

THE ORDER PALPIGRADI THOR.

(KOENENIA MIRABILIS GRASSI)

AND ITS RELATIONSHIP TO THE OTHER ARACHNIDA

BY

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(Plate 4.)

Certainly the most interesting addition which the class of the *Arachnida* has received for many years is the tiny animal described by GRASSI¹ under the name of *Koenenia mirabilis*; it is from Italy², a country in which perhaps other unknown interesting *Arachnida* will be discovered in the future. There are,

¹ Grassi, B.: I Progenitori dei Miriapodi e degli Insetti. Mem. V. Intorno ad un nuovo Aracnide Artrogastro (*Koenenia mirabilis*) rappresentante di un nuovo ordine (Microthelyphonida). (Bull. d. soc. entom. Italiana. Anno XVIII, Firenze 1886, p. 153—172.)

² As far as we know, it occurs only in southern Italy; in Sicily (off Catania) it was found by GRASSI (who had looked for it in vain in the north of Italy and in the south of Germany). He says (p. 153) that «it lives in the campagna of Catania under stones which have not been moved for a pretty long time, and which lie in heaps hidden beneath the branches of Indian figs; in these places there is always some moisture, yet never too much, which two conditions are necessary to the life of our little animal. It lives together with *Fafyx*, *Campodea*, *Pauropus* and *Scolopendrella*. But while (peró mentre) these animals are found beneath the first stones which are removed, our form scarcely ever occurs in the superficial layers . . . It looks like a small scorpion and has a kind of tail which it curves upward almost as the scorpion bends its post-abdomen. It is very active. Its colour is on the whole whitish and the animal is almost transparent.» — The specimens which our Museum pos-

however, certain points in GRASSI's treatise which might easily call forth a doubt whether he has been quite successful in his conception of the animal, e. g. his idea that besides the six pairs of limbs usually found in the Arachnids, it possesses two pairs of rudimentary »antennæ»; his illustrations of the appendages which do not at all resemble the limbs of the higher *Arachnida*; and his rather superficial mention of the other known orders of this class. So it was quite natural that one of us (H. J. HANSEN), during his stay in Southern Italy and Sicily in the year 1893, should pay special attention to this peculiar little animal which represents a particular order of *Arachnida*. As he was also successful in detecting a tolerably large number of specimens, we agreed to submit it to a renewed examination, which, in our opinion, would be of interest. We find that, in spite of the great ability evinced by GRASSI in his researches, his real object was in fact only to exhibit the new order represented by his species; he cannot be said to have given an exact description of the animal itself, and his figures are very unsatisfactory.

We therefore feel bound to state at once that, properly speaking, it is only a personal opinion of ours, if we consider the animal we have examined to be identical with the one described by GRASSI. To give an instance: GRASSI's fig. 12 and his description (p. 155) of the chelicerae differ so much from what our specimens have shown us that — if the animals were really different — we should certainly be justified in establishing ours as a new genus. But as GRASSI's figures on the whole are rather bad, we suppose that the difference is only apparent, and

sesses were taken in Calabria, partly near Palmi, partly at a height of about 300 M. near Scilla. In the former place it occurred, though far from frequently, in an olive wood and in a somewhat moist soil. It appeared on the under side of stones which had been lying a long time in the same place, and which as a rule were not too large to be lifted with one hand. In spite of its lack of eyes, it was often capable of very quickly slipping in under particles of earth. The animal was exceedingly difficult to catch and is very frail, especially the flagellum which terminates the abdomen, so that we do not possess a single specimen with the complete number of joints in the flagellum, though the animals were handled with the greatest care and caught with a very fine brush dipped in alcohol of about 60 %. Near Scilla it lived under stones in copse wood, but it was rare. (In the environs of Messina it was looked for in vain.)

we think we may be dispensed from constantly referring to his paper, except in cases where such reference seems to us necessary. We will only observe that we have everywhere compared GRASSI'S treatise with our own researches.

The figures having been drawn by us (or rather by one of us) with the greatest accuracy possible, we take the liberty leaving out of our description such features as can be represented in the drawings, and we make a point of stating that where no statement to the contrary is made, the spines, setæ or hairs which are seen in the figures, are in every respect exact reproductions of what we have seen.

As a peculiarity in *Koenenia* we think right to emphasize at once that its skin is but slightly chitinized, especially on the abdomen, where consequently there is no distinction between the (dorsal and ventral) plates and the pleura, so the expansion which the abdomen *must* be capable of allowing, probably depends on the elasticity of this thin chitine itself.

The body consists distinctly of the three parts which are typical³ of the *Arachnida*, though, as a rule, they are rather difficult to discern, namely, a head with four pairs of appendages, a thorax composed of two segments, each with its pair of limbs, and a limbless abdomen.

The Head, as usual in the *Arachnida*, is very large; it is flat on the ventral side, pretty strongly vaulted on the dorsal side, and broadest off the coxæ of the third pair of limbs. To the front it slopes down abruptly towards the first pair of limbs (the chelicerae), above the origin of which the foremost couple of particular sensory organs are placed (s¹, figg. 1, 3 and 7). According to the rule in *Arachnida*, its dorsal side forms an independent carapace separated from the sternal carapace by a softer (in *Koenenia* only somewhat softer) skin. The dorsal carapace is provided with short scattered hairs, the number and ar-

³ One of us (WILLIAM SÖRENSEN) hopes to publish next year in »Oversigt over det Kgl. Danske Videnskabernes Selskabs Forhandlinger» a memoir in French on this subject.

rangement of which are only represented approximately in figg. 1 and 3. The head bears a great resemblance to that of the *Tartarides*⁴. However we must point out as a very remarkable feature that the sternal carapace of the head, which is proportionally much larger, and especially broader than in any other order of *Arachnida*, is divided into two parts (fig. 2) by a narrow band of feebly chitinized skin, the hindmost of these parts corresponding distinctly enough to the fourth pair of limbs. Though this has already been mentioned by GRASSI, we must emphasize the fact as a curiosity, as it is quite unique in *Arachnida*⁵, which otherwise show no trace of independence in the segments constituting the head. The foremost larger part of the sternal carapace is furnished with about half a score of plumose setæ which are arranged in two indistinctly arched rows.

Thorax (t¹, t², figg. 1, 2, 3). Both segments are entirely free, a feature which, elsewhere, is only met with in *Tartarides*⁶ and in *Solifugæ*. Hoping that the figures (1—3) render a more detailed description superfluous, we will only add that, except on the dorsal part of the first segment, they are provided with a few setæ arranged in rows. — Evidently the articulations between head and thorax and between the segments of the latter are not very flexible.

Structure of the Mouth (o, figg. 2 and 3; besides figg. 7 and 8). It is simpler than in any other Arachnid, nay than in almost all other Condylpods, no limbs at all participating in its forming, and we are of opinion that in this respect the mouth of *Koenenia* — simple and plain as it is — presents great interest. It has the shape of a downward sloping protruding knot, and its opening consists of a relatively large split extending not quite up to the base of the mouth-eminent. Seen from below,

⁴ *Schizonotus* THOR. (*Nyctalops* CAMBR.). — *Tripeltis* THOR. (of which, however, we do not know the species established by Thorell himself) does not differ generically from *Schizonotus*.

⁵ In order to avoid misunderstanding we observe that we do not consider this feature fundamentally important, or distinctive of the order *Palpi-gradi*. If more genera of this order be found in the future, we shall not wonder if, in this point, such animals resemble *Schizonotus*.

⁶ We are quite aware that this statement disagrees with all that has hitherto been written on the subject.

this split is slightly crescent-shaped and curves towards the front. It is bordered by two flaps which along its margins are furnished with a rather strongly chitinized »list» or frame, which seems to become somewhat weaker towards the corners of the mouth. The foremost or uppermost of these flaps no doubt constitutes the organ which in other *Arachnida* one of us (WILLIAM SÖRENSEN) calls the labrum (or, when divided into two parts, the clypeus and the labrum), but which otherwise (according to the different authors) goes by rather varying names (rostrum, epistoma, camerostoma). As its shape is shown with sufficient distinctness in figg. 7 and 8, we will content ourselves with saying that the somewhat more vaulted part of its lower side is closely covered with extremely short setæ, most of which turn straight backward. From the inside of its frame proceed five very powerful and comparatively long setæ, pointing inward into the mouth. — We entertain some doubts as to how the lower or hindmost flap is to be understood from a morphological point of view. So for the present we will call it *hypostoma*, as we consider this name morphologically tolerably indifferent. It is furnished outwardly with very tiny backward turning hairs placed somewhat less close together than those of the labrum.

The labrum, as well as the hypostoma, is movable, so as to allow the mouth to open and to close. The muscles, which by the by we have not examined more closely, are very strong.

The Limbs, as already stated by GRASSI, show a very simple structure, being, with the exception of the first pair, very uniform in shape. The first pair (figg. 9 and 10) correspond entirely with the type appearing in *Opiliones*. In its minuter details of form, however, it does not remind us of any *genus* of *Opiliones* known to us. The very powerful first joint is slightly compressed at its base towards its exterior side so as to make this compressed part extend somewhat downward beside the mouth (figg. 2 and 3). We emphasize this fact because we do not know any other animal among the higher *Arachnida* in which this pair of limbs is not placed *quite* in front of the mouth. The basal joint is furnished with a number of hairs, the longest of which, being placed on its sub-proximal part, are monolate

rally plumose and extend behind and downward beyond the mouth. The third joint and the oblong excrescence proceeding from the inner side of the second joint form a pair of pinchers; they are provided with a row of strong, slender and pointed teeth⁷ which are placed quite close together; these teeth are turned somewhat forward towards the extremity of the joints, and a little backward (or downward, if we suppose the second joint of the antenna to turn forward horizontally), and they catch obliquely in between each other when the pinchers close. — The levator muscle of the basal joint of this pair of limbs is very long, being attached to the posterior part of the dorsal carapace of the head; its depressor is much shorter as it proceeds from the anterior end of the dorsal carapace just behind its anterior angle⁸.

The remaining five pairs of limbs (figg. 11, 12, 13, 14, 15) we can describe collectively as they show great mutual similarity of structure, being developed only as organs of motion, except the third pair, which are provided with sensory organs as well; moreover, all pairs are articulated very near to the lateral margins of the body, the two first pairs even to the margin itself; the second pair, which corresponds to the »maxillæ» in the other *Arachnida*, consist of nine joints, the third of twelve⁹, the fourth and fifth of seven, and the sixth of eight. In their appearance and mutual relations the different joints of the walking limbs (the legs) showing rather considerable deviations from those of the other *Arachnida*, it is very difficult to conclude from their shape alone, how the joints are to be interpreted. In so small and so slightly chitinized an animal as the *Koenenia* of course it is impossible to see by the flexion of the different joints in what plane the movement takes place, yet this is the only means of ascertaining the fact with absolute certainty. In a tolerably large animal seen through a magnifying glass, we can indeed make

⁷ In the specimens examined by us there are nine teeth in each row.

⁸ These muscles are placed quite similarly in *Opiliones Laniatores*, where however, the musc. levatores extend to the posterior end of the undivided cephalothorax. So we can refer to the description hereof given by one of us (WILLIAM SÖRENSEN) in »Naturh. Tidsskr. 3 R. Bd. XII, Kjöbenhavn 1879, Tab. 1, fig. 3.

⁹ In this (as will be seen further on) the difference from Grassi's statement is only apparent.

out in what plane two joints move against each other by observing the place of the condyli (or of the single condylus) in question, thereby determining the axis of the movement. Care must be taken, however, to see both condyli simultaneously — if both are present —, but this, of course, cannot be done without turning the limb in looking at it. So, this being impracticable under the microscope, we have paid special attention to the shape and outline of the articular membranes, to the shape of the joints and finally to the position of the muscles in the joint nearest to the articulation — beside each other or one above the other — and to the places above, below or at the sides to which the distal ends of the muscles are attached. Besides, we think we may trust to a certain extent that our many years acquaintance with the limbs of the Arachnids may have helped to enable us to form a correct estimate of the morphological value of the joints. Between the joints which we designate as coxa and trochanter, femur and patella (or tibia, in the second pair of limbs), and tibia and metatarsus, the movement goes in a vertical plane, whereas between trochanter and femur, patella and tibia the movement is partly or essentially in a horizontal plane. We have noticed that at least some of the muscular fibres pass through the joints which, as far as we can see, move in a more or less horizontal plane, a fact which has confirmed the notion of the nature of the joints which we had previously acquired on another way. On this point we deviate somewhat from Grassi¹⁰ and we differ likewise with regard to the boundary line between the metatarsus and the tarsus. However, as to the last point we cannot insist with absolute certainty on the correctness of our view, as it is only based on a personal estimate.

The Coxæ (c) stand out freely in all the walking legs, so that they may be said to join the cephalothorax at their proximal end¹¹. They are all somewhat compressed; as for the details

¹⁰ Grassi is of the opinion that a patella is found in all the legs and that the metatarsus never consists of more than one joint.

¹¹ This character, however, we do not consider as being of much importance, for while in the great majority of *Araneæ* the coxæ are united with the cephalothorax in a considerable part of their length, there are, we know, certain forms, as *Myrmecia*, in which the coxæ are attached to the cephalothorax at their proximal end.

of their appearance we refer to the figures. Among the hairs with which they are supplied some are plumose, but the branches are so diminutive that they could not very well be rendered in the drawing.

Trochanter (tr) and Femur (f) are found in all legs. The trochanter is uncommonly large; however it decreases in length from third to the sixth pair of limbs, measuring in the second and third pairs $1\frac{1}{2}$ times the size of the femur, in the sixth pair being somewhat shorter than the femur.

Patella (p) and Tibia (ti). In the four posterior pairs of limbs patella and tibia are separated from each other, but in the preceding (the second) pair the structure is different, as only one joint (fig. 11, ti) is found. In the third pair the patella is perceptibly longer than the tibia, but in the succeeding pairs about of the same length.

Metatarsus (m) is 2-jointed in the second pair of limbs, 4-jointed in the third pair and undivided in the fourth, fifth and sixth pairs. In the third pair (fig. 12a) the two first joints of the metatarsus are separated by an articulation which is seen sideways as a very oblique and somewhat curved line; probably this link only allows of a very slight movement. GRASSI, who considers it as a suture, reckons these two joints as only one.

Tarsus s. str. (ta) is 3-jointed in the second and third pairs of limbs, 1-jointed in the fourth and fifth, 2-jointed in the sixth. Where it is divided, its terminal joint is notably or much longer than the others, especially in the third pair of limbs. All the legs end in two claws (figg. 12b and 13b) besides being provided with a pseudonychium which, as usual, is considerably curved. We cannot say precisely how much of the animal's foot touches the ground in walking, but we think it is only the extremity of it (as in *Chelonethi*); in this opinion we feel confirmed by the fact that none of the joints are provided with spurs.

Sensory organs. Eyes, as already stated by GRASSI, are altogether wanting. As if in compensation, the head of the animal is provided with two couples of sensory organs. Strictly speaking, we cannot prove that they are organs of sense, as they are much too small to allow of a thorough examination. Seen under the microscope, their surface seemed to be closely »dotted» with fine points; these, no doubt, were very short and thin

processes, which, in our opinion (agreeing with GRASSI'S previously stated view) indicates their function as instruments of sense. The foremost of these couples (fig. 5; s^1 in figg. 1, 4 and 7) is situated in the median line of the body and on the front of the head close above the first pair of limbs; it consists of two flat lancet-shaped bodies which by a common basal part are attached to the head, against which they are pressed (fig. 4). The second couple forms two blades (fig. 6; s^2 in figg. 1 and 3), which are placed close up to the sides of the head above the coxæ of the second pair of limbs, and which — though deviating somewhat in shape — in quality very much resemble the first couple of blades; they turn — at least when in repose — horizontally forward and outward. As they are articulated to the head, it is not unlikely that they can move. — Morphologically they are hairs¹².

The *Tartarides* being the group of *Arachnida* to which the *Koenenia* are nearest akin, we have examined *Schizonotus crassicaudatus* CAMBR. and *Sch. Simonis* n. sp. (a description of which will be published later). The above-mentioned sensory hairs are found neither in the former, which is quite blind, nor in the latter, which has an »eye-spot».

Tactile hairs have been found by us as well as by GRASSI (who is inclined to consider them as auditory organs) only on the third pair of limbs: one on the anterior and one on the posterior side of the first metatarsal (sixth) joint, two on the anterior side of the second metatarsal (seventh) joint, one on the anterior side of the fourth metatarsal (ninth) joint, and one on the front side on the second tarsal (eleventh) joint. They are much longer than the others, very thin and nearly of equal thickness from the base to the point¹³. The circumstance that this (third) pair of limbs are so much longer than the others, and that they

¹² GRASSI, no doubt a little thoughtlessly, has taken them for antennæ (antenne interne and esterne). We shall not enter upon any criticism of this notion.

¹³ We refer to a paper by one of us about these and other organs in other *Arachnida*, namely: H. J. HANSEN: Organs and Characters in different Orders of Arachnids (Entom. Meddel. B. IV, Kjöbenhavn 1893--1894, pp. 137--242, Tab. II--V).

are the only ones provided with tactile hairs, seems to indicate that in this animal as well as in *Amblypygi* (*Phrynoideæ*) and *Uropygi* (*Oxopoei* — *Thelyphonoidæ* — and *Tartarides*), these limbs serve the animal as feelers, while walking.

Lyriform organs we have not been able to detect, and as one of us is tolerably familiar with the appearance and occurrence of these organs in other *Arachnida*¹⁴, we think we may be allowed to say that they are wanting in *Koenenia*.

The Abdomen is »stalked». It consists of eleven segments, the first of which, forming the stalk, has been overlooked as a segment by GRASSI, who consequently only counts ten abdominal segments. Grassi has probably confounded it with the connecting membrane between the thorax and the abdomen. This mistake is natural enough, the first segment being very slightly chitinized and therefore lacking the range of setæ which adorn the other abdominal segments. We therefore think we ought to point out that this segment is separated from the hindmost thoracic segment and from the second abdominal segment by a groove which, though narrow, is very distinct and almost similar to the furrows which separate the other segments of the abdomen. These are adorned with a series, or rather a belt, of setiform hairs which are pretty equally distributed all round the segment. As usual in those *Arachnida* whose anterior abdominal segments can be distinguished from each other, the second is the genital one, viz. the one in which the genital organs have their orifices¹⁵. As shown in fig. 2, the posterior margin is curved greatly backward (as in *Thelyphonoidæ*) and besides the median part protrudes considerably (fig. 3), forming a kind of process which is emarginate in the middle so as to form two short down-

¹⁴ We refer to the above-mentioned paper by one of us (H. J. HANSEN) about these and other organs in other *Arachnida*.

¹⁵ We know quite well that this statement disagrees with the general belief. A few years ago R. I. POCKOCK even asserted that the genital segment was the first one in all *Arachnida*. — However, embryological researches by BRAUER in reference to Scorpions, and by PURCELL with regard to *Aranææ*, have led to the result that the genital segment is the second. For further details we refer the reader to the above-announced paper in »Oversigt over det Kgl. Danske Videnskabernes Selskabs Forhandling».

ward and somewhat backward turning lobes, each of which (fig. 2) is provided with four setæ, the innermost one very short, the others increasing in length outward, the outermost being tolerably long.

Third segment. Provided anteriorly on the ventral side with a couple of downward turning projections which are rather closely covered with tolerably strong setæ.

Fourth segment. Provided on the ventral side in front of the middle with a wartlike protuberance which bears six stiff setæ, almost spines (*aculei*), arranged in two transverse rows, the foremost of which is arched and has four spines — GRASSI seems to consider these spines as sensory organs, an opinion we by no means share.

Sixth segment. Is furnished on its ventral side with a rather strongly protruding wart, bearing a somewhat arched transverse row of six forward-curving setæ. — We do not think these to be sensory organs either.

The three posterior segments (9:th—11:th) form — as the 10:th—12:th segment in *Uropygi* — a kind of short »tail», being — especially the tenth and eleventh — considerably narrowed; of these the eleventh is notably longer than the preceding one. The narrowed shape of these segments probably has the effect of allowing freer movements to the supra-anal flagellum.

On the last abdominal segment a long jointed flagellum is articulated above the anus (figg. 1, 3, 17). This flagellum is not complete in any of our specimens; the greatest number of joints we have seen is nine; in our fig. 1, however, we have drawn five joints more in fainter tint, but this is done exclusively on GRASSI'S authority; he says (p. 158, fig. 10) that the flagellum contains altogether thirteen or fourteen joints. Each of these joints is fusiform, as if composed of two truncate cones — one long, the other short — united at their base, and adorned with two rings¹⁶ of backward-turning setiform hairs; in the foremost ring, situated on the widest part of it, we find — where

¹⁶ As the fact of GRASSI'S fig. 10 only showing one ring of hairs on the joints of the flagellum, might seem to indicate that the animal examined by us belonged to another species, we observe that in his text (p. 158) GRASSI nevertheless mentions two rings.

we have been able to count the number — eight long slightly curved hairs; in the hindmost terminal ring sixteen much shorter, thinner and less curved ones.

We have not observed any external character indicating difference of sex. The specimens we have examined more closely were all females.

That *we* have not been able to discover tracheæ in *Koenenia* is a fact to which we do not attribute much importance, as we have only examined specimens preserved in spirit. But as the animals studied by GRASSI were fresh ones in which such an excellent investigator could scarcely have overlooked these organs, it may be considered as an ascertained fact that *Koenenia* lacks special organs of respiration.

Of the internal organs we have not undertaken any examination properly speaking, as, without a much larger material, we should not have been able to advance much further than the results obtained by GRASSI, though these are not considerable either. Still we wish to make a few short remarks which we think there is good reason for setting forth. In the second abdominal segment there is an organ (rs) whose outlines are drawn in fig. 2; it shows the same peculiar lustre and refraction of light which one of us knows so well from the receptaculum seminis of small *Crustacea*.

GRASSI mentions (p. 161, fig. 13) that he has found a paired long tubular gland, »tapezzata d'un semplice strato di cellule epiteliali» which extends through a large part of the »cephalothorax», and which »perhaps» has its orifice in front of the third pair of limbs. In his explanation to his table (p. 171) GRASSI expresses the opinion that this gland corresponds to the one which generally, though incorrectly, is called the Krohnian gland¹⁷.

¹⁷ That this organ is a pouch-like gland, was already ascertained by KROHN (Arch. f. Naturgeschichte, 1867, I, pp. 79--83) with regard to *Opiliones Palpatores*. That in *Opiliones Laniatores* it is a stink-gland, one of us (WILLIAM SØRENSEN) was fortunate enough to make out in 1879. But much earlier still P. GERVAIS was aware of this fact (in Gay, C.: *Historia fisica y*

Though we have only once in a way been fortunate enough to observe this gland (and even then scarcely in its full length), we feel bound to say that Grassi's comparison of this gland in *Koenenia* is not correct. In structure the above-mentioned tubular gland in *Koenenia* does not agree with the pouch-shaped »Krohnian gland» in *Opiliones*. On the other hand, there can scarcely be any doubt that it corresponds to the excretory glands which in the higher *Arachnida* (*Araneæ* and »*Arthrogastris*») just have their orifices on the sides of the cephalothorax and not — like the Malpighian tubes of the Insects — in the rectum¹⁸. And the structure of the afore-mentioned glands in *Koenenia* seems to be exactly the same as the excretory ones in *Opiliones*.

GRASSI already established *Koenenia* as the type of a particular order of *Arachnida* which he called Microtheliphonida.

politica de Chile. Zoologia. Tomo cuarto. Paris 1849). About the fluid we read (p. 19) »su olor particular y muy fuerte, que imita al del ácido nítrico ó al de las avellanas rancios [a rather curious alternative; at least the first suggestion is extremely unfortunate]. La anatomia de algunos individuos vivos nos ha probado que este líquido estaba contenido en dos bolsas ovales, una à cada lado del céfalotórax, y que salia cerca de la cabeza cuando el animal se hallaba perseguido ó en peligro.»

In *Opiliones Laniatores* these glands contain an oil which (combined with the urine) is let out when the animal is exposed to danger. As far as we know, LOMAN (Bijdrage tot de Anatomie der Phalangiden, Amsterdam, 1881) is the next author who after KROHN has examined this gland in *Op. Palpatores*. LOMAN who knows the opinion put forth by one of us concerning this organ in *Op. Laniatores* says (p. 15) that he must leave the question about their function undecided. This year one of us has examined them in *Phalangium parietinum*; they contain no oil, and their contents do not seem to be let out when the animal is in danger. — But we may add that, according to kind information from Dr. FR. PURCELL in Cape Town, there can be no doubt that in a very interesting form (of which we hope to give a description next year) closely allied to *Stylocellus*, they are stink-glands.

¹⁸ The accessory glands of the intestinal tube in Arachnids known by the name of »Malpighian» tubes cannot be said to correspond to the Malpighian tubes in the Insects. For though it must be confessed that there is no full agreement about the fact, recent embryological researches seem to show that the above-mentioned accessory glands of the intestinal tube in Arachnids, originate from the entoderm, not from the ectoderm.

THORELL agreed in this conception though he suggested naming the order *Palpigradi*¹⁹, a name which, like several other group-names introduced by THORELL, bears witness of the particular gift of this author for hitting on the most distinctive characteristic of the group in question. Yet we cannot share what seems to be THORELL'S opinion when he says (l. c.): »... quum *Koenenia* vix nisi abdomine filo caudali articulado prædito cum *Thelypho-noidis* conveniat, præterea ab iis, ut a reliquis *Pedipalpi*, notis gravissimis abhorrens». For though we also think that *Koenenia* forms an order by itself, we must emphasize that the *Pedipalpi* (and among them especially the *Tartarides*) are the only order with which the *Palpigradi* show any relatively close kinship. In so far then we agree with GRASSI where he says (p. 164) »... I Tartaridi a tutta prima sono molte simili ai nostri animali...» But, to tell the truth, we are at a loss to understand GRASSI'S suggestion²⁰ that a closer examination may possibly lead to the result that the *Tartarides* ought to be classed with the *Palpigradi*.

In now attempting to point out the systematic peculiarities of the *Palpigradi*, we think we are right in asserting that — with the sole exception of the *Pedipalpi* — they are far removed from all other orders. For while it is easy enough to show differences between *Palpigradi* and *Scorpiones*, *Chelonethi*, *Solifugæ*, *Opiliones*, *Aranææ* and *Acari*, we confess that we should find great difficulty in detecting resemblances to these orders, except in the fact that they are all Arachnids²¹. Though indeed the order *Pedipalpi* is poor in species, its two sub-orders²² *Am-*

¹⁹ THORELL, T.: *Pedipalpi e Scorpioni dell' Arcipelago Malese* (Ann. d. Mus. civ. d. stor. nat. di Genova. 2 Ser. vol. VI. Genova 1888, p. 327-428). — p. 358.

²⁰ p. 165, note continued from p. 164.

²¹ In 1848 KITZARY (Bull. d. l. Soc. Imp. d. Naturalistes d. Moscou T. XXI, 2, p. 307—371) had already shown that in *Solifugæ* the cephalothorax consists of a head and two thoracic segments, that this feature does not show a closer affinity between *Solifugæ* and *Palpigradi* will presumably become evident from the above announced essay by one of us, which will appear, in French, in »Oversigt over det Kgl. Danske Videnskabernes Selskabs Forhandlinger».

²² Comp.: THORELL, T.: *Arachnida Arthrogastræ Birmani* (Ann. d. Mus. civ. d. stor. nat. di Genova, 2. Ser. vol. VII, 1889), p. 526.

blypygi (with the family *Phrynoidea*) and *Uropygi* (with its tribes *Oxopoei* — the family *Thelyphonoidea* — and *Tartarides*) exhibit great mutual differences, for instance in the structure of the mouth. And indeed, it is the most central of the orders of *Arachnida*: through *Amblypygi* it reveals decided affinity with *Aranee*, through *Tartarides* with *Palpigradi*, and through *Oxopoei* — to a minor degree — with *Scorpiones* and *Chelonethi*. (As stated by THORELL several years ago, *Opiliones* and *Acari* are closely related to each other, but we confess that these two as well as *Solifugæ* must still be said to stand far apart from the others.)

As far as we can see, the most essential external characters of the different orders of *Arachnida* must be taken from the structure of 1) the mouth, 2) the antennæ²³ (first pair of limbs), 3) the other limbs and 4) the (real) number of the abdominal segments.

1. The mouth of the *Palpigradi* (as we have already pointed out above) differs from that of all other *Arachnida*, nay from that of almost all other *Condylopods* in being formed exclusively by the labrum and the hypostoma. And even if *Koenenia* did not offer other characteristics, this circumstance would, to our eyes, be sufficient to set it aside as an independent order.

2. The antennæ of the *Palpigradi* are 3-jointed, and the two distal joints form a pair of pinchers with horizontal movement of the third joint against the prolongation of the second. In this structural feature *Koenenia* agrees with the *Opiliones* and *Scorpiones* and differs most decisively from the *Pedipalpi* in which the antennæ are 2-jointed and do not form real pinchers.

3. The five remaining pairs of limbs are similar in all the most essential features, as none of the anterior three pairs (2nd, 3rd and 4th) are provided with maxillary lobes which help to form the mouth, but are developed exclusively as organs of movement, like the two posterior pairs of limbs which in all *Arachnids* — where they are found at all — are merely instruments of movement. Therefore the foot (tarsus s. lat.) in all five pairs is divided into a metatarsus and a tarsus (s. str.). — In the four

²³ Only in the very extensive and most varying division of the *Acari*, the antennæ show essential differences within the same order.

posterior pairs of limbs patella and tibia are well developed, while in the second pair only one single joint is present.

4. The abdomen consists of eleven segments (which are not divided into dorsal and ventral plates). In the *Pedipalpi* it consists of twelve segments, which (except the three hindmost ones in the *Uropygi*) are divided into a dorsal and a ventral plate. (Only in *Amblypygi* and *Tartarides* the first ventral plate is very sparingly chitinized. Comp. the above announced treatise in »Oversigt over det Kgl. Danske Videnskabernes Selskabs Forhandling».)

We have here enumerated the characters which in our opinion define the order *Palpigradi*. For in our eyes none of the other characters of *Koenenia* — either of such taken from the skeleton or from the anatomical structure²⁴ described by GRASSI are of so great importance that they exclude *Koenenia* from any of the other orders, especially from the *Pedipalpi*. Of course, when being acquainted with only one species of a group of higher rank, it is very difficult to decide which characters would define the genus and which the family. Nor will we attempt to lay down diagnoses of the genus *Koenenia* or the family *Koenoidea*, for if we have considered ourselves capable of pointing out the most essential characters defining the order *Palpigradi*, it is due in a great measure to the fact that we possess some knowledge of the other orders. We do not think it at all likely that *Koenenia mirabilis* should be the only now living animal of the order *Palpigradi*. Only when knowledge of new forms is obtained, and particularly of rather deviating forms, it will be possible to say with absolute certainty if the principal characters of the order — consequently our view of it — are correct.

In conclusion we take the liberty of asserting most positively that we think GRASSI (this otherwise most meritorious author) mistaken in seeing any affinity between *Koenenia* and *Thysanura*. For beyond the fact that *Koenenia* (with other *Arach-*

²⁴ Thus we do not ascribe any systematic importance to the fact that respiratory organs are wanting in *Koenenia*. We feel bound to accentuate this statement, because (in our opinion) it is a great mistake to assign any higher systematic value to the feature that the organs of respiration in Arachnids appear under two forms: as tracheæ properly speaking and as so-called »lungs».

nida) and *Thysanura* (with other Insects) are Condylpods, there is no closer affinity between Insects and Arachnids, or between *Thysanura* and *Palpigradi*: *Arachnida* occupy a very isolated position with regard to the other classes of Condylpods. No doubt, they come closer to *Crustacea* than to the other classes. But that *Poecilopoda* should form the connecting link between *Crustacea* and *Arachnida*, we think is quite out of the question.

EXPLANATION OF PLATE 4.

Lettering.

I—VI. Limbs.

1—4 and 9—11. Abdominal segments.

C. Head (the foremost part of the cephalothorax).

c. Coxa.

f. Femur.

fl. Supra-anal flagellum.

h. Hypostoma.

i. Place of insertion of first pair of limbs.

l. Labrum.

m. Metatarsus.

o. Mouth.

p. Patella (wanting in second pair of limbs).

rs. Supposed receptaculum seminis.

s. Tactile hairs on third pair of limbs.

s¹. First couple of blade-shaped sensory hairs situated on the front.

s². Second couple of blade-shaped sensory hairs situated laterally on the head above the second pair of limbs.

t¹, t². First and second free thoracic segments.

ta. Tarsus (s. str.).

ti. Tibia.

tr. Trochanter.

Fig. 1. The animal seen from above, $\times 32$. The last five joints of the supra-anal flagellum, which are shown in a fainter tint, were wanting in the specimen represented and have been added on GRASSI'S authority. (When the animal is placed on an object-glass the antennæ cause that the dorsal surface of the »cephalothorax» is oblique, raising towards its anterior end, and the result of this position and of contraction produced by the influence of spirit is that the posterior median angle

- of the head seems to be almost a little overlapped by the anterior angle of the last thoracic segment.)
- Fig. 2. Head, thorax and the four first abdominal segments seen from below, $\times 61$.
- Fig. 3. The animal seen laterally, $\times 49$.— Of the second to the sixth pairs of limbs the coxæ only are drawn.
- Fig. 4. The front part of the head with the base of the antennæ (I) seen laterally, $\times 282$.
- Fig. 5. First couple of the blade-shaped sensory hairs of a tolerably small specimen, $\times 282$.
- Fig. 6. Right-hand blade-shaped sensory hair of the second couple of a tolerably small specimen, $\times 282$.
- Fig. 7. The front part of the head with mouth and place of insertion of the antenna, seen from left side, $\times 163$.
- Fig. 8. Mouth and coxa of the right-hand limb of the second pair, seen from below, $\times 163$.
- Fig. 9. Left antenna seen from the inward side, $\times 96$.
- Fig. 10. The two ultimate joints of right antenna, seen from the hindmost (or lower) surface, $\times 180$.
- Fig. 11. Left limb of second pair, seen from behind, $\times 96$.
- Fig. 12a. Left limb of third pair, seen from behind, $\times 96$.
- Fig. 12b. Extremity of the same limb, $\times 290$.
- Fig. 13a. Left limb of fourth pair, seen from behind, $\times 96$.
- Fig. 13b. Extremity of the same limb, $\times 290$.
- Fig. 14. Left limb of fifth pair, seen from the anterior side, $\times 96$.
- Fig. 15. Left limb of sixth pair, seen from the anterior side, $\times 96$.
- Fig. 16. Ventral side of second to fourth abdominal segment, seen from left side, $\times 140$.
- Fig. 17. The two first joints of the supra-anal flagellum, seen from the side, $\times 149$.