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XIV.—*On the Luminosity of Midges* (Chironomidæ). By PETER SCHMIDT, of the Zoological Laboratory of the Imperial University at St. Petersburg*.

FOUR years ago it was shown by I. D. Kusnezoff†, in a little memoir of a bibliographical character, that the luminosity of Midges (Chironomidæ) had already been observed in the last century.

For we find in Pallas‡ the following lines, taken from a letter written by Carl Hablitz from Astrabad (Persia):—“Besides this luminous insect (*Lampyris*), which is of very frequent occurrence on the shore of the Bay of Astrabad, I have likewise had occasion to observe that in the dark a light also emanates from the gnats (*Culex pipiens*, L.). In fact, I noticed this last autumn and in the spring of the present year, since these insects had established themselves in multitudes on board our ships.”

It appears to be scarcely open to doubt that the above quotation refers not to the luminosity of *Culex*, but to that of *Chironomus*§, since, on the one hand, no single subsequent or previous statement exists as to the luminosity of the first-

* Translated by E. E. Austen from the ‘Zoologische Jahrbücher.—Abtheilung für Systematik, Geographie und Biologie der Thiere,’ Bd. viii. Heft 1 (Jena, 1894), pp. 58–66.

† “Zur Frage nach dem Leuchten der Dipteren,” Westnik Estestwosnaniia, St. Petersburg, 1890, no. 4, pp. 167–171 (in Russian).

‡ ‘Neue Nord. Beitr. zur physik. u. geogr. Erd- u. Völkerschreibung,’ Bd. iv. 1783 (referred to by Osten-Sacken, Ent. Mo. Mag. vol. xv. 1878, no. 170, p. 43).

§ As Kusnezoff also presumes: *vide loc. cit.* p. 167.

mentioned Dipteron, while, on the other, almost all the species of *Chironomus* are extremely similar to the true gnats (Culicidæ) in outward appearance, and in a superficial determination may easily be mistaken for them.

For a very long time the observation in question remained altogether unnoticed and unconfirmed. It was not until the year 1874 that the interesting fact was discovered for the second time by W. D. Alenizyn, a member of the well-known Aralo-Caspian Expedition, by whom it was published in a communication addressed to our Naturalists' Society of St. Petersburg*.

During his sojourn on the Sea of Aral, and in the neighbourhood of the mouth of the Amu Daria, Alenizyn was able to observe that a multitude of actively luminous midges settled on board ship. He also had an opportunity of collecting these insects in alcohol, and of subsequently determining them to be a species of *Chironomus*.

The next statement on the subject of the phenomenon which we are discussing is to be found in foreign literature. In the year 1871 two luminous female specimens of *Chironomus* were observed by Dr. Brischke on the River Kadaune, in Pomerania, and were determined by him to belong to *Chironomus tendens*, F.†

In the year 1884 luminous midges were observed on Lake Issykkul by Prof. Ssorokin, the botanist, by whom specimens were collected and forwarded in alcohol to St. Petersburg. On arrival they were examined by I. D. Kusnezoff, but, in consequence of the bad state of their preservation, it was impossible to determine them precisely‡.

In addition to these statements from literature, I am able to adduce a verbal communication from Herr I. K. Tarnani, according to which luminous midges, probably also belonging to the Chironomidæ, were likewise observed near Taganrog, on the Sea of Azov. The specimens of the insects which were collected by Tarnani have unfortunately been lost.

During the past year (1893) our Entomological Society received a luminous *Chironomus* in a dry condition, forwarded by Herr Christoph from Sarepta (Saratow).

The foregoing paragraphs are sufficient to show that the luminosity of midges is a phenomenon which is of somewhat widespread occurrence, although seldom observed by specialists.

* In the Society's 'Trudy,' vol. vi. 1875, p. xi.

† "Leuchtende Dipteren," Deutsche ent. Zeit. Jahrg. xx. 1876, Heft 3. Entom. Monatsblätter v. D. Kraatz, Berlin.

‡ I. D. Kusnezoff, *loc. cit.* p. 170.

For my own part, I had the good fortune to be myself a witness of this interesting manifestation while staying at Lake Issykkul in the summer of 1892. Unfortunately I arrived at the lake too late to be able to witness the phenomenon in the height of its brilliancy; for, according to the statements of the inhabitants of Prshewalsk, the luminous midges are most abundant at the beginning and in the middle of June, while I did not reach the spot until the commencement of July. This is my explanation of the fact that it was only with a considerable amount of trouble that I discovered and obtained six specimens of the luminous insects in the shrubs growing on the shore of the lake, for otherwise, according to the descriptions of the inhabitants, they frequently appear in such multitudes that entire shrubs appear as if aglow.

The specimens observed by me, of which one proved to be a male and the remaining five females, shone very brightly, with a somewhat greenish phosphorescent light, which was entirely similar to that of *Lampyrus*, but materially differed therefrom owing to its continuity and regularity.

Even when touched or actually thrown into alcohol the insects still continue to shine, and apparently are able neither to diminish their light nor to cause it to cease. In alcohol the midges remain luminous for from three to four hours, as was also previously found to be the case by Alenizyn.

Unfortunately the only preservative fluid which I had with me was 70° alcohol, and I was consequently obliged to be content with bringing the specimens which I had collected to St. Petersburg in the spirit.

Since the phenomenon that I had observed interested me in the highest degree, I proceeded in St. Petersburg to make a closer examination of my specimens, and also consulted the material brought back by Ssorokin and Alenizyn*.

As a matter of fact, the collection forwarded by Ssorokin proved to be in a perfectly useless condition: the antennæ, legs, and in part also the wings of the majority of the specimens were broken off, and their colour and markings appeared to be greatly altered, so that it was not worth while to attempt either a determination or description of the insects, or even an investigation of them by means of sections.

On the other hand, the collection, although such a small

* The former was kindly handed over to me by Herr J. N. Wagner, Keeper in the Zoological Museum of the University of St. Petersburg, the latter by Herr J. A. Portschiński from the collections of our Entomological Society. I venture to take this opportunity of expressing to both of these gentlemen my warmest thanks.

one, brought back by myself, and the fairly large series obtained by Alenizyn, afforded several specimens which were perfectly well preserved.

On commencing the investigation I was thoroughly convinced that the luminous species of *Chironomus* with which I had to deal were new, and I consequently intended, with the help of the tables contained in Schiner's classical work 'Fauna Austriaca: Diptera,' to determine their systematic position only approximately. My astonishment may therefore be imagined on finding in these tables a diagnosis which corresponded with the majority of the specimens down to the smallest details.

For it appeared that both all the midges brought back by myself from Lake Issykkul, as well as the majority of those collected by Alenizyn, belong to *Chironomus intermedius*, St., a species which, in the opinion of Schiner, is merely a variety of the extremely common *Chironomus plumosus*, L., since the two forms are distinguished one from another only by size, and also in this respect transitional forms are found between them*.

It is therefore possible that also certain females examined by me, which exceed the stated dimensions of *Ch. intermedius*, St., are to be regarded as belonging to *Ch. plumosus*, L.

I have determined certain smaller specimens among Alenizyn's insects as *Chironomus tendens*, F.b., but am not altogether convinced of the accuracy of this determination.

Besides the above, the same collection contained several specimens of quite small midges, which proved to belong to a species of *Corethra*, and yet are stated by Alenizyn† to be actively luminous—a fact which is quite new to science.

Unfortunately I was not in a position to confirm my determination by a comparison of the specimens examined by me with any determined by a competent dipterologist.

Nevertheless I find a confirmation, although an indirect one, of my opinion that the insects which I collected myself at Lake Issykkul are really nothing else than *Chironomus intermedius*, St., in the fact that on dredging in the lake‡ I found a few specimens of the extremely characteristic larva of *Chironomus plumosus*, L. The larvæ, which were likewise preserved in alcohol, proved on closer investigation to be absolutely identical with Réaumur's description and

* *Vide* Schiner, *op. cit.* Bd. ii, p. 601.

† According to a communication from Herr J. A. Portschiński.

‡ In Kara-ssu Bay, near Prshewalsk.

figures *; it is well known, however, that the larvæ of the midges vary according to the individual species even much more than do the imagines, and this favours the belief that *Chironomus plumosus*, L., or *Ch. intermedius*, Fb., the form which is so closely allied to it, really occurs at Lake Issykkul.

For the rest, however, the agreement of the diagnosis with the insects examined by me is so striking that I have no doubt whatever as to the correctness of my determination.

It consequently follows from my investigation that the luminous midges belong to species which are the commonest and widely distributed, as had also once before been found to be the case by Dr. Brischke (*vide supra*).

We now have to discuss the explanation of their luminosity.

From the purely biological standpoint luminosity in animals in general can be referred to two causes.

In the first place animals are luminous, which for this purpose are provided with special luminous organs, and in which this function plays one part or another in their life-history, though the precise rôle may not always be manifest to us—such as, for instance, our own *Lampyris*, several exotic insects, luminous crustaceans and fishes living at great depths in the sea, &c.

In the second place, there are animals which are luminous by means of luminous micro-organisms living upon them or in them, which indeed, as is well known, also occasion the luminosity of decaying substances (meat, fish, wood, and similar bodies). In this instance we have to distinguish two cases:—

1. The micro-organisms may be harmless to the animal and we must consequently regard them as “room-parasites” (Raumparasiten), or even as commensals (since they perhaps also benefit the animal by their luminosity, by attracting its prey to it). The bacteria of the medusa *Pelagia* and of the mollusk *Pholas*, discovered by R. Dubois†, may serve as a case in point.

2. The micro-organisms may occur as veritable parasites, injurious to their host. Of this, however, we are at present acquainted with only a single instance, which was brought forward by A. Giard‡, namely the luminosity of *Talitrus*.

* Réaumur, ‘Mém. pour serv. à l’hist. des Insectes,’ vol. v. p. 38, tab. v. figs. 1-5.

† R. Dubois, “Sur le rôle de la symbiose chez certains animaux marins lumineux,” Compt. Rend. Acad. Paris, t. cvii. 1888, p. 502.

‡ A. Giard, “Sur l’infection phosphoresc. des Talitres et autres Crustacées,” Comptes Rendus, Sept. 23, 1889, p. 503; Ann. & Mag. Nat. Hist. (6) iv. pp. 476-478 (1889); referred to in Centralbl. f. Bact. u. Parasitenkunde, Bd. vi. 1889, p. 645 (I quote according to Héricourt, “Les microbes lumineux,” Revue Scient. t. xlv. 1890, no. 15, p. 465).

In the year 1889 the naturalist referred to observed a strongly luminous *Talitrus* on the sea-shore near Wimereux. A specimen of this animal, which hitherto had never been observed to possess luminous properties, shone so brightly even by moonlight that it was distinctly recognizable at a distance of several metres. The light was of a greenish hue, and came from the interior of the body, which glowed, not in its various parts, but over the entire surface, even to the tips of the antennæ and feet, while the eyes alone formed two black dots upon this luminous background. The luminous individual moved very slowly upon the sand, instead of jumping about energetically like the other non-luminous members of the same species. On examining a foot belonging to the luminous crustacean under the microscope, it was found that it swarmed with micro-organisms (*Micrococcus phosphoreus*?) between the muscles, and that the muscles themselves were seriously injured by them, which was a sufficient explanation of the sluggish movements of the creature. Giard also succeeded in infecting with these luminous micro-organisms the healthy non-luminous crustaceans, and in thereby inducing luminosity in them. The animals became luminous in less than three days, continued to be so for from three to six days, then commenced gradually to become languid and motionless, and perished, as was also the case with the original specimen, after from three to four days more, while their bodies still continued to be luminous for some hours.

It appears to me that the luminosity of the midges (Chironomidæ) can, with the greatest probability, be regarded as belonging to the same category as the case above recorded, which, so far as I am aware, is at present entirely unique; this view is supported by the following points:—

1. The luminosity appears not in peculiar specially luminous species, but in the most common and widely distributed forms*.

2. The luminosity is (both in accordance with my own observations, as also with the statements of Alenizyn and Ssorokin) not localized at any one point, but embraces the entire body and all its appendages (legs and antennæ). The luminosity is also entirely independent of the will of the animal, and still persists for a long time even in alcohol (*vide supra*). I have even found a *Chironomus* which was caught in a spider's web and already partially sucked dry by the

* The luminous specimens of the species of *Corethra* brought back by Alenizyn likewise appear to belong to one of the most ordinary forms; but I did not succeed in determining them more precisely.

spider (the head was bitten off), and nevertheless its body was luminous, although not so brightly as in the case of the living insects.

3. The luminous insects are very sluggish, whereby they differ considerably from our own midges belonging to the same species. In his communication on the subject of the luminous insects observed on the Sea of Aral, Alenizyn writes as follows* :—"I have observed no independent movements on the part of the insects; those that I took in my hands remained perfectly motionless. On being touched a few individuals appeared to make indistinct movements, but they usually fell down when this was done, and, since they collected for the most part on the outside of the ship's bulwarks, they thus dropped into the water." Almost the same statement is also made by Ssorokin as to the luminous Chironomidæ on Lake Issykkul†, and from my own experience I can but confirm his words. According to the statements of the inhabitants the luminous insects are very rarely seen in flight, but always sit almost motionless on the branches of the bushes, a fact of which I was likewise able to convince myself. It is sufficient to hold a small box, a glass, or simply one's open hand beneath the luminous insect, and to shake the branch slightly, whereupon the midge falls down into the box or into the hand, and does not even attempt to fly away. Altogether the luminous insect conveys the impression of a sickly and, at any rate, an abnormal individual.

4. Neither by Kusnezoff‡, who examined the collection forwarded by Ssorokin, nor by myself by means of making sections (borax-carmin and paraffin) were any structures whatever discovered resembling luminous organs. The fairly well-preserved midges which were obtained by Alenizyn (my own are in a much worse state of preservation, since I had carried them in tubes with ordinary corks, in consequence of which the spirit probably evaporated to a certain extent) exhibit in the sections only a strongly developed fat-body with its typical widely areolate cells.

5. The males are luminous as much as the females, and, consequently, the luminosity can scarcely be of service from a sexual point of view; it is self-evident that the luminosity cannot either serve as a lure, since the midges are not predaceous insects.

The analogy between the first three points and the above-quoted observations of Giard is so obvious that it scarcely

* *Loc. cit.* vol. xii.

† I. D. Kusnezoff, *loc. cit.* p. 170.

‡ *Loc. cit.* p. 170.

needs further discussion. This analogy, as also the last two points, tends, however, to show that the cause also of the luminosity is the same as in the case of *Talitrus*, and that, consequently, we are here likewise confronted with an infection by luminous micro-organisms.

In order to convince ourselves of the justice of this assumption, manifestly the simplest plan would be, as Giard has done, directly to demonstrate the presence of the micro-organisms.

Herein, unfortunately, owing to the fact that the state of preservation of the objects leaves so much to be desired, I have not succeeded.

I have attempted to employ various staining reagents for bacteria (methylene-blue-eosin, gentian-violet, Gram's and the Gram-Günther method), but without obtaining a distinctly positive result.

It is true that in many cells of the fat-body, enclosed in plasma, granules were to be seen which took a strong stain; but whether these are micro-organisms or merely some kind of concretions or decomposition-products of the cells, it is impossible to determine, so long as one is not in a position to examine a fresh specimen, or, at least, preparations for the purpose of comparison derived from the ordinary non-luminous *Chironomus*.

Manifestly the best proof would be the success of attempts at infection, as in the case of *Talitrus*.

As yet, therefore, we must forego, for a while, the final decision of the interesting question as to the causes of the luminosity of the midges, since all the points adduced are to be regarded really as only indirect, not as direct, proofs; and if I have ventured to decide in favour of the bacterial cause of a phenomenon which has at present received so little investigation, it is on account of two reasons:—

1. Because I am convinced that the arguments which have been adduced are still fairly weighty ones, and render the bacterial origin of the luminosity at least in the highest degree possible.

2. Because I considered that any explanation of the interesting phenomenon whatever, based upon facts, is at any rate better than none.

It was also my purpose once more to direct the attention of naturalists to the phenomenon in question, and thereby, perhaps, to stimulate someone to make a closer investigation.

It appears to me to be possible that the luminous midges also occur in Western Europe, as is already shown by the observation of Brischke, isolated at present though it be.

Above all, however, Russian naturalists have good opportunity to make closer acquaintance with the phenomenon, since in our territories in certain localities (*e. g.* on Lake Issykkul) it may be observed not as an exception, but rather as the rule.

The question as to the causes of the luminosity of the midges appears to me to possess a high biological interest and to be worth an exhaustive investigation, even for the reason that, should my hypotheses be confirmed, this phenomenon would constitute the second instance of bacterial-pathological luminosity in animals.

St. Petersburg,
March 1894.

XV.—*Description of a new Eagle-Ray from Muscat.*

By G. A. BOULENGER, F.R.S.

Rhinoptera Jayakari.

Teeth in nine rows, those of the median row of the upper jaw eight times as broad as long, and nearly twice as broad as those next to them; median teeth of the lower jaw six times as broad as long and once and a half as broad as those next to them. Disk once and three fourths as broad as long. Head as long as broad; snout emarginate; the width of the mouth nearly equals its distance from the end of the snout. Skin smooth. Tail two fifths of the total length. Blackish above, whitish beneath.

	millim.
Total length	740
Length of disk	450
Width of disk	750
Length of head	130
Width of head	130
Diameter of eye.....	15
Width of mouth	85

A single male specimen, a skin; presented to the British Museum by Surgeon-Major A. S. G. Jayakar.

By its dentition this species stands nearest to the Atlantic *R. Jussieui*, Cuv. (*brasiliensis*, J. Müll.), which is only known to me from the descriptions; but it can be easily distinguished by its short tail, the tail of *R. Jussieui* being more than twice as long as the disk.