

HISTORICAL NOTES ON ARTEMIA SALINA (L.)

by

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Although an abundant literature exists on *Artemia salina*, there are still interesting facts in the first history of the discovery of this remarkable animal and in the first study of its habits, which seem to be now forgotten.

It is generally considered that Rackett (1812) was the first to give a drawing of *Artemia salina*, accompanying a short paper on the animal, and he himself states this to be the fact. It is, however, not true, as Schlosser's famous original description was illustrated in the french edition (1756). The drawing is an excellent one and much better than the one Rackett gave (fig. 1). As Gautier remarks in an additional note to Schlosser's letter, the first publication in 1755 was not accompanied by a picture.

The drawing, which dates from July 1756, is of particular interest as it unmistakably represents an extreme form of *Artemia*, either var. *milhausenii*, or even *köppeniana*, which are both typical forms for high concentrations. Especially the latter is very seldom found in nature, though it has been bred in the laboratory by several workers. The drawing is in other ways so accurate that we may surely trust this detail. As the text of the letter is very interesting we will give it here in full 1) :

*Extrait d'une Lettre de M. le Docteur Schlosser, concernant un Insecte peu connu.
A Limington en Hampscire le 7. Octobre 1755.*

MONSIEUR,

Je visitois ce matin les salines, qui se trouvent ici le long du bord de la mer, & après avoir vu tout ce qui regarde la maniere de réduire l'eau marine en une lessive extrêmement acre & saline, je fus frappé d'y découvrir des millions d'Insectes les plus agiles du monde. Leur couleur rouge teignoit l'eau d'une vaste citerne, d'où on la tire pour la mettre dans des chaudrons 2). Je ne manquai pas de remplir une bouteille de cette eau, & de suivre de mon mieux les opérations de mes Insectes dans leur élément chéri. Leur corps n'est qu'un tube cylindrique ou vermiculaire, très mince, & d'environ un tiers de pouce de longueur. Au bout de ce tube on voit deux petites antennes très-fines & assez courtes, & deux yeux noirs, ronds & relevés. Leur place est à chacun

1) A facsimile of the letter and the plate was kindly put at our disposal by the Société des Amis de la Bibliothèque Nationale, Rue Richelieu 58, Paris.

2) Apparently Schlosser too held the colour of the water to be due to *Artemia*. Joly (1840) was the first to do away with this idea and he revealed the real cause of the red water.

des côtés, & au milieu se trouve une autre petite tache noire, qui peut-être sert de troisieme oeil. Une bouche courbe est placée sous ces yeux, & aplatie contre la

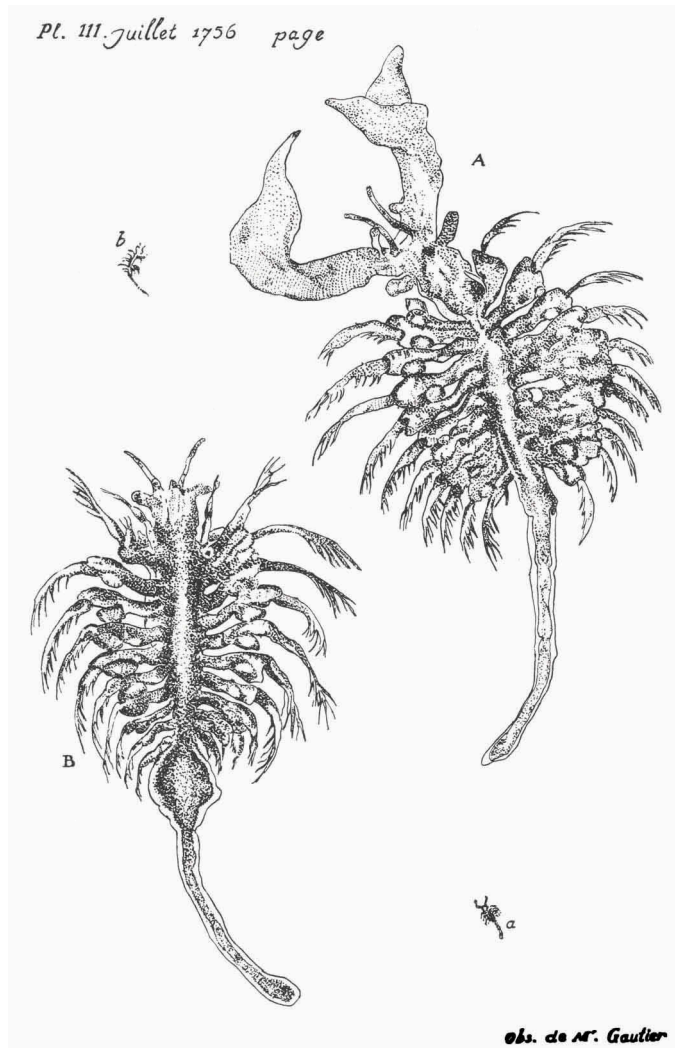


Fig. 1. Schlossers drawing, reproduced from the Observations périodiques etc. de Gautier (1756). The reproduction was made in the following way: the photographic print of the original picture (which was in negative) was made transparent with poppy-seed-oil. A contact-print was then made, showing the picture in positive. It was then completely redrawn in ink on the same piece of paper, whereupon the silver and silver-bromide were washed out. The remaining ink drawing is reproduced here reduced to $\frac{3}{4}$ of the original 1).

1) Our thanks are due to Mr. E. J. Bevelander, artist at the Botanical Laboratory, for his accurate and painstaking reproductions.

poitrine. Toutes ces parties composent la tête; le corps est pourvu de 22. jambes natatoires, qui occupent toute la moitié de la longueur du tube. Il y en a 11 de chaque côté. Elles sont fort près l'une de l'autre; la plus longue est au milieu, & c'est de là que les autres décroissent insensiblement, en approchant ou de la tête ou de la queue. Cette dernière partie est toute nue, l'anus en fait l'extrémité, & on y aperçoit souvent une fente¹⁾. Outre ces divers organes communs à chacun des individus, il y en a qui ne se trouvent que dans quelques-uns, & ceci joint aux actions qui leur sont particulières, me paroît constituer la différence entre les mâles & les femelles²⁾. Les premiers ont tous entre leur tête & les premières jambes natatoires, deux espèces de bras longs & plats. Leurs articulations mettent l'insecte en état de les plier & de les mouvoir presque en tout sens. Les femelles ont sous le ventre, près des dernières jambes natatoires, un sac mou & membraneux, qui par sa transparence permet d'y apercevoir plusieurs œufs. Ce sac est communément trois ou quatre fois plus gros que le diamètre du tube. Les individus, qui ont cet organe, n'ont jamais les bras dont je vous ai parlé, & ceux qui ont les bras se distinguent d'ailleurs des autres, par leur empressement à sauter sur leur dos, dès qu'ils les rencontrent en nageant³⁾. Les deux bras leur servent à serrer le sac, d'où j'ai vu souvent sortir alors plusieurs œufs. Les insectes unis nagent quelque temps ensemble; à peine sont-ils séparés que d'autres prennent leur place, & jamais je n'ai vu des insectes de la même espèce unis de cette manière. Je n'ose décider si cette action est une véritable accouplement, & si mes insectes à bras sont les mâles ou les accoucheurs des femelles, n'ayant pu par un très-bon microscope voir autre chose que ce que je viens de vous dire. J'aurais bien souhaité pouvoir conserver une paire de ses insectes dans leur situation favorite; mais ni l'eau fraîche d'une fontaine, ni le vin de Portugal, ni l'esprit de vin même n'a pu les faire mourir en moins d'une demi-heure, ni les empêcher de se séparer⁴⁾.

J'oubliois de vous dire que ces insectes se meuvent avec une prodigieuse vitesse. Ils font mille sauts, se culbutent souvent, & peuvent nager sur leur dos. Les gens, qui travaillent aux salines, leur donnent le nom de *brine worms* ou de *vers de saumure*; ils m'assurent qu'ils y sont en hiver aussi bien qu'en été, mais si la lessive n'est pas assez forte, il ne s'y en trouve que peu⁵⁾. Je leur ai demandé si ces vers ne se transformoient point en mouches; mais ils m'ont tous répondu négativement, & parmi tant d'insectes de ce genre que j'ai examinés, je n'en ai vu aucun plus ou moins formé que les autres, ou qui montrât quelque disposition à se métamorphoser⁶⁾.

Suivant le système de Linnaeus, le seul livre que je sois à portée de consulter, la place de mes insectes devoit être parmi les *Apteres* ou *non-aillés*; mais aucun genre

1) As Schlosser studied the abdomen, he would certainly have seen the appendages, had there been any. Hairs of course may have escaped his attention.

2) His tentative distinction between male and female is quite correct.

3) The homology of the second antennae in the males and females did not occur to him and he must have thought the female antennae to be nothing but a part of the head itself.

4) It is necessary for *Artemia* to be able to close the mouth and anus completely, as it would otherwise not be able to keep the strong brines from entering its gut more than necessary for ingesting the food. The cuticula too is extremely impermeable and even in formol and other quickly-permeating fixatives *Artemia* can live for a considerable time.

5) Unfortunately he does not give any further details. It would have been extremely interesting to see at what concentration *Artemia* disappeared.

6) In harmony with the views held at Schlosser's time, he apparently tries to fit the animals into the existing system of classification, in which case they should be larvae, although he does not seem any too certain himself.

de cette classe n'a les caracteres que j'ai trouvés à celui-ci 1). Si vous jugez mon observation digne d'une place dans votre Journal, faites-moi le plaisir d'inviter en mon nom les Naturalistes à m'apprendre, si ces insectes ont déjà été décrits par quelque Auteur ou à perfectionner par leurs découvertes ce qu'il y a d'imparfait dans la mienne. Je suis &c. SCHLOSSER.

Troisieme Planche.

La planche qui accompagne cette Lettre représente en *A* le mâle & *B* la femelle dans leur grandeur naturelle, & on les voit tels qu'ils paroissent grossis par la lentille No. 4. du Microscope composé de M. Cuff. Tout ce que l'ingénieux observateur a découvert se voit dans ces figures, & l'on n'a pas cru qu'il fût nécessaire de les charger de lettres. Comme il n'a paru aucun œuf dans le sac, qui probablement s'étoit vidé, & qu'on n'a pu appercevoir la bouche, on n'a pas osé les représenter, & l'on s'est borné à ce qu'on a vu. L'articulation des jambes ou des nageoires est singuliere. Les petits corps ovales qui se trouvent entre chacune d'elles, sont sans doute destinés à faciliter leurs mouvemens, *A* & *B* leur grandeur naturelle 2).

Le Journal Britannique a fait mention de cet insecte: mais il ne le donne pas avec ses couleurs naturelles comme on nous les a envoyées.

Linné describes *Cancer salinus* with only 20 feet. How he came to this mistake is difficult to say. Whether he never saw the original description, or did not consider the exact number of any importance (as Abonyi suggests), or whether he deliberately changed the number because he expected it to be 20, cannot be decided.

Soon afterwards, Pallas (1777), journeying in Russia and Siberia in 1770—1771, found the animal in some Siberian lakes. It was coloured intensely red, and served (together with "*Cancer pulex*") as food for *Tadorna*, which occurred there in great flocks, and for a white gull. Even on his own map it was not possible to locate the lake (called Kulat) exactly, but the position must be between 61° and 62° E. and at about 55° N. Later on he found *Artemia* in other lakes of the Isetsk province, more or less near the first lake, but he mentions no names or positions.

Linné's mistake and his great authority combined to introduce the erroneous number of feet into literature. Even Rackett (1812) drawing "from own observation" makes it 10 pairs. Conclusions may hardly be drawn from this picture although it certainly appears to be the same variety as Schlosser saw. Rackett mentions that the brine in which *Artemia* occurs is so strong that: "A pint contains about a quarter of a pound of

1) Linné indeed put *Cancer salinus* amongst the Aptera, but he extended the genus *Cancer* to receive it and did not consider it necessary to make a new genus for this animal. Probably Leach was the first to put it into a separate genus (see below).

2) The explanation of the plate, obviously written in great haste by Gautier (he begins and ends by mentioning that "A and B are the natural size") supposes the "small oval bodies" to make the movements of the feet easier. In all probability we cannot hold Schlosser responsible for this fallacy.

salt; ...", which corresponds to about 26 % salt. It is not at all improbable that the varieties mentioned might occur there. Rackett then continues:

"These tanks are called clearers, as the liquor becomes clear in them; an effect which the workmen attribute in some degree to the rapid and continual motion of the Brine-worm, or to the particles which cloud the liquor serving for its food; but this is mere conjecture 1). So strongly persuaded, however, are the workmen of this fact, that they are accustomed to transport a few of the worms from another saltern, if they do not appear at their own. They increase astonishingly in the course of a few days".

Rackett then proceeds to say that *Artemia* does not occur in the first pans where the seawater is first exposed to the sun. Nor does *Artemia* occur in great quantities "from October till May", but a few may be found then all the same. Again he does not give data for the concentrations at which *Artemia* reappears.

As the pictures (fig. 2) are printed in the Transactions on the same plate with drawings which illustrate a paper by Montague, we also find the latter in references as the author of these drawings. This mistake again is taken over several times.

All further description and discussion is for a long time onwards based on Linné's faulty description and none of the leading scientists seems to have seen the animal themselves.

To Leach is ascribed the first new generic name, this being *Artemisia*. This belief arose from a sentence by Latreille (1817, p. 68): "M. Leach forme, avec le Cancer salinus de Linnaeus un genre qu'il nomme Artemisia".

Lamarck (1818, p. 135) rejects this name as it was given to a plant-genus before, a perfectly good reason at the time, and substitutes *Artemisus* for it. Keilhack tried to reintroduce the name in 1909, and it should be preferred again now, since zoological and botanical nomenclature are completely separated. It appears, however, from a sentence by Leach himself (1819) that he never used the name. He writes: "M. Latreille observe..... que "M. Leach forme avec le Cancer salinus de Linnaeus un genre qu'il nomme Artemisia". Je dois reveler ici cette méprise. Le genre

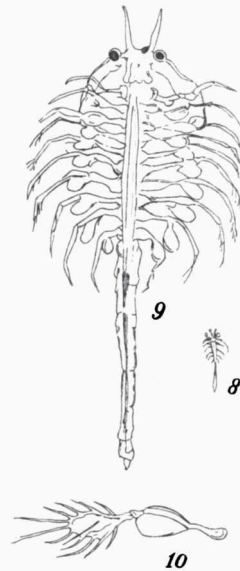


Fig. 2. Reproduction of Rackett's (1812) figures. The small specimen (original fig. 8) represents *Cancer salinus* in natural size, the large specimen (original fig. 9) is the same magnified, the lower figure (original fig. 10) shows one of the legs, considerably magnified.

1) We now know for certain that *Artemia* plays an intrinsic part in the production of good salt.

fut nommé par moi Artemia, et non point Artemisia..." Probably the name was actually published, and then of course before Lamarck used *Artemisus*. We have, however, not been able to find the publication, and no reference is made to it by any author except by Latreille, who gives no details and probably did not see it himself. At present it is not possible to decide which name ought to be used.

After this "theoretical" period in the study of *Artemia* attention is again directed to the animal itself when Payen (1836) describes experiments he performed in different concentrations of salt to show that the red colour of salterns is due to this animal. He remarks that the colour appears before the salt begins to crystallize. The maximum concentration for *Artemia* he found to be 23°—25° B.

Audouin (1836) studies the animal, used in Payen's experiments, from a systematic point of view. He identifies it as *Cancer salinus* of Linné and rectifies the latter's mistake as to the number of feet, by reproducing Schlosser's letter.

As a prize-essay Joly (1840) published his excellent study on *Artemia*, showing that the colouration of the salterns is not due to *Artemia*, but to "a microscopic animal", which he calls *Monas Dunalii* 1). He studies both organisms in extenso and gives a complete series of pictures to accompany the text (figs. 3, 4).

In fig. 3 we find: 1—10, the first development of *Artemia*; 5 is a partly decayed specimen, in 7 and 8 the feet have not been represented in full, 10 is a specimen of 19 days old; 11, an adult specimen, natural size 2); 12, full-size *Artemia*, enlarged and seen from the ventral side; 13, head; 14, eye; 15, side of the egg-sac; 16, empty skin of the first pair of thoracopods of a larval stage after moulting; 17 is again a young stage of development, to show especially the structure of the appendages.

In fig. 4 Joly represents in 1, strongly magnified, a thoracopod; 2 and 3, maxilla and mandibula from the right side; 4, a nearly developed specimen without the thoracopods; 5—8 illustrate *Monas Dunalii*; 9, part of the gut of *Artemia* where we see "...crystals of sodium-sulphate and sodium-chloride, together with a few globular infusoria, recently ingested by the animal; 10 and 11 illustrate coloured water, and 12—16 too were coloured in Joly's own drawing as they mean to illustrate a few peculiarities of *Artemia* and its

1) *Dunaliella salina* Teod.

2) The plates are reproduced here on a reduced scale.

3) Although Joly repeatedly refers to the colouration of the accompanying plates, the "Annales" printed them in black.

digestion, when transferred to coloured water, etc.³). Apart from a few minor mistakes his observations are very accurate. The animals represent

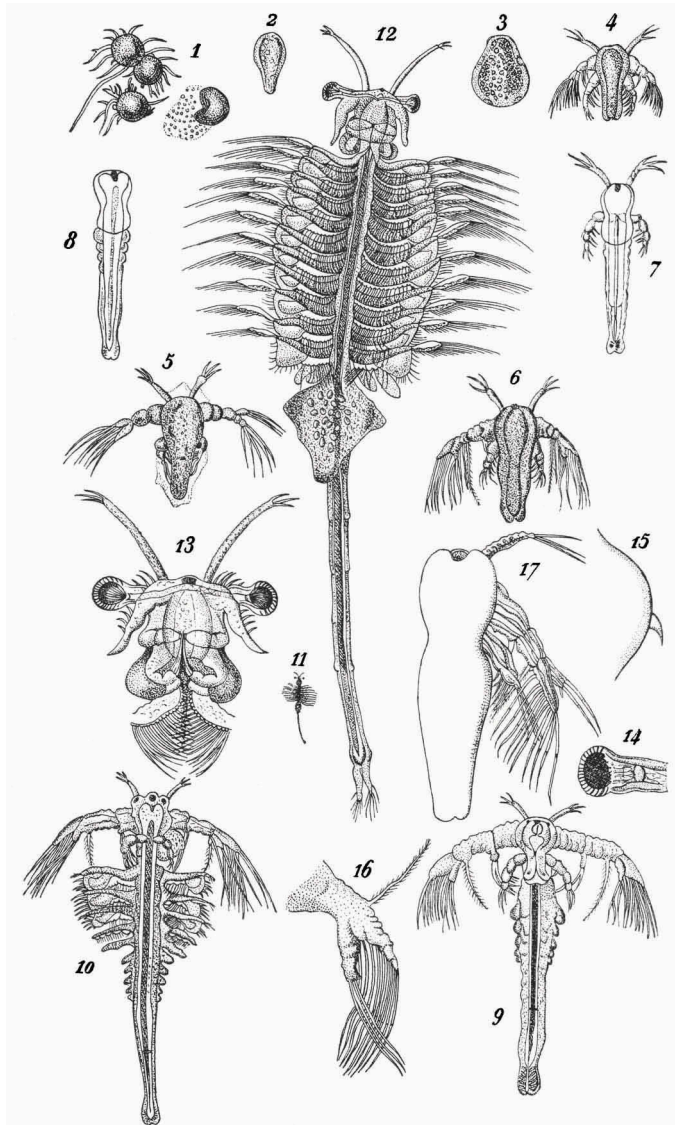


Fig. 3. Reproduction of drawings by Joly (1840, pl. 7), reduced to $\frac{3}{4}$ of the original.

decidedly the var. *arietina*, a very common form, which has been found all over the world. Amongst the more than 3000 specimens Joly inspected he found no such animals as Schlosser described as males. He concludes that

the latter must have made a mistake in distinguishing between males and females, and supposes the first to have been undeveloped individuals. He

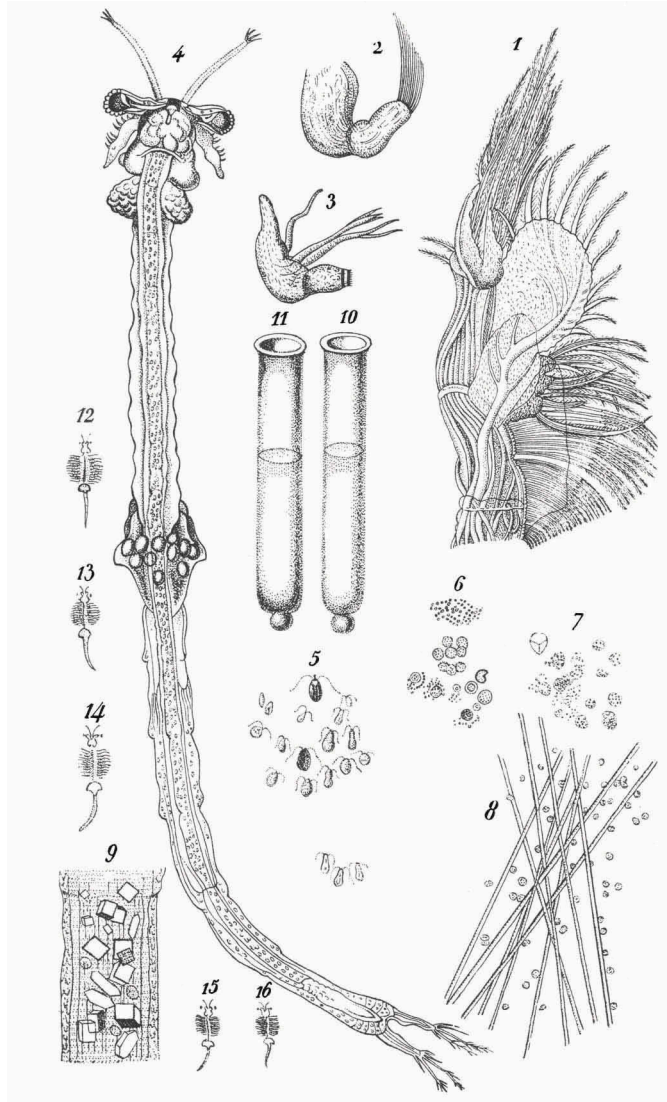


Fig. 4. Reproduction of drawings by Joly (1840, pl. 8), reduced to $\frac{3}{4}$ of the original.

also criticizes Schlosser's description of the abdomen. It is clear, however, that both were right, Schlosser describing a bisexual form and Joly a

parthenogenetic. Even now *Artemia* occurring in the S. of France is only parthenogenetic, in England the species has disappeared.

Joly's memoir is the beginning of a new period in the study of *Artemia*, observation and experiments taking the place of faith in the accuracy of Men of Great Authority.

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