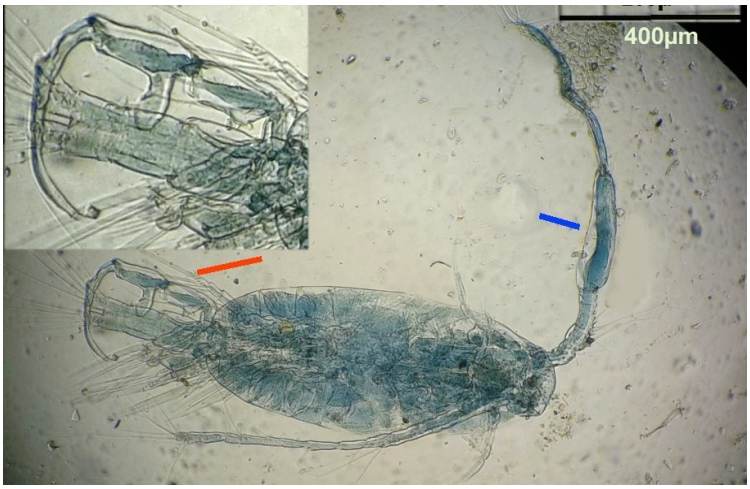
IDENTIFICATION of a CALANOÏD COPEPOD

J.M. Cavanihac - France

In all marine samples we encounter copepods to such an extent that we end up not paying attention to them anymore. They are sometimes even annoying because their rapid movements on the slide move the subjects we are observing. At the beginning of my plankton observations, about twenty years ago, I had made some slides of copepods mounted in glycerine gelatin… By revisiting these slides I find this colored copepod of the order Calanus (which has about forty families):



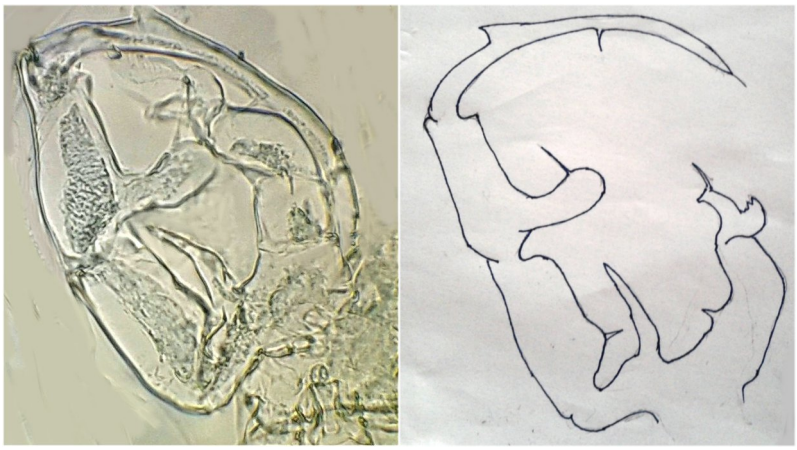
We notice two things: red arrow: a leg of the fifth pair strongly modified (called P5) and blue arrow: an antennule (A1) with an enlarged part. These two details suggest sexual dimorphism ... And will help to identify the species.
There are determination keys (see end of page) but I am not comfortable with them because they assume to know perfectly the terminology used in their field and especially to be able to visualize the parts of the specimen which allow this identification: indeed often the interesting appendages are hidden .
Example of definition of a key: and this is not the case more complex:
"Terminal point of Re3 of P3 and P4 strongly toothed on the outside; F more than 5 times longer than wide . "
Translation : Terminal point of the 3rd External ramus of the 3rd thoracic leg and of leg 4, strongly toothed on the outside. Furca more than 5 times longer than wide…..(Provided you can see all the legs!)

Here the very particular claw (in medallion) and quite visible, should help as well as the particularity of the antennule ... The 1933 collection of "Faune de France 26" provides corresponding drawings which identify : *Paracartia Grani*

With this precise name we can query the remarkable database of the Banyuls Observatory which gives the descriptive sheet of this species and the documents relating to it, coming from several studies on the species. (link at the bottom of the page)
We find the bibliographical references of these studies on the Net; some extracted plates confirm the shape of the claw and also show that of the female.

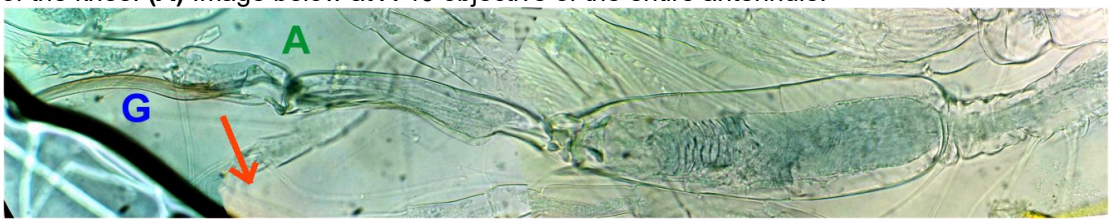
And on other specimen on the slide, we find the shape of the female's claw (which is simpler): image below at X 40 objective

We imagine that the male's clamp has a specific purpose in mating, but knowing how it works is interesting: it is similar to reverse engineering on micromechanics. Since there are two or three males on the slide, we find various positions of the clamp, of which here is a 'cleaned' image and on the right a diagram that I made from these images



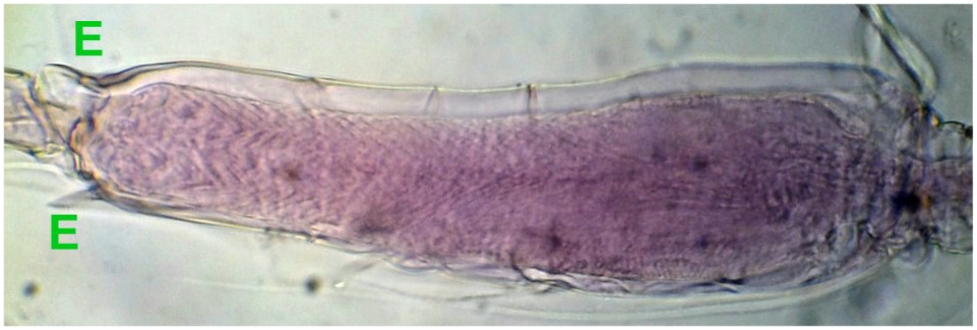
The structure on the right in the drawing, opposite what appears to be an oval palette, has a very complex structure and is not flat: 3 images at different focalizations at X 40: the whole is described as "tweezers, claw and shears". Sensitive cilia are visible

We also find on the plates, the drawing of the antennule A1. Which is also described and we learn that it is a geniculated antennule, because of the shape of the articulation recalling that of the knee. **(A)** Image below at X 40 objective of the entire antennule:

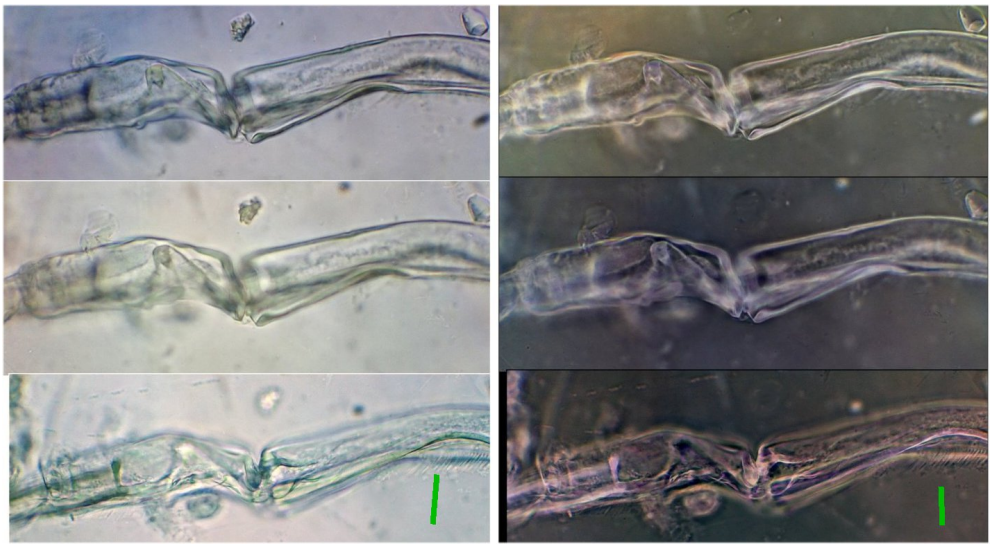


G: naturally colored terminal claw**, A** 'knee' joint, **arrow:** direction of flexion

In this image: the thickened part shows a herringbone pattern that suggests an anti-slip function: the spines E seem to limit the flexion of the 2nd segment...



Detail of the “knee” (A) at several levels of focus (on the right in negative: we can see hairs better on the 2nd segment: green arrow)

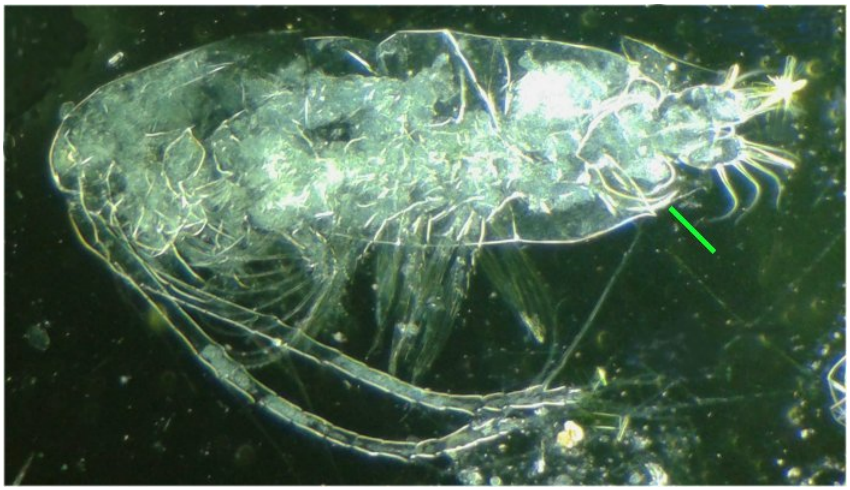


I spent several hours on this slide finding details that I discovered through my readings... the presence of several specimens in different positions was a valuable help.

REPRODUCTION OF COPEPODS *Paracartia Grani*

Why be interested in the reproduction of these species of calanus? Because of their importance in the transfer of energy, in the food chain, between phytoplankton and zooplankton: copepods are one of the main sources of food for young fishes.
Their number is considerable, and for just one other species (*calanus finmarchicus*) in the Nordic seas, the annual production is estimated at ... 300 million tons!

Below is an image of the female in dark field (the uncolored subject is too transparent). We can see the claw (arrow) different from that of the male: This is again a sexual dimorphism. Note the two antennules without thickening.



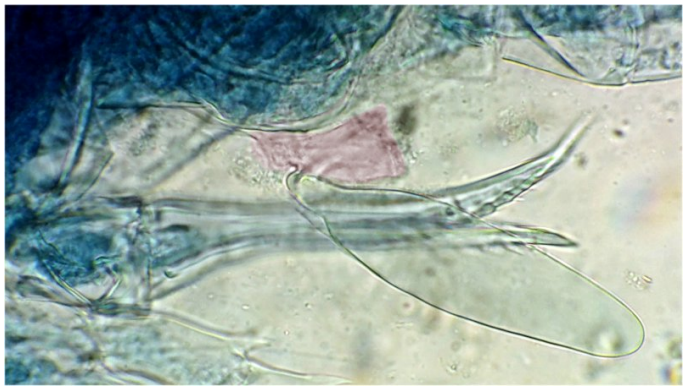
Here is a brief summary of the mating process (which can vary depending on the species): the male holds the female by means of the claw of the geniculate antennule (case of the species Paracartia) and thanks to this P5 clamp (a fifth pair of modified legs) transfers a spermatophore to her which will adhere quickly to the abdomen thanks to a sticky substance.

Depending on the species, the female transfers the sperm (which is not motile) into her spermatheca or keeps the spermatophore which will be used to fertilize her eggs in due time according to their maturation… The spermatozoa do not have a flagellum.
This is a strategy that favors the expansion of the species: the female does not need a random encounter with a male when her eggs are mature.
A methodical search on the slide shows the spermatophore on the female: colored pink on the image on the right, the forceps has been colored green. Over time, the specimens have become lighter, which explains the low-contrast images.

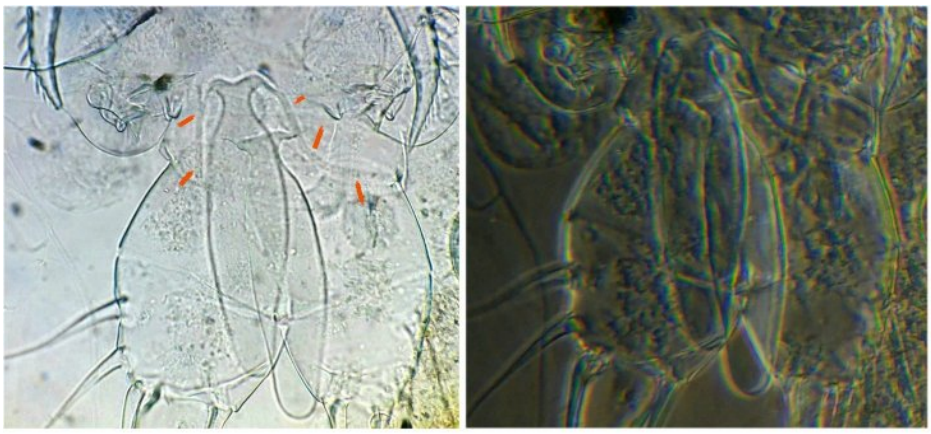
By taking the same slide and exploring it methodically, there are two males and about ten females, almost all of which carry a spermatophore; below are images of 4 of them at x 15 objective: in the second image, the spermatophore has been colored pink because it is not very visible.. .
There are few images of this temporary "organ" on the Internet, hence the interest in this montage of images: The spermatophores all have a particular shape at their upper end and are all positioned in exactly the same place on the female. According to the literature, the male of this species uses a plate carrying the spermatophore which adapts perfectly to the morphology of the female and adheres to it with glue.

Here we see the spermatophore with the male's clamp, perhaps in the process of being transferred.

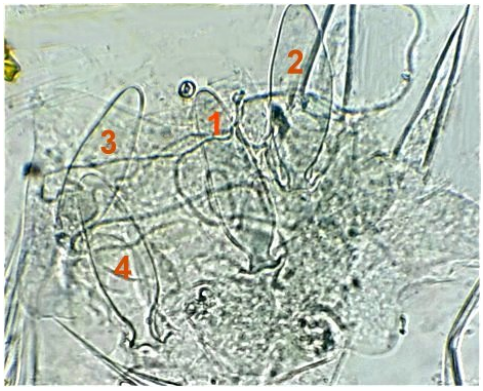
Looking at another slide we see the forceps of a female manipulating the spermatophore: it is not known whether she is trying to remove it, but the part artificially colored pink could be the plate mentioned above.



Looking closely at the last image of the montage (the one with the two spermatophores) we can see on the zoom below what appear to be two tubes (red arrows) starting from the upper part (maybe an artifact?): the lower spermatophore is well placed but the second one seems to be stuck higher up at random. Image at X 20 phase contrast objective on the right picture

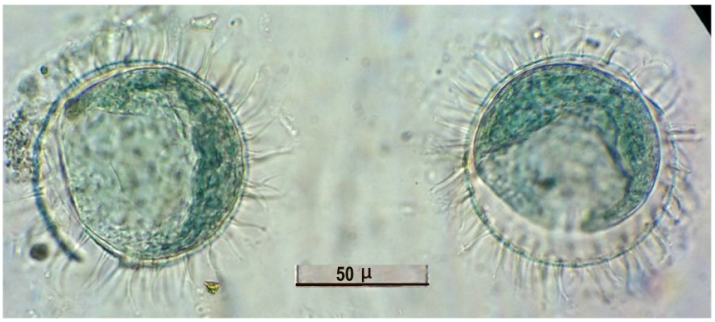


There is even a female Paracartia carrying 4 spermatophores! Only one seems well positioned (1) the others seem stuck randomly



Another scan of the slide reveals a female of **another species** which carries two spermatophores stuck laterally,similar to those of Peracartia:, perhaps an error by the males!
A close-up at X 40 objective reveals this very long tube (red arrows): in fact the neck of the spermatophore can lengthen considerably during transfer.

Elsewhere on the slide, close to two female specimens, here are eggs with a spiny envelope, with a strong probability that these are those of Paracartia



I also learned that this calanus, first recorded in Norway, (old name was *Paracartia Grani Norvegicus)* appeared in our southern regions around 1998, probably during shellfish transfers from Atlantic shellfish farms to Mediterranean lagoon farms.

In conclusion to this exceptional observation, on which I spent several captivating hours, it is interesting to see that over time we can deepen our knowledge of specimens and see things that we do not often encounter in documentation !

Currently, the quality of the photo images and especially the better knowledge of the points to be observed mean that I no longer mount slides, preferring "live" observation

https://copepodes.obs-banyuls.fr/en/fichesp.php?sp=70

J.MauchlineEds.TheBiologyofCalanoidCopepods-1.pdf

M.ROSE(Faune de France 26)Copepodes-pelagiques - 1933
FÉDÉRATION FRANÇAISE DES SOCIÉTÉS DE SCIENCES NATURELLES

https://www.researchgate.net/publication/226464935_Sexual_dimorphism_in_calanoid_copepods_Morphology_and_function

Comments to the author J.M. Cavanihac are welcomed, email:
micromars1 AT orange DOT fr
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