

(nos. R. 506-508) agree so closely in general characters with the genus *Bothriceps*, Huxley, presumably from the Hawkesbury Beds of Australia, that they may be regarded as indicating a new species of that genus, for which I propose the name *Bothriceps Huxleyi*.

The skull of this species is distinguished from that of the typical *B. australis* by its smaller size and narrower contour, the extreme length being about  $2\frac{3}{4}$  inches in the specimen which I take as the type (no. R. 507). The sculpture is of the pitted nature characteristic of the typical species of *Bothriceps*, which at once serves to distinguish this form from *Petrophryne*, Owen, which (as Prof. von Zittel has pointed out) appears to be inseparable from *Micropholis*, Huxley.

The occurrence of *Bothriceps* in the Australian Hawkesbury Beds and the Karoo System of the Cape district is paralleled by that of the Ganoid genus *Clithrolepis*, which Mr. Smith Woodward has recently recorded from the latter deposits.

*On the Phosphorescent Infection of the Talitri and other Crustaceans.*

By M. A. GIARD.

Several naturalists have noted the phenomenon of phosphorescence in Amphipoda of different groups and often badly determined (*Gammarus*, *Talitrus*, *Orchestia*, &c.). Tilesius, Viviani, Suriray, and Snellen van Vollenhoven have cited cases of this kind, and the Rev. T. Stebbing, in the admirable bibliography of his Report upon the 'Challenger' Amphipoda, has summarized these older observations. In most cases the observed phosphorescence did not belong to the animal itself. In *Talitrus*, especially, M. de Quatrefages has indicated the cause of this apparent phosphorescence; it is due to *Noctiluca* which attach themselves to the carapace of the Amphipod as they lie upon the damp sand after the retreat of the tide\*. Therefore my surprise was great when, on the 3rd September last, I found on the beach at Wimereux a phosphorescent *Talitrus* of such intense and continuous lustre that the *Noctiluca* evidently had no part in the phenomenon. It was at 10 o'clock at night, and notwithstanding the brightness of the moon, then nearly at the full, the luminous *Talitrus* could be perceived at a distance of several metres. The light was greenish; it proceeded from the interior of the body of the Crustacean, which was completely illuminated to the extremities of the antennæ and legs, and presented no dark points except the two eyes, which formed two black spots upon this brilliant ground. The animal walked slowly upon the sand, instead of leaping briskly like its congeners. All search made on the same night and following evenings to find other *Talitri* in the same state were absolutely unsuccessful.

This excessive rarity of the phosphorescent *Talitri* upon a beach on which those animals exist in thousands led me to suppose that we had to do here with a parasitic action rather than a physiological peculiarity. Therefore the next day I examined under the microscope a leg cut off from the luminous animal. This limb proved to be stuffed with Bacteria swarming among the muscles, and particularly visible in the terminal joints, which were thinner and more transparent. Under the influence of this microbe the

\* "Sur la phosphorescence de quelques Invertébrés marins," in Ann. Sci. Nat. sér. 3, vol. xiv. p. 236, 1850 (see also 'Silliman's Journal,' vols. xv. and xvi., and 'Annals,' ser. 2, vol. xii. pp. 15 and 180, 1853).



muscles presented a profound alteration, which explained the enfeebling of the animal's movements.

To study the Bacteria more completely I collected a drop of blood from the *Talitrus* and added to it a drop of gentian-violet. Thus treated the Bacterian was brightly coloured. It presents the form of a *Diplobacterium* measuring about  $2\ \mu$ ; each of the geminate joints is less than  $1\ \mu$ . There are also chaplets of three or four joints, rarely more, and here and there a few isolated bacilli, a little longer ( $3\text{--}5\ \mu$ ).

The phosphorescent disease being manifestly of an infectious nature, I tried inoculations upon *Talitri* and *Orchestie* (*O. littorea*, Mont.). For this purpose I cut off two more legs of the luminous *Talitrus*. Each of these was torn up separately in blood of *Talitrus* and of *Orchestia*; then with a sterilized needle I pricked the *Talitri* and the *Orchestie* on the sides of the body, taking care not to wound the liver or touch the dorsal vessel, in order to avoid a too abundant hæmorrhage. I then applied a drop of virus to the wounded places, and the inoculated animals were enclosed in glasses furnished with a thin layer of sand, and covered over and placed in the cellar of the laboratory at the temperature of  $59^{\circ}\text{--}64^{\circ}\text{ F}$ .

The result exceeded my expectations. Of the *Talitri* inoculated on the 6th September six began to shine on the 8th and appeared on the evening of the 9th as brilliant as the first luminous *Talitrus*. Out of a dozen *Orchestie* inoculated the same day three became phosphorescent on the 9th and were resplendent on the 10th. I have since continued the inoculations, operating about every two days; and I possess at present *Talitri* of the sixth luminous generation and *Orchestie* of the fourth generation. The action of the microbe does not seem to diminish at all, and in the evening the cellar of the laboratory presents a fairy aspect, which is the admiration of the bathers staying at Wimereux.

The Bacteria is not modified by passing into the *Orchestia*; *Talitri* inoculated with virus taken from *Orchestie* of the third generation behaved as if they had been infected by the blood of other *Talitri*.

The disease follows a very regular course. At first one sees only a luminous point at the place of the puncture. After the lapse of from forty-eight to sixty hours the whole animal is phosphorescent, but with a white light which has little external diffusion. At this time the *Talitrus* still shows great activity. After the third or fourth day the phosphorescence becomes brilliant and of a fine greenish tint and the animal throws out a bright light around it. It may be perceived at a distance of 10 metres, and two *Talitri* suffice to enable one to see the time by a watch as in full daylight. At this phase of the malady the *Talitrus* progresses more slowly; it can still issue from its burrow, which it illuminates, and return there if disturbed. The period of this state may last from three to six days; then comes a period of immobility, during which the phosphorescence retains all its brilliancy. Lastly, in three or four more days the animal dies; the body remains phosphorescent for some hours and then acquires a very characteristic brown tint. Frequently the point of inoculation is surrounded by a small blackish circle. Lowering of the temperature seems to prolong the life of the animal; *Talitri* inoculated on the 9th September and kept at a temperature of  $50^{\circ}\text{--}57^{\circ}\text{ F}$ . were still living on the 22nd September.



In the *Orchestia* the inoculations do not succeed so easily because the operation is more delicate; but the animal longer retains its muscular power: an *Orchestia* inoculated on the 12th still jumped on the 19th, although it was in full phosphorescence. The *Talitri* and *Orchestia* in which the inoculation does not succeed remain in perfect health long after their congeners are dead; the puncture, when well made, therefore is not serious in itself.

I have inoculated examples of *Hyale Nilssoni*, Rathke, with perfect success; in these little Amphipoda phosphorescence is produced in forty-eight hours. Specimens of *Ligia oceanica*, Linn., though more resistant, also gave a favourable result. Of six *Ligia* unsuccessfully inoculated on the 10th and reinoculated on the 16th only one was infected; but after the 20th it presented an admirable spectacle.

I have also succeeded in inoculating crabs (*Carcinus mænas*, Linn., and *Platyonychus latipes*, Penn.). In these animals, however, the morbid phenomena are much more complex, and I will notice them in a subsequent communication. At the same time I will describe my experiments in the culture of the Bacteria in artificial media.—*Comptes Rendus*, September 23, 1889, p. 503.

*On the Parasitic Castration of the Typhlocybæ by a Hymenopterous Larva (Aphelopus melaleucus, Dalm.) and by a Dipterous Larva (Atelenevra spuria, Meig.).* By M. A. GIARD.

The Hymenopterous and Dipterous larvæ parasitic upon *Typhlocyba* noticed by the author in a former communication\* belong, the former to *Aphelopus melaleucus*, Dalm., the latter to *Atelenevra spuria*, Meig. (*A. velutina*, Macq., *Chalarus spurius*, Schin.).

These insects, like their hosts the *Typhlocybæ*, have two generations in the year: one, proceeding from pupæ formed during the second fortnight in June, comes out at the beginning of July; the other infests the second generation of *Typhlocyba*, enters the pupa state towards the end of September or in October, and probably passes the winter in that state, producing the perfect insect in the following spring.

Combining these observations with those of Perris (on the parasitism of *Dryinus pedestris*, Dalm., upon *Athysanus maritimus*, Perris) and of J. Mik (on the parasitism of *Gonatopus pilosus*, Thoms., upon *Deltocephalus xanthoneurus*, Fieb.) it seems probable that the Procotrupians of the family Dryinidæ are generally parasitic upon Homoptera of the family Jassidæ.

On the other hand, as regards the Diptera, the present observation, especially in conjunction with Boheman's statements, particularly as to the infestation of *Cicadula virescens*, Fall. (*Thamnotettix sulphurella*, Zett.), by the larva of *Pipunculus fuscipes*, Fall., makes it probable that the Diptera of the family Pipunculidæ are also generally parasitic upon Jassidæ.

The *Typhlocybæ* with yellow or whitish elytra form a small group of species often living side by side upon the same trees, and resembling each other so closely that it is almost impossible to distinguish them. Mr. James Edwards, of Norwich, has recently called attention to the very distinct differential characters presented by the male genital armature in these different species. In accordance

\* *Comptes Rendus*, July 8, 1889, p. 79; see *Annals*, *suprà*, p. 254.



Giard, Alfred. 1889. "On the phosphorescent infection of the Talitri and other Crustaceans." *The Annals and magazine of natural history; zoology, botany, and geology* 4, 476–478. <https://doi.org/10.1080/00222938909460570>.

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