Parker, W. N.,

On the Poison-Organs of Trachinus

With plate.

ICONOGRAPHIE

DER

LAND- & SÜSSWASSER-MOLLUSKE

MIT VORZÜGLICHER BERÜCKSICHTIGUNG

DER

EUROPÄISCHEN NOCH NICHT ABGEBILDETEN ARTEN

VON

E. A. ROSSMÄSSLER,

FORTGESETZT VON

DR. W. KOBELT.

NEUE FOLGE.

ERSTER SUPPLEMENT-BAND:

H. ROLLE UND W. KOBELT, BEITRÄGE ZUR MOLLUSKENFAUNA DES ORIENTS.

DRITTE UND VIERTE LIEFERUNG.

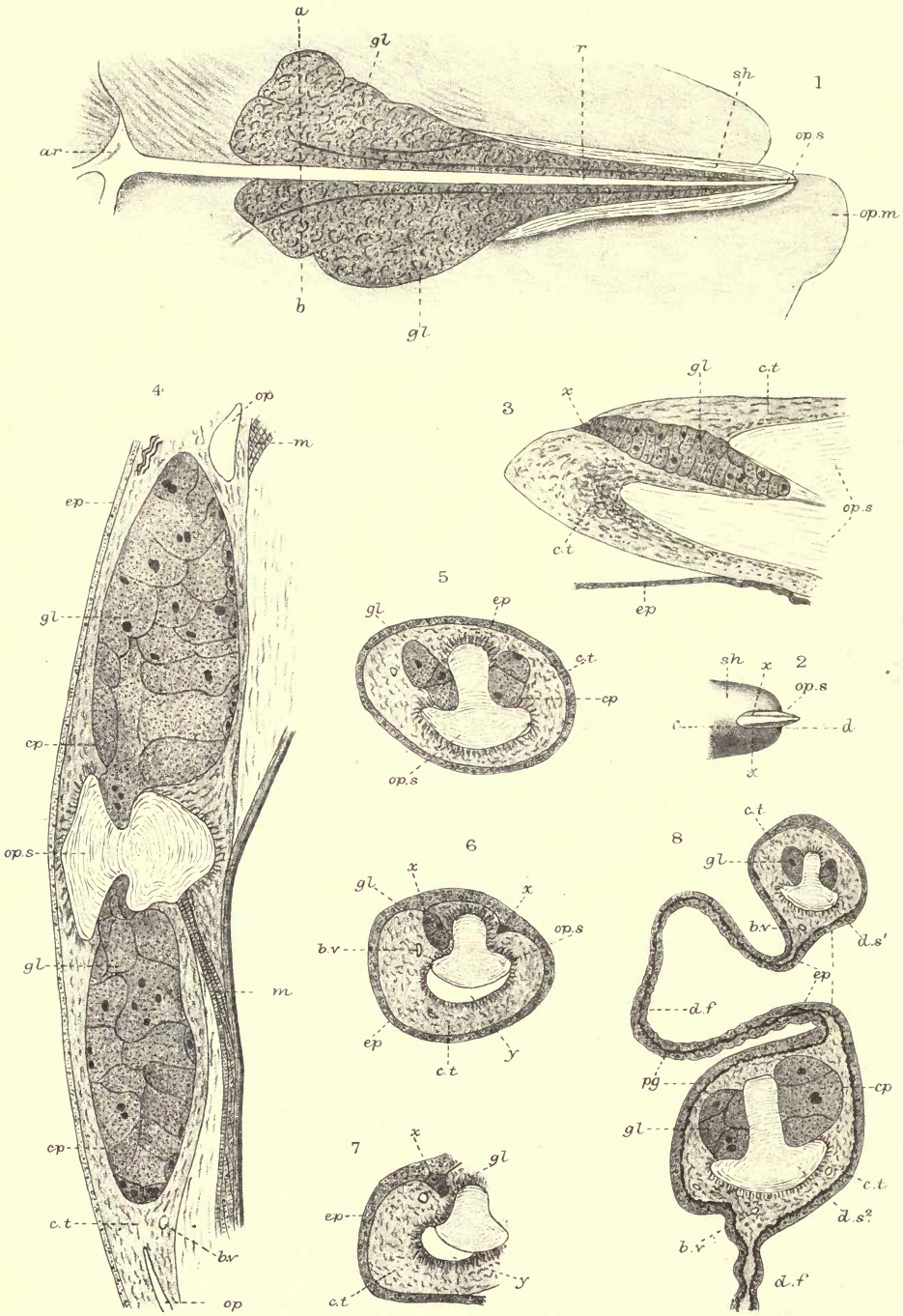
MIT ZEHN TAFELN.

Colorirte Ausgabe.

WIESBADEN.

C. W. KREIDEL'S VERLAG.

1895.



W.N.P. del. ad nat.
Parker & Coward lith.

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Poison-organs of Trachinus.

and the Ceylon species. I suppose *S. octona* will soon get down here; I am on the watch for it."

Prof. Bell exhibited and made remarks on a specimen of *Cerianthus membranaceus* in its tube; this fine example had been obtained by Mr. John Murray at a depth of 71 fathoms in Loch Etive.

Mr. Tegetmeier exhibited and made remarks on the feet of an Australian Rabbit, supposed to have acquired arboreal habits, and made some observations on the change of habits of this Rodent since its introduction into Australia.

Mr. J. B. Sutton, F.Z.S., read a paper on some abnormalities occurring among animals recently living in the Society's Gardens.

The following papers were read:—

1. On the Poison-Organs of *Trachinus*. By W. Newton Parker, F.Z.S., Professor of Biology in the University College of S. Wales and Monmouthshire.

[Received June 2, 1888.]

(Plate XVII.)

Although it is well recognized that the British Weevers (*Trachinus draco* and *T. vipera*) are poisonous, most ichthyologists express doubt as to the existence of any specific glands in connexion with the stinging-apparatus, some even denying altogether the presence of such glands.

Before passing on to a description of my own observations, I will briefly refer to those of former investigators whose works I have had an opportunity of consulting. It must, however, be noted first that in both species of Weever the anterior dorsal fin is provided with five or six strong and grooved spines, the second and third of which are the longest; and a still larger spine is present upon the opercular bone, extending backwards, and projecting freely for a short distance posteriorly. All these spines are enclosed in a sheath of connective tissue, and their apices are sharply pointed; in transverse section they have somewhat the form of the letter T, the base of the T being anterior in the case of the dorsal, external in the case of the opercular spines.

In 1841, Allman (1)[1] accurately described and figured the opercular spine of *T. vipera*. But he could detect no gland, "only a small pulpy mass in each of the conical cavities," at the base of the spine, which he thought might possibly be of a glandular nature,

[1] The numbers in brackets refer to the list of works at the end of this paper.

and he simply conjectures that the seat of the virus is in "the pulpy sheath of the spine."

The most important observations on the subject which have been made by any English naturalist are undoubtedly those of Byerley (3), which appeared in 1849, but which have not been credited by many subsequent authors.

Byerley correctly describes and figures transverse sections of the opercular and dorsal spines, as well as the position of the glands in connexion with them. In examining the microscopic structure of the glands, he simply scraped a portion out of its groove with a needle and mounted it in water, so that it is not to be wondered at that in this respect his conclusions are far from accurate; the "tubes," "sacculi," and "follicles" which he describes are quite imaginary. He was unable to make out any duct, and mentions that the integument completely covers even the points of the spines in a normal condition, but that they are rarely seen thus, as they usually protrude for some distance from their loose sheaths. His explanation of the manner in which the secretion is injected into the wound is that when the spine is driven some distance forcibly into the flesh, the integument which covers it yields to the pressure of the wounded parts, and is thus thrust downwards towards the base of the spine. In this way the gland must be squeezed with some violence, and its contents pass along the grooves of the spine into the wound. This unsatisfactory account of the structure of the glands led Günther (13) to doubt the accuracy of Byerley's conclusions, and to consider that the substance which he took for a gland was simply "the poisonous fluid itself, coagulated or hardened by the action of the spirits in which the specimen had been preserved." Günther, moreover, states elsewhere (11) that "no special poison-organ has been found in these fishes, but there is no doubt that the mucous secretion in the vicinity of the spines has poisonous properties." (Comp. also 12.)

Day (9) also states that nothing certain is known, either as to the seat of the poison or the manner of its ejection, and mentions that "it has been surmised that the virus is a secretion or excretion from the mucous surface of the loose skin which covers the spines."

Couch (5) describes "the skill and precision with which the formidable spine of the neck (of *T. draco*) is directed to an object of fear," and, without mentioning Byerley at all, states that "the spines of the dorsal fin have also been an object of dread; but in these cases the wound is only accidental, and the fish does not employ them for any purpose of injury or defence." He also states that "it is certain that no exudation or discharge of a poisonous fluid proceeds from this projecting (opercular) spine."

Yarrell (22) quotes Couch, and mentions that the Weever "strikes with great force either upwards or sideways. Pennant states that he has seen it direct its blows with as much judgment as a fighting cock."

Macalister (16) simply states that the Weever "is commonly thought to inflict poisonous wounds;" and Seeley (18) speaks of the

opercular spine as "an offensive weapon," while Saville Kent (15) makes similar statements to those of Günther and Day.

Turning now to observers in other countries, I find that Cuvier (6, 7, & 8) and Bleeker (2; quoted by Dr. Günther, 13) not only deny the existence of a gland, but even state that it is a mistake to suppose that the Weevers are poisonous at all. Cuvier, moreover, mentions the *dorsal* spines only. And as recently as 1886, Tybring (19) has made the following statement:—"In the Norwegian waters there are no poisonous fishes, but it is well known that the sting-bull [a local name for the Greater Weever, see Day, 9], may be dangerous if one happens to run the pointed dorsal fin into the finger, or any other part of the body."

Canestrini (4) gives a brief reference to Byerley's paper, and acknowledges his conclusions.

In Wiedersheim's 'Lehrbuch d. vergl. Anatomie' (20) the following passage occurs in the chapter on the integument (p. 20):—"Weiter gehört dahin die unter der Stacheln der Rückenflosse von *Trachinus* liegende Giftdrüse. Sie ruht jederseits auf dem Grund vom sackartigen Haut-Einstülpungen, während ihre Ausführunsgänge im Bereich der Stacheln liegen." (See also 21.) I am unable to state on whose authority this statement is made, as Professor Wiedersheim cannot at present lay his hands on the paper from which the passage was abstracted. But it will be noticed that no mention is made of the opercular poison-organ; and that the description of the glands of the dorsal spines differs considerably from my own observations.

Before sending in the present paper for publication, a reference was given me by Professor Hubrecht to a work by Gressin (14), and I much regret that I have been unable to obtain a copy, especially as from its title it is probably an important contribution to the subject. But as apparently this work is not known to most English ichthyologists, I have been advised to publish my own observations independently.

Structure of the Poison-Apparatus.

Opercular Organs.—The form of the opercular spine and its relation to the bony operculum are shown in the accompanying drawing (fig. 1, p. 362). A deep groove (*gr*) runs along both upper and under surfaces right to the apex; and where the base of the spine joins the operculum the grooves are continued forwards for a short distance into small conical cavities (*z*), entirely surrounded by bone. Fig. 2 represents the third dorsal spine, which is slightly stouter than the others; the grooves here also extend from base to apex.

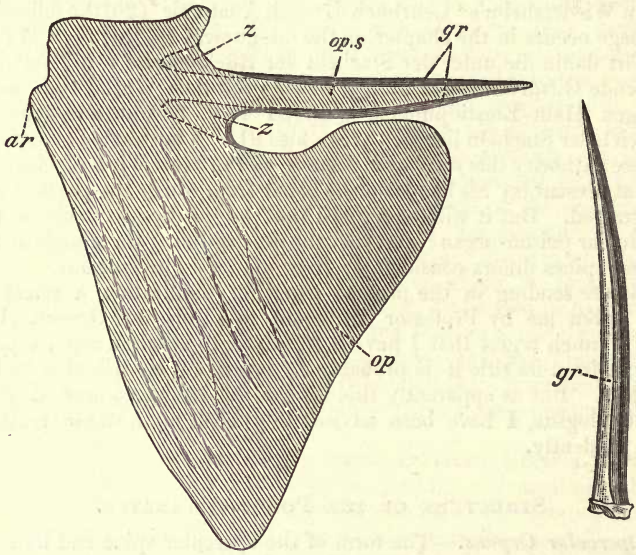
Both figs. 1 and 2 are taken from *T. draco*[1], the other figures (Plate XVII.) refer to *T. vipera*. I find there is no important difference between the two species as regards the structure of the apparatus, and have chosen the smaller species for histological examination, as it requires less decalcification and is more convenient for preparation.

[1] I am indebted to Mr. J. J. Neale of Cardiff for a fresh specimen of this fish.

In both species *distinct glands are present in the grooves of the opercular and dorsal spines*, and in the former they are very large, extending a considerable distance both above and below the spine, along the greater part of its length. *The glands consist of relatively enormous granular nucleated cells*, the structure of which is apparently similar in both species.

Plate XVII. fig. 1, taken from a transparent preparation, shows the general form and relations of the opercular glands. Anteriorly both dorsal and ventral portions project into the bony cavities already described as being present at the junction of spine and bony operculum. From this region each gland broadens out to form a large anterior

Fig. 1. Fig. 2.



Trachinus draco.

Fig. 1. External view of the left opercular bone and its spine.
Fig. 2. Side view of the third dorsal spine.

ar. Articulation of opercular bone with hyomandibular. *gr.* Groove in spine. *op.* Opercular bone. *op.s.* Opercular spine. *z.* Conical cavities in opercular bone, continuous with the grooves of the spine.

lobe, which in its widest part consists roughly of about nine or ten irregular rows of cells. About halfway along the spine the anterior lobe gradually narrows, and ends a short distance from the projecting apex of the spine.

In Plate XVII. fig. 2 a surface view of the apex of the spine is shown, indicating the manner in which it usually projects from its

sheath, and the two points (*x*, *x*) at which the glands are connected with the epidermis. It will thus be seen that the end of the spine somewhat resembles in its arrangement a hypodermic syringe.

In order to make out the more detailed structure of the various parts, serial sections were taken of both opercular and dorsal organs in various planes. The specimens were decalcified, stained with borax-carmine, imbedded and mounted in the usual way.

A transverse section through the line *a–b* in fig. 1 is represented in fig. 4. The spine (*op.s.*) in this region broadens out on both sides of the grooves, which are thus narrower here than they are more posteriorly; the dorsal and ventral glands (*gl.*), enclosed in their thin membranous capsules (*cp.*), are seen projecting into them. The capsule proper is surrounded by a mass of dermal connective-tissue (*c.t.*), except where it projects into the groove of the spine: the epidermis (*ep.*) is seen covering the connective-tissue layer externally. *No special muscles are present in connexion with the glands*: the fibres shown in fig. 6, inserted into a slight ridge of the spine, belong to one of the opercular muscles.

The glands, which contain no lumen, consist of a number of very large rounded or irregular cells; their contents are granular and in most of them one or more distinct nuclei can be seen, many of which show indications of recent division. Around the edges of the glands smaller—probably immature—cells are present here and there in transverse sections through this region. The cell-boundaries cannot everywhere be clearly made out, and I am inclined to think that *in the discharge of their secretion the cells simply burst*, their contents passing along the grooves amongst the other cells to the exterior.

With the exception of the smaller number of cells and the different form of the spine, the structure of the posterior narrower part of the organ shows no important difference from the anterior enlarged part. Towards the narrow termination of the gland, however, shortly in front of the apex of the spine, in which region the cells are smaller, the connective-tissue lying between the gland and the epidermis thins out, and *the cells of the epidermis and gland become continuous with one another* (comp. figs. 3, 5, 6, 7, *ep.*, *c.t.*, *x*). Owing to the toughness of the decalcified spine and to the looseness of its connective-tissue sheath, it is exceedingly difficult to obtain satisfactory unbroken sections in this region, and I have not yet succeeded in ascertaining with certainty the manner in which the secretion passes to the exterior, but am inclined to accept Byerley's explanation. There can, however, be little doubt that the gland is developed as an epidermic involution, the whole of which gives rise to secretory cells, so that there is no marked differentiation into gland and duct.

Dorsal Organs.—The arrangement here is precisely similar to that seen in the posterior narrow part of the opercular organ. There is an expanded part of the gland, which extends along both grooves of each dorsal spine, showing not more than three or four cells in a single transverse section through the broadest part. A connexion

with the epidermis a short distance below the apex can here also be made out.

Fig. 8 represents a transverse section through the first and second dorsal spines. The first being shorter than the second, it is cut through at a relatively different level.

So far as I am aware, there is only a single other case in which the presence of an integumentary gland which gives rise to a definite secretion has been distinctly proved amongst fishes: I refer to the gland of the clasper (*glandula pterygopodii*) of male Elasmobranchs[1]. But from the similarity in many points between the general arrangement of the poison-organs in *Trachinus* with those of *Thalassophryne*[2] and *Synanceia*[3], as described by Dr. Günther, I cannot help thinking that a careful histological examination of the "poison-bags" of these fishes might prove the existence of gland-cells in them also. A number of other fishes, which are said to be poisonous, might likewise repay further examination.

It would be exceedingly interesting to ascertain the nature of the poison of *Trachinus* and to obtain more facts as to its effects. An account of an experiment which Prof. Allman made upon himself is given in the paper already quoted (1). He stung himself in the thumb with the opercular spine of a *T. vipera*, and found that it caused most excruciating pain which lasted about an hour and a half, as well as swelling and inflammation of the thumb and hand. The swelling lasted for some days, but the pain on pressure continued for more than a week. Sir William Jardine (10) quotes a Dr. Parnell as saying that the sting gives rise to a "painful wound, which causes the parts to swell and almost immediately to assume a dark-brown appearance which remains for 4 to 6 hours." Couch (5) mentions that "there are instances where, within a few minutes, the pain has extended from the hand as high as the shoulder;" and states that the danger is not wholly removed after the fish is dead: on this account it is provided by law in some places that the spines shall be removed before the fish is offered for sale in the market. Allman, however, found that inoculation from a fish about 24 hours dead only caused a slight smarting. Byerley (3) describes the erection of the dorsal spines and operculum, and with regard to the effects of the poison gives the following details:—The acute pain caused by the punctures is stated to last usually four or five hours, and to leave the parts in a numb and tender state for some time afterwards. In some cases acute inflammation follows, causing sloughing or mortifying of the parts around the puncture, and even

[1] See Petri, Zeitschrift f. wiss. Zoologie, Bd. xxx. Brock has described some gland-like cells in the curious dendritic appendage which is situated behind the urinogenital papilla of *Plotosus anguillaris* (Zeitschrift f. wiss. Zoologie, Bd. xlv., 1887, p. 532). Comp. also R. von Lendenfeld, on the luminous organs of Fishes, 'Challenger' Reports, vol. xxii. Appendix B. Saville Kent (15) states that *Uranoscopus* and its allies are provided with poison-glands, but does not give his authority for this statement.

[2] Trans. Zool. Soc. vi. p. 437.

[3] Fische d. Südsee, i. p. 84.

giving rise to permanent stiffening of the part. In other cases, instead of a slough of this kind being produced, intense inflammation of the finger, hand, and even forearm may follow, the lymphatic vessels becoming inflamed up to the arm-pit, the glands of which become enlarged and painful. Purulent matter is also often formed amongst the tissues, and the effects of the poison will sometimes be felt for from three to five months in severe cases.

Day (9) states that the swelling usually subsides in about 12 hours, but mentions one case in which a sailor was incapacitated from work for many weeks, and refers to Schmidt (17) as giving further details concerning the effects of the virus.

Mention is also made of the physiological aspect of the question in the paragraph already referred to by Wiedersheim (20), where it is stated that "Die Wirkung des Giftes, selbst auf grössere Thiere, ist eine starke. Es afficirt das centrale Nervensystem und das Herz (Convulsionen, Starrkrampf, Paralyse)."

Additional evidence as to the effects produced by the sting of the Weever is given in many of the works already quoted, but much of this, like the accounts one hears from fishermen themselves, is not sufficiently authenticated to be of much value. Dr. Day states (9) that "surgeons have found that olive-oil, to which a little opium has been added, is most efficacious as a cure."

T. vipera is said to be much more venomous than *T. draco*; but this can probably be explained by the fact that the former has had more attention directed to it, owing to its habit of burying itself in the sand, when it is liable to be trodden upon by bathers; whereas in the case of the Greater Weever the cases of poisoning are mostly confined to fishermen who have incautiously handled the fish when it has been brought up in the trawl.

List of Works referred to.

1. Allman, G. J. On the Stinging-properties of the Lesser Weever (*Trachinus vipera*). Annals of Nat. Hist. vol. vi. 1841, p. 161.
2. Bleeker. Atlas Ichthyol. ii. Silur.
3. Byerley. Proc. Literary and Philosoph. Soc. of Liverpool, No. 5, 1849, p. 156.
4. Canestrini. Compendio di Zool. ed Anat. Comp. i. 1869, p. 307.
5. Couch. British Fishes. Vol. ii. London, 1877, p. 45.
6. Cuvier. Hist. Nat. des Poissons, t. iii. p. 184.
7. Cuvier. Règne Animal. Paris, 1877.
8. Cuvier. Animal Kingdom (transl. by Carpenter and Westwood, London, 1854).
9. Day, F. The Fishes of Great Britain and Ireland. London, 1880–1884, vol. i. pp. 78–82.
10. Jardine, Sir Wm. Naturalist's Library. Vol. xxxvi. British Fishes, part i. p. 137.

11. Günther, A. The Study of Fishes. Edinburgh, 1880, p. 464.
12. Günther, A. Article "Ichthyology" in Encycl. Brit. vol. xii. 1881, p. 666.
13. Günther, A. On a Poison-organ in a Genus of Batrachoid Fishes. Proc. Zool. Soc. 1864, p. 155.
14. Gressin, Léon. Contributions à l'étude de l'appareil à vénin chez les poissons du genre "Vive" (*Trachinus*). Thèse de Paris, 4to. 1884.
15. Kent, W. Saville. British Marine and Freshwater Fishes. Fisheries Exhibition Handbook, London, 1883, p. 29.
16. Macalister, A. An Introduction to the Systematic Zoology and Morphology of Vertebrate Animals. Dublin and London, 1878.
17. Schmidt. Nord. Med. Arch. vi. no. ii. 1875.
18. Seeley, H. G. Cassell's Natural History. Vol. v. London, 1884, p. 92.
19. Tybring, Oscar. Poisonous Fish (translated from the Danish by Hermann Jacobson). Bulletin of the United States Fish Commission, vol. vi. 1886, p. 148.
20. Wiedersheim, R. Lehrbuch d. vergl. Anat. Jena, 1886, p. 20.
21. Wiedersheim, R. Comp. Anat. of Vertebrates (translated by W. N. Parker). London, 1886, p. 18.
22. Yarrell. British Fishes. Vol. ii. pp. 3, 8.

EXPLANATION OF PLATE XVII.

All the figures refer to *Trachinus vipera.*

Fig. 1. The whole of the opercular apparatus, drawn from a transparent preparation mounted entire in Canada balsam.

Fig. 2. The apex of the opercular spine, showing the manner in which it projects beyond its sheath.

Fig. 3. A slightly oblique longitudinal section, taken about through the line *c–d* in fig. 2. The epidermis has broken away, but the point at which the cells of the gland were continuous with it is shown at *x*.

Fig. 4. Transverse section through the opercular apparatus taken through the line *a–b* in fig. 1.

Fig. 5. Transverse section through the narrower part of the apparatus, near the apex of the spine.

Fig. 6. The 20th section posterior to (that is, nearer the apex of the spine than) the last, passing through the region at which the involution of the epidermis occurs (*x*); the section is slightly oblique, and thus passes through the involution at different levels on either side.

Fig. 7. The 6th section posterior to the last, also passing through the epidermic involution.

Fig. 8. Transverse section through the first and second dorsal spines and glands. The first spine being shorter than the second, the section cuts it nearer the apex, through its narrower portion.

The sections were all drawn with the camera lucida to the same scale.

LIST OF ABBREVIATIONS.

ar. Articulation of opercular bone with hyomandibular. *b.v.* Blood-vessel.

c.p. Capsule of gland. *c.t.* Connective tissue. *d.f.* Dorsal fin. *d.s.* Dorsal spine. *ep.* Epidermis. *gl.* Poison-gland. *gr.* Groove in spine. *m.* Opercular muscles. *op.* Opercular bone. *op.m.* Opercular membrane. *op.s.* Opercular spine. *pg.* Pigment-layer of skin. *r.* Outer ridge of opercular spine. *sh.* Sheath of opercular spine. *x.* Region at which the cells of the epidermis are continuous with those of the gland. *y.* Space between the opercular spine and its sheath.

2. On a Collection of Coleoptera from Korea (Tribes Geodephaga, Lamellicornia, and Longicornia), made by Mr. J. H. Leech, F.Z.S. By H. W. Bates, F.R.S., F.Z.S., &c.

[Received June 5, 1888.]

During his recent entomological exploration of Japan and the neighbouring coasts of Eastern Asia, Mr. J. H. Leech paid a visit of six weeks' duration (May–June 1886) to the eastern side of the Korean peninsula, and was enabled, though his attention was chiefly occupied with Lepidoptera, to obtain a considerable collection of Coleopterous insects. His excursions were limited to the hilly country in the neighbourhood of Gensan, a district which appears never before to have been visited by an entomologist. Our knowledge of the products of Korea in this branch was previously confined to the western side of the country, where a small collection was made in 1883 and 1884 by Dr. C. Gottsche, and another, somewhat more extensive, a little later, by Herr Otto Henz. The former was catalogued and described by Herr Kolbe in Wiegmann's 'Archiv für Naturgesch.' in 1886; the latter by Ganglbauer in 'Horæ Soc. Entom. Rossicæ,' vol. xx. (1886), and by Von Heyden in the same periodical, vol. xxi. (1887). To the number of species thus recorded, viz. 286, Mr. Leech, in the three groups here catalogued, has added about 60, making a total of 346, which is, of course, but a small fraction of the Coleopterous fauna of the country. It is welcome, however, as affording us for the first time a glimpse of the nature of the fauna and of its relations to those of Japan and the regions of continental Asia to the north and south. So far as it goes it points to an essential unity of the Coleopterous fauna with those of the Amur and Northern China, and at the same time a decided difference between the faunas of Korea and Japan, in the same Order of Insects. The difference is twofold—it consists, first, in a large proportion[1] of continental Palæarctic genera and species being found in Korea but not in Japan; and, secondly, in the mixture of tropical forms, which is so well known a feature of temperate latitudes in Eastern Asia, being of a different nature in the two countries, for the proportion of these forms is decidedly less in Korea than in Japan, and consists of different genera as well as species.

[1] Of the 100 Korean species here catalogued, no fewer than 42 appear not to be found in Japan. Four of the 42 are tropical, not properly Palæarctic, forms.

This seems to show that the source and perhaps the epoch of immigration of tropical forms have been different for the two countries. It is, however, too soon to generalize with confidence on these points, seeing that we at present know scarcely a tenth of the species of Coleoptera almost certainly existing in Korea. I put forward these considerations, suggested by the examination of a large portion of Mr. Leech's acquisitions, chiefly to show that interesting problems lie before us in the fauna of this country, and that an attractive field lies open for future travellers and residents.

Fam. Cicindelidæ.

Cicindela chinensis, De Geer, Ins. 4, t. 17. f. 23.

Two examples, closely resembling the richly-coloured form prevalent in Japan.

Cicindela gemmata, Faldermann, Mém. Acad. Petrop. ii. (1835), p. 14, t. 3. f. 1; Kolbe, Archiv f. Naturgesch. Berlin, 1886, p. 164, t. xi. f. 21.

Taken abundantly at Gensan, and found also by Dr. Gottsche between Söul and Fusan. On the Amur it reoccurs as a rather well-marked variety. Faldermann described it from Mongolian specimens taken by Bung more than half a century ago. To Herr Kolbe belongs the credit of resuscitating this species, which had been by most authors suppressed as a synonym of *C. sylvatica*, from which it is very distinct.

Cicindela raddei, Morawitz, Bull. Acad. Petrop. iv. p. 188 (1862).

Three examples, agreeing well with the above-cited description.

Cicindela japanensis, Chaudoir, Bull. Mosc. 1863, i. p. 202.

Many examples taken at Gensan. Common in Japan and on the Asiatic mainland as far south as the Yang-tsze.

Fam. Carabidæ.

Carabus van-volxemi, Putzeys, Ann. Soc. Ent. Belg. xviii. p. 2.

Gensan. One example only, differing from Japanese specimens in the fainter granulations of the interstices, and possibly indicating a distinct local variety.

Carabus tuberculosus, Dejean, Sp. Gen. Col. v. p. 549.

Gensan, one example.

Carabus bilbergi, Mannerheim, Hummel's Ess. vi. p. 25.

One example, apparently an elongate variety of this species.

Coptolabrus smaragdinus, Fischer, Ent. Russ. ii. p. 103.

Two examples of a rich uniform golden-coppery colour, the apex