Citation:

Hoek, P.P.C., On the Polyandry of Scalpellum Stearnsi, in:
KNAW, Proceedings, 8 II, 1905-1906, Amsterdam, 1906, pp. 659-662

In order to find the formula (II^a) for curved wires we can put, approximately, for b its value at the point $x = 0$ $y = 0$.

So that we may put for

$$b = \frac{S_n}{\pi R} = \frac{S}{Rd_1}.$$

By this the formula (II^a) gives

$$v = \frac{S}{12\mu d_1}\left(\frac{d}{R}\right)^3 \quad \ldots\ldots\ldots \quad (II^b)$$

S being equal to the weight hanging at each end.

If the angle between the tangents at the ends is 2α, we have other formulae. The equation of the curve becomes

$$\cos\frac{2\alpha}{d_1}x = e^{-\frac{2\alpha}{d_1}y},$$

and the velocity, if P is again the weight at each end

$$v = \frac{2\alpha CP}{d_1 \sin\alpha} \quad \ldots\ldots\ldots \quad (III^a)$$

By the hydrodynamical method the same velocity is found to be

$$v = \frac{2\alpha P}{12\pi\mu d_1 \sin\alpha}\left(\frac{d}{R}\right)^3 \quad \ldots\ldots\ldots \quad (II^c)$$

Dr. J. H. MEERBURG has made a series of experiments, of which he will communicate the results at a later opportunity. The agreement with the theory is not very satisfactory. It must be noticed however that d is very small. The roughness of the surface of the wire will therefore greatly increase the resistance to the motion of the water, so that the result of the hydrodynamical method can no longer be considered as correct.

Zoology. — "*On the Polyandry of Scalpellum Stearnsi*" by P. P. C. HOEK.

One of the largest forms of the genus *Scalpellum* which is so rich in species is *Scalpellum Stearnsi*, PILSBRY from shallow water near the coast of Japan.

This species is represented by two varieties or sub-species in the collection of Cirripedes made by the Siboga Expedition in the waters of the Dutch East Indies and handed over to me for description. Both forms agree in the main with PILSBRY's species — they differ, however,

in some regards from one another as well as from the Japan species. I made the acquaintance of the latter by studying a few samples which were kindly lent me from the Berlin museum by the Director (Prof. K. MOEBIUS) and by the curator of the Crustacea Department (Prof. W. WELTNER).

Apart from PILSBRY [1]), the Japan species has also been named and described by FISCHER [2]); one of the two varieties from the Malay Archipelago has of late again met with the same fate from ANNANDALE [3]), who tried to introduce it into the literature of the Cirripedia as a new species.

Yet, though we dispose at present of three names and three fairly extensive descriptions for this species, a very curious phenomenon in the life-history of the reproductive period of this *Scalpellum* has hitherto escaped the attention of its describers; for I can hardly believe that they could have discovered this peculiarity and yet not mentioned it in their papers.

PILSBRY says of this species (and FISCHER in this regard quite agrees with him) that it was found in shallow water in Japan. The specimens of the Berlin Museum were from Nagasaki and apparently also from coastal waters. Those of the Siboga Expedition are from four different stations the depths of which range from 204 to 450 m. ANNANDALE had a single specimen at his disposal, caught in Bali Straits at a depth of 160 fathoms, about 290 m.

Scalpellum Stearnsi belongs to the unisexual species of the genus: the large specimens with fully developed capitulum of a length of about 5 cm. and with (for a species of *Scalpellum*) very long peduncles (of 5—9 cm. length) are the females. The males (which should not be called "complemental" males in this case) are looked for in vain at the place they ordinarily occupy, viz., at the inner side of the scutum, near the occludent margin, a little in front of or above the adductor muscle, in a duplicature of the sac or mantle which covers the valves of the capitulum on their inner surface. They are not to be found there — and I think this explains why they escaped the attention of the earlier describers. DARWIN discovered that the little males in one of the species (in *Sc. rostratum*, DARWIN) were attached as three little parasites to the body of the hermaphrodite, close under the labrum, between it and the adductor muscle almost in the median line of the body — but even at that place they are not

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[1]) Proceed. Acad. Nat. Sci. Philadelphia. 1890. p. 441—443.

[2]) Bullet. Soc. Zool. d. France. XVI. 1891. p. 116—118.

[3]) Memoirs Asiatic Soc. of Bengal. I. N°. 5. 1905. p. 74—77.

to be found in *Sc. Stearnsi*. I noted, however, that that part of the sac or mantle, which unites the two scuta behind or beneath the adductor muscle and which can be better seen by moving the two scuta slightly from one another, in the largest and oldest specimen of the collection, showed a crusty and grainy surface — just as if a Flustra or other Bryozoon were attached to it. Investigating a part of that crusty covering I easily found that each grain represented a male and that over a hundred of these were attached to the same female. Each male is inclosed in a kind of capsule (a thickening of the mantle) and that part of the mantle-surface which is opposite the head-end with the prehensile antennae forms a little elevation over the surface of the capsule. They are in parts so closely placed as to flatten one another mutually. Their dimensions are 0.7×0.5 mm. — they are even small for males of *Scalpellum*. Their structure agrees with that of the males of several other species of this genus: round about the opening of the mantle, at the extremity of the little elevation over the surface of the chitinous capsule, four rudimentary valves are observed. What I think, so far as my experience goes, is characteristic for this species, is that short rudimentary tentacles are attached to the surface of the mantle between (alternating with) the small valves, little appendages — which of course have nothing in common with the articulated antennae or other limbs of the Cirripedes. Should any doubt remain, as to whether these little parasites really represented the males of this species, these tentacles might be used to dissipate it. A few small, quite young females, in which the capitulum however was already furnished with calcareous valves and the whole appearance of which corresponded with an early condition of fullgrown females, were found attached to the surface of the capitulum of one of the large specimens. Now, these little females are furnished with the same tentacles. They are embryological organs, which of course may have importance from a morphological or phylogenetic point of view, but which have disappeared in the fullgrown females. In the young females they occupy the same place as in the males, viz. at the free extremity (the tip) of the capitulum attached to the chitinous surface between the two calcareous plates which represent the terga, near the anterior extremity of the orifice — in the females large, in the males relatively much smaller — which gives entrance to the cavity in which the animal's body is lodged.

I do not believe that examples are known in animals so highly developed as Cirripedia of such a pronounced polyandry as in this species of Scalpellum. As a rule, the number of males found attached

to the capitulum of the female or of the hermaphrodite is one at each side only, in some species it is two or three and the largest number I have observed was five. How can we explain that there is a species with such a large number as the case mentioned? I have tried in vain to find an explanation. We do not know much of the habits of these animals. It is hardly admissible that the great number of males should be connected with the depth at which they live, for (1) the same species which is found in the Malay Archipelago at a depth of 200—400 m. lives in the Japan sea in shallow water, and (2) we know species living in coastal waters and others found in depths of over 1800 m., all of which have two males only. A connection exists no doubt between the place where the little males are found attached and their great number – but I am at a loss to understand what the relation may be. The eggs of these Cirripedes are fecundated at the moment they are excluded and form two leaves (the so-called ovigerous lamellae) which remain in the sack or mantle-cavity of the female until the eggs hatch out. If the males are attached at the margin of the mantle-cavity, the chance that the eggs will be impregnated is of course larger than in the case when they are attached at a greater distance, as in *Sc. Stearnsi*. So it is easily understood that in the latter case a greater number of males would be required — but why did they choose for attachment a place which is less favourable for impregnation? Because they were so numerous and did not find space enough at the ordinary place?

Mathematics. — "*A group of complexes of rays whose singular surfaces consist of a scroll and a number of planes*". By Prof. JAN DE VRIES.

1. The generatrices of a rational scroll can be arranged in the groups of an involution I_p; to this end we have but to arrange their traces on an arbitrary plane in the groups of an I_p. If we consider each pair of lines l, l' of I_p as directrices of a linear congruence, it immediately occurs to us to examine the complex of rays Γ which is the compound of the ∞^1 congruences determined by it.

Let the scroll ϱ^n be of order n and let it have an $(n-1)$-fold directrix d. The generatrices l form a fundamental involution I_{n-1}, each group of which consists of the $(n-1)$ right lines, coinciding in a point of d. This I_{n-1} has evidently $(n-2)$ $(p-1)$ pairs in