# NOTES ON A NEW LAND PLANARIAN FROM CEYLON.

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(With Plate IV. and one Text Figure.)

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In March last Professor R. C. Punnett kindly handed me an interesting animal which was caught at Namunukula, Ceylon, by Dr. Willey, then the Director of the Museum at Colombo. At first I took the animal to be a land nemertean, but it soon became clear that I was dealing with a land planarian. Further examination has revealed the fact that the animal is not only an undescribed form of the Rhynchodemidæ, but it also possesses several remarkable characters, some of which are quite new to the family. Moreover, some of these peculiarities are similar to certain typical characteristics of the family Cotyloplanidæ. The following is a brief description of this curious land planarian, representing a new genus and a new species. I wish to record my thanks to Professor Punnett, who kindly gave me the valuable specimen in connection with my studies.

*Pseudartiocotylus ceylonicus*, n. gen. et n. sp.

The single specimen (Plate IV., fig. 1) was preserved in formaline and was in a fairly good condition, except that it was torn near the posterior end. The body, which is nearly round in section, is about 28 mm. long and 2 mm. thick at its broadest part. The anterior end is much broader than the posterior, which is pointed. Anteriorly the body is conspicuously compressed dorso-ventrally so as to form a distinct head-flap, which is turned upwards. On the ventral side of the head-flap there is a small depression, which is shallow but well defined, lying just in front of the anterior termination of the sole. Anteriorly and laterally the depression is bordered by a prominent ridge of a horseshoe shape, while posteriorly it becomes shallower, and gradually merges into the general ventral surface. By means of sections it has been ascertained that this ridge represents anterior portions of the so-called glandular margins ("Drüsen-Kante"), which are developed slightly below the lateral margins of the body, and extend backwards to about 3·5 mm. from the head-apex. Fuller description of this structure will be given later. At the very tip of the head there is present a small colourless spot (see Plate IV., figs. 1 and 3) measuring about 0·6 mm. in diameter, which is, as I shall try to prove later, a sensory organ not hitherto described in land planarians. Two small deeply-pigmented eye-spots (see Plate IV., figs. 1 and 3) are situated slightly behind the above organ.

On the dorsal side the colour of the animal is dark brown mixed with a light violet tint, both ends, especially the anterior, being

much more lightly coloured. There are three black dorsal stripes, the medium one being narrower than the two others. On account of the deep ground colour on the greater part of the body the stripes are more clearly defined at the two extremities, particularly at the anterior end, where the ground colour is much lighter. The colour of the ventral surface of the body is grayish, excepting a median colourless band represents the sole, which is slightly elevated.

The sole extends almost the whole length of the body, but ends abruptly behind the ventral depression of the head-flap. Near its anterior end the sole is a little broader, so as to show a special area (see Plate IV., fig. 4) about 0·4 mm. long. Close to both lateral edges of this swollen area are two fine parallel ridges (see Plate IV., fig. 4). On examining the sections it is seen that these two ridges are ciliated, as also is the shallow groove between them. The mouth is a small elliptical slit near the middle of the sole. The genital opening is about 5 mm. behind the mouth.

All three kinds of the "Stäbchen" (von Graff) are met with in the epidermal layer. Rhammites and chondrocysts generally occur together, and are very widely distributed almost over the entire body-surface, excepting the sole and that part of the head-surface which lies above the brain and is dorsal to the horseshoe-shaped glandular ridge. The chondrocyst (see Plate IV., fig. 5, *ch*) is a relatively large and oblong body, nearly homogeneous in structure, which is lightly stained with hæmatoxylin. It is found almost always surrounded by a number of long and slender rhammites (*rm*). The latter are easily distinguished from other "Stäbchen" by their thread-like shape and curled, pointed endings. In those narrow regions which are hemmed in between the sole and the glandular margins (inclusive of the ridge), the two "Stäbchen" are sparsely scattered, and the chondrocysts are rather indistinctly outlined (see Plate IV., fig. 8). The rhabdites are straight thick bodies pointed at both ends (see Plate IV., fig. 8, *rd*), and are moderately stained by hæmatoxylin, more lightly than the rhammites, but more deeply than the chondrocysts, so that they are readily distinguished. The rhabdites are remarkably scarce. They are only found in those regions which lie between the sole and the glandular margins, and extend posteriorly only as far as the ventral ciliated organs. They are never found in company with chondrocysts or rhammites. The presence of the three sorts of "Stäbchen" and the peculiar distribution of the rhabdites mark definite, though not very important, points of distinction between the present species and other members of the Rhynchodemidæ, since the latter, according to von Graff,* form a group in which the three "Stäbchen" rarely occur together, and the rhabdites, if present, are usually scattered over the whole body-surface (as in *Dolichoplana*), or over both the dorsal and ventral

* Von Graff, Ludwig: Monographien der Turbellarien, II. Triclada Terricola (Land Planarien). Liepzig, 1899.

surface of the head. Further description of the distribution of the rhabdites in the horseshoe-shaped depression of the head will be given later in connection with the sensory and the glandular margins.

Among the various epidermal glands, the erythrophile and the marginal glands need only be referred to here, as the others have less direct relation to the classification. The erythrophile glands (Plate IV., fig. 5, *ep*) are in this species uniformly distributed over the entire surface, though they are a little more densely aggregated in the sole-epithelium. They are readily recognized by their coarse granular contents, which have a strong affinity for eosin stains. The presence of the erythrophile glands and the chondrocysts in the epidermis seems to preclude any direct generic relationship of the present form to *Platydemus*, in which the two structures are completely absent.

The marginal glands in this species are well developed, and have their openings on the glandular ridges and on the glandular margins. Their posterior limit is about on the same level as that of the ovaries, being about 3·5 mm. from the head-tip. The glands are very large and long, reaching nearly to the brain or the lateral nerve cords and the gut (Plate IV., figs. 6 and 8, *mg*). They have an extremely oblique course from behind forwards, except at the head-apex, where they run directly downwards to open on the prominent ridge of this region (see Plate IV., fig. 6). The present species is peculiar in having both the erythrophile and the marginal glands, since, according to von Graff, these two glands rarely occur together in the land planarians. Hence he states that "im Allgemeine en erythrophile Körnerdrüsen der Haut und Kantendrüsen einander ausschliessen scheinen, da es nur zwei Formen giebt, bei welchen beide zusammengefunden werden. Es sind dies *Dolichoplana feildeni* und *Polycladus gayi*, doch kann ich wenigstens von letzter Species bestimmt angesehen, dass die Kantendrüsen derselben gar nicht den Charakter der Kantendrüsen der übrigen Landplanarien an sich tragen, sondern sich mehr als eine lokale Anhäufung von birnförmigen erythrophile Drüsen darstellen. Es liegt dem nach hier derselbe Fall vor wie bei *Rhynchodemus terrestris*, wo in der Umgebung der Sinneskante—also an der Stelle pflegen—eine dichtere Anhäufung erythrophile Körnerdrüsen zu beobachten ist."* It may be mentioned here that the present species is only remotely related to the genus *Dolichoplana*, since it lacks the important generic character of having the longitudinal parenchyme muscles developed only on the ventral side of the body. Von Graff's view of the relation between the erythrophile and the marginal glands may explain the nature of another kind of marginal glands which are found in the present species on the inner or ventral border of the glandular ridge (see Plate IV., fig. 8, *mg*). These

* Von Graff, *op. cit.*, p. 66.

secondary marginal glands, as they may be termed, appear to have several characters which are intermediate between those of the erythrophile glands and the true marginal glands; for instance, they are larger than the first, but much smaller than the second; they are stained less intensely with eosin than the first, and are also stained very lightly with hæmatoxylin. The erythrophile granules are more minute than those of the true erythrophile gland. As fig. 8 represents, these secondary marginal glands form a thin layer (two or three cells thick in section) immediately below the glandular ridge. The two zones in which both sorts of marginal glands open to the exterior are separated from each other by a narrow area of the epidermis, which is characterized by containing a few closely-set rhabdites (see Plate IV., fig. 8, *rd*). There is a similar distinct layer of rhabdites more ventral to that just mentioned (see Plate IV., fig. 8, *rd*). Between the two rhabdite layers is interposed a narrow clear space of the epidermis (see Plate IV., fig. 6 and 8, *sm*), probably corresponding to the so-called sensory margin known in many land planarians.

The structure, which may be compared with the "Sinneskante," is seen, in transverse sections through the glandular ridges, to be a narrow clear space of the epidermis (about 0·02 mm. wide) lying between the two rhabdite-layers. Its most characteristic features are the total absence of nuclei in the epidermis of this region, and also the absence (probably apparent) of the basement membrane (see Plate IV., fig. 8, *sm*). The epidermis is here represented by a group of faintly stained fine threads which frequently anastmoose. These threads are directly continuous with a small, clear, and compact mass of elongated cells, which are certainly nucleated. The cells run parallel to each other and obliquely to the epidermal surface. I have not been able to detect any distinct connection of the above cells to the nerve-fibres, which abound in the neighbouring parenchymatous tissue. Nor have I found any ciliary appendages either on the sensory margin or on the whole epidermis, excepting that of the sole.

Although there are still some points to be elucidated in the histology of the sensory tissue described above, I cannot entertain any doubt as to the homology of this structure with the "Sinneskante" observed by von Graff in many land planarians. Three chief points of homology may be noticed: (1) the absence of nuclei in the external plasmic layer; (2) the direct connection of the latter to the underlying nucleated spindle-shaped cells; and (3) the absence or imperfect formation of the basement membrane. If the above homology be accepted, the species under examination differs in a striking manner from other land planarians with regard to the relative positions of the sensory and glandular margins. In all previously known cases the former invariably lies to the latter, while in the present case the relative positions are reversed. Lastly, it must be added that that horseshoe-shaped depression which is

bordered by the glandular ridge of similar shape has nothing to do with the so-called "Sinnesgrübchen," but seems rather to be an artificial effect, due to the contraction of the radial parenchyme muscles, which are specially well developed in this region, and extend from the ventral side of the brain to the dermal layers forming the roof of the depression (see Plate IV., figs. 6 and 8).

The structure of the single eye-like organ (see Plate IV., fig. 9, *ao*) at the head-tip presents some points of interest. Fig. 9 represents a median saggital section through a small portion of that region of the head which contains the organ. Here it is represented by a special clear part of the epithelium, which lies above a region of parenchyme, which is peculiar in having none of the fine pigment granules which are elsewhere present in great abundance. In this region the epidermis (*ao*) contains neither nucleated cells nor any sort of epidermal glands, but consists merely of a plasmic layer, which takes the stain faintly, and which contains minute vacuoles and irregular radial striations, as if to indicate cell boundaries. In the parenchyme underlying this part of the epidermis there are ordinary parenchyme-cells, together with a few muscle-fibres and numerous nerve-fibres (*npl*). There is also a thin cell-layer composed of slender nucleated cells, which lie vertically on the basement membrane and the dermal musculature. Owing to the inadequate fixation of the specimen, I have not been able to make out what relations exist between the outer non-nucleated plasmic layer and the inner nucleated layer. But from the close resemblance to the similar structures already described on the sensory margin, I am inclined to regard both layers as actually continuous with each other through the basement membrane.

A striking feature of the present species is the presence of paired ciliated organs on the sole. Seen in sections the groove itself (Plate IV., figs. 7 and 10, *co*) is rather shallow, and is bordered on either side by a comparatively prominent ridge. The cilia which cover the surface of the organ as well as the sole (see Plate IV., fig. 10, *s*) are longest on the ridges, shortest on the sole, and of an intermediate length in the groove. The epithelium lining the groove and ridges is formed of nucleated cells, which stain fairly, and have a coarsely reticulated plasma. The nuclei are perceptibly smaller than those of the neighbouring epithelial cells. The ciliated epithelium which lines the groove and ridges does not contain any "Stäbchen" or epidermal glands, and is sharply separated from the overlying parenchyme by the distinct basement membrane and the two dermal layers (*dm*). The parenchyme in this region is rich in fine branches of the nerve fibres (see Plate IV., fig. 10, *npl*), which are probably connected with the ciliated organ. When I detected these curious organs, I supposed they might be something similar to the suckers of the Cotyloplanidæ. But this is merely superficial, since both organs are entirely different in their histological structure.

No particular mention need be made of the epithelial layer of the sole, except to point out that the epithelium is composed of a single layer of cubical ciliated cells, which are interrupted by numerous erythrophile and cyanophile glands. The "Stäbchen" never occur in this region, though a very few rhammites are often found in that part of the epithelium which passes over from the sole to the inner ridge of the ciliated organ (Plate IV., fig. 10, *rm*). I have carefully examined the sections of the sole to ascertain if there were any sinking of the sole-epithelial cells into the parenchyme, as von Graff has observed in many species of the genus *Rhynchodemus*. But I have not recognized this phenomenon in a single case. This fact and the presence of the well-developed marginal glands must be regarded as evidence against the direct relationship of the present form to the genus *Rhynchodemus*.

The structure of two eyes is essentially the same as described and figured by von Graff* in *Platydemus grandis*, Spencer. The only point of difference is that the vitreous body filling the interior of the eye-camera is represented in the present case by a homogeneous substance perforated by many irregular clear spaces; consequently there is no indication of any trace of the prismatic structures, which are, according to von Graff, always present in the so-called "Retina-Augen." But I fear that the deviation shown in the present instance is not actual, but is probably due to the improper fixation of the eye tissues.

As mentioned above, the longitudinal parenchyme muscles (see Plate IV., fig. 7, *lpm*) are, as in all genera of the Rhynchodemidæ, except *Dolichoplana*, developed all round in the parenchyme as a thick and continuous sheet surrounding the gut and the central nerve cords.

The two ovaries are situated about 3·5 mm. from the head end. They give rise to two slender oviducts, which run straight backwards along the dorso-lateral side of the two nerve cords. The testes are numerous, roughly 50 to 60 on each side, and are arranged generally in two irregular alternate rows. Their anterior extremities are about 0·5 mm. behind the ovaries, and they extend posteriorly as far as the mouth. The two vasa deferentia run posteriorly along the inner side of the oviducts. I regret that owing to my careless manipulation while cutting the body with the scissors the connection of the common duct of the vasa deferentia with the penis was destroyed. Consequently I have not been able to determine how the common male duct enters into the penis, and how the latter opens to the male atrium. In the attached semi-diagrammatic figure representing the copulatory organs the broken parts are indicated by dotted lines. At the level of the common genital opening (*go*) the male atrium (*ma*) communicates with the underlying female atrium (*fa*),

* Von Graff, *op. cit.*, p. 144, figs. 1 and 2, in Taf. L.

which is about 0·2 mm. wide. This female atrium is connected posteriorly with a long tubular cavity (*ut*), which is about 1 mm. long and 0·1 to 0·15 mm. wide. The walls of the atrium and the tubular cavity are of the same structure, that is, the inner columnar ciliated cells, the outer thick muscular layer, and the outermost thick covering of the tubular glands. The glandular duct (*gd*), which is also invested with the tubular glands, opens into the female atrium by a small pore which lies on the left side and at the anterior end of the tubular cavity. The short proximal portion (*va*) of this duct is much narrower and less glandular than the greater distal part; the former may probably be the so-called vagina. The glandular duct gives off a slender canal, which swells abruptly into a spacious cavity (*sr*) directed posteriorly and nearly horizontally.

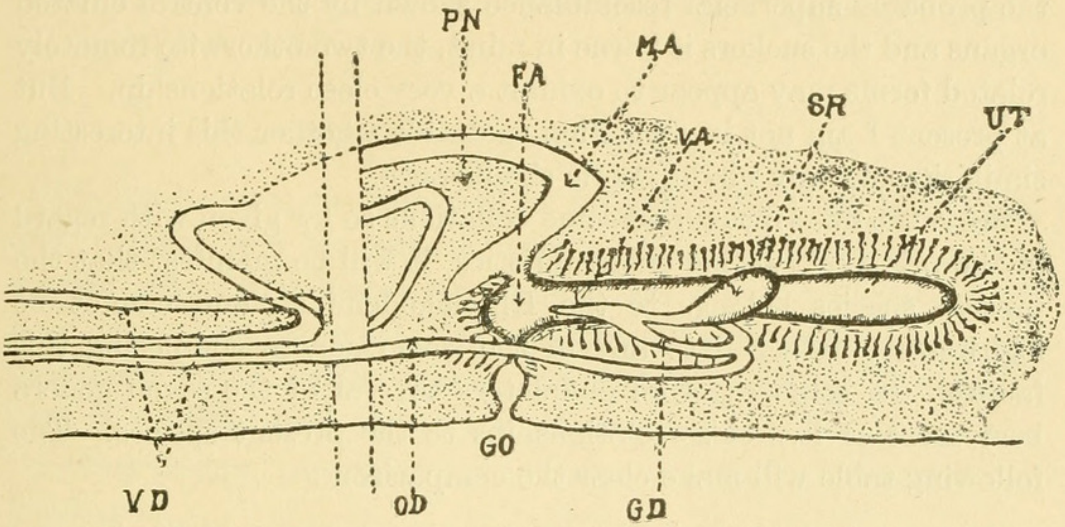


Fig. 1.

A semi-diagrammatic figure showing the copulatory organs seen from the left side: *fa*, female atrium; *gd*, female glandular duct; *go*, common genital opening; *ma*, male atrium; *od*, oviduct on the left side; *pn*, penis; *sr*, seminal receptacle; *ut*, uterus; *va*, vagina; *vd*, vas deferens.

The latter cavity communicates in a peculiar manner with the middle part of the tubular cavity (*ut*) through a broad aperture. The walls of this cavity, too, are essentially of the same structure as those of the atrium and the tubular cavity, so that we may admit that these three cavities were originally derivatives of one cavity or primary female atrium. It is, however, somewhat difficult to clearly identify these different compartments with von Graff's diagrams illustrating the types of the copulatory organs. From the point of view of some structural and topographical analogies, I will call the three cavities respectively the female atrium, the uterus (the tubular cavity), and the seminal receptacle. That the uterus and the glandular duct communicate with each other by a connecting passage is a remarkable fact, which has been known only in *Artiocotylus speciosus** (the Cotyloplanidæ). Von Graff states:

* Von Graff, *op. cit.*, pp. 201 and 209. Text figs. 58 and 59.

"Die merkwürdige Erscheinung an den weiblichen Copulationsorgan der vorliegenden Art (*A. speciosus*) ist nun aber der Umstand, dass von der Stelle, wo der unpaare Drüsengang in die Vagina einmündet, ein kurzer Verbindungsgang zum Trichter des Uterusstieles abgeht und dadurch eine Communication mit dem Uterus herstellt...."* In that species, too, the connecting passage "empfängt ebensowenig als der Uterus Schalendrüsen." Then, the two structures in question differ slightly from each other in their respective relative positions and degrees of development; that is, in *Artiocotylus speciosus* the structure is a simple canal passage, which arises from the proximal part of the uterus and ends in the vagina, while in the present species it is a spacious thick-walled cavity connecting the middle part of the uterus to the proximal end of the glandular duct. Thus, the female genital ducts are compared in this manner, and also when the probably superficial resemblance shown by the ventral ciliated organs and the suckers is borne in mind, the two otherwise remotely related forms may appear to exhibit a very close relationship. But at present I am not in a position to decide whether this interesting similarity has any phylogenetic significance.

From the description and some collations so far given with regard to the principal specific characteristics, it will be manifest that the present species belongs to the Rhynchodemidæ, and cannot be legitimately attached to any of the seven genera composing this family. In some external characters several of the seven genera bear more or less close relationships to the present species. The following table will make clear the comparison :—

X means that the animal possesses the character of the heading under which it is placed. O means that the animal does not possess the character of the heading under which it is placed.

| | Sole Ridge. | | | Sensory Margin. | | Glandular Margin. | | Body Form. | | | Cephalic Furrow. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Narrow. | Wide. | Absent. | Present. | Absent. | Present. | Absent. | Roundish and Elongate. | Roundish, Long, and Slender. | Depressed and Elongate. | Present. | Absent. |
| *Rhynchodemus* .. | X | O | O | X | O | O | X | X | O | O | O | X |
| *Microplana* .. | O | O | X | O | X | ? | | X | O | O | O | X |
| *Amblyplana* .. | X | O | O | O | X | O | X | X | O | O | O | X |
| *Nematodemus* .. | O | O | X | ? | | ? | | X | O | O | O | X |
| *Platydemus* .. | O | X | O | X | O | X | O | O | O | X | O | X |
| *Dolichoplana* .. | X | O | O | X | O | X | O | O | X | O | O | X |
| *Othelosoma* .. | X | O | O | ? | | ? | | X | O | O | X | O |
| Present species .. | X | O | O | X | O | X | O | X | O | O | O | X |

* Von Graff, *op. cit.*, pp. 210–211.

Thus, as regards the above-mentioned characters, *Dolichoplana* seems to most resemble the present form, next *Platydemus* and *Rhynchodemus* in order. Even *Dolichoplana* can hardly claim direct relationship to the present species, when we take into consideration those characters relating to the distribution of the longitudinal parenchyme muscles and the structure of the female copulatory organs. *Platydemus* is characterized by having a broad sole and by lacking the erythrophile glands and the chondrocysts of the integument. Besides, the unpaired sensory organ, the paired ciliated organs, and the reversed relative positions of the marginal and the sensory margins are remarkable characters, all of which indicate clear points of difference between the present species and the established genera of the Rhynchodemidæ.

For these reasons I propose to establish a new genus and species for the animal as follows :—

*Pseudartiocotylus ceylonicus*, n. g. et n. sp.

The genus may be diagnosed as follows : The body is elongate and rounded, and the anterior end is blunt and flattened on the ventral side. The glandular margins are well developed in the head region and lie dorsal to the sensory margins, which are poorly developed. The sole is narrow but distinct, and in its anterior part is modified into two-paired ciliated organs. Beside the two "Retina-Augen," a single unpaired sensory organ is present at the head-apex.

As already referred to, *Pseudartiocotylus ceylonicus* bears a curious resemblance to *Artiocotylus speciosus* in having similarly constructed female genital organs. Whether this implies more than a chance resemblance ought not to be hastily decided from the present observations made on the single specimen. Similar hesitation must be expressed with regard to the resemblance between the ciliated organs of the present species and the suckers of *Artiocotylus speciosus*. I hope to have in the future a further opportunity of studying these interesting points. Here is von Graff's view of the origin of the suckers of the Cotyloplanidæ : "Auch die Familie der Cotyloplanidæ ist keine natürliche Gruppe und die Gattungen *Cotyloplana* und *Artiocotylus* weisen nach dem Baue ihres Nervensystems und ihrer Musculatur—von dem aberranten Typus der Geschlechtsorgane bei *Artiocotylus* gang abgesehen—auf völlig getrennte Ursprünge hin. Der für die praktische Systematik so brauchbare Charakter der Saugnäpfe dürfte also in jeder der beiden Gruppen selbstständig erworben sein." *

* Von Graff, *op. cit.*, p. 285.

The following eight species of the Rhynchodemidæ have been described from Ceylon :—

(1) *Rhynchodemus nematoides*, Loman.
(2) *Rhynchodemus ceylonicus*, von Graff.
(3) *Amblyplana teres*, von Graff.
(4) *Amblyplana hæckeli*, von Graff.
(5) *Nematodemus lumbricoides*, von Graff.
(6) *Platydemus thwaitesi*, Moseley.
(7) *Dolichoplana feildeni*, von Graff.
(8) *Dolichoplana nietneri*, Humbert.

All the above species have been found to be distinct from the present species in their external characteristics. Some principal points of difference may be mentioned as follows :—

(1) *Rhynchodemus nematoides :* yellow ground colour; four dorsal stripes.

(2) *Rhynchodemus ceylonicus :* yellow ground colour; three dorsal stripes are distinct throughout the length of the body.

(3) *Amblyplana teres :* body is relatively short and thick; a deep reddish-brown colour ; no dorsal stripes.

(4) *Amblyplana hæckeli :* yellow ground colour ; four dorsal stripes.

(5) *Nematodemus lumbricoides:* grayish-brown ground colour; one dorsal stripe.

(6) *Platydemus thwaitesi :* ground colour is nearly the same as in the present species, but the three dorsal stripes are distinct from the ground colour.

(7) *Dolichoplana feildeni :* the body is very large; six dorsal stripes.

(8) *Dolichoplana nietneri:* body is very large; six dorsal stripes.

Lastly, it may be added that I have examined some references* dealing with a few species of the Rhynchodemidæ which appeared later than von Graff's Monograph, but no allied forms have been found in them.

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* Mell, C.—Die von Oscar Neumann in Nordost-Afrika gesammeltan Land Planarien (4 n. sp. of *Amblyplana*, 3 sp. of *Platydemus*), Zool Jahrb., Abt. Syst., Bd. 20, 1904.

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