130. Hesperia diomus.

Hesperia diomus (Hopff.); Kirby, op. cit. p. 615 (1871).
Pyrgus diomus, Trimen, op. cit. iii. p. 287 (1889).
a. Nzoi, 3500 feet, May 15, 1892.

131. Hesperia sataspes.

Hesperia sataspes (Trim.); Kirby, op. cit. p. 615 (1871).
Pyrgus sataspes, Trimen, op. cit. iii. p. 289 (1889).
a, *b*. March from Mreru in Ndi to Tsavo, 2300 to 1650 feet, Jan. 9, 1892.

132. Hesperia dromus.

Pyrgus dromus (Plötz); Trimen, op. cit. iii. p. 283 (1889).
a. Kikuyu, 6500 feet.

133. Cyclopides metis.

Heteropterus metis (Linn.); Kirby, op. cit. p. 623 (1871).
Cyclopides metis, Trimen, op. cit. iii. p. 266 (1889).
a. Ndara, Teita, 3300 feet, Feb. 3, 1892.

134. Pterygospidea djælælæ.

Nisoniades djælælæ (Wallgr.); Kirby, op. cit. p. 630 (1871).
Pterygospidea djælælæ, Trimen, op. cit. iii. p. 354 (1889).
a–d. March from Mreru in Ndi to Tsavo, 2300 to 1650 feet, Jan. 8, 1892.

EXPLANATION OF PLATE XIX.

Fig. 1. *Rhaphiceropsis pringlei*, p. 336.
2. *Rhaphiceropsis pringlei* (underside).
2 *a*, 2 *b*. Figures of structure of do.
3. *Papilio pringlei*, p. 352.
4. *Ypthima albida*, p. 336.
5. *Alæna johannæ*, p. 338.

April 17, 1894.

W. T. Blanford, Esq., F.R.S., Vice-President, in the Chair.

Mr. Sclater called attention to the attempts about to be made to induce the specimens of *Protopterus annectens* to breed in the Society's Reptile-house, where one of the large oval open tanks had been specially fitted up for their accommodation. There were now six adult examples of this Mud-fish in the Collection, two presented by Mr. H. H. Lee in 1887 and four purchased in 1889. These had been until now all kept together in one of the large water-tanks, and had thriven well, the largest having attained a length of 18 or 19 inches—except that they were all more or less

mutilated from the loss of their fins, which were continually eaten away by the Mud-fishes from each other.

The mode of reproduction of *Protopterus* seemed to be wholly unknown, except as regards the information contained in an article recently published in 'Le Mouvement Géographique' (1894, p. 30), in which it was stated, from observations made by the French Missionaries at Mpala on the western shore of Lake Tanganyika (lat. 6° 45′ S.), that the embryos of the *Protopterus* (there called locally *Sembé* or *Sompé*) were carried about in an elongated gelatinous sac attached to the sides of the back of the parent and were very numerous.

1. On the Bones and Muscles of the Mammalian Hand and Foot. By Prof. Karl von Bardeleben, M.D. Berol.

[Received April 16, 1894.]

(Plates XX. & XXI.)

As the Committee of the "Anatomische Gesellschaft" has asked me to give a Report on the Mammalian Hand and Foot at the next meeting of the Society at Strassburg, I wish previously to publish my own investigations on this subject made since 1885 at Jena, Leyden, Amsterdam, Brussels, Berlin, and Paris, and especially in 1889 and 1890 in the Natural History Museum, in the Royal College of Surgeons, and in the dissecting-room of the Zoological Society's Gardens in London, of which I have only published short abstracts in the Proc. Zool. Soc. 1889 (p. 259, pl. xxx.), in the Anat. Anz. 1890, and in the Verhandlungen d. anat. Ges. P. V. 1891.

I have examined the distal parts of the fore and hind limbs in all orders of Mammals either in skeletons or in specimens dissected by myself.

Naturally I have paid greatest attention to the "præpollex" and "præhallux" and to the "postminimus"[1], especially to the muscles and other soft parts of these structures. Apart from all theory, I think everybody may agree with me in calling a bone or a thumb-like outgrowth on the radial side of the pollex "præpollex," and a structure behind the minimus "postminimus."

The name "sesamoid bone" is much more misleading, and as I cannot agree that the structures I am speaking of are "sesamoids," or that they consist only of *bone*—for there are also soft parts, such as muscles, vessels, nerves—I must use the abbreviations Pp., Ph., and Pm.

This paper will be divided into three parts: the first concerning the skeleton, and the second relating to the muscles; in the third the bones and the muscles will be compared, and the conclusions concerning the meaning of Pp., Ph., and Pm., and concerning the homologies between the bones of hand and foot, will be given.

[1] I will use the abbreviations Pp., Ph., Pm.

A.—ON THE SKELETON.

As the pisiform and the calcaneum are present in *all* mammals, and as it is of no importance whether these bones are large or small, and whether they are directly connected with the ulna or the fibula, or not, I will not give here details on this point. Nobody will doubt that these bones are constant and that the large pisiform of lower mammals is homologous to the smaller one of the highest, *e. g.* Man—nor that the calcaneum of Monotremata, though it is directed forwards or outwards, is homologous to the calcaneum of higher mammals, where it is always directed backwards. Further, I must recall what I published in these Proceedings in 1889, that the pisiform is divided into *two* pieces in *Bathyergus*, being the only animal in which I met with this separation.

As I cannot tell here the names of *all* mammals in which I have found the Pp. and Ph., I will only mention those in which I made a sketch or measured these structures.

I am sorry I did not pay attention to the carpus and Pp. in my first investigations made in 1885 in Berlin, when I examined the mammalian foot for the "intermedium tarsi" or "os trigonum."

To the names of the animals which I examined in London, Berlin, Leyden, and other places I put the letters Lo., Be., Le., Pa. (Paris), Je. (Jena), A. (Amsterdam), Br. (Brussels); otherwise London, especially the Nat. Hist. Museum, is intended. I use the following abbreviations :—long or length l., breadth br., thickness th.; do.-vo. (dorso-volar), do.-pl. (dorso-plantar), sag. (sagittal), tr. (transverse), r. (right), l. (left); 0 = no, or not present. The numbers mean millimetres.

N.B.—As the Pp. and Ph. are often lost in preparing and cleaning the skeletons, I am often doubtful whether a Pp. or a Ph. had been present (and lost) or not. In such cases I put a "?".

Marsupials.—The Pp. is situated on the trapezium (carp. dist. 1), the Ph. on the internal cuneiform.

Macropus (*Halmaturus*) *bennetti*: Pp.

Trichosurus vulpecula: Pp.

Phascolomys wombat: Pp. 7 l.; 4 br.; 3 do.-vol.

(Be., Lo.) *Didelphys marsupialis* [*cancrivora*, Be., Je.; *aurita*, Be.]: Pp. Ph., 4·5 l.; about 3·0 br.; 2 do.-pl. "*D. aurita*": 5 l.; 3 br.; 2 th.

Didelphys elegans: Pp. Ph. consists of *two* bones!

(Be.) *Didelphys azaræ*: Pp. Ph.

Didelphys philander: Pp. Ph.

Didelphys crassicaudatus: Pp. Ph.

(Le., Be.) *Chironectes minimus* (*variegatus*): Pp. Ph. 2·5 l.; 1·8 do.-pl.; 1·2 br.

Edentata.—The Pp. is attached on the scaphoid and trapezium; the Ph. on the naviculare and first cuneiform.

(Be., Lo.) *Tamandua* (*Myrmecophaga*) *tetradactyla*: Pp. Ph. (Be.), 10 l.; 5–6·5 do.-pl.; 2·5 sag.

Myrmecophaga jubata: Pp. Ph. 18 l.
Dasypus sexcinctus: Pp. Ph. (*vide* Plate XX. fig. 1).
Euphractus minutus (dissected): Pp. Ph.
Euphractus minutus (skeleton): Pp. Ph. very well developed, resembles metatarsal bone.

Ungulata.—Naturally neither a Pp. nor a Ph. is present in the Ungulata vera nor in *Hyrax*.
Proboscidea, or *Elephas africanus*, "Embryo" (R.C.S.) has a large Pp.; it is longer than the pollex. The Ph. is also very strong.
In *Cetacea* the Pp. has been found by Prof. Kükenthal.

Insectivora.—Pp. on the scaphoid; Ph. on the naviculare and internal cuneiform.
(Je., Le., Be., Lo., A., Pa.) *Centetes ecaudatus*: Pp. Ph. 2 l.; 1 br.; 1 th. (*vide* Plate XX. figs. 2, 3).
(Le.) *Hemicentetes nigriceps*: Pp. Ph.
Hemicentetes variegatus: Pp. Ph.
(Le., Lo.) *Ericulus setosus*: Pp. Ph.
(Je., Le., Be., Pa., Lo.) *Talpa europæa*: Pp.! sickle-shaped. Ph.! sickle-shaped.
(Le., Lo.) *Talpa wogura*: Pp.! sickle-shaped. Ph.! sickle-shaped.
Scalops argentatus: Pp. sickle-shaped.
(Be., Le.) *Myogale moschata*: Pp. Ph. very long, transv.
(Le.) *Urotrichus talpoides*: Pp. Ph.
Tupaja tana: Pp. 1 l.; 0·75 br. Ph.
(Je., Le., Be., Pa., Lo.) *Erinaceus europæus*: Pp. Ph.
Gymnura rafflesii: Pp. Ph.? (single bones in a box).
Galeopithecus philippinensis: Pp. Ph.

Rodentia.—Pp. on the scaphoid (and metac. I.). Ph. on the internal naviculare and internal cuneiform.
Sciurus arizonensis, *S. niger*, *S. vulgaris*: Pp. large. Ph.
Xerus erythropus (Monbuttu, Emin Pasha): Pp. 1 l.; 0·6–0·7 br. Ph. small.
Cynomys ludovicianus: Pp. 7·2 l.; 4·7 br. Ph.
Arctomys marmotta: Pp.! sickle-shaped (though thumb reduced). Ph. 2·5 l.; 3 do.-pl.; 2 transv.
(Je., Be., Le., Lo.) *Castor fiber*, *canadensis*: Pp. and Ph. enormous.
(Be.) *Myoxus glis* (*avellanarius*): Pp.?
(Be.) *Spalax typhlus*: Pp.? Ph.
(Be., Lo.) *Bathyergus maritimus*: Pp. 7·5 l.; 4·5 br. Ph.—(Be.) 6 l.; 2·5 do.-pl.; 1 th. (1885): (Lo.) 7 l.; 3 do.-pl.; 1 th. (1889), ending cartilaginous (*vide* Plate XX. fig. 4).
Georychus capensis: Pp.? Ph. 2·7 l.; 2·5 do.-pl.; 1 tr.
Myoscalops (*Heliophobius*) *argentocinereus*: Pp. and Ph. resemble *Bathyergus*, but much smaller.
Geomys hispidus: Pp. 9·5. Ph.?
Dipus jaculus: Pp.?

Pedetes capensis (*caffer*): Pp. two bones,—prox. 13 l., 4·5–5·5 br.; dist. 7 l., 5·2 br. No Ph.

(Be.) *Myopotamus bonariensis*: Pp. 7 l.; 5·5 br.

Aulacodus swindenerianus: Pp. very large. No Ph. (hallux rudimentary).

Chætomys subspinosus: Pp. Ph. very large.

(Be., Lo.) *Cercolabes* (*Synetheres*) *insidiosa*: Pp. and Ph. triangular.

Synetheres prehensilis: Pp. about 8 l.; 4·5 br. Ph. 12·5 l.; 7·5 br.

(Pa., Lo.) *Erethizon dorsatus*: Pp.? lost. Ph. 9 l. (int. cuneiform divided into *two* bones) (*vide* Plate XX. figs. 5, 6).

Hystrix malabariensis and *H. javanica*: Pp. large. Ph. 5 l.; 3 br.

Carnivora.—Pp. on the scapho-lunatum and trapezium. Ph., if present, on the naviculare and internal cuneiform.

Felis macroscelis: Pp.

Felis paguros: Pp.

(Be., Le., Lo.) *Felis tigris*: Pp. ca. 15 l.; 10 br.

(Be., Le., Lo.) *Felis pardus*: Pp.

Felis tigrina: Pp.

Felis macrura: Pp.

Cynælurus jubatus: Pp. large.

(Be., Le., Lo.) *Cryptoprocta ferox*: Pp. Ph. lost?

Viverra tangalunga: Pp. 3·2 l. and do.-vo.

Viverricula malaccensis: Pp.

Genetta pardina: Pp. lost?

Linsang (*Prionodon*) *pardicolor*: Pp. very small (almost 1 mm.).

Linsang (*Poiana*) *gracilis*: Pp.

Paradoxurus philippinensis: Pp. 5 l.; 2 br. Pp. has a transv. direction. Ph.! 5 l.; 2·75 br.; 2 th.

(Be.) *Paradoxurus typus*: Pp. 5 l.; 3 br.; 1 th. Ph.!

(Be., Lo.) *Herpestes fasciatus*—(Be.) Pp. 2 l.; 1·5 br.; 1·5 th.: (Lo.) Pp. 2·5 l.; 2·5 do.-vo.

Herpestes griseus: Pp.

Herpestes javanicus: Pp.

Herpestes ichneumon: Pp. 3·8 l.; 2·5 do.-vo.

(Le.) *Herpestes pulverulentus*: Pp.

} No Ph.

Cynictis penicillata: Pp. seems to be united with the scapho-lunatum.

Galidea olivacea: Pp.

Hemigalea (= *Herpestes*) *galera*: Pp. 2 l.; 2 br.

Hemigalea hardwickii: Pp. 3 l.; 3 br.; 2 th. Ph.! 2·8 l.

Eupleres goudotii: Pp. 2 l.; 2 br.; 1 th.

Proteles cristatus: Pp.? lost?

Hyæna striata: no Pp.; no Ph.

In the *Canidæ* there are separated neither Pp. nor Ph.

In the *Ursidæ* Pp. seems to be coalesced with the scapho-lunatum. No Ph.

(Le.) *Procyon lotor* (3 spp.): Pp. and Ph.
(Le.) *Procyon cancrivorus* (3 spp.): Pp. 4 l.; 2·5 br. Ph. (Lo. no Ph., always lost).
Ælurus fulgens: Pp. 6 l.; 4 br.; 3 th. Ph. 7 l.; 2·5–2 br.; ending cartilaginous (*vide* Plate XX. figs. 7, 8, 9).
(Le., Lo.) *Nasua narica* (*nasica*): Pp. Ph.
(Je., Be.) *Cercoleptes caudivolvulus*: Pp.
(Be., Lo.) *Lutra brasiliensis*: Pp. Ph. (Be.) 12 l.; 6–4 br. (pointed); 4th on the proximal end; like a metatarsal.
Lutra canadensis: Pp. Ph. 0!
(Be.) *Lutra platensis* (2 sp.): Pp.
Latax lutris: Pp.
Mephitis mephitica: Pp. 4 l.; 1·5–1·8 br. (top ends cartil.); shaped like a metacarpal. Ph. 2·3 l.; 2 br.
Conepatus mapurito: Pp. Ph.
Mydaus meliceps: Pp. 2·5 l.; 1·2 br.
Meles taxus: Pp. 4·8 l.; 3 br.; pointed.
} Traces of a suture (Ph.?) in the internal cuneiform.
Taxidea americana: Pp. 7·7 l.; 3 br.; a little sickle-shaped, pointed.
Helictis orientalis: Pp. 3·5 l.; 1·6 br. Ph. 2·5 l.; 1·5 br.
Ictonyx (*Zorilla*) *capensis*: Ph. on the l. hand separated and isolated; on the r. hand coalesced with the scapho-lunatum.
(Le.) *Galictis* (*Grisonia*) *barbara* (2 spec.): Pp.
Galictis (*Grisonia*) *vittata* (young): Pp. 3·2 l.; 1·5 br.; resembles a metacarpal bone. Ph. 2·5 l.; 2 br.
Gulo borealis: Pp.! 16 l.; 5 br.; 3 th.; comma- or sword-like; top cartilaginous.

Pinnipedia :—
(Br., Lo.) *Trichechus rosmarus*: Pp.
Phoca vitulina: Pp.?
Arctocephalus cinereus: Ph. (Pp.?)

Chiroptera.—Pp. attached to the scaphoid, small. Ph.?
Pteropus medius: Pp.
Cynopterus marginatus: Pp.
Vesperugo: Pp.
Phyllostoma hastatum: Pp.

Lemuroidea.—Pp. situated on the side of the trapezium, before the scaphoid, behind and on the side of the metacarpale 1.
(Je.) *Indris brevicaudata* (*Lichanotus indri*): Pp.
Avahis (*Microrhynchus*) *laniger*: Pp. 3·0 l.; 1·5 br. Ligament to the trapezium.
Lemur catta: Pp. 3·0 l.; 2·0 br.
Lemur macaco: Pp.
Lepidolemur mustelinus, Geoffr., and *L. microdon* (Forsyth Major): Pp. 4 l.; 2 br.; pointed, at the free end cartilaginous.
(Je.) *Otolicnus galago* (*Galago* sp.): Pp.
(Je.) *Nycticebus* (*Stenops*) *tardigradus*: Pp.

(Je., Lo.) *Loris gracilis*: Pp.
Perodicticus calabariensis: Pp.
Tarsius spectrum: Pp.
Chiromys madagascariensis: Pp. 4·3 l.; 3 br. on the basis.

Primates s. s. (Anthropoidea).—Pp., if situated on the trapezium, connected by ligaments with the scaphoid.
Cebidæ:—*Chrysothrix sciurea*: Pp. 2 l.; 2 th.
Cercopithecidæ:—
(Je.) *Cynocephalus anubis*: Pp.
Cynocephalus (*Hamadryas*) *ægyptiacus*: Pp. r.! (l. lost).
Macacus leoninus: Pp. 6 l.; 5·5 do.-vo.
Maccaus laniger: Pp. 4 l., 3·1 do.-vo.
Macacus sp? (young spec.): Pp.
Macacus inornatus: Pp.
Cercopithecus ruber: Pp. 4 l.; 3·5 do.-vo.
Cercopithecus cephus: ? lost.
Cercopithecus mona: ? lost.
(Je.) *Cercopithecus cynosurus*: Pp.
Semnopithecus mitratus: Pp. seems to be coalesced with the scaphoid.
Colobus bicolor: Pp. ? lost.
Colobus ursinus (2 spec.): Pp. 3 viz., 3 l.
Simiidæ:—*Hylobates lar*: Pp. 5·8 l.; 4 do.-vo.
In *Simia*, *Gorilla*, *Anthropopithecus* no Pp. (= tuberos. scaph.?); no Ph.
Homo: no separated Pp. or Ph.

B.—ON THE MUSCLES AND NERVES.[1]

I. Forearm and Hand.

a. MARSUPIALS.

1. Didelphys marsupialis. (Plate XXI. figs. 1, 2.)

a. Flexores.

The nerv. medianus and art. brachialis pass the supracondylar foramen of the humerus. Nerv. ulnaris accompanied by the ulnar artery runs behind the internal condyle.

The *pronator radii teres* arises from the radial border of the humerus (or entepicondyloideum); it is not perforated by the median nerve.

The *n. ulnaris* supplies the following muscles:—

Forearm:—(1) The *ulnaris internus* (flex. carpi ulnaris) arises by two heads (humeral and ulnar) which become united; inserted into the pisiform.

(2) The *palmaris longus* takes origin connected with the ulnar head of the former muscle; it is divisible into two layers, a radial and superficial one and a deep or ulnar: the super-

[1] I am very sorry to say that my notes and sketches concerning the Monotremata, Edentata, and some of the other lower mammals have been lost.

ficial muscle ends in a weak aponeurotic expansion (fascia palmaris) and the Pp.; the deep one goes to the lig. carpi transversum.

Hand:—(3) The "*piso-metacarpeus*" comes from the pisiform and the lig. c. transv., and is inserted into the fifth metabone.

(4) A muscle from the lig. carp. transv. (tendon of the deep palmar muscle) to the fifth metacarpal and first phalanx of the minimus, divides into

$$\left\{\begin{array}{l}(a) = \text{the } \textit{opponens} \\ (b) = \text{the } \textit{flexor brevis}\end{array}\right\} \textit{minimi digiti.}$$

(5) A muscle from the tendon of the superficial *palmaris* to the second phalanx of the fifth digit; the tendon is perforated by the tendon of the *fl. profundus*.

I consider the muscle (4) and its homologue—also in Man—as the vestiges of an old *flexor brevis superficialis* (comp. *Hyrax*).

Supplied by the *n. ulnaris* and *medianus*:—

(1) The *flexor digitorum sublimis*, connected with the *profundus* at the origin and with the lumbricales of the 4th and 3rd digits (*vide* below).

The *fl. sublimis* arises—(i.) from the humerus, connected with the humeral head of the ulnaris internus and two heads of the palmaris longus; (ii.) from the radius, in common with the radial head of the profundus; (iii.) from the ulna, with the ulnar part of the profundus.

Insertion: digits 2–4; ends in tendon-sheaths and on the phalanges.

(2) The *flexor digitorum profundus*.

Origin: (i.) humerus, with the radialis internus; (ii.) radius, with the sublimis; (iii.) ulna, with the sublimis.

Insertion: by five tendons to digits 1–5 and eight lumbricales-like muscles to the tendon-sheaths of digits 2–5.

(3) The 8 "*lumbricales*" are quite remarkable:—

Origin.	*Insertion.*
(*a*) Tendon for the 5th dig., radial side.	Radial border of the 5th dig.
(*b*) Tendon for the 4th dig., above.	Tendon of the flex. subl. to the 4th dig., and sheath.
(*c*) Tendon for the 4th dig., rad. side.	Rad. border of the 4th dig.
(*d*) Tendon for the 3rd dig., above (ulnar).	Tendon of the flex. subl. for the 3rd dig., and sheath.
(*e*) Common tendon and tendon for the 3rd dig., rad. side.	Rad. border of the 3rd dig.
(*f*) Tendon for the 3rd dig., rad. side.	Ulnar border of the 2nd dig.
(*g*) Tendon for the 2nd dig., above (ulnar side).	Tendon of the flex. subl. 2nd dig., and sheath.
(*h*) Common tendon, tend. 1st and 2nd dig.	Radial border of the 2nd dig.

I think the muscles *a*, *c*, *e*, and *h* are real "*lumbricales*." What the others mean I do not know. Perhaps we have here the

explanation of the two-headed *lumbricales* of higher mammals, which, *e. g.* in Man, are so very often met with.

β. Extensores.

	Origin.		*Insertion.*
The *supinator longus* (brachio-radialis).	Humerus	as in man.	*Pp.*, with the tendon of the abd. (ext.) pol. longus.
The *radialis ext. longus.*	Humerus		Metacarpus II.
The *radialis ext. brevis.*	Humerus		Metacarpus III.
The *extensor dig. comm. rad. s. subl.*	Humerus, radius.		digits 2–5.
The *extensor dig. comm. uln. s. prof.*	Ulna.		digits 1–3.
The *extensor dig. IV. and V.* (*ext. minimi*, Man.)	Ulna.		4th and 5th digits.
The *ulnaris externus.*	Humerus.		Metacarpus V. and into *volar* ligaments.

The *præpollex* gets a very long *nerve* from the n. medianus, and *vessels* from the art. brachialis.

2. Trichosurus vulpecula. (Plate XXI. fig. 3.)

α. Flexores.

The *ulnaris internus*: origin, humerus and ulna; insertion, pisiform.

The "*palmaris longus*" consists of two muscles, a superficial and a deeper one; the superficial one is inserted into the Pp. and the ligam. c. transv., some fibres going to the pisiform; the deeper palmaris ends in the fascia palmaris (*vide* Plate XXI. fig. 3).

The *flexor digitorum sublimis* is weak; it divides into four rather slender tendons which go to digits 2–5, mostly ending in the thin sheaths of the deep tendons.

The *flexor digitorum profundus* is strong; it comes from the humerus and both ulna and radius. The five tendons spring from a united tendinous mass; they become almost superficial on the digits.

There are *four lumbricales.*

β. Extensores.

The *supinator longus*, a strong muscle, arises from the humerus and is inserted on the radial side of the scaphoid (Pp.?).

The *radiales externi longus* and *brevis* are almost quite separated.

N. medianus supplies the Pp.; a strong nerve goes to the dorsum of the hand for the supply of the thumb and the radial side of the 2nd digit.

3. Macropus bennetti.

(Zool. Soc. Gardens, London.)

The *palmaris longus* ends in a long narrow tendon which continues into a triangular aponeurotic expansion on the wrist, sending a distinct tendinous strip to the Pp., 3rd digit, and Pm.,—not only to the bones but also to the pads and even to the skin. Nerve-supply by the ulnaris.

From the *pronator radii teres* goes a muscular belly to the *radialis internus* (comp. Rodentia and Carnivora).

A muscle arises from the Pp. and is inserted into the metacarpal I. (as in Carnivora)=Interosseus 0 ?

There is an *extensor pollicis et præpollicis.*

A very strong muscle is present on the *hypothenar*, arising from the distal end of the pisiform and the tendon of the *palmaris longus.*

b. INSECTIVORA.[1]

The "*palmaris longus*" gets its nerve only from the ulnaris, the muscle being situated rather on the ulnar side and inserted into the pisiform.

The *ulnaris internus* is also implanted in this bone (perhaps there are two ulnares ?)

c. RODENTIA.

1. Sciurus arizonensis. (Plate XXI. fig. 4.)

(Zool. Soc. Gardens.)

Bone and pad of the Pp. are large, the thumb being small; on the Pm. a large pad.

The *palmaris longus* has on the wrist an aponeurotic expansion of triangular shape; it is inserted into the Pp., Pm., the other pads of the volar manus, and the sheaths of the digits. Nerve-supply from *medianus* (from the ulnaris no branch being found).

Very strong muscles are met with in the pad of the minimus digit, connected with the palmaris longus and the ulnaris internus; the muscular fibres reach the Pp. *N. ulnaris*: the tendons of the *fl. digit. sublimis* (phalanx II.) are weak, those of the *fl. profundus* (phalanx III.) are very strong.

There is an *extensor* (or *abductor*) *pollicis et præpollicis* arising from the ulna (comp. *Herpestes*).

2. Bathyergus maritimus.

On the Pp. and Pm. there are nail-like formations (comp. *Pedetes capensis*). Its Pm. consists of *two* bones (P. Z. S. 1889, p. 260); there are also two muscles, one for each bone. Whether these muscles be *two ulnares interni* or one of them be a *palmaris longus* I cannot say. Both are supplied by the *ulnaris* nerve.

On the wrist there are five muscles:—(1) A superficial muscle running obliquely from the Pm. to the Pp. and pollex, it continues the supposed palmaris (or ulnaris int.); (2) a superficial muscle from the Pp. to the thumb (nerv. medianus); (3 & 4) deep transverse muscles on the carpal joints (nerv. ulnaris); (5) a deep muscle between Pp. and pollex.

Each digit has two "*interossei*" or deep short flexors.

Extensor pollicis et præpollicis longus runs obliquely from the

[1] My notes and sketches concerning *Centetes* and other Insectivora having been lost, I can for the present give these few remarks only.

ulna to the aponeurotic sheaths of these digits, like the *ext. pollicis* in Man.

3. Dipus jaculus.

From the Pp., which is of enormous size, a strong muscle—*m. transversus carpi*—arises; it is inserted into the fifth metacarpal bone.

A very large superficial muscle is situated on the flexor side of the forearm and hand: it takes origin from the humerus and the ulna and ends by tendons on the Pp. and on the top of the pisiform (Pm.). As there is another superficial muscle with distinct tendons running down to the hand, and there are also *flexores digitorum sublimis* and *profundus*, I suppose that those two superficial muscles are parts of the *palmaris longus* (the *flexor digitorum superficialis*).

I could not make further investigations, this animal not being well preserved.

d. UNGULATA.

1. Hyrax brucei.

α. Flexores.

From the tendons of the *palmaris longus* arises a *flexor brevis superficialis*; this is common in the foot, but *very seldom* met with in the hand.

As this animal has not four digits (*Mivart*) but five (*Dobson*), there are muscular bellies to each digit except the third, i. e. *four*. (*Dobson* describes only three.)

The belly for the thumb is 3·5 mm. long and 2·5 mm. broad.

The tendons of this superficial flexor are cleft and let pass the deep tendons.

The three inner bellies of the *flexor brevis* are supplied by the *medianus*, the outer one (5th digit) by the *ulnaris*.

Ulnaris internus consists of *two* muscles (taking origin from the humerus and the ulna).

β. Extensores.

The *radialis externus*, situated under the *ext. poll. longus*, ends by *four* tendons:—the first is inserted into the second metacarpal bone; the second and third into the third metacarpal; the fourth into the unciform.

The *ext. pollicis* is very strong, its broad tendon ends on the small rudimentary thumb (quite as in the Pp. in animals with "five" digits).

The *ulnaris externus* is also very strong, it is inserted into the *fifth metacarpal* bone.

The *extensor digitorum communis* is perforated by the (2) tendons of the *extensor minimi* (*et quarti*) *digiti*.

2. Elephas africanus (Embryo).

(Roy. Coll. Surg.) The specimen was already dissected for the Collection.

The *palmaris longus* is large, it ends in the *fascia palmaris*.

There is only one *flexor digitorum*, which gets an accessory belly from the ulna.

From the very large Pp. arises a strong muscle which goes to the pollex.

From the deep layer of the wrist comes a muscle which is inserted into the Pp. and the pollex. It may be called *flexor pollicis et præpollicis brevis*, or, as it is also a "little adductor," perhaps "*opponens poll. et præpollicis.*"

e. CARNIVORA.

1. Linsang gracilis. (Plate XXI. fig. 5.)

(*Viverra, Prionodon.*)

a. Flexores.

There are *two palmares longi* and *two ulnares interni*.

The *palmaris longus radialis* is supplied by the *n. medianus*; the *palmaris longus ulnaris* by the *n. ulnaris*; both *ulnares interni* (*radialis, ulnaris*) being supplied by the latter nerve.

The *palm. long. rad.* arises with the *m. ulnaris int. uln.* from the internal condyle of the humerus, and ends in the volar pads and in digits 2–5, also *between* them in the webs.

The *palm. long. uln.* arises with the former muscle and goes to both the radial and ulnar pads on the wrist, mainly to the ulnar one.

The *ulnaris int. rad.* (*humeralis*) takes origin from the internal condyle of the *humerus*, while the *ulnaris int. ulnaris* s. *proprius* comes from the *ulna*; *both* are inserted together into the pisiform.

In this animal can be observed the fissure of main tendons and the coalescence of its delicate parts, and the development of a fascia or aponeurosis from tendons.

Muscles on the wrist :—

Connected with each other. (1) An almost transverse muscle, like the *palmaris brevis* of Man, ending in the ulnar pad.
(2) An oblique muscle, ending in the thumb.

(3) A muscle representing the greatest part of the "lig." carpi transversum of Man; this "ligament" consisting *partly* of the tendon of the *palmaris longus ulnaris*, for the greater part of muscular fibres.

The *flexor digitorum sublimis* sends four tendons to the second phalanx of digits 2–5; the tendons are very weak, they are not so distinctly divided in two parts as in Man; a strong tendon joins the profundus and continues mostly into the 2nd and 3rd digits.

The *flexor digitorum profundus* forms a fibrous mass near the wrist; from this mass arise five strong tendons for digits 1–5.

There is to be observed the first stage of a crossing of the tendons of the sublimis and profundus, as in the planta pedis.

β. Nerves of the *extensor* side :—

Ramus superficialis of the musculo-spiral *nerve* (*n. radialis*) runs just as in Man.

The deep branch, situated between the *m. brachialis internus* and the *supinator longus*, ends in branches for the skin which provide the *whole dorsum manus*, except only the ulnar border of the fifth digit.

2. Herpestes griseus.

(Zool. Soc. Gardens.)

α. Flexores.

From the *pronator r. teres* come tendinous fibres to join the *radialis internus* (comp. *Sciurus*).

The *palmaris longus* ends partly in the pads, partly it is inserted into digits 2–5 by delicate tendons which are a little connected with each other.

Nerve-supply : *n. medianus* (only).

There are *four* strong superficial muscles on the wrist, connected with the ligam. c. transv. and also (partly) with the deep ligaments of the carpus :—

Nerv. medianus.
- (1) Origin : Pp. ; insertion : pollex.
- (2) Origin : tendon of the *palmaris longus* and the former muscle ; ins.: pollex.
- (3) Origin : tendon of the *palmaris l.* ; ins. : pad of the Pm. (or the pisiform) = *musc. transversus carpi.* (Nerve-supply not quite sure.)

N. ulnaris : (4) A deep muscle like the former, separated from it by the nerv. ulnaris.

There are *two m. ulnares interni*, as in *Linsang* :—

The *ulnaris int. ulnaris* (proprius), the stronger one, arises from the humerus and the *ulna* ; it is inserted by a flat tendon into the pisiform, more superficial and ulnar than the following muscle.

The *ulnaris int. rad.* (*humeralis*) springs from the humerus (cond. int.) and ends fleshy on the pisiform.

The *flexor digitorum sublimis*, supplied by both the median and *ulnar* nerves, divides in four thin and narrow tendons, which end in the tendon-sheaths of digits 2–5.

The *flexor digitorum profundus* has five very strong tendons for the 1–5 digits.

The four *lumbricales* are also connected with the *fl. sublimis* ; they form a mass filling the space between the *sublimis* and the *profundus*.

β. Extensores.

The *supinator longus* is fleshy as far as the carpus ; its insertion is not quite distinct on *one* bone ; there is one insertion into the

lower end of the radius, but also an aponeurotic expansion reaching to the first and second metacarpal bones.

The *extensor digitorum communis* ("*sublimis*") arises from the humerus and goes to digits 2–5.

The *extensor digitorum* "*profundus*," as I should like to call it, takes origin from the ulna and has the following insertions:—

(1) Three tendons for digits 3–5 (ulnar border); (2) a tendon dividing and going to the 3rd and 2nd digits; (3) a strong muscular belly with a very broad tendon divides into two, which end on the first metacarpal and on the Pp.

3. Paradoxurus, sp.

α. Flexores.

There are *two palmares longi* (as in *Linsang*), the stronger radial one being supplied by the *n. medianus*, the other (ulnar) by the *ulnar* nerve.

Two m. ulnares interni are present, both being supplied by the *ulnar* nerve:—

(1) The *uln. int. rad.* (*humeralis*) comes from the humerus and is inserted into the top of the pisiform; (2) the *uln. int. ulnaris* springs from the ulna and ends in the wrist in a fascia (ligam. carpi transversum).

These muscles are supplied by the ulnar nerve.

The "*flexor digiti brevis superficialis*" is present in this animal; it springs from an aponeurotic expansion on the wrist (which is connected with the Pp.) and has three bellies, two of them being inserted into the fifth digit, one into the fourth ending on phalanx I. and on the sheaths of the tendons.

The tendon of this *flexor br. superfic.* for the 4th digit is cleft and perforated by the corresponding tendon of the *flexor sublimis.*

Both *flexores longi*, *sublimis*, and *profundus* take origin from the humerus, the radius, and the ulna; the sublimis is weak and goes to phalanx II. of digits 1–4 (!), the profundus is strong and ends on phalanx III. of digits 1–5.

There are four *lumbricales*; the third is the strongest, the fourth arises from the tendon of the *sublimis* (4th digit).

On the radial border of the forearm runs a strong muscle from the humerus (*internal* condyle) to the radius and the Pp., where it ends in an aponeurotic expansion which is perforated by the art. radialis.

The superficial muscles on the Pp. are connected with the tendon of the *pronator radii teres.*

β. Extensores.

The *extensor pollicis et præpollicis longus* (*ext. poll. l.*, Man) is present; it arises from the ulna and the radius.

The *supinator longus* is weak.

The *radialis ext. long.* and *brev.* are both present.

The *ulnaris ext.* is extremely strong; it takes origin from the

humerus and the ulna and is inserted into the pisiform and the fifth metacarpal bone.

The *extensor digit. long.* (*radialis subl.* ?) goes to digits 3–5.

The "*extensor dig. minimi proprius*" ends by three tendons on digits 3–5 (1st phalanx).

The *ext. indicis et pollicis* comes from the distal end of the ulna.

4. Viverricula malaccensis. (Plate XXI. fig. 6.)

Flexores.

The "*palmaris longus*" arises (very broad) from the internal condyle (hum.) and ends by four tendons (connected with each other) on digits 2–5, some fibres going to the Pp. and to the neighbourhood of the Pm.

As this muscle has *two* nerves (from the medianus and the ulnaris) it may perhaps be considered as formed by union of two *palmares*.

On the wrist there are *four* little muscles :—

N. ulnaris. (1) From the pisiform and the tendon of the *ulnaris internus* to the ulnar border of the manus.
(2) From the pisiform : continue into *one* tendon, which ends on the sheath
(3) From the Pp : of the *flexor longus* on the fifth digit.

N. medianus : (4) From the Pp to the thumb.

Underlying these four muscles there is a strong transverse ligament.

N. medianus and ulnaris. The *flexor dig. subl.* has delicate and narrow tendons which are cleft and perforated by the following muscle.
The *flexor dig. prof.* has very strong and broad tendons, which are connected with those of the *perforatus* where they pass it.

The radial part of the *profundus* goes to the pollex and index.

II. Leg and Foot.

a. MARSUPIALS.

1. Didelphys marsupialis. (Plate XXI. figs. 1, 2.)

a. Flexores.

There are strong nerves and vessels running to the Ph.

The *gastrocnemius* consists of *two* separate muscles arising from the inner and the outer condyle of the femur, joining each other only on the insertion on the calcaneum.

The *plantaris* takes origin in common with the lateral *gastrocnemius*, runs down, crossing the tibial or inner *gastrocnemius* at an acute angle ; it is fixed on the calcaneum and ends in the "fascia" plantaris, the tendinous fibres going mostly to the Ph.

Beneath this tendon there is an oblique muscle like a *musc. transversus* s. *obliquus carpi*.

From the fascia arises a weak muscle which seems to be the remains of the *flexor brevis superficialis*.

There are also an *abductor minimi* and an "*opponens*" which forms the outer part of the *flexor brevis superficialis*.

The *tibialis posticus* (or *medialis*?) is inserted:—

(1) By an aponeurotic triangular expansion on the Ph.; (2) it gives origin to a strong muscular belly (like a *lumbricalis*) ending in a tendon which goes to phalanx II. of the 2nd toe; it is perforated by the tendon of the *profundus* (*fibularis*); (3) it continues into a tendon which joins the *flexor digit. profundus*, where it sends the tendon to the hallux.

"*Tibialis quartus*" I should like to name a muscle which is situated on the outer side of the "*tibialis posticus*." It seems to be rudimentary or reduced; I could not find the insertion, because the tendon was torn on the back of the os trigonum.

The *flexor digitorum sublimis* (*tibialis*) goes to toes 3–5; first it is fleshy for a long way, then tendinous, and finally fleshy again (=*lumbricalis*?). The *sublimis* is largely connected with the *profundus* (*fibularis*), contra *Dobson*.

β. Extensores.

The nerv. peronæus goes to the 5th, 4th, 3rd, and 2nd toes (half).

There are *four m. peronæi*:

Origin.	*Peculiarities.*	*Insertion.*
(1) Cond. lat. femoris.	Superficial, strong, behind (2).	Planta.
(2) Cond. lat. fem., head of the fibula (lat.), representing a fleshy lig. laterale.	First flat, then rounded.	Metat. V., 5th toe.
(3) *a*. Middle third of fibula, outside.	Strongest tendon of all peronæi.	Outer border of the foot.
b. Femur, connected with (1).	Between (1) and (3 *a*).	
(4) Anterior surface of the fibula, upper half.		Dorsal aspect of the 5th, 4th, 3rd toes.

2. Trichosurus vulpecula.

The 2nd and 3rd toes reduced and united; hallux *widely diverging*.

α. Flexores.

The *gastrocnemius* is strong, two-headed, takes origin from the femur; inserted into the tuberositas calcanei.

The *plantaris* is also strong; inserted into the tuberos. calc. and fascia plantaris.

The *flexor brevis digitorum superficialis* arises from the tendon of the *plantaris* and ends on the outer border of the foot.

(Nerv. plantaris medialis supplies the four toes 1–4 and the inner half of fifth, but there is an anastomosis between the lateral branch of the nerve and the medial.)

The tendons of the *flexor digitorum sublimis* (*tibialis*) are weak; they are perforated by the tendons of the *profundus*. The *sublimis* goes to the 5th, 4th, 3rd, and 2nd toes; it ends on the I. phalanx and on the tendon-sheath of the *profundus*, especially on the ligg. annularia.

The *flexor digit. profundus* (*fibularis*) gives five tendons to toes 1–5, the tendons for the 2nd and 3rd toes being more connected than the others.

I have found only *two lumbricales*, to the 4th and 5th toes; they are very strong.

The *adductores* (plantar layer, *Cunningham*) go to the hallux, 2nd and 5th toes.

The *abductor dig. minimi* arises from the calcaneum and ends on phalanx I. of the 5th toe.

The tendon of the *tibialis posticus* is cleft, both parts ending on the naviculare.

β. Extensores.

The *tibialis anticus* is inserted into the internal cuneiform, the tendon being a little divided.

The *peronæus longus* is very strong; it crosses almost transversely on the planta and ends on the first metatarsal bone.

b. EDENTATA.

1. Euphractus minutus.

a. Flexores.

The *plantaris* (?) arises from the femur (lower end) and the fibula (upper end), or the knee-joint; it ends in the fascia plant. superfic. and tendons which go to the Ph. and the "five toes," ending there in the tendon-sheaths.

No *flexor brevis superficialis* is present.

The *flexores longi* (*subl.* and *prof.*) are connected with each other but divisible; they form *one* large tendon which divides into separate tendons. Each tendon is cleft, but there is no perforation.

A muscle arises from the fibula and is inserted into:—(1) the proc. transversus calcanei; (2) the tendon-sheath of the peronæus brevis and minimi; fascia dorsalis; (3) the ligam. transversum on the ankle-joint.

β. Extensores.

The *extensor digitorum et hallucis longus* goes to all five toes, the fourth toe getting two tendons.

There is an *extensor hallucis "proprius"* (like the *ext. poll. longus*) arising from the *fibula* and inserted into the first phalanx of the great toe together with the *extensor brevis*.

c. RODENTIA.

1. Sciurus arizonensis. (Plate XXI. fig. 4.)

(Zool. Soc. Gardens.)

The *nerv. plantaris medialis* supplies all 5 toes except only the outer half of the 5th.

An *abductor* (*extensor*) *præhallucis* (*tibialis medialis*) (v. *Bathyergus*) is present; it takes origin from the inner (tibial) surface of the tibia and ends in the Ph.; the muscle is covered in by the *tibialis posticus*. Nerv. tibialis.

The *plantaris* arises in common with the lateral head of the *gastrocnemius*; it is a little fixed on the calcaneum and ends in four tendons, which are provided with a weak fleshy belly each (=*lumbricales*?).

2. Sciurus niger.

α. Flexores.

The *gastrocnemius* is a two-headed, strong, and flat muscle; it is inserted into the tuberos. calcan.

The *plantaris* is large; it arises from the external condyle, becomes tendinous near the calcaneum, where it is fixed by connective tissue, and is inserted by four tendons into toes 2–5. These tendons are cleft and perforated by those of the *flexor longus*.

A muscle (*soleus*?) taking origin from the capitulum fibulæ joins the tendon of the *gastrocnemius*.

The two *flexores longi* are united into *one* muscle coming from the tibia and fibula and ending in five tendons. One tendon of the flexor communis joins the tendon of the plantaris which goes to the 5th toe.

There are present four large *lumbricales* muscles.

The *tibialis posticus* is inserted into the naviculare tibiale.

The *abductor* (*extensor*) *præhallucis* (*tibialis medialis*) arises from the internal surface of the tibia (in the upper half) and is inserted into the Ph. and the first metatarsal bone and phalanx I. of the hallux.

There are five *flexores breves profundi*.

β. Extensores.

The *tibialis anticus* is so very large that it covers the *ext. hall. l.* and *ext. dig. com. l.* in the upper part of the leg.

There are four *peronæi* muscles:—(1) the *peronæus longus*; (2) the *peronæus brevis*, both very strong; (3) the *peronæus* "*tertius*," arises from the fibula (upper end) and goes to the *capitulum* metatarsi quinti; (4) the *peronæus* "*quartus*" takes origin from the middle and lower third of the fibula and joins the outer border of the *extensor digitorum brevis*.

The *extensor brevis* goes to toes 2–5, the tendon to the fifth toe being very delicate.

3. Bathyergus maritimus.

Flexores.

The *biceps femoris* remains fleshy on the leg and ends tendinous ("fascia") on the foot.

The *gastrocnemius* is strong, and also the *plantaris*; the latter is inserted into the fascia and continues in the *flexor brevis*.

The insertion of the *soleus* is separated from that of the *gastrocnemius*.

The *abductor præhallucis* (*tibialis medialis*) is very strong (23 mm. l., 5 mm. br., more than 2 mm. thick; the tendon measures 25 mm.), supplied by the n. tibialis. It arises from the upper, inner, and anterior parts of the tibia, until close to the origin of the *tibialis anticus*; it ends on the tibial surface of the Ph.

The *flexor digitorum subl.* and *prof.* are not divisible; there are m. *lumbricales* as usual and a m. *accessorius*.

There are two "*interossei*" for each toe, except for the third toe, which has only one. The *interosseus medialis* of the hallux comes from the Ph., the *inteross. lateralis* of the fifth toe comes from an accessory ossicle situated on the top of the Pm.

d. UNGULATA.

1. Hyrax brucei.

The muscles of the leg and foot of this animal show some peculiarities which are of less interest for our subject.

2. Elephas africanus (Embryo).

(Roy. Coll. Surg.)

Length of the leg 15 cm.

The *biceps femoris* ends on the foot.

The *gastrocnemius* arises only from the *inner* side of the femur and from the planum popliteum.

The *plantaris* is strong and, after passing behind the calcaneum, ends in the fascia plantaris. From this fascia springs only *one* muscle, which joins the *flexor digitorum communis*.

Four *lumbricales* are present.

The *flexor digit. subl.* and *profundus* join each other in the planta.

The *tibialis posticus* goes on the inner border of the tibia to the dorsum pedis, where it ends on the third and second toes.

Beside this muscle there is another which continues partly the *semitendinsous* (!) and goes to the *hallux* and the *præhallux*.

The *extensor digitorum longus* goes to toes 2–5, the fourth getting *two* tendons; as the *extensor brevis* ends on toes 2–4, the fourth is provided with *three* tendons.

There are *three* muscles arising from the Ph.:—(1) to the hallux; (2) to the capitulum of the metatarsal II.; (3) to the 2nd toe, a long thin tendon, besides that of the *flex. longus*.

e. CARNIVORA.

1. Linsang gracilis.

The *gastrocnemius* consists of two heads; insertion, tuberos. calcanei (behind).

The *soleus* is represented only by a weak tendon (as very often the plantaris in Man).

The *plantaris*, connected with the *gastrocnemius*, but divisible by the forceps, is very strong, fleshy till near the calcaneum; it then becomes tendinous, passes the calcaneum, connected with it by the tendon-sheath, becomes again fleshy, and ends on the toes. No "fascia" plantaris is present (as in the Cat, *Mivart*).

Nerve-supply by the plantaris medialis (proximal) and lateralis (distal).

The *flexores longi* (*subl.* and *prof.*) do not cross each other, but continue separate and run down parallel, the *profundus* or *fibularis* being the stronger; the *accessorius* joins the latter (*Dobson*).

The *lumbricales* spring from the *profundus* (fibularis).

2. Viverricula malaccensis.

The *plantaris* is quite separate from the *gastrocnemius* and continues in the planta into the *flexor brevis*; nerve-supply as in *Linsang* (plant. med. and lat.) (very similar to *Linsang*).

3. Herpestes griseus.

In this animal there is also a continuation from the "plantaris" into the "flexor brevis." Nerve-supply as in *Linsang* and *Viverricula*, two branches coming from each nerve.

C.—CONCLUSIONS AND GENERAL REMARKS.

On comparing the bones and muscles of the distal parts of the mammalian limbs we see:—

(1) That the *palmaris* ends on the Pp. in Marsupials, Insectivora, some Rodentia,—while in some Carnivora there are only tendinous fibres going to that bone, and in higher mammals only traces of those connections are found. The palmaris can be separated into two muscles.

(2) That the *plantaris* is inserted into the Ph. in Marsupials, Edentata, some Insectivora, while in higher forms it goes only to toes 1–5 or 2–5; finally we see the tendons being united to an aponeurosis.

In the superficial layer of the forearm and the leg we have also the *ulnaris internus* (often separated into two muscles) going to the pisiform, and the *gastrocnemius* going to the calcaneum.

I am not quite sure about the meaning of the *tibialis medialis*

("*abductor præhallucis*"), but I am inclined to take this muscle together with the *gastrocnemius* (and *soleus* when present) as the superficial *flexor digit. longus*. I do not know how to interpret the *radialis internus* and, as I suppose, its homologue the *tibialis posticus*, but I think that they may have been formerly real *flexores digitorum*.

A question of great importance is, on which bones of the hand and foot are muscles inserted and on which not? I will answer this question here :—

Hand.		*Foot.*	*Muscles.*
(1) "True" carpal bones, except pisiform	—proximal row—	tarsal bones except calcaneum:	no insertion, no origin.
(2) Carpal bones	—distal row—	tarsal bones:	no insertion.[1]
(3) Pisiform	"Pm."	calcaneum:	insertion and origin.
(4) Præpollex		præhallux:	only origin.
(5) Metacarpal bones		metatarsal bones:	insertion and origin.
(6)	Phalanges:		only insertion, no origin.

Or in the form of a table (+ =present, 0=absent) :—

	Insertion.	*Origin.*
(1) True carpal and tarsal bones, proximal row	0	0
(2) True carpal and tarsal bones, distal row	0	+
(3) Pisiform, calcaneum	+	+
(4) Præpollex, præhallux	+	+
(5) Metacarpal and metatarsal bones	+	+
(6) Phalanges	+	0

Therefore I conclude, if in our subject the muscles are true guides as to the homology of bones (and I do not doubt it), that neither the pisiform and calcaneum (as Gegenbaur and others have supposed long ago) nor the so-called præpollex and præhallux are true carpal and tarsal bones, but that they have the same rank and position as the metacarpal and metatarsal bones. If other authors prefer to call bones on which is an insertion and an origin of a muscle a "*sesamoid bone*," then they ought also to call the metacarpal and metatarsal bones (which may be often reduced and very small ossicles) "sesamoid bones."

Further evidences for my view on the præpollex and præhallux are the following :—

The bones I call Pp. and Ph. are generally present everywhere in all orders and families of mammals which have five true digits.

These bones have everywhere the same situation on the radial and tibial border of the hand and foot, and almost the same relations to the surrounding parts.

In some animals there are distinct pads on the apex of Pp. and

[1] The insertions of the *tibialis anticus* and *posticus* are not really on tarsal bones, but originally either on digits or on the free bone or bones of the border of the foot.

Ph., and in *Pedetes* there is a true nail (in some specimens only a nail-like structure).

The resemblance of Pp. and Ph. to a reduced thumb or great toe is very striking (*e.g.* foot of Carnivora).

If the first digit of the mammalian hand and foot had always been lost as a true digit, and if we knew only mammals with *four* digits, then we might be in the same doubt about this reduced structure—"præ-index"—as many of my colleagues are now about my præpollex.

The Pp. and Ph. are much better developed in lower mammals than in higher ones—they are present and free in primitive types; they are lost or become united with their neighbours in higher or more differentiated mammals, or they get the appearance of "sesamoid bones."

In lower mammals the Pp. may consist of *two* bones, in higher there is always only one bone.

The Pp. consists of at least *two* bones in *Theriodesmus phylarchus*, the position of that animal being not yet sufficiently ascertained. Five years ago (P. Z. S. 1889) I supposed it to be a Promammal, but, as Prof. Seeley kindly told me this March, there is now evidence for this interesting animal being a true *reptile*.

We must make a clear distinction between the *fission* of digits which occurs in Cetacea (and Ichthyosauria perhaps) and the existence of rudiments of digits. In Cetacea there is also a real Pp., as Prof. Kükenthal has shown.

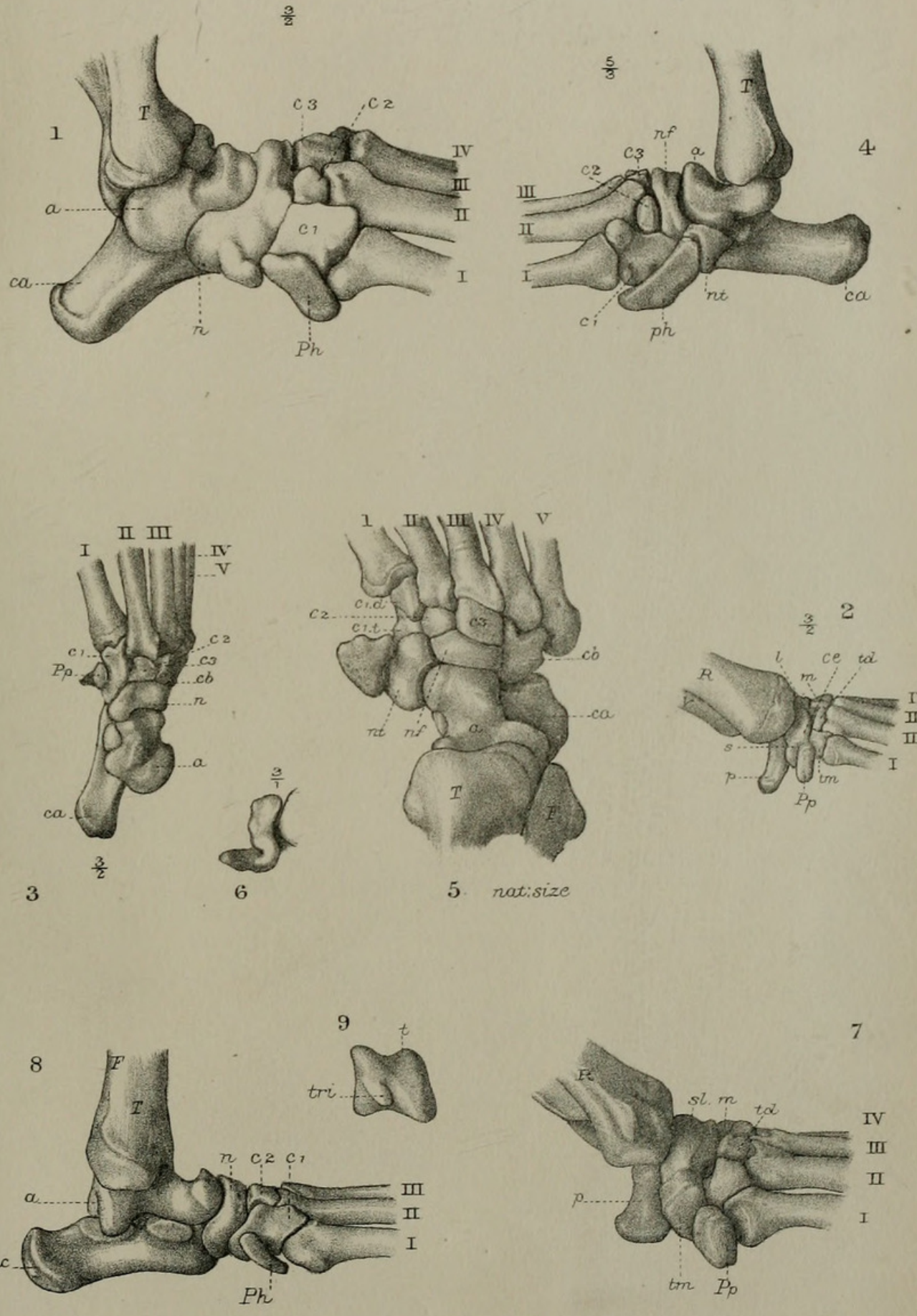
It may be that the Pp. and Ph. of many animals represent not only an old (reduced) structure, but also a partly new one, and that only the basis of the Pp. of *Pedetes* was inherited in those species and that it gradually increased in size.

There are many muscles in the mammalian hand and foot which have to do with the Pp. and Ph. exclusively or nearly so. When the Pp. and Ph. disappear or coalesce with other bones, these muscles may also vanish or they may become united with other muscles, or they may get inserted in those parts of bones which have been originally free and more or less movable, as *e.g.* Pp. and Ph.

Concerning the nerve-supply of muscles I found that the following muscles are provided with *two* nerves:—

the flexor digitorum superficialis brevis manus et pedis	in lower mammals.
the palmaris longus or flexor digitorum superficialis longus	
the ulnaris internus (flexor postminimi)	
the flexor digitorum sublimis	
the flexor digitorum profundus, in all mammals.	

Concerning the homology of the *true* carpal and tarsal bones I give here a table which, though it may be incomplete, I hope may contain definite results:—



nat: size

E.C & G.M.Woodward del. et lith.

West, Newman imp.

Bones of Mammalian Hands and Feet.

	Hand.		*Foot.*	
Prox. row.	Scaphoid.	Radiale.	Naviculare tib. (tuberos.).	Naviculare.
	Centrale.	Centrale.	Naviculare fib. (lat.).	
	Lunatum.	Intermedium.	Talus s. s.	Astragalus.
	Triquetrum (pyramid.).	Ulnare.	Trigonum.	
	(Pisiform.)		(Calcaneum.)	

As regards the distal row there cannot be any doubt that the trapezoid and uncinatum are homologous with the middle cuneiform and the cuboid.

As the internal cuneiform (*Erethizon*, Man sometimes) and the external (*Cryptoprocta*) can be divided into *two* bones, we must look for the homologous bones in the hand; and I think that the radial part of the trapezium (sometimes a free ossicle in Man) corresponds to the tibial or the plantar internal cuneiform, and that the head or proximal part of the magnum (Man), or the lateral part of the centrale (e. g. *Centetes*), corresponds to that bone which is situated proximally to the external cuneiform in *Cryptoprocta*. I cannot prove beyond all doubt that this is the second centrale, but there seems to be no other explanation. Consequently the distal row would be as follows:—

Hand.		*Foot.*	
Trapezium.	Carp. tars. dist. 1.	Internal cuneiform.	Plantare. Dorsale.
Trapezoid.	Carp. tars. dist. 2.	Middle cuneiform.	
Magnum.	Carp. tars. dist. 3.	External cuneiform s. s.	
	Centrale 2.	Triangulare, B.	
Unciform. (separated: *Ziphius*).	Carp. tars. dist. 4.	Cuboid.	
	Carp. tars. dist. 5.		

P.S. (*April* 23, 1894).—Since I read this paper I have found a specimen of *Euphractus minutus* in the Nat. Hist. Museum in which there is a very well-developed præhallux, like a metatarsal bone (see Plate XXI. fig. 7). There is also a muscle between the Ph. and the first metatarsal bone.

EXPLANATION OF THE PLATES.

Plate XX.

Skeleton *of Mammalian Hands and Feet.*

Fig. 1. Right foot of *Dasypus*, 3/2 enlarged (p. 356).
2. Right hand of *Centetes ecaudatus*, 3/2 enlarged (p. 356).
3. Right foot of *Centetes ecaudatus*, 3/2 enlarged.
4. Right foot of *Bathyergus maritimus*, 5/3 enlarged (p. 356).
5. Right foot of *Erethizon dorsatus* seen from above, nat. size (p. 357).
6. Præhallux of *Erethizon*, seen from behind, 3/1 enlarged.
7. Right hand of *Ælurus fulgens*, 5/4 enlarged (p. 358).
8. Right foot of *Ælurus fulgens*, nat. size.
9. Astragalus of *Ælurus* seen from behind, showing the division into "talus" s. s. and "trigonum."

Reference Letters.

(*a*) Hand:—*R*, radius. *U*, ulna. *s*, scaphoid. *sl*, scapho-lunatum. *tm*, trapezium. *td*, trapezoid. *m*, magnum. *ce*, central. *Pp*, præpollex. I–V, metacarpal bones, first to fifth.

(*b*) Foot:—*T*, tibia. *F*, fibula. *a*, astragalus. *ca*, calcaneum. *n*, naviculare. *nt*, tibial, *nf*, fibular naviculare. *c* 1, *c* 2, *c* 3, internal, middle, external cuneiform. *c* 1 *d*, dorsal, *c* 1 *p*, plantar part of the internal cuneiform. *cb*, cuboid. *Ph*, præhallux. I–V, metatarsal bones, first to fifth.

Plate XXI.

Muscles *of Mammalian Hands and Feet.*

Fig. 1. Left foot of *Didelphys marsupialis*, 2/1 enlarged (p. 359).
2. Second toe of *Didelphys marsupialis*, 4/1 enlarged.
3. Forearm of *Trichosurus vulpecula* (p. 361).
4. Hand of *Sciurus arizonensis* (p. 362).
5. Forearm and hand of *Linsang gracilis* (p. 364).
6. Wrist of *Viverricula malaccensis* (p. 356).
7. Præhallux of *Euphractus minutus* (nat. size): *m.*, interosseus præhallucis (p. 373).

Reference Letters.

(*a*) Fore limb:—*Pp*, præpollex. *Pm*, postminimus. *po*, pollex (thumb). *pis*, pisiform bone. *plm*, m. palmaris longus. *plm. r*, *plm. u*, m. palmaris l. radialis, ulnaris. *u.i.*, m. ulnaris internus (flexor c. uln.). *r.i.*, m. radialis internus (fl. c. radialis).

(*b*) Hind limb:—*Ph*, præhallux. *h*, hallux (great toe). 2 *t*, second toe. *pla*, m. plantaris. *tib. p*, m. tibialis posticus. *w*, web.

2. On two Sea-pens of the Family *Veretillidæ* from the Madras Museum. By G. Herbert Fowler, B.A., Ph.D., Assistant Professor of Zoology in University College, London.

[Received April, 2, 1894.]

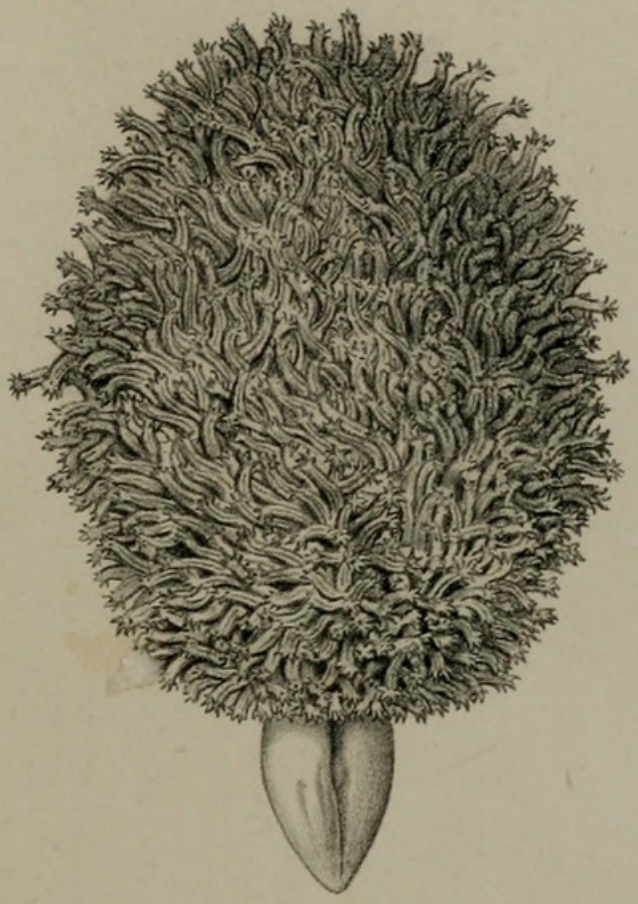
(Plate XXII.)

For the opportunity of examining these specimens, I am indebted to Prof. F. Jeffrey Bell, who received them from Mr. Thurston of the Madras Museum.

Cavernularia malabarica, sp. n.

This beautiful species (Plate XXII. fig. 1) differs from all other Veretillidæ with which I am acquainted in the great breadth of the rhachis, and in the sharpness of the curvature by which the rhachis is marked off from the stalk; the result is to give the colony a club-shaped outline described only in *Cavernularia glans*, of this family. To what extent such a difference of form as this may be produced, or at least accentuated, by different degrees of expansion or contraction of the colony, I am unable to say; and I have therefore sought for other specific marks.

The dimensions of the colony in millimetres are as follows:—



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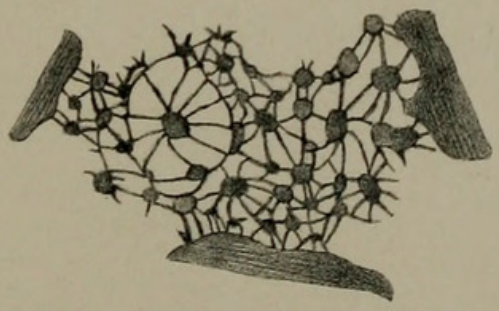

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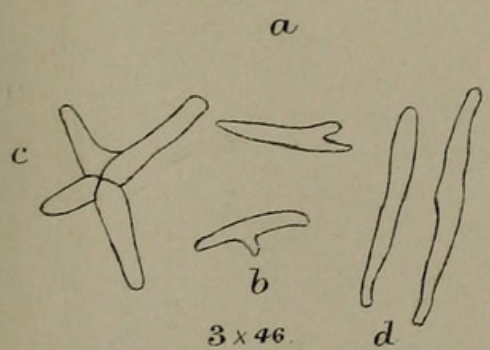

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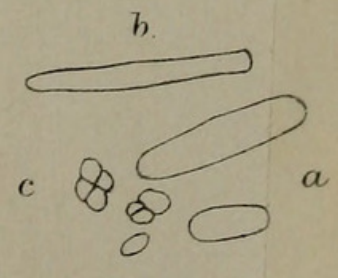


4 x 105

P. Smit & G.H.F. del. et lith.

Mintern Bros. imp.

CAVERNULARIA MALABARICA.

piece, 3 mm. long, was about 7 mm. distant from the upper end of the rhachis; the lower end of the other piece, 9 mm. long, was about 5 mm. from the lower end of the stalk. The two fragments together measured therefore about 12 mm. and were 30 mm. apart. Nothing in the appearance of the colony indicated, either before or during dissection, that the fracture of the axis was attributable to rough treatment after death, and from the appearance of the fractured surfaces I incline to think that the break occurred during life. In the second specimen the axis was unbroken; it measured a little less than 12 mm. in length, and lay at the junction of stalk and rhachis. In both cases the axis was pointed at both ends, and measured ·43–·48 mm. in diameter; its surface was covered by irregular warts and knobs, and its colour was a brilliant white.

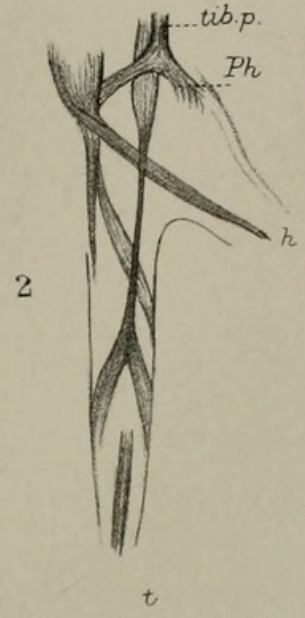
The **spicules** are of different size and character in rhachis and stalk. In the rhachis (fig. 3) they take the shape of elongate needles of irregular form (*d*). These are very numerous, and are distributed throughout the cœnosarc. A few are bifurcated (*a*), or carry a prominence at one side (*b*); rarely one meets with "Vierlinge." An average spicule of the needle type measures 480 μ × 32 μ.—In the stem (fig. 4) the spicules were very much smaller than in the rhachis, as will be seen by the magnification of the two figures. By far the greater number are regularly elliptical (*a*), an average specimen measuring 49 μ × 24 μ. Scattered sparsely among these are needles of the same character as those of the rhachis (*b*), but very much shorter; they are about 208 μ × 32 μ. "Vierlinge" are fairly numerous (*c*).

It is possible, but, I think, unlikely, that the specimens under description may prove to be old specimens of *Cavernularia lütkeni* (Köll.), which also came from the Bay of Bengal. The proportionate dimensions of the colony are not quite close enough to allow of this determination; expressed in percentages of total length they are:—

	Rhachis.		Stem.		Axis.
	Length.	Breadth.	Length.	Breadth.	Length.
C. lütkeni	70	37	28·5	14	36?
C. malabarica...	78	58	22	14	24

Further, the very numerous elliptical spicules of the stalk are not mentioned by Kölliker ('Pennatulida,' p. 347); the polyps of *C. lütkeni* are described as "entferntstehend," and the shape of the colony (Köll. Penn. pl. xxii. fig. 211) is quite unlike that of our specimens.

Locality. Calicut, Malabar Coast.



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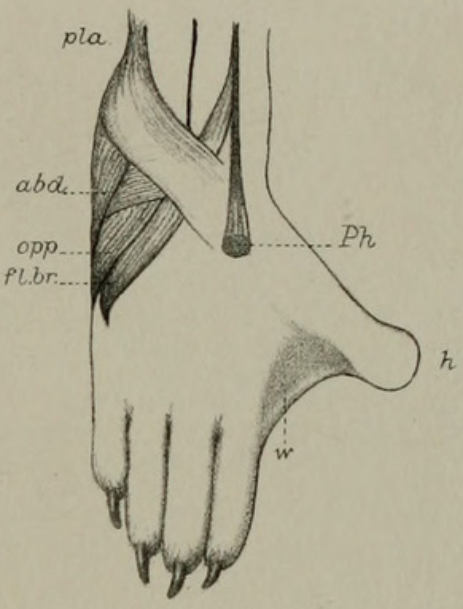

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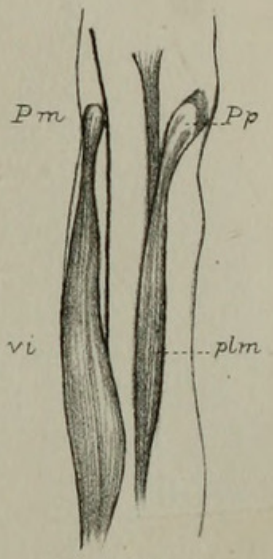

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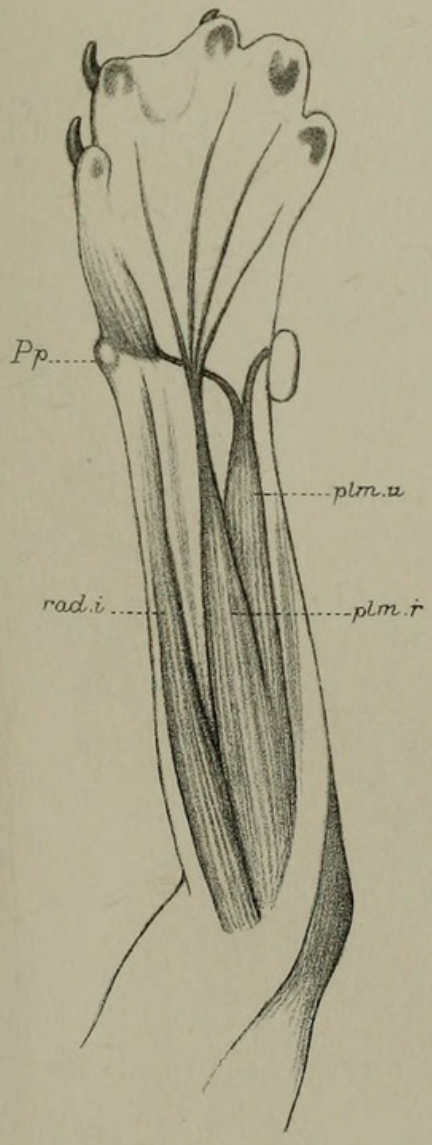

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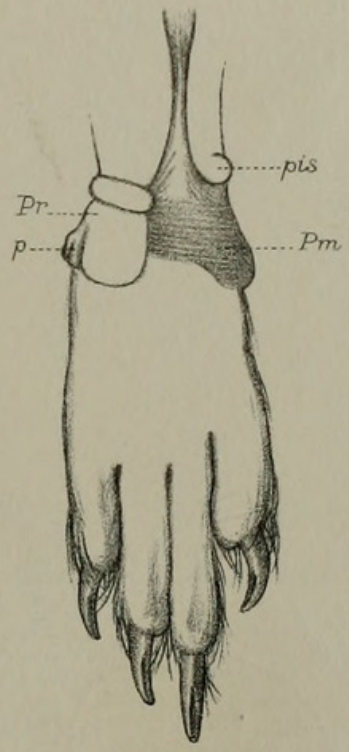

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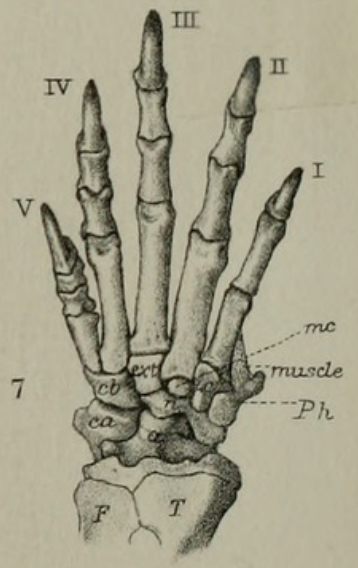

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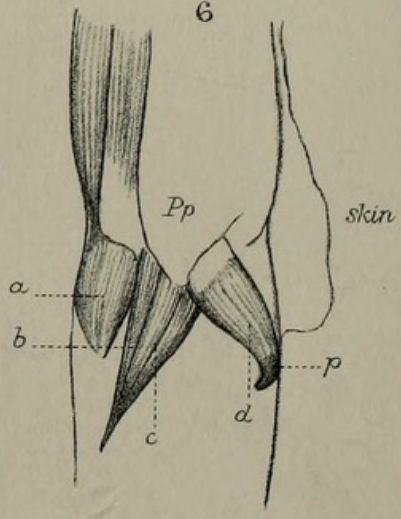


6

E.C.& G.M.Woodward del. et lith.

West, Newman imp.

Muscles of Mammalian Hands and Feet.

LITUARIA PHALLOIDES (Pallas).

A single specimen of this, labelled "Dutch Bay, Ceylon," was sent along with the *Cavernularia* just described. It presented no features of special interest, and differed from other specimens which have already passed through my hands (Marshall and Fowler, "Pennatulida of the Mergui Archipelago," Journ. Linn. Soc., Zool. xxi.) only in the point that the siphonozooids practically filled all the space between the autozooids, instead of forming rings round them. A plane of bilateral symmetry, mentioned in the paper quoted, was also indicated here. The specimen, as so often happens with Pennatulids, had been apparently truncated above and scarred over; a new autozooid and several siphonozooids had been formed on the scar.

EXPLANATION OF PLATE XXII.

Fig. 1. *Cavernularia malabarica*, sp. n.; view of the colony.
Fig. 2. Surface of the cœnosarc, showing the siphonozooids filling up the space between the bases of three autozooids.
Fig. 3. Spicules of the rhachis.
Fig. 4. Spicules of the stalk.

3. On Two new Genera, comprising Three new Species, of Earthworms from Western Tropical Africa. By FRANK E. BEDDARD, M.A., F.R.S., Prosector to the Society.

[Received April 2, 1894.]

The specimens of worms now described I owe to the kindness of Mr. Alvan Millson, Assistant Colonial Secretary at Lagos, to whom I have frequently had to express my indebtedness for material. Within the last few weeks I have received from him a number of tubes containing a large number of specimens of Earthworms, which proved to be referable to four species. Of these I only describe three in the present communication; the fourth was not new, but was found to be a particularly fine specimen of my species *Siphonogaster millsoni*; this specimen I have sent to the Oxford Museum. The remaining species belong to the family Cryptodrilidæ, which is not well represented on the African continent, so far as our present knowledge enables a judgment to be formed. The most characteristic family of Earthworms of the Ethiopian region are unquestionably the Eudrilidæ, which are indeed limited to that continent, with the sole exception of the almost ubiquitous genus *Eudrilus*. So abundant are the members of this family that it is really a remarkable fact to receive a collection of Earthworms from that part of the world which does not include representatives of that family. Such, however, is the case with the collection upon which I report here. It may be noted, however, that the Cryptodrilidæ are rather more abundant in

Western than in Eastern Africa. I have already described several species of a genus nearly confined to Western Africa, viz. *Gordiodrilus*; and at Lagos a species of *Pygmæodrilus* also exists. The same two genera also occur on the West Coast, but the former is there not nearly so common. The present paper increases the number of West-African Cryptodrilids by three; and I refer these worms to two new genera. *Nannodrilus africanus* seems, from the large number of specimens sent to me, to be an exceedingly common species.

It is a curious fact that both of the two genera show certain resemblances to the Eudrilidæ: there is, in my opinion, little doubt but that the Eudrilidæ are derivatives of the Cryptodrilidæ; but I cannot agree with those who would unite two such extremely diverse types in one family. I shall now direct attention to the anatomical characters of the new species, beginning with a definition of the first genus, which I propose to call after Mr. Alvan Millson.

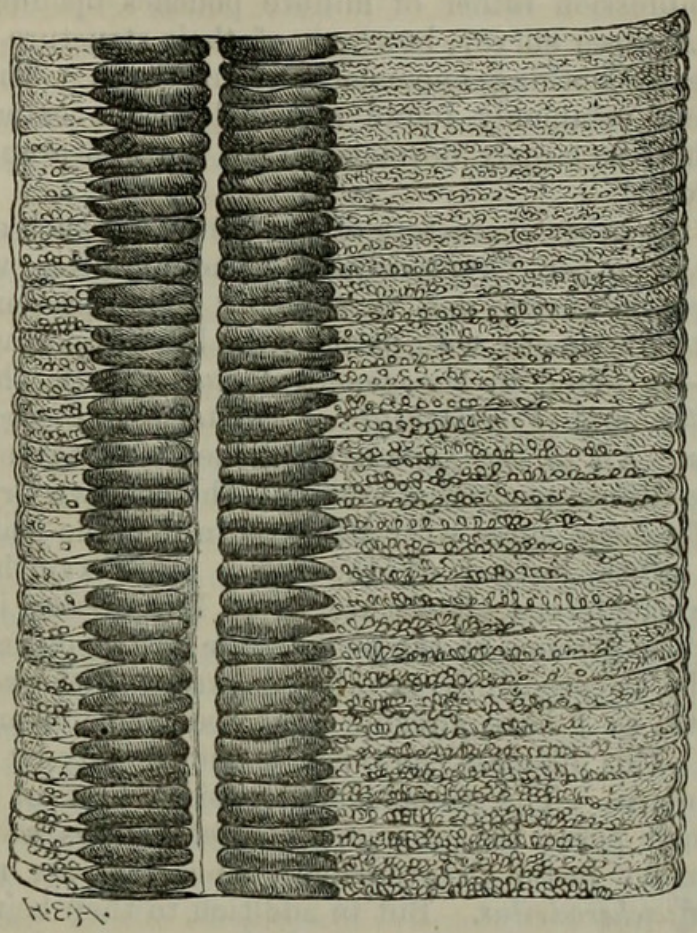
Millsonia, gen. nov.

DEF. *Large worms with strictly paired setæ. Male pores (single or paired) upon xvii. Two gizzards in v., vi.; calciferous glands, three pairs in xv.–xvii.; intestine with about* 30 *pairs of cæca, a pair to each segment. Nephridia diffuse. One pair of spermathecæ without diverticula; spermiducal glands tubular; no penial setæ.—Hab. West Africa.*

This definition will differentiate the present genus from any other Cryptodrilid at present known. The two most salient characters of the genus which are peculiar to itself concern the nephridia and the intestinal cæca. These alone would serve to distinguish the genus; it is principally on account of them that I unite the two species, which I shall describe, into a single genus. These two species, as will be seen in the course of the following pages, differ from each other in a good many points of, as I believe, subsidiary importance. The two matters referred to are not exactly novelties of structure in the group, but they are exaggerations, so to speak, of characters already found in allied forms. The cæca are precisely like those of the genus *Perichæta* only that there are so many of them. In *Perichæta sieboldi* and in one or two other species there are, it is true, six or seven pairs of these appendages of the intestine; but then they are all contained in one segment; whereas in the genus *Millsonia* they are contained in as many segments as there are pairs of cæca. The existence of these cæca is interesting as tending to knit still closer together the, in other ways not very remote, Cryptodrilidæ and Perichætidæ.

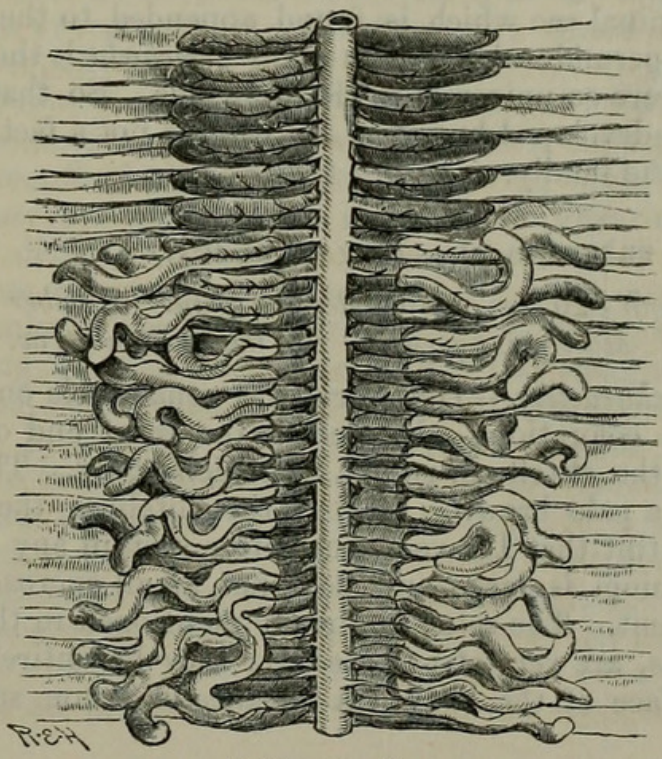
The second peculiarity of this genus concerns the nephridia. The structure of these organs will be described more at length immediately; but in the meantime attention may be directed to the fact that they present the curious appearance illustrated in the accompanying drawing (fig. 1, p. 381). The excretory tubes of the posterior segments of the body have ceased altogether to look

Fig. 1.



Millsonia nigra.
Part of the posterior region of the body cut open to display the excretory system.

Fig. 2.



Millsonia rubens.
Intestinal cæca.

like excretory tubes in the usual "plectonephric" genera; they give the impression rather of minute pouches opening on to the exterior. A closer survey, however, of their structure shows that there is really nothing anomalous about them. The vesicular layer of cells commonly found attached to the exterior of the tubules is here so largely developed that the appearance referred to is produced.

Most of the other characters of the genus are such as are to be met with in other Cryptodrilids. The affinities which they indicate are, however, not very plain. The presence of two gizzards—to commence with perhaps the least important of these characters—is found in the genera *Digaster* (with which I unite *Didymogaster* and *Perrisogaster* of Fletcher), *Dichogaster*, and *Microdrilus*. All of the genera mentioned also agree with *Millsonia* in the diffuse nephridial system. The last two Cryptodrilids, as well as *Typhœus*, agree with *Millsonia* in that the male pores are upon the xviith instead of the more usual xviiith segment. Finally the calciferous glands are, as in *Microdrilus*, in segments xv.–xvii. The absence of the penial setæ distinguishes *Millsonia* from all the Cryptodrilids mentioned except *Dichogaster*. *Millsonia* shows, as I have already intimated, some likeness to the Eudrilids. This likeness, however, is shown only by the species *Millsonia nigra*. The resemblance consists first of all in the unpaired male pore; the unpaired genital orifices are not absolutely unknown in the Cryptodrilidæ, since they are met with in the genus *Fletcherodrilus*. But in addition to their being unpaired in the worm now under discussion, there are a pair of terminal muscular sacs which are like the bursa copulatrix of many Eudrilids. The genus *Nannodrilus* which I describe in the present paper is the only other Cryptodrilid in which there is a similar bursa or rather a pair of them. But I am disposed to consider that the terminal sac which is found appended to the end of the duct of the spermiducal glands in many *Perichætæ* is the homologue of the structure so universal in the Eudrilids. So that the existence of well-developed bursæ in *Millsonia* is not a fact of absolute novelty for the family.

Millsonia rubens, n. sp. (Fig. 2, p. 381.)

Def. *Length* 320 *mm.*; *diameter* 12 *mm.* *Number of segments* 363. *Male pores paired.* *No bursa copulatrix.*

External characters.—This worm was remarkable on account of its peculiar coloration. In alcohol the front end of the body, in front of the clitellum, is of a pale violet-grey. The clitellum itself is of a pale brown. Behind the clitellum the colour is a brick-red, a tint that I have never before seen in any Earthworm. The prostomium is large and does not at all encroach upon the buccal segment. The setæ, as already mentioned in the definition of the genus, are very strictly paired; they lie entirely upon the ventral surface of the body. A distance of 2 mm. separates the

two couples of each side, while the ventral couple of one side is separated from its fellow of the other side by a distance of 2·5 mm. I could not find any trace of setæ at all upon the first five segments of the body. If this absence of setæ upon the head end be confirmed it is of interest, as this cephalization is rare among the Cryptodrilidæ, though a common character in the family Geoscolicidæ. *Geodrilus* in fact is the only Cryptodrilid in which I can recall anything of the kind. Segments vii.–xii. are bi-annulate. The dorsal pores are very obvious. They commence on the borderline of segments x./xi., possibly one or two segments earlier. There are three of these pores upon the clitellum—one marks its posterior boundary, while two lie on the first two segments. The clitellum is rather extensive, occupying segments xiii.–xxii. The median ventral region behind the male pores seems to be free, at any rate to a large extent, of glandular tissue. The two male pores lie upon segment xvii.; they are highly conspicuous and are transversely elongated orifices, which correspond in position to the missing ventral setæ of the segment. Neither the oviducal nor the spermathecal pores were visible. The body-wall of both the present species and *Millsonia nigra* is exceedingly tough. Mr. Millson informs me that this was also the case during life.

Vascular system.—The dorsal blood-vessel of the worm is single from end to end of the body. In segments xvi. and xvii. it is distinctly dilated, forming thus a kind of heart. A local dilatation of the dorsal vessel is not unknown, though rare, among the Oligochæta. In the Geoscolecid *Microchæta* I and Benham have described the same kind of thing, while many Enchytræids also show a dilatation of the dorsal blood-vessel just after its emergence from the peri-intestinal sinus (or plexus). I regard all these local expansions of the dorsal blood-vessel as having some relation to the heart of the Arthropods. The last pair of circumœsophageal trunks are in segment xii.; the five pairs which lie in front of these are equally large.

Intersegmental Septa.—The first distinguishable septum lies between segments iv./v. It is tolerably stout and runs in a straight course across the body. The four following septa are excessively delicate and are pushed back by the stout gizzards so as to have lost their definite relation to the segments which they separate. After these thin septa come a number which are very strong and muscular. The septa dividing segments ix./xvii. are stout, diminishing in thickness posteriorly. The anterior of these and those which lie in front of them as far back as septum xiv./xv. are traversed by or give rise to muscular straps which are also attached to the parietes and to the alimentary canal.

Nephridia.—I do not give a long account of the nephridia under the present species as they are constructed upon the same plan as those of *Millsonia nigra*, in which species it so happens that I investigated them more closely. The peculiarity of the nephridia of this genus, to which I have already referred, is not quite so strongly marked in the present species as it is in the next to be described.

In the middle region of the body the nephridia form a denser coating of the parietes than I have before noticed in any worm with plectonephric excretory organs.

Alimentary Canal.—The pharynx of *Millsonia rubens* ends with the fourth segment; in each of segments v. and vi. is a strong gizzard which measures about 7 mm. in length and not less in breadth. The two gizzards are separated by an interval of soft walled œsophagus. Calciferous glands are present and show a rather unusual appearance. There are three pairs of them, which lie in segments xv., xvi., and xvii. These segments, be it noted, are the same in which the calciferous glands of the Acanthodrid genus *Benhamia* lie. I have already pointed out that another Cryptodrilid, viz. *Microdrilus*, is distinguished by the same position of its calciferous glands. These glands in *Millsonia rubens* have a very remarkable appearance; the surface is so much furrowed as to give them the look of a small though highly convoluted mammalian brain. In microscopic examination they are seen to present the characters usually found in these glands; the interior is occupied by numerous long folds of the lining epithelium, whose cells are rather flattened. The intestine begins in segment xviii. This part of the gut is most remarkable for a long series of cæca, which I have already referred to as a character of the genus. I counted altogether 32 pairs of these cæca, which begin at about the 28th segment. They begin and end abruptly; the first pair and the last are neither larger nor smaller than those which precede and follow them. The shape of the cæca is precisely that of the cæca of the genus *Perichæta*. They taper gradually towards the free extremity and are in fact exactly like the finger of a glove. The length averages some 6 mm. In the region of the intestine occupied by these cæca, the dorsal blood-vessel gives off in each segment two equi-sized trunks; one of these—the most anterior—is entirely concerned with the blood-supply of the cæcum of its side. The other supplies the walls of the intestine and appears not to run over the cæcum; in the section of intestine in front of the region where the cæca are I only noticed a single pair of intestinal trunks in each segment. It will be understood that these cæca are entirely metameric in arrangement—that is to say, there is a pair to each segment; they arise at first more laterally in position, afterwards their origin is nearer to the dorsal line.

Reproductive Organs.—There are two pairs of testes and of sperm-duct funnels, which occupy the usual segments, *i. e.*, segments x., xi. The sperm-sacs are in segments xi., xii. attached to the front walls of these segments; the sacs are not particularly large and do not stray beyond their segments. The spermiducal glands lie entirely within the xviith segment; they are coiled into a compact mass. The muscular duct is of a moderate length and has a nacreous appearance. I am unable to state what is the relation between the gland and the sperm-ducts. The ovaries are large and occupy the xiiith segment. There are only a single pair of spermathecæ; these lie in the viiith segment. The sacs are

rather thin-walled, but have a stout duct leading to the exterior. I could not see the least trace of a diverticulum. It is rare for the members of the family Cryptodrilidæ, indeed for any worm belonging to the Megascolicidæ, to be without diverticula to the spermatheca. There are here and there a few cases, but these are mostly of worms which have a simple structure and are perhaps rather degenerate in their organization. Examples are furnished by the genera *Gordiodrilus* and *Ocnerodrilus*. I know of no large and well-developed genus like *Millsonia* in which the spermathecæ are devoid of diverticula. It may of course be that there are really diverticula, but that they are concealed in the thickness of the muscular walls of the duct of the spermatheca.

Millsonia nigra, n. sp. (Fig. 1, p. 381.)

Def. *Length* 230 *mm.; diameter* 7 *mm. Male pore single. Spermiducal glands open each into a bursa copulatrix.*

External characters.—This species, judging from the single specimen at my disposal, is rather smaller than the last. It is also rather different in colour, being of a dark brown thoughout, almost black in parts. The setæ, dorsal pores, and prostomium are as in the last species; the clitellum was undeveloped. The most salient external difference, apart from colour, that distinguishes this species from the last is in the orifices of the male organs. The male pore, as stated in the definition of the species, is single and median. It is of some size and occupies an area equal to that which would be occupied by the missing ventral setæ of its segment. It is surrounded by a smooth area of skin, doubtless the commencement of the otherwise wanting clitellum. The spermathecal pores are also fairly conspicuous, but they are paired, though the orifices are very close together. These orifices correspond in position to the ventral setæ. They are on the boundary line of segments viii./ix., though, as will be pointed out later, the pouches themselves lie principally in the viith segment.

Intersegmental Septa.—The character of the septa plainly distinguishes this species from the last. They commence at the same segment, *i. e.*, between segments iv./v., but they are from the first thickened; the last of the series of thickened septa separates segments xiii./xiv. Numerous stout muscular strands tie them together and to the parietes. These bands are found also attached to the septa separating segments xiv./xvi.

Nephridia.—This species shows the peculiar character of the nephridia better than does the last. On opening the body the nephridia of the anterior segments were seen to present the usual characters of the diffuse nephridia; those of the fourth and fifth segments seemed to be a little thicker than the others, but whether these formed a compact "peptonephridium" I am unable to say. Elsewhere (in the anterior segments) the nephridia were scattered tubules not quite so densely packed as in *Millsonia rubens*. Further back the coiled masses of tubes seem to disappear and to be

replaced by flattened oval vesicles of various sizes, which have much the look of small spermathecæ, such as characterize many Geoscolicidæ, e. g. *Microchæta*. The transition is not abrupt, but gradual. By the thirteenth segment, or even a little before, the transition is accomplished and the nephridial system has the curious appearance indicated in the accompanying drawing (wood-cut, fig. 1). When the vesicles are removed separately and examined in glycerine they are seen to be sacs with excessively delicate walls and crammed with cells. These cells are oval to rounded in shape and are sometimes granular, sometimes homogeneous in appearance. In transverse sections these globular sacs were seen to overlie the nephridial tubes. I am of opinion that they are merely an exaggeration of the covering of peritoneal cells, which often take on a glandular appearance and give to the nephridia which they cover a white colour, owing to the granules with which they are laden. The cells are very differently acted upon by the borax carmine which was used as the staining reagent. The homogeneous cells were very deeply stained; the more granular cells were not at all stained. In these sections the masses appeared oval or circular; at the side nearest to the body-wall were one or two nephridial tubules cut transversely.

Alimentary Canal.—As in the last species, there are two stout gizzards in segments v. and vi. The calciferous glands also occupy the same segments as in *Millsonia rubens*; they are perhaps a little less furrowed and appear to be smaller. The intestine has a moderate typhlosole and also the cæca of the last species. I counted the same number of these and they begin at the same point; their commencement is indicated by the dark pigmentation of the intestine. The posterior set of cæca are rather shorter.

Reproductive Organs.—The testes are two pairs of little white tufted bodies, which lie on the anterior septa of segments x. and xi. The ovaries are rather larger, but occupy an exactly similar position in the xiiith segment. There are three pairs of sperm-sacs in segments xi., xii., xiii.; they are attached in every case to the anterior walls of their respective segments. Only those of segment xiii. are of any size, and they are not very large. The terminal part of the male efferent apparatus has a very unusual structure. It has been already mentioned that the external pore is single; the internal organs, however, are double, only uniting just at the pore. When the worm is dissected and the intestine removed, two large elevations, one on either side of the nerve-cord, are exposed. Each of these is about five millimetres long and is quite conspicuous. They are tied down to the parietes by thin straps of muscle, which doubtless serve to retract them after protrusion. The nerve-cord sends to each two nerves on either side, which are the ordinary nerves of the segment. These nerves, instead of coming off at right angles to the cord, run, the anterior pair forwards, the posterior pair backwards. The terminal chamber of the efferent apparatus bears a close resemblance to the