartilaginous rod or spinous process; this is found in *Cryptobranchus* and *Menopoma*. In *Amblystoma* each neural arch of the posterior trunk-vertebræ possesses two such pits placed side by side in the same transverse horizontal line as if for two cartilaginous neural spines; and the same structure obtains throughout the caudal vertebræ. In the Axolotl the trunk neural arches

Fig. 6.



Dorsal view of three caudal vertebræ (sixth to eighth postsacral) of *Axolotl*, from specimen No. 582c in Museum of College of Surgeons.

have, from before backwards, successively longer and longer neural spines; but each one has a concave depression at its tip, as if it were continued in cartilage. The caudal vertebræ in the same form, from the fourth backwards, have each bifid neural spines, as in the trunk- and all caudal vertebræ of *Amblystoma*; and each is concave at its

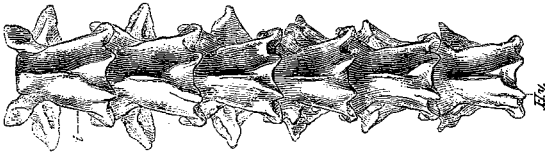
* These parts appear to correspond with those mammalian processes for which I have proposed the term *hyperapophyses* (P. Z. S. 1865, p. 576), and the presence of which often serves as a good osteological character for zoological groups. See Cambridge Journal of Anatomy and Physiology, vol. ii. pp. 143-154.

summit, and in the fresh state has evidently a cartilaginous continuation (fig. 6). Rarely (as sometimes in *Menobranchus*) the neural arches, towards the end of the tail, each develop two neural spines, one in front of the other.

As has been said, almost every neural arch has four zygapophyses; but the cervical vertebra has only the two posterior ones. In the tail these processes are all developed on the anterior caudal vertebræ, but the posterior processes abort at about the fifth or sixth caudal vertebra in *Menobranchus*, and at about the seventh in *Cryptobranchus*. In other forms, however, they extend far back—*e. g.* to the last vertebra but four in *Aneides*, to the last but five in *Triton cristatus*, and to the last but nine in *Siren*. The anterior zygapophyses continue to be developed for a longer distance, being traceable in *Aneides* to the last vertebra but four, and in *Cryptobranchus* to the last but three. In *Amphiuma* both continue to the very small vertebræ near the end of the tail.

A longitudinal ridge (figs. 3, 7, 8, 17 *i*), more or less marked,

Fig. 7.

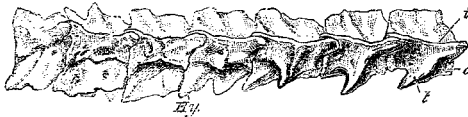


Dorsal view of last trunk- and anterior caudal vertebræ of *Amphiuma*.

Hy. Hypapophysis. *i.* Interzygapophysial ridge.

generally extends along each side of each neural arch between the two zygapophyses of the same side. This interzygapophysial ridge is most marked in *Amphiuma* and *Siren* (fig. 17 and fig. 3), especially in the latter. In other forms it is but little so in the trunk-vertebræ, though often becoming prominent in the caudal ones, as notably in *Chioglossa*.

Fig. 8.



Lateral view of anterior caudal last trunk-vertebræ of *Siren* (No. 576 B in Museum of College of Surgeons).

c. Capitular process. *t.* Tubercular process. *i.* Interzygapophysial ridge.

TRANSVERSE PROCESSES.

With the exception of the cervical vertebra and of all the caudal vertebræ except the first few, each centrum gives out on each side a large and conspicuous transverse process. More or less completely rudimentary transverse processes are to be traced throughout the

greater number of the caudal vertebræ, and in the genera *Proteus*, *Menobranchus*, and *Siren* (fig. 18) in the cervical vertebra also. Generally the fully developed transverse processes are more or less cylindrical or somewhat compressed from before backwards, their long diameter, however, extending outwards and more or less (fig. 15, c) obliquely backwards, as in *Menopoma*, *Cryptobranchus*, *Salamandra*, &c. Sometimes, however, as in all the transverse processes of *Siren* (fig. 9, c), except the first one or two, and as in the posterior ones of *Proteus* and the middle ones of *Amphiuma* (fig. 16), each one, though very short, is wide, *i. e.* much extended from before backwards.

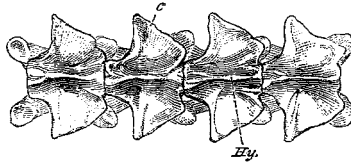
Each such transverse process springs generally from about the middle of each centrum's length, but sometimes, as in most posterior trunk-vertebræ of *Siren* (figs. 14 & 9) and *Amphiuma* (figs. 1 & 16), mainly from near the anterior end of each vertebra, and sometimes, as in the anterior trunk-vertebræ of *Amphiuma*, *Menobranchus*, and *Siren* (fig. 13), from near the hinder end of each.

The backward inclination of the distal end of each transverse process is sometimes rather more marked at the anterior part of the series, as in *Siren*, *Amphiuma*, *Menopoma*, and *Cryptobranchus*. Each of these fully developed transverse processes is more or less excavated by a groove or depression on its anterior surface, and another one on its posterior face; and these excavations are often such as to cause more or less of a division of the distal part of such transverse process into a superior portion and an inferior part. It is also to be observed that each transverse process at its point of origin from the vertebra, is connected below with the centrum of such vertebra, while above it is continuous with its neural arch and more or less distinctly continuous with the interzygapophysial ridge. Thus each transverse process may be regarded as made up of two parts, each ending distally in a more or less distinct process, the upper one of which is called the upper or *tubercular* process*, while the lower one is termed the lower or *capitular* one. Similarly it will be convenient to speak of the rib as made up of two portions, a superior tubercular part and an inferior or capitular one. When the transverse process is nearly cylindrical, as in *Salamandra* and most forms, these two component parts are of about equal antero-posterior extent; but sometimes, as in the middle trunk-vertebræ of *Amphiuma* (figs. 4 & 5), *Proteus*, and *Siren* (fig. 2), the capitular part is much wider from before backwards than is the tubercular part. The same is observable in a less degree in *Menobranchus* and *Aneides*. When (as in *Siren* after the first nine vertebræ) the tubercular process is also wide, and the groove before mentioned almost or entirely confined to the front surface, where it is immense, the transverse process assumes the form of two triangular plates (of which the upper is the smaller) united to the centrum by one margin and to each other by their two posterior edges, leaving a space between them which widens as they (the plates) diverge forwards (fig. 3, c. i). This space or fossa,

* By analogy with the condition of higher vertebrates in which the rib has a "tubercle" and a "head" respectively articulating with parts homologous with those here described.

open in front, is thus bounded internally by the centrum, superiorly by the tubercular process, and inferiorly by the capitular one.

Fig. 9.



Underview of four trunk-vertebræ of *Siren* (No. 576 B in Museum of College of Surgeons).

c. Capitular process. Hy. Hypapophysis.

The distal end of each trunk-transverse process is provided with two superimposed articular surfaces for corresponding parts of each rib; these surfaces may be in close apposition, as in *Cryptobranchus* and others, or they may be separated by the before-described distal tendency to bifurcation of the transverse process as in *Menobranchus*, *Amblystoma*, and others. The only exceptions are offered by many of the trunk-vertebræ of *Siren*, *Proteus*, and *Amphiuma*, in which forms only the more anterior trunk-vertebræ support ribs. The transverse process of the last trunk-vertebra (which is connected indirectly with the pelvic girdle) is generally stouter than the others.

In the caudal region this part generally undergoes a marked change, though sometimes, as in *Cryptobranchus* and *Menopoma*, the transverse processes of the caudal vertebræ remain much the same (except successively decreasing in size) as their anterior homotypes—the first two, at least, having still the double distal articular surface.

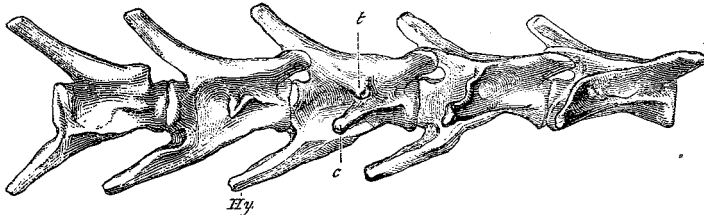
In most cases, however, as in *Menobranchus*, the process becomes more pointed at its free extremity, and generally, in the anterior caudals, projects more or less directly outwards and but little backwards also, unlike the more anterior transverse processes. Sometimes, as in *Siren* (fig. 8), the tubercular part of the transverse process becomes entirely suppressed at the second, third, or fourth caudal vertebra provided with large hypapophyses, while the capitular part remains traceable for a variable distance further back along the tail, even to the last vertebra but thirteen in *Siren**. In *Cryptobranchus* every trace of a transverse process disappears at the ninth or tenth caudal vertebra, if not earlier, and at the seventh or eighth in *Menopoma*, and sixth or seventh in *Menobranchus*. Sometimes, as in *Salamandra*, traces of the transverse process exist almost to the end of the tail.

Occasionally, as in *Triton palmatus* and *Pleurodeles waltlii*, and others, the caudal transverse processes soon cease to project much outwards, but are to be distinguished for a very long distance as ridges connecting the interzygapophysial ridge above with the

* *E. g.* in Brit. Mus. specimen.

oblique one which traverses (in a downward and backward direction) the outside of each hypapophysial arch. This condition is perhaps best exemplified in the caudal vertebræ of *Chioglossa*, where the transverse process is in just such a condition as would be one of those of the midtrunk of *Siren*, if its tubercular and capitular parts were so reduced as to be mere prominent ridges on the side of the centrum instead of strongly projecting, more or less horizontal plates. Thus in *Siren* we have the tubercular process extending downwards and backwards from the interzygapophysial ridge and ending in a backwardly projecting process, which is also the termination of the capitular process, the free edges of the plates forming an angle open forwards. Now in *Chioglossa* we have a ridge (the representative of the tubercular part of the transverse process) running downwards and backwards from the interzygapophysial ridge, and terminating in a backwardly projecting process, which process is also the termination of another ridge which runs forwards and downwards from it, and is the representative of the capitular part of the transverse process. This latter ridge, as it descends, unites with the ridge traversing obliquely the outside of the hypapophysial arch, and terminating behind and below in one of the posteriorly projecting processes of that arch hereafter described.

Fig. 10.



Lateral view of anterior caudal vertebræ of *Menobranchius* (No. 582 a in College of Surgeons' Museum).

t. Tubercular process. *c.* Capitular process. *Hy.* Hypapophysis.

Sometimes both the capitular and tubercular parts of the transverse process are to be seen distinctly projecting out (though of small size) one above the other (fig. 10, *c.* *t.*), from the side of a caudal vertebra, as *e. g.* sometimes, at least, in the fourth caudal vertebra of *Menobranchius*. Occasionally a certain osseous connexion exists between the caudal transverse process and the hypapophysial arch, or caudal hypapophyses. This is the case sometimes in the first one or two vertebræ of *Siren* which possess hypapophyses.

In *Menobranchius* also a bony connexion distinctly exists, in the third and fourth caudal vertebræ, between the root of the hypapophysial arch on each side and the under surface of the capitular process above it (fig. 15). This shows a certain degree of imperfection in the separation of the hypaxial part of the skeleton from the paraxial part.

The transverse processes at their roots, *i. e.* near their origin from the centrum, are often traversed by a canal passing from behind forwards and transmitting an artery. This is well seen in *Cryptobranchus*, *Menopoma*, *Menobranchus*, and *Salamandra*.

RIBS.

With the exception of the genera *Amphiuma*, *Siren*, and *Proteus*, all the transverse processes of the dorsal* and sacral regions support ribs, and not unfrequently the anterior caudal ones also.

The first vertebra of all, however, even when furnished with a rudimentary transverse process, remains always destitute of such bony appendages.

The ribs form a series of cylindroidal bones (figs. 11, 12, 13 & 18), each extending outwards and more or less downwards and backwards, and ending distally in a free pointed termination, with the exception of the single pair attached (one on each side) to the hip-girdle. They never have cartilaginous or osseous parts attached to their distal ends and answering to the sternal ribs or cartilages of most higher vertebrates. Rarely, as in more or fewer of the ribs of *Axolotl* and *Amblystoma*, they extend rather upwards and backwards. The number of ribs varies from five or six pairs in *Amphiuma*†, eight in *Siren*‡, seven, eight, or nine in *Proteus*§ (if the second vertebra bears any) to some twenty-one or twenty-two pairs (counting the caudal ribs) in *Menobranchus* and *Cryptobranchus*. Proximally the ribs very commonly bifurcate into two short and nearly equal branches, diverging from each other at a more or less acute angle (fig. 12). These branches are placed one above the other, and are attached respectively to the tubercular and capitular parts or processes of the respective transverse processes. The upper branch of this fork may

Fig. 11.



Lateral view of first four vertebræ of *Siren* (No. 576 B in Museum of College of Surgeons).

thus be called the tubercle (*tuberculum*) of the rib, and the lower branch its head (*capitulum*): When, as in *Siren*, *Menopoma*, and *Cryptobranchus*, the distal articular surfaces of the transverse processes are near together, the proximal ends of the ribs do not bifurcate,

* Rusconi represents none to the first dorsal of *Proteus*.

† Cuv. Mém. du Mus. vol. xiv. 1827, p. 9. The College of Surgeons specimen looks as if it had had ten pairs at least.

‡ Cuv. Oss. Foss. 4th edition, vol. x. p. 350.

§ Cuvier (*loc. cit.* p. 358) says seven, counting from the second vertebra. Rusconi represents seven, beginning with the *third* vertebra: the last is so small as to be with difficulty detected.

but nevertheless show indications of separation exactly corresponding to the distal ends of the transverse processes to which they are attached, having two superimposed articular surfaces when the last-mentioned processes have such, and presenting a longitudinal groove in front and behind each rib, the two grooves being most marked at the proximal end of the rib, and vanishing distally.

The number of trunk ribs which thus bifurcate proximally is sometimes as many as eighteen* on each side; but the number is subject to some variation even in the same species. Thus in some individuals of *Salamandra maculata* (fig. 12) I have found three ribs (on each side) thus bifurcating, in others six; and in *Triton cristatus* twelve pairs of ribs will sometimes be thus conditioned. It is always, however, towards the anterior and posterior ends of the trunk that this bifurcation tends to disappear, and mainly towards its posterior end, the bifurcation generally commencing at the second vertebra when the first one has its proximal end undivided. The sacral rib rarely bifurcates†, and it generally differs from the preceding ones by its greater stoutness, though it is usually short. The ribs in general maintain a tolerable equality of length throughout the trunk; very rarely (only in *Taricha*) the ribs increase markedly in length towards the middle of the body, and then as obviously become again shorter. In *Axolotl* the second, third, or fourth is the longest pair, and thence backwards they markedly decrease in length to the sacral, which is suddenly much longer again. Occasionally they are very short indeed, being much less in length than the vertebræ to which they are attached; this is the case especially in *Proteus*, *Amphiuma*, and *Siren*, where they are rudimentary (the posterior ones being quite so) and, as has been said, few in number. In *Spelerpes*, *Amblystoma*, and especially *Plethodon*, they are very short indeed, never, except very slightly, exceeding a single vertebra in length. Generally they do not equal in length two midtrunk-vertebræ of the same individual; but *Pleurodeles* differs from all the other *Urodela* in the length and strength of its ribs, the longer ones considerably exceeding the length of two of the longest vertebræ of the body.

As has been said already, ribs are not unfrequently developed behind the sacrum. I have seen two such pairs in *Glössoliga poireti*, and traces of such in *Plethodon* and *Amblystoma*; one at least is sometimes present in *Menobanchus*, and often two and sometimes three (if not more) pairs are present at the root of the tail in *Menopoma* and *Cryptobranchus*. These postsacral ribs, however, never bifurcate at their proximal ends, and they are always short and more or less rudimentary.

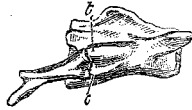
The first rib of all is generally stouter as well as shorter than the ribs of the trunk which follow after (fig. 11). Not unfrequently it develops a process from its outer or upper side towards its distal end; this process projects outwards and somewhat upwards, and very rarely is so considerable as almost to equal in size the remainder of

* *Spelerpes rubra*, British Museum.

† It does so in *Spelerpes rubra* and *Amblystoma punctatum* in Brit. Mus.

the rib beyond the point from which it starts (figs. 11 & 12). In this case the rib may be truly said to bifurcate distally.

Fig. 12.



Lateral view of sixth vertebra of *Salamandra* (No. 589 B in Museum of College of Surgeons), showing rib bifurcating at each end.

c. Capitular process. t. Tubercular process.

A similar process is also sometimes developed from the same part of the ribs next succeeding; but it is rarely to be traced beyond the fourth pair of ribs, and diminishes in size as we proceed from before backwards, and in many forms is not to be detected at all, as far as I have observed, e. g. *Menopoma*, *Cryptobranchus*, *Menobranchus*, *Aneides*, *Spelerpes rubra*, and *Plethodon*.

Though, as has been said, the ribs of the opposite side are never connected together by hard parts, but only by membranous prolongations, yet in the middle line of the anterior part of the body there is in many *Urodela* a solid structure answering to the sternum of higher animals, and connected with the membranous prolongations of the ribs.

THE STERNUM.

This part is a constant structure in adult *Urodela*, except in *Proteus*, *Menobranchus*, and perhaps *Siren*. It is rhomboidal in shape, about as broad as long, and with an apex turned forwards. Sometimes, e. g. *Salamandra*, there is a short xiphoid process, which extends backwards from the middle of its hinder margin. Rarely (e. g. *Axolotl*) that margin is medianly notched.

Each side of the sternum is more or less deeply grooved for the reception of the coracoid lamella, and the inner lip of each groove is much more developed than the outer one.

The sternum never ossifies in any Urodele, and originally it is always formed *within* the coracoids. This might be expected to be the case from the fact that the sternum is a portion of the paraxial skeletal system which the pectoral girdle externally surrounds. But Mr. Parker* has actually verified by observation this primitive condition of the sternum, and proved that the lateral parts of the structure, which embrace the coracoid lamellæ externally, are subsequent and secondary outgrowths of a structure which is at first completely internal to the shoulder-girdle. These secondary growths are so large that ultimately the sternum comes to lie outside the coracoids†.

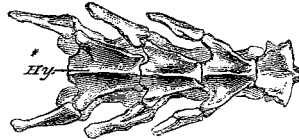
* See 'Shoulder-girdle,' p. 65.

† Parker, *l. c.* pl. 3. fig. 14.

HYAPOPHYSES.

That system of inferior arches, or parts of such, which is in more immediate relation with the great dorsal artery attains in the *Urodela* its full development only in the caudal region, where it appears as the hypapophyses and hypapophysial arches. In the trunk the most anterior indication of this system of parts is found (1) in the anterior trunk vertebræ of *Siren* and *Amphiuma* (fig. 13), and more

Fig. 13.

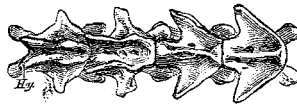


Under view of first four vertebræ of *Siren* (No. 576 B in Museum of College of Surgeons).

Hy. Hypapophysis.

or less in *Menobranchus* (beginning with the second or third vertebra), where there is a median antero-posteriorly extended subcentral crest, and (2) in certain small bifold processes found in *Amphiuma* (fig. 16) and *Spelerpes rubra*. These processes may project forwards, as in the first-named genus, from the anterior margin of the under-surface of each centrum, except the first three, close to the anterior end of the hypapophysial ridge; or, as in *Spelerpes rubra*, they may project backwards from the hinder part of the under surface of all the præcaudal vertebræ, except the first and the last one or two. This ridge is more or less divided (fig. 14) medianly into

Fig. 14.



Under view of transitional vertebræ (from trunk to tail) of *Siren* (No. 576 B in Museum of College of Surgeons).

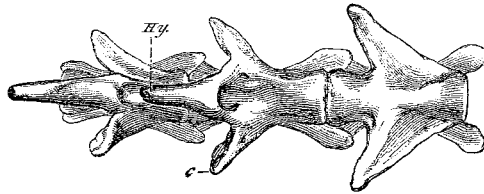
Hy. Hypapophysis.

two in that vertebra of *Siren* which precedes the first one provided with conspicuous hypapophyses, and also in the second vertebra, and in the second and third of *Menobranchus*. The first caudal vertebra is always destitute of any hypapophysis*; and very often the second

* In a skeleton of *Cryptobranchus japonicus* in the British Museum the apparent first caudal is really the second one, the true first caudal has coalesced with the sacral vertebra. This really second caudal has a long hypapophysis on one side, although the transverse process is furnished with a distinct though small rib.

caudal is in the same case; but at the third, or sometimes the second caudal, this process suddenly reappears, greatly increased in size and generally united with its fellow of the opposite side, forming the first hypaxial arch. Such arches (figs. 1 & 15) are always present in the

Fig. 15.



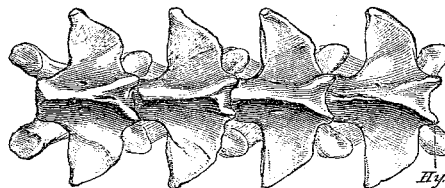
Under view of anterior caudal vertebræ of *Menobranchus* (No. 582 A in College of Surgeons' Museum).

c. Capitular process. Hy. Hypapophysis.

caudal vertebræ, except in *Siren*; but there, though the caudal hypapophyses remain medianly disunited below, yet each is broad antero-posteriorly, as well as much vertically extended (fig. 8, Hy). The hypaxial arches are sometimes narrow from before backwards, though much elongated from above downwards; this is the case in *Menopoma*, *Cryptobranchus*, *Menobranchus* (fig. 10, Hy), and *Proteus*. In the three first-named genera especially they are produced obliquely backwards and downwards into long inferior spines, even exceeding in length the neural spinous processes above them, and are similarly bony cylinders unossified at their summits. In *Axolotl* and *Amblystoma* the hypaxial arches repeat the characters offered by the neural ones, inasmuch as each is provided with a pair of diverging sockets (fig. 6) apparently for the reception of two cartilaginous spines placed side by side.

The posterior margin of these hypaxial or hypapophysial arches

Fig. 16.



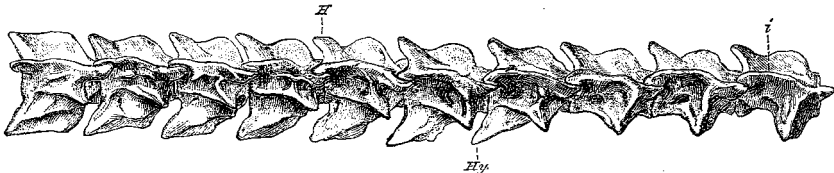
Under view of 23rd, 24th, 25th, and 26th vertebræ of *Amphiuma*.

Hy. Hypapophysis.

is often medianly notched like the corresponding margin of the epaxial or neural arches above. This correspondence is often further increased by the frequent development of a median longitudinal hypaxial crest, which, bifurcating at the notch, is continued forwards

into each arm of the notch (fig. 16), ending in two strongly projecting processes, like the similarly conspicuous productions of the caudal neural arches before described. These processes are also especially marked in *Proteus*, *Amphiuma* (fig. 17), and *Spelerpes rubra*, and more or less so in *Triton palmatus*, *Pleurodeles waltlii*, &c. In *Spelerpes rubra* these prominences descend almost vertically, corresponding with the position of their vertical homologues above. The median inferior crest is often more vertically extended than is the corresponding neural one, as is the case in the species last mentioned (except *Amphiuma*, where there is hardly any median inferior crest, and then only in the very posterior caudals) and in *Aneides*. These backwardly projecting lateral processes extend over the anterior part of the hypaxial arch next behind, and thus somewhat simulate posterior zygapophyses; but these arches have no true articular processes, as is well seen in such forms as *Cryptobranchus*, *Menopoma*, and *Amphiuma*, where the contrast is marked. Very generally, as in *Triton*, *Amphiuma* (fig. 17), *Pleurodeles*, and, above all, in

Fig. 17.



Last trunk- and anterior caudal vertebræ of *Amphiuma* (No. 579 A in College of Surgeons' Museum).

H. Hyperapophysis. Hy. Hypapophysis. i. Interzygapophysial ridge.

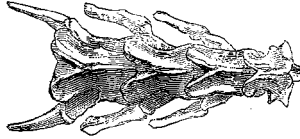
Chioglossa, an oblique ridge extends backwards and downwards from the anterior point of attachment of each half of the hypaxial arch to the backwardly projecting inferior process of the same side. These ridges appear to be the only parts of the hypapophyses that are left in those forms in which the hypapophysial arches are very narrow. They somewhat resemble the interzygapophysial ridges of the caudal neural arches, but are more oblique in direction.

THE CERVICAL VERTEBRA.

The vertebra which comes first and articulates in front with the skull differs importantly from all the vertebræ which succeed it. Like the others, it constantly presents a centrum which is concave behind, and from which a continuous, ascending neural arch is developed. But not only are there no hypapophyses, but transverse processes are completely absent, except in *Siren* (fig. 18), *Proteus*, and *Menobranchus*; and in these genera they are quite rudimentary, while the vertebra is invariably destitute of any costal appendage or rib. But it is the anterior face of the vertebra which is most remarkable. This presents on each side (at the junction of one half

of the neural arch with the body) a large concave articular surface which receives one of the projecting articular processes or *condyles* of the posterior end of the skull. Moreover the median part of the vertebra, instead of presenting either a concavity (like the hinder

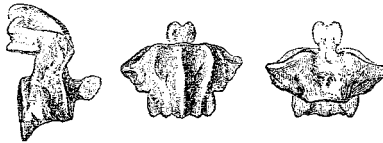
Fig. 18.



Dorsal view of first four vertebrae of *Siren* (No. 576 B in College of Surgeons' Museum).

surface) or a rounded articular ball (like that always present in the other vertebrae of Opisthocelous forms such as *Salamandra*, *Triton*, &c.) exhibits between the two anterior large articular concavities a small or considerable median process* (fig. 19). This projects forwards and fits into a recess at the base of the skull between the two posterior (*occipital*) condyles, and generally bears on each side of it a small articular facet; but sometimes these two facets are united into one continuous articular surface on the inferior and infero-lateral aspects of the process.

Fig. 19.



Lateral, dorsal, and under view of first vertebrae of *Amphiuma* (No. 579 A in Museum of College of Surgeons).

This azygos part attains its maximum of development in *Amphiuma*. It is small in *Axolotl*, but at its minimum in *Menobranchus* and *Proteus*, especially the latter. As far as I have observed or been informed, no bony or cartilaginous part is ever developed between the neural arch of the cervical vertebra and the skull; that is to say, if this cervical vertebra is really the axis, then the neural arch of the atlas vertebra of higher vertebrates is quite absent in the *Urodela*. The size of the cervical vertebra, as compared with that of succeeding vertebrae (*e. g.* with the third) varies somewhat.

In most cases the two vertebrae are of nearly equal length and size; but in *Amphiuma* the cervical vertebra is rather smaller than the third; and it is much so in *Menobranchus* and *Proteus*, in the last especially, where it is very remarkable for its small size.

* It is the presence of this process which renders it probable that the cervical vertebra is an axis vertebra and not an atlas one.

DORSAL VERTEBRÆ.

The vertebræ interposed between the cervical vertebra and the sacrum vary in number from twelve (*Taricha*) to sixty-three (*Amphiuma*). They are always the largest vertebræ of any one individual axial skeleton.

All have neural arches and anterior and posterior zygapophyses.

Except in *Siren*, *Proteus*, and *Amphiuma*, all these vertebræ support a transverse process and a rib on each side of the body.

Some few forms have small hypapophysial processes (e. g. *Speiropes*), or single median ridges, or such ridge more or less cleft longitudinally. The various parts and processes of the vertebræ have been already described.

SACRAL VERTEBRA.

Never more than one vertebra is normally connected with the hip-girdle; but not very unfrequently the ilium of one side is connected with the transverse process of one vertebra, while the other ilium attaches itself to another vertebra. The transverse process of the sacral vertebra is generally stout, as also the annexed rib. The latter is especially predominant, as compared with the ribs in advance of it, in *Axolotl*. In *Proteus* and *Amphiuma* this vertebra is without a rib. In no genus does it develop a hypapophysial process.

CAUDAL VERTEBRÆ.

These vertebræ always decrease in size successively from before backwards; the last ones are often merely little bony ossicles without processes of any kind. The number of caudal vertebræ varies from 22 in *Cryptobranchus japonicus**, and sometimes in *Menobranchus*, to about 43 in *Amphiuma* or 53 in *Siren*. All except the more posterior ones are provided with neural arches and, with the exception of the first one or two, with hypapophyses. These latter unite to form hypaxial arches in all the species except *Siren*. Transverse processes are sometimes to be traced for a great distance along the tail, as in *Siren*, *Chioglossa*, &c. Sometimes, as in *Cryptobranchus* and *Menopoma*, every trace of them disappears at the seventh or eighth caudal vertebra. Sometimes both tubercular and capitular processes stand out distinctly one above another, as occasionally in the fourth vertebra of *Menobranchus* (fig. 10, *c*, *t*). Small ribs are sometimes attached to the first caudal vertebra, and also to the one or two following ones, as in *Menopoma* and *Cryptobranchus*.

Anterior and posterior zygapophyses are always developed in the anterior caudals, and continue backwards for a variable, sometimes (e. g. in *Amphiuma*) for a great extent. But it is here unnecessary to recapitulate details as to the various parts and processes of these vertebræ, which have already been given under the various preceding headings.

* In Brit. Mus.



M. & N. H. & Co. New York.

J. C. Kennel del.