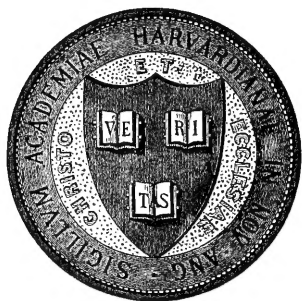


Emery, C. On *Melanenchytraeus solifugus*.

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On *Melanenchytraeus* *Solifugus*

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AN OLIGOCHAETOUS ANNELID OF THE FAMILY
OF THE ENCHYTRAEIDAE

By CARLO EMERY



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On *Melanenchytraeus Solifugus*

An Oligochaetous Annelid of the family of the Enchytraeidae.

By CARLO EMERY

In his expedition to Mount St. Elias, J. C. Russell observed on the Malaspina Glacier numerous specimens of a small black worm, which "literally covered" the snow before the rise of the sun, and disappeared beneath the snow as soon as they felt the warmth of the sun rays.¹ Russell states that he never found these worms when the temperature was above freezing point.

The same worms were found again and for the first time collected by Dr. De Filippi, in the conditions described by Russell. They appeared at morning and evening; on foggy days they disappeared later in the morning and re-appeared earlier before sunset; but they were never seen in the hours near mid-day. During the sunny hours, Dr. De Filippi tried digging under the snow to a depth of about fifty centimetres without finding any. In contradiction to Russell's statement, he observed these worms also when the temperature was above freezing point; but during the return journey they were much less numerous, and only on those spots of the glacier which were covered with snow.

The specimens which I have used for this study were put directly in strong alcohol, and are therefore somewhat shrunken; but the state of preservation of the tissues would have allowed a more complete study of the structure of this animal, had the specimens been more numerous,² and collected at a more advanced season.

Most of these specimens were immature; they had not developed spermducts or sperm-sacs or spermathecae. In the more mature specimens, the eggs were minute, and I could not recognise any vestige of female genital ducts; but one showed a beginning of clitellum development. With few exceptions they were lacking in the organs which are the most important for the discrimination of genera and the determination of affinities in this order of Annelides.

The worm preserved in spirits (Fig. 1) is dark-brown, nearly black.

¹ *Second Expedition to Mount St. Elias*, Washington, 1894, p. 33. Wright (*The Ice Age of North America*, London, 1890, p. 44) mentions also worms found on a glacier of Alaska and properly on Muir Glacier, "in shallower inclosures of the surface, containing water and a little dirt." The conditions in which they were observed, very different from those in which the worm detected by Russell lives, lead me to think that our worm is not identical to the *Melanenchytraeus* of the Malaspina, but belongs to a different species.

² The number of specimens would have been greater, had not a part of the collected material been lost by accident.

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Having bleached a specimen by means of a mixture of chlorate of potassium and hydrochloric acid and mounted it in glycerine, I succeeded in making it sufficiently transparent to count the segments exactly, to observe the bundles of chaetae, and to control by examination of the whole animal some results of the study of microtomic series.

The colour is due to dark pigmentation of the hypodermis (Fig. 7); it is so intense that limits of cells or their nuclei are not visible on sections if they are not extremely thin. This fact may depend on the shrinking of the plasma of the epithelium-cells, under the direct action of strong alcohol. In one specimen, unfortunately injured in the genital region, I could recognise the beginning of development of glandular cells in the hypoderm of the twelfth (clitellar) segment (Fig. 8).

In the cephalic lobe, sagittal sections show a well-marked *cephalic pore* (Fig. 3 *pc*); in the space between this pore and the mouth the hypoderm is much thickened; its cells are much elongate, pigmented at their base and apex only. In this region there are in the hypoderm club-shaped bodies, strongly pigmented at their superficial part, nearly pigmentless at their deep or basal part, which shows a large nucleus (Fig. 9 *cs*). I believe that these bodies are *sense cells*, possibly organs of sight; they seem to be connected with a thick nerve, which arises from the lateral commissure of the oesophageal ring, and distributes itself in that region (Fig. 2). A more accurate study of these supposed sense bodies was not possible on preserved material.

The cutaneous pigment was not confined to the hypoderm; large cells filled with dark-brown pigment were found around the bundles of chaetae (Figs. 12, 13, 15) and in their neighbourhood. I was not able to recognise the precise nature of these cells; each of them has a clear round spot showing the nucleus. Brown pigment lies also in the end of the nephridial ducts, near their external opening (Figs. 12, 13).

The *chaetae* are slightly sigmoid, more markedly bent at their apical end (Fig. 10). They are about a third longer in the posterior half of the body than in the anterior segments, as it appears by comparing Figs. 12 and 13. Each bundle consists of four nearly equal chaetae. The ventral bundle is absent in the 12th (clitellar) segment, which receives the opening of the sperm-duct.

The *brain*, as I have made out by graphical construction from a series of sections (Fig. 2), is of nearly quadrate shape, with the anterior margin slightly concave. From the base of each of the lateral commissurae arises the large nerve mentioned above, which distributes to the skin of the cephalic lobe.

In the *mouth*-opening the epithelium is for a short tract pigmented (Fig. 3). Further backward the epithelial cells are pigmentless; but in their interstices we find branched cells, filled with granular brown pigment. In the pharynx, the epithelial cells are very high and hardened at their superficial end, but without a distinct cuticle; between them lie pigmented cells with long branches (Fig. 6).

MELANENCHYTRAEUS SOLIFUGUS

The *pharynx* builds a dorsal appendage of the œsophagus, in the 2nd and in the beginning of the 3rd segment (Fig. 3 *ph*); its dorsal part gives insertion to a system of muscular bundles, which suspend this organ to the walls of the foremost four body-segments. Fig. 4 gives, in a somewhat schematic form, the graphic reconstruction of these muscles, made from a series of sagittal sections. The system consists of an anterior and posterior group. The former arises from the dorsal wall of the 1st and anterior end of the 2nd segment; the other is more complex and offers two knots, to which the bundles from the dorsal wall of the 3rd and 4th segments, and a bundle from the ventral wall of the 4th, converge.

The part of the alimentary canal which follows on the pharynx, and may be called *œsophagus*, offers no notable widening, and is continuous without partition with the rest of the gut. The long cilia of the intestinal epithelium are clearly shown in my preparations (Fig. 5 *ei*).

I have found in the gut some specimens of an Infusorium of the genus *Anoplophrya* (Fig. 18); I could not see cilia on its surface, although the long cilia were well preserved on the intestinal epithelium in the same section. The intestine of the same specimens of the worm contained a number of ovate, brown bodies, closed in a thin membrane, and filled with clear spherules (Fig. 19 *a*); some of them were cut by the microtome knife (Fig. 19 *b*), and showed in each spherule a grain (the nucleus?), coloured by carmine. I don't know whether these bodies have any relation to the *Anoplophrya*; they might be incapsulated germs of the parasite.

The intestine, and more markedly its posterior part, is filled with very fine crystalline mineral detritus, which seems to be the ordinary food of this worm.

The cells of the *chloragogen* (Fig. 5) are very long, and build a dense coating to the intestine.

In the segments 4-8, the most part of the body-cavity is filled by *unicellular glands* (Fig. 11 *gl*); their very thin excretory prolongations form numerous threads directed towards the ventral side, which can be easily followed on the sections to the sides of the ganglion chain. Their thinness and flexuous course make it extremely difficult to follow them to their end on the surface of the skin. I believe that they converge towards the bundles of chaetae of the ventral series. As Mr. Michaëlsen writes me, these glands may be regarded as morphological equivalents to those gland-cells which in other Enchytraeids are related to the chaetae of the genital segments. In *Melanenchytraeus*, I don't think that these glands have any relation to the functions of reproduction, because I find them no less developed in immature specimens.

In some anterior segments, and peculiarly in the 9th and 10th, there are, between the nephridium and the body-wall, clusters of cells (Fig. 12 *x*) whose plasma is filled with very minute and strong refracting granules, rendering them obscure in transmitted light, white in incident light. These cells are not clearly outlined, and in the middle of each a small round nucleus

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appears. As a whole, these clusters have the aspect of glands, but no excretory duct could be detected. The aspect of the white and strong refracting granules leads me to think that they are uric products, and that the function of these problematic organs is excretory.

The *dorsal vessel*, or heart, appears on the sections from the 12th segment towards the head. Its posterior end is therefore neither praeclitellitic nor postclitellitic, but intraclitellitic. This includes a *cardiac body*, or cardiac gland, of irregular shape, made of a small number of cells, in each transverse section. Having at my disposal only preserved specimens, I could not observe the colour of the blood; I was unsuccessful in reconstructing from the sections the distribution and course of the blood-vessels.

The *lymph cells* seem to be all of one sort; I have drawn some in Fig. 14.

The *nephridia* (Fig. 15) are of irregular shape, with few large nuclei; the cells corresponding to these nuclei are not clearly outlined. Nearly the whole mass of the nephridium is built by the intricate and densely coiled tube. The wall of the excretory duct is thick and pigmented as it approaches the external opening. The latter lies on the line of the ventral bundles of chaetae, in front of the bundle of the segment in which it opens.

The *testicles* and *ovaries* offer no noteworthy peculiarities; in my specimens the latter were little developed, even in the most mature, in which the spermatogenesis was rather advanced. This fact indicates a condition of proterandry.

In the more developed specimens enormous *sperm-sacs* extend from the 10th to the 15th segment, and fill nearly the whole body-cavity. We find in them all the stages of spermatogenesis—large spermatogonia, sphaeric follicles derived from multiplication of them, and bundles of very minute zoosperms; the latter are, however, in small numbers. But in most of the specimens I did not observe sperm-sacs nor spermathecae; testicles and ovaries were very small and the sperm-ducts wanting, their distal part only being recognisable as a rudiment.

My Fig. 16 gives the reconstruction of the left *sperm-duct* from a series of sagittal sections. The funnel (*i n*) opens in the cavity of the 11th segment. It gives rise to a somewhat twisting tube, which runs backwards as far as the 15th segment, where it is tightly coiled; from there it returns forward to its external opening in the 12th segment. The last tract forms a spherical bulb (*a*), but before reaching it the tube presents a fusiform swelling (*c*), whose wall is very thick and made of long cells, directed radially on the transverse section, the lumen being not widened. Bundles of prostatic (spermiducal) glands (*b*) are related to the bulb; another little group of glands (*e*) lies around the tube, above its fusiform thickening. As I mentioned above, the 12th segment, in which the sperm-duct opens, is deficient in ventral bundles of chaetae.

I have given in Fig. 17 a reconstruction of the *spermathecae*, made from a series of transverse sections of the most developed specimen, which I

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examined anatomically. Their external opening lies near the anterior limit of the 5th segment. A cylindrical duct made of cylindrical cells leads from the external opening to a wide cavity, which extends at its base into closed appendages or diverticula. These are only two larger on the right side, three smaller on the left. The two spermathecae communicate with one another, or, more exactly, they form a continuous whole, which traverses the dorsal portion of the intestine, without opening into the latter.

This anatomical description and the accompanying plate show so many singular facts in the structure of the worm examined, that I feel justified in forming for it a new genus, of which it is the only known species. From its obscure colour and light-shunning habits, I have called it *Melanenchytraeus solifugus*.

I translate here the diagnosis which I have already published in the *Rendiconti della R. Accademia dei Lincei*.¹

Melanenchytraeus, Emery.

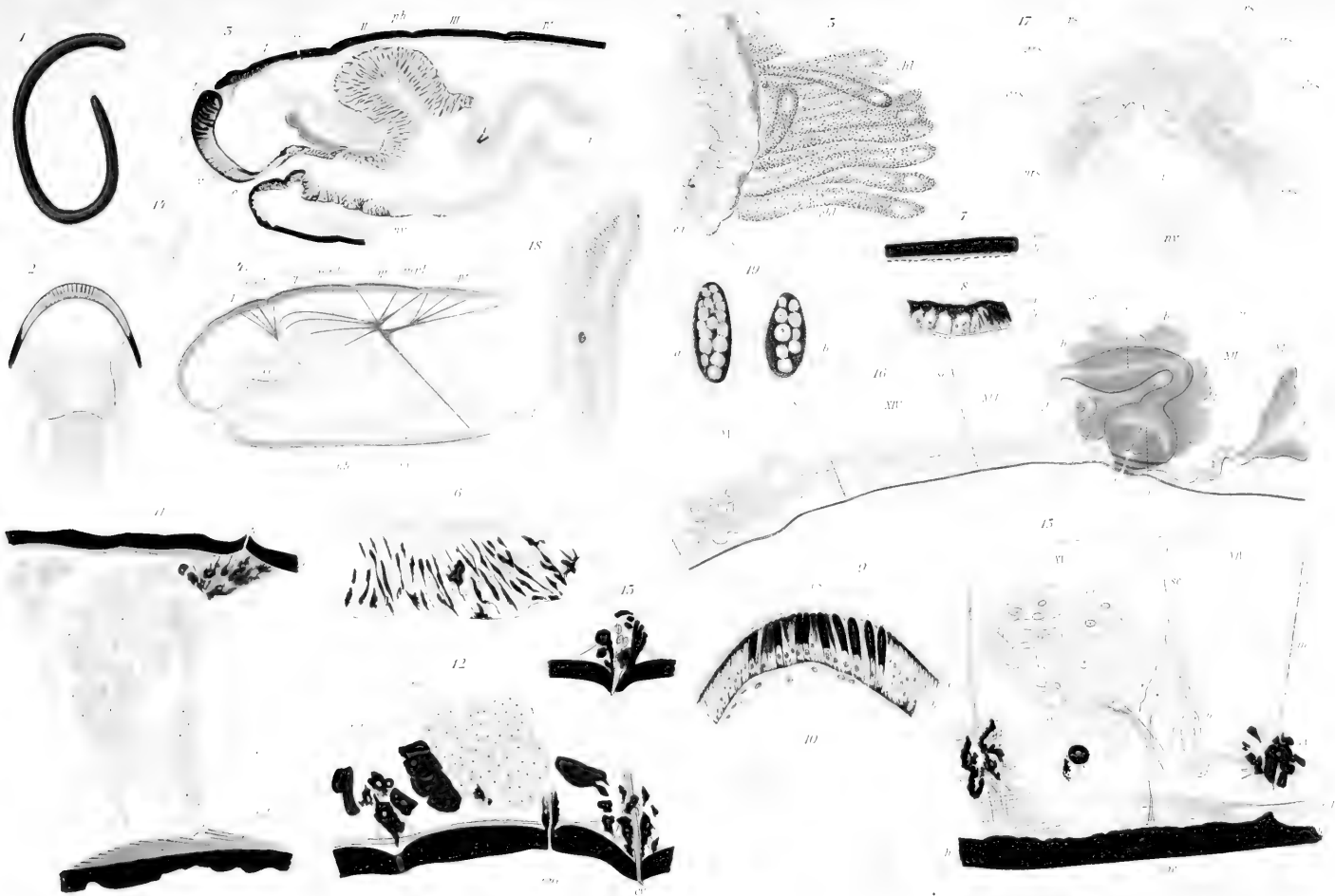
Hypoderm pigmented. All the segments with dorsal and ventral bundles of 4 chaetae each. The latter are slightly sigmoid, longer in the foremost segments. No ventral bundle in the 12th segment, which bears the opening of the sperm-duct. The latter is very long, and forms a coiled loop, extending back to the 15th segment. Above the spherical bulb, which forms its distal end, it presents a fusiform swelling; spermiducal glands are present. The sperm-sacs are ample, extending through several segments. The spermathecae do not open into the intestine; they are continuous with one another, and bear at the base of their ampullæ two or three diverticles each. The nephridia are very much convoluted, with few nuclei. The dorsal vessel begins in the 12th segment, and includes a cardiac gland. A cephalic pore is present, but no dorsal pores. The epithelium of the pharynx contains branched pigmented cells. There are no salivary glands, and no distinct limit separates the œsophagus from the intestine. In segments 4-8 the body cavity is largely taken up by unicellular glands, which, by means of long and very thin prolongations, reach the surface of the skin near the ventral bundles of chaetae.

M. solifugus, Emery.

The largest specimens are a little over one centimetre in length; the diameter of specimens preserved in spirits and moistened in water is about one-third of a millimetre. The body is cylindrical, tapering imperceptibly towards the hindmost extremity. The cephalic lobe is rounded. I counted 53 segments in one specimen. Colour dark brown, nearly black.

The sigmoid chaetae, the cardiac body, and the much convoluted nephridia assign to *Melanenchytraeus* a position near *Mesenchytraeus*. It differs from the latter chiefly by the long and complicated sperm-duct. The dark colouring of the hypoderm and other organs has not been observed in any other member of the Enchytraeidae.

¹ Vol. VII., 1° sem., ser. 5. *Seduta del 6 marzo*, 1898, p. 110.



MELANENCHYTRAFUS SOLIFUGUS



MELANENCHYTRAEUS SOLIFUGUS

EXPLANATION OF THE PLATE.

Letters common to all figures.

cd dorsal chaetae.
cv ventral chaetae.
ce brain.
cu cuticle.
h hypoderm.
i intestine.
in funnel.
lc cephalic lobe.

ml longitudinal muscles.
mt transversal muscles.
ne nephridium.
nv ventral ganglion chain.
o mouth.
ph pharynx.
pn nephridial pore.
se septum.

Roman numerals indicate the order of the segments.

- FIG. 1.—*Melanenchytraeus solifugus*; magnified 9 : 1.
- FIG. 2.—Brain and œsophageal ring; reconstructed from a series of horizontal sections. In front of the brain the cephalic lobe shows a thickened hypoderm, with pigmented sense cells. 130 : 1.
- FIG. 3.—Sagittal section of the foremost part of the body (combined from a series of not perfectly sagittal sections), *pc* cephalic pore, *v* blood-vessel. 130 : 1.
- FIG. 4.—System of muscular bundles, which move the pharynx (*m*, *ph*); reconstruction; the outer wall of the body is supposed to be transparent. Of internal organs, the central nerve system and the intestines only are drawn. 100 : 1.
- FIG. 5.—Section of the intestinal wall in the fore part of the body, with the chloragogene cells, *chl*; *ei* ciliated intestinal epithelium, *s* blood lacunes. 380 : 1.
- FIG. 6.—Section of the epithelium of the pharynx; between the epithelial cells there are branched pigment cells. 380 : 1.
- FIG. 7.—Transverse section of the body wall. 380 : 1.
- FIG. 8.—Section of the body wall in the clitellar segment; from a specimen approaching maturity. 360 : 1.
- FIG. 9.—Horizontal section of the cephalic lobe: *cs* sense cells. 380 : 1.
- FIG. 10.—The four chaetae of a bundle in a posterior segment, isolated by means of caustic potash. 380 : 1.
- FIG. 11.—Longitudinal vertical section of the 6th segment, showing the body cavity filled by unicellular glands *gl*. 250 : 1.
- FIG. 12.—Longitudinal vertical section of the 10th segment, showing the cluster of granulated cells, *x*, and the large dark pigmented cells, *pg*, which lie around the bundles of chaetae. 250 : 1.
- FIG. 13.—Longitudinal section through the ventral bundle of chaetae in a posterior segment. 250 : 1.
- FIG. 14.—Three lymph cells in the coelome. 380 : 1.

MELANENCHYTRAEUS SOLIFUGUS

FIG. 15.—The right nephridium of the 15th segment, with the neighbouring bundles of chaetae. Combined figure from two sections. 250 : 1.

FIG. 16.—Reconstructed sperm-duct of the right side. *p* pore, *a* bulb (drawn as semi-transparent), in which the prostatic glands *bb* open; *c* fusiform swelling of the duct; *d* loop surrounded by the glands *e*; *in* funnel. 130 : 1.

FIG. 17.—Reconstructed spermathecae as a transverse section (from a series of transverse sections), *prs* external pore, *dvs* duct, *rs* cavity of the spermathecae, *ars* its appendages. 130 : 1.

FIG. 18.—*Anoplophrya* sp? parasite in the intestine of *Melanenchytraeus*. 380 : 1.

FIG. 19.—Parasitic cysts from the intestine of *Melanenchytraeus*; *a* entire cyst; *b* longitudinally cut cyst, showing its contents of nucleate clear globules separated from each other by pigmented matter. 380 : 1.

Additional Note.—The Italian edition of the above pages was in the press when I received from Mr. Percy Moore a separate copy of his valuable paper on the Alaskan Enchytraeid.¹ Mr. Moore had at his disposal many more specimens than I had, and among them a number of sexually mature specimens, which allowed him to recognise the ovisacs and female pores. He found that the spermathecae do communicate with the intestine by a small pore. I have revised the only series of sections which I possess from a specimen with apparently fully developed spermathecae, and cannot find any pore; but the organs lie in close contact with the intestinal wall, and it may be supposed that my specimen was abnormal or not fully mature.

Mr. Moore describes another smaller species whose spermathecae are without diverticula, and calls it *M. nivus*. This and *M. solifugus* he refers to the genus *Mesenchytraeus*, regarding the characters of *Melanenchytraeus* not sufficient to justify a separate genus.

After the snow was melted on the glacier, Mr. Bryant observed the worms to become more active, living in little water pools on the glacier. I suppose that the most mature specimens came from such localities, and that the eggs are laid in the water. Mr. Moore examined also specimens collected by Mr. Wright on the Muir Glacier, and identified them with both *M. solifugus* and *nivus*.

BOLOGNA, July, 1899.

¹ *A. Snow-inhabiting Enchytraeid (Mesenchytraeus solifugus, Emery)*, collected by Mr. Henry G. Bryant on the Malaspina Glacier, Alaska, in *Proc. Acad. Nat. Sc. Philadelphia*, 1899, pp. 125-144, pl. VII.

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