

ON SIX SPECIES OF KOENENIA, WITH REMARKS
ON THE ORDER PALPIGRADI

BY

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Pl. 2-4.

I. Historical Notes.

In 1885 a paper (14 pages) was published (Naturalista Siciliano, Anno IV): »Intorno ad un nuovo Aracnide Arthrogastro (*Koenenia mirabilis*) che crediamo rappresentante d'un nuovo Ordine (*Microteliphonida*) per il Prof. B. GRASSI (in collaborazione coll' Assistente S. CALANDRUCCIO).» The next year GRASSI published his well-known essay on the same subject (Bull. della Soc. Entomol. Italiana, Anno XVIII, Firenze, 1886, p. 153—172, Tav. IX—X). In 1888 THORELL (Ann. Mus. Civ. di Stor. Nat. di Genova, Ser. 2, Vol. VI, p. 358) proposed the excellent name *Palpigradi* for the order, suppressing — and I think with good reason — that given by GRASSI (and CALANDRUCCIO) as being a misleading one. In one of the first months of 1898 appeared the fourth part of Entomol. Tidskrift, Årg. 18, 1897; it contained an essay by H. J. HANSEN & WILLIAM SÖRENSEN: The Order *Palpigradi* THOR. (*Koenenia mirabilis* GRASSI) and its relationship to the other Arachnida (p. 223—40, Tafel. IV). We possessed only female specimens of the Italian species, which was redescribed and illustrated by new figures. In the following pages I have to make about three small corrections and some additions to our text (and figures), but as to all other particulars the reader is referred to our older paper. Only some few re-

marks I wish to quote. We (Dr. W. S. and I) wrote on p. 238: »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 *Koenenoidæ*, 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». At the present time I have examined six species from various parts of the world, and therefore I am now able to point out a number of characters defining the species *K. mirabilis*. Some of the features which I now make use of as specific characters are described in the text of the paper above referred to, others (for instance the relative length of some of the joints in the appendages) are seen on our figures, and only a lesser number are quite new — but I am still unable to lay down diagnoses for the genus and the family, and the study of my five new species deducts nothing from and alters absolutely nothing in that portion of our older text, in which we set forth the principal external characters of the order *Palpigradi*.

In 1899 Dr. F. SILVESTRI secured a specimen of *Koenenia* near Valparaiso, and published a note: *Distribuzione geografica della Koenenia mirabilis* GRASSI ed altri Artropodi . . . (Zool. Anzeiger, B. XXII, 1899, p. 369—71). The animal in question I describe here as *K. chilensis* n. sp. He also communicates three new localities (in Italy and Tunis) for the real *K. mirabilis* — In 1900 W. M. WHEELER discovered *Koenenia* in the vicinity of Austin, Texas, and subsequently published an interesting paper: A singular Arachnid (*Koenenia mirabilis* GRASSI) occurring in Texas (The Amer. Naturalist, Vol. XXXIV, Nov. 1900, p. 837—50). He had captured a large number of specimens, and the title of his paper shows that he believed them

to belong to the Italian species. He kindly sent me a copy of the paper, and instantly I saw from his description and figures that it was a new species. Later on he presented me with six specimens, and now I am able to say that he has discovered two new species, of which that which is common at Austin is described below as *K. Wheeleri* RUCKER. Prof. WHEELER writes on p. 845 that from his preceding description of the common form »a single specimen among my material differs so much that I am compelled to regard it either as the hitherto unknown male of GRASSI's species or as an entirely new form». He says that this specimen was »only .5 mm. in length», he describes and figures its flagellum containing only six joints, and he figures the genital valves which differ exceedingly from those of all the species known to me. Of the six specimens he sent me five are females and one is an adult male belonging to the same species as the females; I am therefore able to state with absolute certainty, that the very small specimen with six-jointed flagellum must be another species; and the shape of its genital valves differs so widely from that in all the other species that I should not be surprised, if this small species on a closer examination exhibited other aberrant features and must be established as a new genus. Prof. WHEELER writes (p. 842): »HANSEN and SÖRENSEN have failed to give a satisfactory account of the ventral surface of the abdomen». If he had had a little more confidence in the accuracy of our account and of that given by GRASSI he would not have fallen into the error of referring his larger specimens to the species *K. mirabilis*. Our description and figures of the spine-like setæ on the fourth segment and of the six procurved setæ on the wart-like protuberance on the sixth segment are quite correct, and these structures are not met with in the species from Texas or in any other of my species. He mentions (p. 843) six pairs of papillæ at the genital aperture, and this proves that he described and figured the male, while the surroundings of the same aperture in the female of his larger species are very much like our old figure of the female of *K. mirabilis*. A most interesting feature discovered by him, viz. the occurrence in his species of three pairs of abdominal ventral pouches, will be treated later on. Apart from the diffe-

rences due to the fact that he was dealing with species distinct from ours, Prof. WHEELER'S account is quite in accord with that of Dr. SÖRENSEN and myself.

In 'Das Tierreich' 12. Lieferung (Febr. 1901) Prof. K. KRAEPELIN deals with the order *Palpigradi*, but his account being based only on the literature already enumerated a special mention is scarcely necessary.

The number of 'Zool. Anzeiger' published Sept. 16. 1901 contains an essay by stud. rer. nat. CARL BÖRNER: Zur äusseren Morphologie von *Koenenia mirabilis* GRASSI (B. XXIV., No. 652, p. 537--56; with twelve figures in the text). He refers to our paper as follows: »Alle wesentlichen Punkte, möchte ich sagen, finden sich hier zum ersten Mal richtig beschrieben. Nichtsdestoweniger bedarf auch diese Beschreibung einiger Verbesserungen und Zusätze, die in der phylogenetisch-systematischen Auffassung von *Koenenia* nichts ändern, für eine specielle Systematik, zum Vergleich mit anderen, wie ich glauben möchte noch in grosser Zahl zu entdeckenden Arten dieser Familie, jedoch von nicht untergeordnetem Werthe sind». For various reasons I think it useful to examine more closely the contents of an essay with such promising sentences. All points worth mentioning will be dealt with, but their consecutive order is partially altered.

Mr. BÖRNER writes (p. 538) that we (H. and S.) »bilden den Cephalothorax in etwas gequollenem Zustande ab, etwa so wie er nach der Behandlung mit Kalilauge etc. eintritt. Man erkennt dies an der Insertion des vorderen Doppelsinneshaares und an der starken Wölbung der hinteren Partie des dorsalen Carapax». But his description, his fig. 1 and especially fig. 1 a (both figures unfortunately diagrammatic) show that his specimens were contracted by the action of strong spirit or perhaps other fluids: when collecting the animals he evidently preserved them for the purpose of anatomical study by section-cutting. (He kindly lent me a specimen with the flagellum complete along with some specimens of *Pauropus* and *Scolopendrella*: the *Koenenia* (stained and mounted in balsam) is exceedingly contracted, and all the other animals are stiff, hard and considerably or much contracted). When collecting such animals as *Koenenia* and small Myriopods I always put them into spirit of only 60—63 % and

keep them in this rather weak fluid for a considerable time: after this treatment most of the specimens are well preserved for systematic study, being extended as in life and having the legs tolerably flexible. The outlines of the figures in our paper of 1897 were made from such specimens not treated with caustic potash — I have re-examined the type-specimen of my former figures of the head, and both this and another chosen at random specimen show my drawings to be correct. (On pl. 4 in this paper I have figured the anterior part of two specimens of *K. angusta* in order to exhibit the extreme difference in the shape of the cephalothorax in a contracted specimen and in an extended one, and no specimen of this species has been treated with caustic potash. I believe that if an animal or a part of it is to be figured to exhibit the natural shape, one must select naturally extended specimens in preference to such as are contracted by strong liquids. Further, the frontal part of the head between the anterior edge of the dorsal scutum and the mouth in BÖRNER'S fig. 1 a is retracted and deformed to a degree which the living animal is scarcely able to produce by its muscles.

His fig. 2 which also is »etwas schematisch» (I am unable to understand why the figures mentioned are drawn diagrammatically), is incorrect in the arrangement of the hairs on the anterior cephalic sternum. He describes these hairs, mentioning eight in the posterior row, while on specimens re-examined by me only five or six are present; and the five hairs which in his figure form the anterior row are placed otherwise in nature: the median hair is close to the posterior row and very far from the hypostoma, the two other pairs are arranged in two oblique lines directed outwards and moderately or considerably forwards. And as the number and arrangement of these hairs furnish excellent specific characters, a drawing such as his fig. 2 is rather misleading.

The most interesting point in Mr. BÖRNER'S paper is his new theory that the thorax is not constituted only of the two separate segments bearing the two last pairs of legs (the interpretation given in our previous paper), but that the posterior part of the head bearing the fourth pair of appendages (second pair of legs in Arachnids) also must be referred to the thorax. He be-

lieves that the thorax in *Palpigradi* and other orders of Arachnids consists of three segments, and he promises to prove this view in a subsequent more voluminous paper on the structure of *Koenenia*. The discussion of this question I leave completely to my colleague Dr. W. SÖRENSEN who years ago announced a treatise on the segments of the body in all orders of Arachnids. I shall only add that I do not accept the feature mentioned by BÖRNER as an oblique suture on the carapace above the fourth pair of appendages, a suture described as incomplete and which »keineswegs das Segment des 4. Beinpaares ganz vom Carapax trennt»; I consider this suture to be only a lateral folding of the skin, originating, when present, from quite other grounds than a rudimentary segmental division.

In his description of the abdomen I find but little of interest. He correctly states that the lateral portion of some segments is without setæ. In the group of spine-like setæ on the ventral side of the fourth segment he counts five; we had written six, and later on I had observed both numbers. But when he applies the name »Sinnesborsten» both to these and to the well-known setæ on the ventral protuberance of the sixth segment, I disagree: he does not set forth any ground for the name, and I have seen numerous shapes of sensory setæ in Arachnids and elsewhere, but never any one of these forms, and they do not look like sensory organs.

In a foot-note to his description of the abdomen (p. 551) he points out, that the animal described by WHEELER as *K. mirabilis* is another species, which he even establishes as the type of a new sub-genus; he names it *Prokoenenia Wheeleri*. He has not seen any specimen and refers only to WHEELER's description and drawings. But the result is, and must be, partially erroneous: he could not detect that the animal described by WHEELER as the female is in reality the male, and that the specimen considered by WHEELER to be perhaps the male of *K. mirabilis*, belongs to a third, very aberrant species. Of course I must adopt the name *Wheeleri* for the one species¹, but I suppress

¹ After this paper was written and after the plates were finished I received a copy of a paper on this species. The author, Miss AUGUSTA RUCKER, proposes also the name *K. Wheeleri* for the species, but her paper being

his sub-genus *Prokoenenia* and another quite superfluous sub-genus *Eukoenenia* established in order to receive *K. mirabilis*.

Only in one of the (seventeen) specimens seen by Dr. W. S. and myself nine of the thirteen joints of the abdominal flagellum were preserved, in the others only a few or none of them remained. Now Mr. BÖRNER spends almost three pages on a description with three figures of this organ; he describes the joints, measures them and counts their setæ very circumstantially. The terminal joint bears two whorls of long plumose setæ, and therefore he thinks it formed by a coalescence of two joints and counts two in the enumeration of the joints, but no vestige of coalescence is seen, furthermore it is impossible to prove that two joints ever were developed, and on these grounds I think it more appropriate to count it as one joint. — He writes (p. 553): »Das Proximal- oder erste Glied scheint man bisher ganz übersehen zu haben . . . Es ist äusserst klein . . .» But that is not quite correct, this very short 'joint' is defined on fig. 17 in our paper of 1897, but its four shorter setæ are not drawn, and it was not regarded as a joint. Mr. BÖRNER writes that the glabrous setæ forming the subapical whorl on six of the following joints originate as an »innerer» ring in his (contracted) specimens, but he has not seen that this whorl always is inserted on a very short joint consisting of proportionately thick chitine, separated by a membrane from the main part of the joint, or the main joint, and that this subjoint in his specimens is withdrawn into the cavity of the main joint (so that the subapical whorl seems to originate as an interior one), while in extended specimens it is turned out, with the base of the setæ of the whorl lying quite uncovered. Furthermore he has not seen that all the joints which have their basal portion covered by the glabrous setæ from the preceding subjoint, have the proximal part set off by a transverse suture (which is drawn in fig. 17 in our previous paper). And if he is to consider his »Proximal-Glied» as a real one, he must at least count all the six

issued about one month before that of Mr. BÖRNER, the species must be named *K. Wheeleri* RUCKER. This name is used below, but on the plate Mr. BÖRNER'S name is added to the species. For the rest the reader is referred to the postscript below.

subjoints possessing a whorl of glabrous setæ as similar — and almost better — joints, and perhaps even the basal part of the joints following on the those adorned with subapical whorls must be counted. Mr. BÖRNER thinks it to be a good reason for counting the very short basal joint that it remains on the abdomen, when the »Flagellum sich vom Körper loslöst», but I can state that I have found a flagellum of *K. mirabilis* broken just in the membrane between a joint and its following subjoint with the glabrous setæ. We get in *K. mirabilis* thirteen long joints, six subjoints with a strong whorl, one (the basal) subjoint with a few shorter setæ and, if one wishes it, still six subjoints without setæ (not taking Mr. BÖRNER's apical joint into account): but this becomes rather complicated, and I should prefer the old mode of counting, considering only the long joints as being real ones, the others as secondary ones or subjoints. For the rest the reader is referred to my subsequent description of the flagellum of the various species.

Mr. BÖRNER spends almost six pages (with four figures) on the description of the cephalothoracic appendages — but I cannot praise it much. A part of it is measurements of all the joints and counting of setæ etc.; it may be very industrious, but I am unable to perceive the value of it. To day I have studied six species from very different regions of the world, and now I think it fortunate that Dr. W. SÖRENSEN and I did not expatiate upon all »details» in the single species, *K. mirabilis*, as Mr. BÖRNER has done: when several species are procured it is possible to point out the differences worth mentioning, but an exceedingly long description with endless counting of hairs and about half a hundred measurements of a single species of an order will later on prove itself to be for the most part superfluous — and in spite of its extreme length it of course does not contain several points which are valuable as specific characters. And some of Mr. BÖRNER's statements on topics deemed by me worthy of a re-examination are not even correct. On the distal part of the first pair of legs (third pair of appendages) he has discovered »Gabelhaare» and writes that these exceedingly short hairs »sind bisher bei *Koecenia* übersehen»; on fig. 12 a in our previous paper the largest of these hairs is drawn, but the enlargement

of the figure was too small for a fuller representation of them, and we did not mention them. — We had briefly described six tactile hairs on the first pair of legs, Mr. BÖRNER draws attention to a seventh one on the patella not mentioned by us (it is wanting in our preparation of the legs), but he does not say that it was seen by GRASSI. And when he writes that only one tactile hair »[nicht zwei, wie H. und S. angeben]» is present on the fourth metatarsal joint, I may perhaps quote our text (p. 231): »one on the anterior side of the fourth metatarsal (ninth) joint, and one on the front side on the second tarsal . . . joint», and scarcely any body will be able to discover more than one on our fig. 12 a. — Finally his description and large drawing of the chela must be mentioned. He says that the chela is figured from above, but it is far from being vertically above, and the result is several grave faults. The movable finger is not all jointed to the hand as shown in the figure, in which 10 mm. of its exterior margin is represented as covered by the lateral wall of the hand, while in nature this margin is quite free, and the articulation similar to that in the chela of a scorpion or a crab. He has completely overlooked the strong condylus, and a long seta »dicht vor dem Zahnfelde» is quite incorrect: in nature it stands even more distally on a small curious process, which projects freely over and beyond the inner margin of the immovable finger. He writes of the teeth that they »inscrieren auf einem breiten Feld, das etwas gekrümmt ist und sich sehr deutlich von dem basalen und distalen Theil der Scherenarme abhebt, wie es aus der Figur zu ersehen ist». But figure and description are equally wrong: the teeth are in this and in all the other species real processes without any vestige of insertion; his erroneous statement originates from the fact that the chela was situated in an oblique position. The teeth on the chelæ in other Arthropods (Decapods, Scorpions, Chelonethi, Opilionids) are always processes without vestige of insertion, even when they are proportionately much longer and more slender than in *Koenenia*. He describes and figures a long fissure near the articulation of the movable finger and supposes it to be a lyriform organ; in a certain position one may think that one sees this fissure, but when the chela (which must be examined cut off and

without pressure — see my remarks in the following chapter) becomes gradually turned and at last seen vertically on the »fissure» from above (the position necessary to a real examination of lyriform organs) the supposed fissure shows itself during this manipulation to be the inner margin of the movable finger shining through the skin of the articulation. I have very carefully re-examined the chela both in the natural condition and cleaned in caustic potash — which is absolutely necessary when one wishes to avoid disturbing refractions of light from fibres etc. in the internal tissues — and a fissure does not exist. Finally he mentions another fissure at the basis of the hand, but this also was an illusion. I lay some stress on the non-existence of these fissures; having discovered hundreds of this kind in various orders of Arachnids I am tolerably familiar with them and with the difficulties in finding them and pointing them out with certainty. In 1897 I searched for them in vain in *Koenenia*, and the existence of them in the *Palpigradi* would be really interesting — but I must maintain the earlier statement that they do not exist in that order.

The rough-draught of my present paper was written out and all the figures drawn before the middle of June (and probably even earlier), but a letter from Prof. WHEELER etc. caused a postponement; the drawings were sent off to the lithographer before the end of August, and the text copied fair after the reading of Mr. BÖRNER's paper. And I state expressly that, with exception of the name *Wheeleri* for the American species, I have in all only added a foot-note on his statement of the varying length of the animal and besides two words (viz. 'mostly' at the description of the tactile hairs and 'four' at the terminal setæ of the flagellum) in order to embody any structural feature pointed out in his treatise (he had written to me before on his basal joint of the flagellum and its four setæ), nor have I omitted any sentence found in my rough-draught as being in opposition to some observation of Mr. BÖRNER — but I have felt it necessary to insert this review of his paper.

II. The Material and its Treatment.

In June 1900 the Danish Zoologist Dr. TH. MORTENSEN returned from a voyage to Siam. He brought to Copenhagen rich collections of marine animals and besides a number of terrestrial (and fresh-water) Arthropods collected by him on the Islands in the Bay off Siam, especially on Koh Chang. Fortunately he had paid special attention to very small wingless Arthropods which are quite neglected by most collectors, and the result was, that he had secured a number of *Scolopendrella*, *Pauropus* (which I shall describe in two papers in course of composition) and nine specimens of *Koenenia*.

The discovery of these last-mentioned very interesting animals in tropical Asia and my disbelief in the determination of the American specimens mentioned above caused me to be desirous of undertaking a study of as much material as possible of the order in question. At my request Prof. WHEELER gave me six specimens of his larger species from Texas, and Dr. F. SILVESTRI not only lent me his single specimen captured in Chile, but presented me with two specimens of a species collected by him in Paraguay and with two analytical figures, one of which is inserted in my paper as a woodcut. I beg Dr. SILVESTRI and Prof. WHEELER to accept my warm thanks for this most valuable help. Later on Mr. C. BÖRNER (Marburg) kindly lent me a mounted specimen of *K. mirabilis*, in which the flagellum is quite complete.

Thus I have had the good fortune to examine a comparatively enormous material, viz. six species, of an order of which only one had been established. But I think it advisable to state that the quality of my material has given rise to several shortcomings. The specimen of *K. chilensis* is, in my opinion, scarcely quite adult; of four other species the adult female (and sometimes also immature specimens) were present, and only one species, *K. Wheeleri*, is represented in both sexes. Furthermore, in some species the major part of the flagellum was wanting, and the two South American species were not very well preser-

ved. But in spite of the deficiencies originating from these causes I believe that I can describe the six species so that they can be distinguished with certainty from any form still to be discovered. And I believe that when — in a rather remote future — the tropical and subtropical countries have been well explored by able collectors, the number of species of the order *Palpigradi* will amount to fifty or perhaps considerably more.

The animals (of which always a portion should be put by the collector into spirit at least not exceeding 65 %) are not very easy to examine. I should advise Zoologists to lay them in glycerine diluted with water on an object-glass, and to introduce a small, thin wooden wedge (cut for instance of the margin of a match-box) under the middle of the back edge of the glass-cover in order to prevent this from crushing or at least depressing and deforming the animal. By moving the wedge forward or backward the glass-cover is easily arranged so that it either only touches the animal or presses it as much as desired, and when the animal by the help of a hair is arranged in a direction at right angles to the length of the object-glass, it can be rolled round by slight pushing of the glass-cover to the left or to the right side and thus become examined from all sides without damaging it.

III. On some Structural Features and Characters.

As almost nothing is known about specific characters in this order, and it is necessary for me to attempt to lay down a base, I think it advisable first to consider the characters employed later on in the description of the species in order to help future students as much as possible. Thus we get a general view of a series of structural features, and though this chapter is a rather long one, I hope that it may render some service to the users of the systematic descriptions of the species. — It may be added, that practical reasons have induced me to apply the name palpi to the second pair of appendages and the name legs to the four posterior pairs.

a. Sense-organs of the head. GRASSI and later on HANSEN and SÖRENSEN have described peculiar sense-organs on the

head of *K. mirabilis*: one organ (one coalesced pair of organs) on the front and one on the lateral margin on each side above the insertion of the palpi. H. and S. wrote: »Morphologically they are hairs», but our description of them is not quite correct. The two branches of the frontal organ look indeed very like lancet-shaped, flat bodies, but they exhibit this shape both when seen from above and from the side, and therefore they must be round. In *K. mirabilis* the lateral organ is apparently formed as an oblong entire leaf, but in reality transverse sections must be nearly circular. The branches of the frontal organ differ somewhat in length and thickness from species to species: they are longer and more slender in *K. Grassii* (pl. 4, fig. 3 b), while they are shorter and thicker in *K. angusta* (pl. 3, fig. 3 a) than in *K. mirabilis*. In *K. mirabilis* we find always only one single lateral sense organ (one transformed hair), in *K. chilensis* at least two are present (pl. 3, fig. 2 a), in *K. Grassii* (pl. 4, fig. 3 a), *K. angusta* (pl. 3, fig. 3 b) and *K. siamensis* I found three, and in *K. Wheeleri* (pl. 2, fig. 2 b) four organs. They are always placed very close together, and to count them with certainty is sometimes far from easy — it is best performed when the head is seen obliquely from above, so that they project freely. The organs in a group are always about of the same length and shape. The organ in *K. mirabilis* is a little more to a little lesser than two and a half times longer than thick, the organs in *K. Grassii* are about six times longer than thick and very acute (pl. 4, fig. 3 a), while the organs of the other species exhibit a shape intermediate between that in the two species mentioned. — The difference between the species in the number of the lateral sense-organs seems to me to be very interesting.

b. Sensory hairs on the legs. In the previous paper *tactile hairs* on the third pair of appendages — the first pair of legs — are mentioned. These hairs originate from the bottom of jar-like holes; they are very thin, nearly equal in thickness from the base to the end, mostly considerably longer than the other hairs and adorned with numerous exceedingly short, almost invisible branches. We enumerated six hairs (on the sixth, seventh, ninth and eleventh joints); GRASSI had found still another

hair of the same quality (his interpretation of them as probably auditory organs is erroneous) on the inferior side of the fourth joint (the patella), and this I have now seen on a leg situated in a fortunate position. In four of my other species I have also found seven tactile hairs on the same joints and inserted almost on the same places as in *K. mirabilis*; the preservation of the one species, *K. Grassii*, was not good enough for an exact inquiry, but what I saw did not deviate from that in the other species.

I shall now point out the existence of other hairs or setæ which probably are sense-organs. On pl. 2 fig. 2 g is seen a peculiar seta (s) originating towards the middle of the upper side of the metatarsus on the last pair of legs in *K. Wheeleri*. This seta diverges but little from the upper margin of the leg, in its whole length it is adorned with fine dots, which seem to be exceedingly short hairs (the magnifying power of my microscope is not high enough for an investigation); furthermore it is hollow quite out to the apex, which is obtuse. Judging from (unpublished) studies of hairs in other orders of Arachnids I believe this seta to be an organ of sense. It exists in all the species but is generally less thick than in *K. Wheeleri*, and its length presents good specific characters. In *K. angusta* it is exceedingly long (pl. 3, fig. 3 h, s), inserted at a short distance from the base of the metatarsus and reaching almost to the middle of the last tarsal joint; in *K. Wheeleri* it overreaches but slightly the metatarsus, and in *K. mirabilis* it reaches scarcely to the end of this joint. — Several other hairs, especially on the tarsi and metatarsi of the three posterior pairs of legs, are hollow through most of their length, and the apex is turned sharply outwards, but I am unable to decide if these may be sensory organs.

On the posterior (exterior) side of the third metatarsal joint in the first pair of legs in *K. Wheeleri* I found a seta (pl. 2, fig. 2 e, s), which is somewhat shorter than the longest hairs of normal quality, but considerably thicker than these, stiff as a spine, feebly curved and besides under rather high magnifying power (600 times) showing a structure different from that of the other hairs. This structure I have been unable to elucidate as I could wish, but it can be stated, that the seta is dotted with

very short hairs of equal length from its base to the apex. This spine-like seta is met with in all species, but though always robust it is yet more slender in some of the species than in *K. Wheeleri*. Its place on the outer side of the third metatarsal joint offers an excellent specific character: in *K. Wheeleri* it is inserted at the end, in *K. angusta* (pl. 3, fig. 3 f, s) at the base, in *K. siamensis* (pl. 4, fig. 2 c, s) at the middle of the joint. I think it probable that this seta has a sensory function.

c. Other hairs. On the upper side of the metatarsus and tarsus of the first pair of legs (not in the other pairs) are found some very short, biramous hairs. The basal part of them (pl. 2, fig. 2 f) is usually shorter than the upper branch, which usually is longer than the other; both branches and sometimes the stem are finely plumose. The number and arrangement of these biramous hairs seem to offer specific characters, but I have not made use of them, as they are too difficult to count with certainty.

d. Abdominal sacs. As already mentioned Prof. WHEELER discovered paired ventral sacs on the fourth, fifth and sixth abdominal segments of *K. Wheeleri* RUCKER. These sacs or pouches are easily seen on the specimens he sent me. When the sacs are in what I suppose to be their natural position, they are totally invaginated into the animal. The entrance to each sac is a transverse, linear slit (p in pl. 3, fig. 2 f, representing *K. chilensis*), the margin of which is somewhat thickened, and thus the entrance resembles a button-hole. On each of the segments mentioned is found one pair of such slits, situated somewhat nearer to the posterior than to the anterior margin of each segment, and the distance between the slits of the same pair is in *K. Wheeleri* nearly twice as long as each hole. The sac, which is a little longer than broad, is in my material often evaginated quite as a pocket turned inside out (pl. 2, fig. 2 i, p and fig. 2 h, p). I have not been able to discover any muscle to the sacs or any contents within them. Along the anterior margin of each hole four hairs are arranged, and nearer to the median line on the fourth and fifth segments three rather long and very robust setae. — In my single specimen of *K. chilensis* I found similar sacs on the three same segments, but here the

distance between the sacs of the same pair is a little shorter than the length of each of them.

In the other four species described in this paper I have searched in vain for such sacs, and the quality of my material enables me to deny their existence with certainty. But this circumstance renders it still more difficult to interpret the morphological significance or the function of the three pairs of sacs in the two species. When Prof. WHEELER writes: »These sacs are in all probability lung-books», I do not believe this interpretation to be a very probable one, as it seems to me very unlikely that in some species such respiratory organs should be present, while they are completely wanting in other species of similar volume, and the species with sacs do not offer any other character which could justify their reference to another genus. As to the function of the sacs I am unable to set forth any hypothesis tolerably probable to myself, and therefore I prefer to give up the question, leaving it undisturbed by airy speculation to real study in nature.

e. Flagellum. The material examined by W. Sörensen and myself was, as mentioned on p. 199, very defective as to the flagellum. Now I have examined a well-preserved flagellum of *K. mirabilis*, *K. Wheeleri* and *K. chilensis*, besides a fragment in two other species and a drawing of a third (*K. Grassii*). It may perhaps be convenient first to describe the flagellum in *K. mirabilis* and then to mention the differences observed in the other species.

The flagellum in *K. mirabilis* consists of thirteen oblong, well developed joints, each with a whorl of very long, faintly pubescent setæ inserted on (or just beyond) the thickest part of the joint, which is situated beyond the middle or at a rather short distance from the end of the joint; on the last joint the whorl is found a little beyond the middle, and near to the end is seen another whorl of only four setæ, which are long, but yet somewhat shorter than those in the first whorl and of similar structure. The second, third, fifth, seventh and ninth joints are conspicuously shorter than the others; these five shorter joints and the basal one present besides a subapical whorl of very conspicuous glabrous setæ, which are several times shorter but

more numerous than the setæ in the above-mentioned whorl, only about half as long as their joint, and while the very long setæ in the whorl on the thickest place stand out almost at right angles to the surface, the setæ in the subapical whorl are directed almost backward and lie rather close to the surface of the following joint. In the seven other joints of the flagellum the subapical whorl is quite wanting. Now we have seen the more coarse structural features of the flagellum, but a closer examination reveals still several interesting points. Then it is perceived that the whorl of shorter glabrous setæ on the six joints mentioned is inserted on a very short subjoint (pl. 2, fig. 1 f, p), which proximally is separated from the main joint (a) by a membrane. In an extended flagellum, a portion of which is shown in fig. 1 f., the subjoint forms the apical part of the joint, and the bases of its setæ are free; in a contracted flagellum the subjoint is retracted into the terminal part of the main joint, where it is seen as an exceedingly short ring of proportionately rather thick chitine, and the bases of its setæ are covered by the membrane at the end of the main joint. The second, third, fourth, sixth, eighth and tenth joints, that is to say the joints having their basal third covered by the whorl of the preceding joint, offer another curious feature: the basal part is subcylindrical and marked off by a transverse suture as a very short ring (fig. 1 f, q) or subjoint from the main joint (b), but the suture does not allow any movement; in extended specimens this very short subjoint is quite free, in contracted specimens it is retracted into the preceding joint or, more correctly, into the subjoint with the whorl of glabrous setæ (pl. 2, fig. 1 d, showing the outline of some joints without indication of the subjoints, which scarcely could be represented with this enlargement, when the two subjoints are retracted into the apical part of the preceding main joint and besides the one subjoint into the other). — The basal portion of the first joint of the flagellum is marked off plainly as a separate very short joint with four shorter marginal setæ of almost equal length; I believe that this short joint, which is articulated to the end of the abdomen, is quite the same thing as the basal part or basal subjoint of the second, the third and the other joints just described.

— The joints which have their basal part not hidden by a whorl of glabrous setæ from the preceding one, exhibit another shape of their basal part. This other structure is thus found in the fifth, seventh, ninth, eleventh and twelfth joints (in the last joint the feature is indistinct): the proximal part of these joints is shaped like an hour-glass (pl. 2, fig. 1 c, 1 d and 1 e), but it is scarcely marked off by a transverse line from the distal part; in contracted specimens this curious proximal part is retracted deeply into the preceding joint (fig. 1 d), and much deeper than we find is the case in the other joints; in extended specimens (fig. 1 f) it is scarcely retracted. — The structure of the flagellum is thus very complicated; the figures on pl. 2 exhibit sufficiently the length of the setæ, the plumose clothing etc.

The flagellum in *K. Wheeleri* is similar to that in *K. mirabilis* in most respects. I have examined two complete flagella, and each contained fifteen joints (pl. 2, fig. 2 k); of ten specimens examined by Wheeler eight had fifteen, one specimen had fourteen and one only eleven joints in the flagellum (Wheeler op. cit. p. 844), but unfortunately he does not say if the last-named specimen was adult or immature or showed signs of anomaly. My figure shows that the flagellum has the same joints furnished with a whorl of glabrous setæ as we saw in *K. mirabilis*, the division into subjoints is also as in that species. But all the joints (the apical one excepted), which do not possess strong subapical setæ, have a whorl of very short hairs close to their end. The apical joint (pl. 2, fig. 2 l) has two whorls of long pubescent setæ as in *K. mirabilis*, and in the subapical one seven setæ are present in both specimens. The basal subjoint of the first joint has four short setæ, the two upper of which only half as long as the two others.

I have examined a complete flagellum of *K. chilensis* (pl. 3, fig. 2 g, 2 h and 2 i). It contains thirteen joints and does not differ very much in structure from that in *K. mirabilis*, but it is much more slender and the joints are more elongated. At least the first joint and probably even all the other joints are still more slender than shown in my figure (2 g), since the joints appeared to be somewhat flattened by the pressure of the glass-cover in the preparation lent me by Dr. SILVESTRI. The sub-

apical whorl of glabrous setæ is found on the first, the second, the third, the fifth and the seventh, but not, as in the two preceding species, also on the ninth joint; the setæ in these whorls are only half as long as in the preceding species and more slender; the shape of the basal part of the joints and the division into subjoints are as in *K. mirabilis* with the exception of the reductions accompanying the loss of a subapical whorl on the ninth joint. The two last joints are comparatively short; the apical has only one whorl of very long, pubescent setæ, and it terminates in one very long seta. The flagellum of *K. Grassii* I am only acquainted with from a drawing kindly sent me by Dr. SILVESTRI and inserted here. We see that it contains only nine joints, that a subapical whorl of strong and comparatively long glabrous setæ is found on the same five joints as in *K. chilensis*, while the fourth, the sixth and the eighth joints possess a subapical whorl of much shorter setæ which are conspicuously longer than in *K. Wheeleri*. Furthermore the terminal joint possesses two whorls as in *K. mirabilis*. The flagellum looks very robust.

One of the specimens of *K. angusta* had a defective flagellum with five joints (pl. 4, fig. 1 e) still preserved. It exhibits a curious anomaly: the third joint is coalesced with the fourth and quite misshapen: of the subapical whorl only some few setæ are seen on the lower side, and the submedian whorl on the fourth joint is also imperfect. The joints preserved are short and very robust, their plumose setæ shorter than in *K. mirabilis* and *K. Wheeleri*, the division between the main joint and the subjoint with the glabrous setæ can not be discerned with certainty in the first joint but is plainly observed in the others, and of the four setæ on the basal subjoint the two lower ones are more than twice as long as the upper ones. — In one specimen of *K. siamensis* the basal joint is preserved (pl. 4,

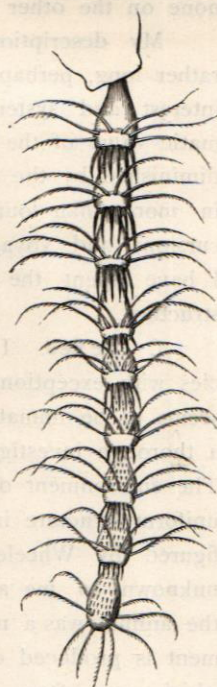


Fig. 1. *Koenenia Grassii*,
Flagellum.

fig. 2 g); it is more slender than in *K. angusta*, but offers no other point of interest, with the exception that its basal subjoint has at least six exceedingly short setæ on the lower side, but none on the other two thirds of its margin.

My description of the flagellum in the various species is rather long, perhaps too long in proportion to the morphological interest and systematic value of this organ. And the systematic value of the differences between the species is very much diminished by the fact, that the flagellum is partly or wholly lost in more than four fifths of the animals brought home from excursions and voyages. Nevertheless I think it justifiable that I have spent the space necessary to describe its complicated structure.

f. Sexes. I have examined adult females of all my species with exception of *K. chilensis*, of which the single specimen seems to be immature (it was flattened much from pressure and a thorough investigation of the area in question was impossible). The environment of the female genital aperture presents a rather uniform structure in the species known to me (the genital valves figured by Wheeler op. cit. p. 845 and belonging to a species unknown to me are very aberrant, but I do not know whether the animal was a male or a female). The second abdominal segment is produced downward and somewhat backward into a lobe, which seen from in front is broadly triangular, and its end is generally more or less incised in the median line. The lower surface of this second segment faces downward and much forward; this surface and the lobe are adorned with hairs, the number and arrangement of which offer specific characters (comp. f. inst. fig. 1 f, fig. 2 f. and fig. 3 f. on pl. 4). The third segment is anteriorly on the ventral side produced into a lobe, which seen from the side is triangular and terminates in a ventral process; examined from below it is perceived with more or less difficulty that in reality a pair of processes with a narrow incision between them is present; the lobe is adorned posteriorly with two pairs of short hairs.

Among the specimens of all the species I found but one which certainly is a male. This specimen belongs to *K. Wheeleri*. Fig. 1 a on pl. 3 exhibits the surroundings of the genital aper-

ture in the female (the figure terminates behind at the beginning of the fourth segment); fig. 1 b exhibits — with the same degree of enlargement — the same surroundings in the male (the figure embraces besides the major part of the fourth segment with its ventral pouch (p) and the hairs and setæ on the left side). A comparison between these two figures shows the very pronounced difference between the two sexes. The lobe from the third segment is distally considerably thicker in the male than in the female and adorned with double the number of longer hairs; in the female the two usual terminal processes are slender and close to each other, while in the male the lobe is deeply divided into two rather distant thick processes. The lobe from the second segment is proximally much thicker in the male than in the female; the distal part of the lobe is formed almost similarly in both sexes, but with fewer and much longer hairs; the front wall of the lobe presents as usual no protuberances in the female, but in the male we find in front of and above the distal part of the lobe five pairs of slender subcylindrical processes and two pairs of big, distally rounded processes, each of all seven pairs terminating in a stiff seta; and all these fourteen processes form almost a bundle which on the sides and especially in front surrounds the distal part of the lobe. The difference in the genital lobes between the two sexes of *K. Wheeleri* is thus a very great one, and it is to be expected that a rather similar or perhaps another curious structure exists in the males of the other species. And it must be mentioned that I have discovered no other external difference between the two sexes, either in the body, in the legs, in the number and arrangement of hairs or in the dimensions — and only one organ of the male, the flagellum, is unknown to me.

In our present state of knowledge I have found it impossible to discover an explanation of the fact, that the collectors — with exception of Prof. WHEELER — have captured only females (and immature specimens), and it is, indeed, very surprising that Dr. SILVESTRI, Mr. BÖRNER and I, who in all have captured between 150 and 200 specimens of *K. mirabilis*, have not met with one single male! Whether Prof. GRASSI really has seen any male specimen has now become doubtful to me.

In a rather large but immature specimen of *K. siamensis* the genital lobes are fully developed, there is an impression, but no real slit — no genital aperture — between them, and their hairs are less numerous than in the adult female; furthermore the hairs on the ventral surface of the fourth, fifth and sixth segments are reduced in number with one pair or with two pairs, and the eleventh segment has only eight setæ, while ten are present in the adult. Similar reduction is certainly found in immature specimens of all species.

g. Characters and their value. Of all the differences between the species examined by me the presence or absence of abdominal ventral sacs is, in my opinion, the most curious. But being unable to combine this feature with other characters I thought it most correct not to establish a genus for the reception of the American species which possess these sacs. On the preceding pages attention has been drawn to a series of characters: number and shape of the lateral sense-organs on the head, differences in the structure and number of joints in the flagellum, differences in the number and arrangement of the hairs on the ventral side of the second abdominal segment with its genital lobe, differences in the place of insertion of the stiff seta on the third metatarsal joint of the first pair of legs, differences in the length of the sensory seta on the metatarsus of the last pair of legs.

But it may perhaps be convenient to mention the other characters I have found.

The number of processes or teeth on the two fingers of the antennal chela offers apparently a character: in some species I have found nine, in others only eight well-developed teeth on each finger — always the same number on both fingers — besides one or two which are quite rudimentary. Furthermore the shape of the teeth offers some difference: in *K. Wheeleri* the teeth (pl. 2, fig. 2 c), the distal ones excepted, are rather broad and present on the proximal side a feeble incision at a short distance from the acute apex, so that a secondary very small apex is formed on the posterior margin. In *K. angusta* (pl. 4, fig. 1 c) this feature is more feebly developed, and in *K. Grassii* (pl. 4, fig. 3 d) it is not found, all the teeth being slender with

obtuse apex. But these differences in the number and especially in the shape of the teeth — or spines, as they are named in the descriptions of the species — are always rather slight and difficult to observe with certainty (the chela must be cut off and its fingers removed somewhat from each other by preparation) and therefore of slight value as distinctive character between the species. But other species hitherto unknown may perhaps possess another number of teeth.

Among the appendages the palpi and the first and the last pairs of legs offer very practical and solid characters, not only in the difference between length in proportion to thickness in some of the joints (f. inst. the tibia in the palpi and in the first pair of legs, the last tarsal joint in the first pair of legs), but besides in the relative length of two joints in the same appendage, and in this respect the joints in the metatarsus and tarsus of the palpi and of the last pair of legs are very valuable and must be drawn with care in all species. And in more than half-grown immature specimens I have found the same differences between the length of the joints as in the adult animals. That the thickness of the appendages is rather different in various species is easily seen on the plates, but this is most easily apprehended and described by pointing out the proportion between length and thickness (both dimensions measured) in some of the joints. — In the number of joints in the appendages all species agree with *K. mirabilis*.

The large sternum between the first pair of legs is in all species adorned with a lesser number of short, plumose hairs. The number of these hairs varies much from species to species, but very little or — when the number is low — not at all between specimens of the same species, and the arrangement of the hairs is also very different. A comparison between several figures (fig. 1 a and 2 a on pl. 2, fig. 2 b and 3 c on pl. 3, fig. 2 a on pl. 4) elucidates these differences which offer practical characters.

The hairs and setæ on the ventral side of the abdomen present excellent characters in the adult animals. The hairs on the second segment and its lobe have been already mentioned. The fourth, fifth and sixth segments — and to a lesser degree

the seventh — are adorned very differently in some of the species, and none of my species agrees completely in this respect with another. — An examination of several specimens of some of the species gave the result that the individual variation between adult specimens in the number of hairs was at most very slight, and that long and especially stiff hairs and setæ only in one case (the group on the fourth segment in *K. mirabilis*) varied in number, and the difference was as slight as possible. Furthermore the three last segments present a specific character: in three of the species these segments have one of their setæ in the ventral median line, but in the three other species (*K. mirabilis*, *K. chilensis* and *K. Grassii*) this seta is wanting. The last segment in *K. Grassii* has only seven long setæ, in the other species the number is a little higher and the greatest number, ten setæ, is found in *K. angusta* and *K. siamensis*. But these setæ are often not easy to count with certainty.

It may be inserted here that the middle portion of the side of the second to sixth abdominal segments lacks hairs (pl. 2, fig. 2 h; pl. 4, fig. 2 e). And I must rectify an error in fig. 3 (and the corresponding sentence on p. 232) in the paper of HANSEN and SØRENSEN: the median one of the lateral hairs on the second to the sixth segment shall be omitted.

Before ending this chapter another thing may be mentioned. The exact dorsal limitation of the two free thoracic segments is better studied on animals treated with caustic potash than on specimens in the normal condition. The material of my new species is rather scarce, and I found it unnecessary to sacrifice specimens for the study of the cephalothorax, as no difference of any importance seems to exist. But fig. 1 a on pl. 4 elucidates the feature that sometimes the thorax is reduced in length by contraction to such a degree, that the median portion of the wall of the head overlaps even the anterior part of the last thoracic segment, while fig. 1 b exhibits a specimen with distended cephalothorax, in which both thoracic segments are quite free. (The limits between the segments and the connecting membrane were not visible on the object delineated). In the shape of the head I find small differences between the specimens, but generally they are difficult to describe and of very little value, and

for these reasons they are omitted. In the structure of the mouth I found no difference worth mention.

IV. Geographical Distribution.

It is proved here that the order *Palpigradi* has a wide distribution: southern half of Italy, Tunis, Siam and America from Texas to Paraguay. But only as to one species, *K. mirabilis*, it is possible to speak of a certain and yet moderately extended geographical range, viz. Roma, Calabria, Catania, Palermo and Souk el Arba in Tunis; each of the other species has been only found, as yet, in one locality. Our present knowledge of the species and their occurrence is certainly still very rudimentary, but I wish to emphasize the extreme improbability of finding the Italian form in remote parts of the world. *Koenenia*, *Pauropus*, *Scolopendrella*, *Fapyx*, *Campodea* are generally considered by Zoologists as very ancient types; several authors have written that this antiquity should be connected with a very wide distribution over remote parts of the world of at least one of the European species of each of the groups mentioned (viz. *Koen. mirabilis*, *Pauropus Huxleyi* LUBB., *Scolopendrella immaculata* NEWP., *Fapyx solifugus* HALIDAY and *Campodea staphylinus* WESTW.). But I believe that most and perhaps all statements about this wide range of a species are quite wrong, originating from insufficient knowledge of the species or insufficient study of the specimens. Here I prove this as to the order *Palpigradi*, and I hope soon to publish other papers which shall prove the same on at least two of the other types. The wide geographical range of certain species of all the groups mentioned should be positively denied until the animals have been studied much better than they are at present — and then we shall certainly obtain results differing widely from those rather dogmatic statements now generally admitted.

V. Description of the Species.

Analytical Conspectus.

- I. On the ventral side of the abdomen a group of five or six spine-like setæ on the fourth segment and a protruding wart

with six procurved setæ on the sixth segment. Only one sense-organ on each side of the head.

1. *K. mirabilis* GRASSI (et CALANDRUCCIO).

II. On the ventral side of the abdomen no spine-like setæ on the fourth segment and no wart with setæ on the sixth segment. A group with two to four sense-organs on each side of the head.

A. Ventral sacs on the fourth, fifth and sixth abdominal segments. Legs more slender; last tarsal joint in the first pair more than four times longer than thick.

a. The palpi have the second metatarsal joint only a little longer than the first and not twice as long as thick. In the first pair of legs the tibia is not three times longer than thick; the third metatarsal joint is much longer than the fourth, with the stiff seta inserted at the apex. The flagellum is moderately robust with fifteen joints.

2. *K. Wheeleri* RUCKER.

b. The palpi have the second metatarsal joint much longer than the first and more than twice as long as thick. In the first pair of legs the tibia is more than three times longer than thick; the third metatarsal joint is not longer than the fourth, with the stiff seta inserted at its middle. The flagellum very slender with thirteen joints.

3. *K. chilensis* n. sp.

B. No ventral sacs on any abdominal segment. Legs more robust; last tarsal joint in the first pair at most three and a half times longer than thick.

a. Fourth, fifth and sixth abdominal segments each with at most two pairs of longer hairs on the ventral side, and in the fourth segment the two hairs of the pair next to the median line are rather or very distant from each other. A ventral median seta in the three posterior abdominal segments.

α. Sternum anterius with only three hairs arranged in one transverse row. The palpi have the second metatarsal joint conspicuously thicker

than long and the last tarsal joint much longer than the two preceding ones together. The stiff seta on the third metatarsal joint in the first pair of legs is inserted at the base of the joint. The sensory seta on the metatarsus of the last pair of legs reaches about to the middle of the last tarsal joint. 4. *K. angusta* n. sp.

β. Sternum anterius has seven hairs arranged in four transverse rows. The palpi have the second metatarsal joint a little longer than thick and the last tarsal joint considerably shorter than the two preceding ones together. The stiff seta on the third metatarsal joint in the first pair of legs is inserted at the middle of the joint. The sensory seta on the metatarsus of the last pair of legs reaches only a little beyond the end of the metatarsus.

5. *K. siamensis* n. sp.

b. Fourth and fifth abdominal segments each with four pairs of long setæ on the ventral side and the sixth segment with three pairs, the two setæ of the pair next to the median line rather near each other. No ventral median seta in the three posterior abdominal segments. (The flagellum with nine joints).

6. *K. Grassii* (SILVESTRI in litt.), n. sp.

1. *Koenenia mirabilis* GRASSI (et CALANDRUCCIO).

Pl. 2, fig. 1 a—1 f.

1885. *Koenenia mirabilis* GRASSI (and CALANDRUCCIO), Naturalista Sicil., Anno IV, 1885 (fourteen pages).

1886. » » GRASSI, Bull. d. Soc. Ent. Ital. Anno XVIII, 1886, p. 153—172, Tav. IX—X.

1898. » » HANSEN and SÖRENSEN, Entom. Tid-

skrift, Stockholm, Årg. 18, 1897, p. 223—40, Taf. IV.
1901. *Koenenia (Eukoenenia) mirabilis* C. BÖRNER, Zool. Anzeiger B. XXIV, No. 652, 16 Sept. 1901, p. 537—56.

Material. A good number of well preserved females, but no male, have been examined.

Head. The frontal sense-organ is rather slender, almost two and a half times longer than broad; the rami with acute apex. On each side only one lateral sense-organ which is proportionately thick, on an average about two and a half times longer than thick and with subacute or obtuse end. — The large sternum has a posterior transverse, considerably recurved row of five or six hairs (fig. 1 a), close in advance thereof a hair in the median line, and from this hair proceeds on each side a row with two hairs outward and forward (often more forward than in the figure) towards the base of the palpus.

Chela. Each finger has nine slender spines, the distal one somewhat thicker but not longer than the others; none of the spines with any perceptible rudiment of a subapical incision.

Palpi slender. The tibia is a little more than three times longer than thick. The second metatarsal joint is about one third longer than the first and slightly more than twice as long as thick; the first tarsal joint is somewhat shorter than the second, the last joint somewhat shorter than the two preceding joints together.

Legs slender. The first pair has the tibia nearly three times longer than thick; the third metatarsal joint is about as long as the fourth, and its stiff seta is inserted at the middle; the last tarsal joint is five times longer than thick. — The last pair of legs has the metatarsal joint a little longer than both tarsal joints together, its sensory seta is inserted about at the end of the first fourth of the joint and reaches almost to the base of the tarsus; the first tarsal joint is one third shorter than the second.

Abdomen. Ventral sacs are wanting. The fourth segment on the ventral side with a median group of five or six robust spine-like setæ set on a low protuberance close to each other

in two transverse rows (with three or four setæ in the anterior row); besides between this group and the naked lateral part of the segment two rather long and two short hairs, the long hairs shortly removed from each other and the submedian somewhat removed from the median group. The fifth segment has on its ventral side four pairs of hairs, the two pairs nearest to the middle are longer than the others, the distance between the two hairs of the pair next to the median line is about twice as long between one of them and the following hair. The sixth segment has on the ventral side a median rather high protuberance adorned with a transverse somewhat arched row of six robust setæ, which project downward and are curved forward; between this protuberance and the side only two hairs. The three posterior segments are without any median seta; the last segment has eight setæ in all.

Flagellum. It consists of thirteen joints and is moderately robust (fig. 1 c). The first joint is without its basal subjoint almost two thirds longer than thick, the subapical joint is two and a half times longer than thick (fig. 1 e). The three proximal joints and the fifth, the seventh and the ninth joints have a subapical whorl of proportionately long, glabrous setæ; the last joint with a subapical whorl of four long setæ.

Sexual characters. Female. The ventral surface of the second abdominal segment (fig. 1 b) has three pairs of hairs; a single pair of shorter hairs is inserted at the margin of the genital lobe, and this margin is adorned with four pair of hairs; the two pairs nearest to the middle short, the two other pairs very much longer.

Length. An adult female measured 1.2 mm. without flagellum, which seems to be somewhat longer than the abdomen, but somewhat shorter than the whole body².

² Mr. BÖRNER writes: »Die Länge des angewachsenen Thieres (♀) schwankt zwischen $\frac{3}{4}$ und $1\frac{1}{2}$ mm. ohne das Flagellum, das ebenso lang werden kann wie das Abdomen». The contracted specimen he lent me has probably in natural condition been only little more than .75 mm., but the flagellum, which is well preserved, is absolutely somewhat longer than the abdomen, when this was straight. And GRASSI writes on the flagellum (p. 158): »la quale è lunga presso a poco come il resto del corpo», which in all probability is more correct than Mr. BÖRNER's statement.

Locality. Southern half of Italy: Roma (SILVESTRI), Palmi (HANSEN, BÖRNER), Scilla (HANSEN), Catania (GRASSI, BÖRNER), Palermo (SILVESTRI). Besides in Tunis at Souk el Arba (SILVESTRI). (On the nature of the localities where the animal lives I refer to the communications in the papers of GRASSI and of HANSEN et SÖRENSEN).

2. *Koenenia Wheeleri* RUCKER.

Pl. 2, fig. 2 a—2 l; pl. 3, fig. 1 a—1 b.³

1900. *Koenenia mirabilis* WHEELER, The American Naturalist, Vol. XXXIV, Nov. 1900, No 407, p. 837—850 (the animal described on p. 845 excepted).

1901. *Koenenia Wheeleri* A. RUCKER, The American Naturalist, Vol. XXXV, August 1901, No 416, p. 615—630.

1901. *Koenenia (Prokoenenia) Wheeleri* BÖRNER, Zool. Anzeiger, B. XXIV, No. 652, 16 Sept. 1901, p. 551 (footnote).

Material. Six well-preserved specimens, five of which were adult females and one an adult male, have been examined.

Head. The frontal sense-organ is scarcely more than twice as long as broad; the branches with acute apex. Four sense-organs in each lateral groups (fig. 2 b); each organ on an average three times longer than broad, with acute apex. — The large sternum (fig. 2 a) has posteriorly a straight transverse row of eight hairs, close in advance thereof a hair in the median line, and from this hair proceed a pair of oblique irregular rows of three hairs outward and much forward. (One may also say that these seven hairs in advance of the posterior row are arranged in four transverse lines, the posterior of them with one hair, each of the three others with two hairs).

Chela (fig. 2 c). Each finger has eight robust, acute spines, the distal one conspicuously larger than the following ones; the more proximal spines have a small cleft on the proximal margin.

³ As to the name of this species on the plates the reader is referred to the postscript, p. 232.

Besides on the fixed finger two rudimentary spines and on the movable finger a sharp angle instead of a spine.

Palpi (fig. 2 d). They are rather slender. The tibia is nearly three times longer than thick. The second metatarsal joint is a little longer than the first and not twice as long as thick. The first tarsal joint is considerably shorter than the second, and the third joint is about as long as the first and the second together.

Legs. Rather slender. The first pair (fig. 2 e) has the tibia not three times longer than thick; the third metatarsal joint is much longer than the fourth, with its stiff seta (s) inserted close to the apex; the last tarsal joint is a little more than four times longer than thick. — The last pair of legs (fig. 2 g) has the metatarsus (m) as long as both tarsal joints (ta) together, its sensory seta is inserted towards the middle of the joint and reaches a little beyond its end; the last tarsal joint is almost twice as long as the first.

Abdomen (fig. 2 i and 2 h). Ventral sacs (p) are well developed on the fourth, fifth and sixth segments; the distance between the sacs of the same pair is in the fourth and fifth segments about twice as long as the slit, in the sixth segment somewhat shorter. On the fourth and the fifth segments are inserted three pairs of long, robust, plumose setæ between each pair of sacs and a little in advance of them; the three hairs on the same side of the median line are arranged in a transverse row, but rather close to each other, while the distance between the two hairs of the pair next to the median line is somewhat longer, but yet rather short. In front of each sac and close to it we find in all three segments four somewhat shorter and more slender hairs and between these and the naked side of the abdomen still two shorter hairs. Thus the ventral side of the fourth and the fifth segments possesses nine pairs of hairs (and setæ), on the sixth segment only six pairs, the three long pairs between the sacs being absent. — The three posterior segments (fig. 2 i) have a seta in the median line; the last segment has nine setæ.

Flagellum (fig. 2 k and 2 l). It contains normally fifteen joints (on the number found by WHEELER see above p. 210) and is moderately robust. Its first joint, without the basal subjoint,

is scarcely more than one half longer than thick, the subapical joint only a little more than twice as long as thick. The three proximal joints and the fifth, the seventh and the ninth joints have a subapical whorl of proportionately long, glabrous setæ; the terminal joint with a subapical whorl of seven long plumose setæ (fig. 21).

Sexual characters. Female. The ventral surface of the second abdominal segment with its lobe has together eleven (or twelve) pairs of hairs (fig. 21 and pl. 3, fig. 1 a); four pairs of these are short and inserted at or on the margin of the lobe, and four other pairs are arranged in two rows directed upward and inward, thus converging forward; the lobe of the third segment — as usual — with two pairs of hairs posteriorly, and the two terminal processes are close to each other, slender, with their apex almost obtuse. — Male (pl. 3, fig. 1 b). The inferior part of the second segment with the proximal part of the lobe is much thickened and adorned on the sides and especially in front of the distal part of the lobe with five pairs of slender, subcylindrical processes and two thick, distally rounded processes; each of these fourteen processes terminates in a stiff seta; the ventral surface of the segment has outside and in front of these processes about eight pairs of hairs; the lobe of the third segment is deeply divided into two rather distant processes which are much thicker than in the female, and the lobe has posteriorly and at the end four pairs of partially long hairs.

Length. An adult female measured 1.25 mm. and its flagellum .88 mm.; another female and an adult male are 1.18 mm. in length.

Locality. At Austin, Texas, where it is common (W. M. WHEELER, who in the paper mentioned above gives good information (p. 848) on the natural conditions under which the animals live).

3. *Koenenia chilensis* n. sp.

Pl. 3, fig. 2 a—2 i.

Material. A single specimen is seen; it was sent to me in three microscopical preparations (all with glycerine); one of

them contained the flagellum, which was somewhat flattened, another contained a few of the appendages and the third the animal, which had its thorax crushed and the abdomen flattened by the pressure of the glass-cover. The animal is scarcely adult, but the genital region was pressed so that I do not venture to pronounce a final judgment.

Head. The state of preservation does not allow me to say anything about the frontal sense-organ. Of lateral sense-organs two were found on the one side (I do not think that any was broken off, but this is not certain) and they (fig. 2 a) are elongate, about four and a half times longer than thick, with acute and even acuminate apex. — The large sternum has eight hairs (fig. 2 b) arranged as four pairs: four hairs stand as at the four angles of a rectangle which is somewhat longer (in the direction of the median line of the animal) than broad, the two other pairs form a trapezoid within the rectangle.

Chela. Each finger has eight spines and a rudimentary one; the distal spine is not longer or thicker than the next; all the spines with exception of the distal one seem to be slightly trifid, the median elongation being the longest.

Palpi (fig. 2 c). They are slender. The tibia is more than three and a half times longer than thick. The second metatarsal joint is much longer than the first and more than twice as long as thick. The first tarsal joint is somewhat shorter than the second, and the third joint is conspicuously shorter than the first and the second together.

Legs. They are slender. The first pair (fig. 2 d) has the tibia more than three times longer than thick; the third metatarsal joint is not longer than the fourth, with the stiff seta (s) inserted at the middle; the last joint is about five times longer than thick. — The last pair of legs (fig. 2 e) has the metatarsus a little shorter than the two tarsal joints together, its sensory seta (s) is inserted towards the middle of the joint, but being broken its length is uncertain; the first tarsal joint is two thirds as long as the second.

Abdomen (fig. 2 f). Ventral sacs (p) are well developed on the fourth, fifth and sixth segments; the distance between the sacs of the same pair is a little shorter than the length of each slit. In ad-

vance of each slit I found — in this scarcely adult specimen — three long, robust hairs, the innermost of them a little nearer to the median line than the end of the split, and just outside and a little behind the lateral end of each slit is inserted a fourth shorter hair; on each of these three segments only these four pairs of ventral hairs were discovered. — The three posterior segments have no seta in the median line; the last segment has eight setæ.

Flagellum (fig. 2 g, 2 h and 2 i). It contains thirteen joints and is very slender. The joints are much constricted at their base and more or less elongate with exception of the two last ones. The first joint, though flattened from pressure, is yet without the basal subjoint twice as long as thick, the eighth more than four times, the penultimate about two and a half times longer than thick. The three proximal joints and the fifth and the seventh joints with a subapical whorl of proportionately very short and thin setæ; the last joint without a subapical whorl, but terminating in a single long seta (only the basal part of this seta is drawn in fig. 2 i).

Sexual characters. As already mentioned the specimen is probably immature and certainly a female. As all the hairs met with in the adult are yet scarcely present and the parts in question damaged by pressure no description will be given, but the reader is referred to the figure (2 f), which exhibits what is observed.

Length. The body measures .9 mm. in length, the flagellum 1.24 mm.

Locality. Viña del Mar at Valparaiso (Chile), April 13 1899 (Dr. F. SILVESTRI).

4. *Koenenia angusta* n. sp.

Pl. 3, fig. 3 a—3 h; pl. 4, fig. 1 a—1 f.

Material. Six adult females, well preserved, with the exception that only a part of a flagellum is present.

Head. The frontal sense-organ (fig. 3 a) is scarcely twice as long as broad, the rami are robust with almost obtuse end. The lateral groups (fig. 3 b) with three organs, which are four times to four times and a half longer than thick, with acute end. — The

large sternum has only three hairs arranged in a transverse row (fig. 3 c).

Chela (fig. 1 c). Each finger with eight well developed spines and a rudimentary one. The distal spine is slightly larger than the following, and a number of the spines have an accessory very small apex on the proximal margin.

Palpi (fig. 3 e). They are robust and proportionately short. The tibia is only slightly more than twice as long as thick. The second metatarsal joint is somewhat longer than the first and conspicuously shorter than thick; the first tarsal joint is somewhat shorter than the second, and the third joint is much longer than the first and the second together.

Legs. They are robust and proportionately short. The first pair (fig. 3 f) has the tibia scarcely twice as long as thick; the third metatarsal joint is slightly longer than the fourth, with its stiff seta (s) inserted near the base; the last tarsal joint is scarcely three and a half times longer than thick. — The last pair of legs (fig. 3 h) has the metatarsus (m) scarcely longer than the last tarsal joint; its sensory seta (s), which is exceedingly long, is inserted near to the base and reaches almost to the middle of the last tarsal joint; the first tarsal joint is about one fourth shorter than the second.

Abdomen. It is more elongate and narrower than in any of the other species, and some specimens are more slender than that exhibited in fig. 1 a. Ventral sacs are wanting. The ventral side of the fifth and sixth segments (fig. 1 d) has two pairs of rather long and two sublateral pairs of short hairs; the two setæ on either side of the middle line being separated from each other by less than twice the distance between each and the seta next to it on the outer side. The fourth segment has two pairs of short sublateral hairs but only one pair of longer hairs, and the distance between the longer hairs is longer than between the inner pair, but shorter than between the outer pair on the fifth segment. — The three posterior segments have a seta in the median line; the last segment has ten setæ.

Flagellum (fig. 1 e). Only five joints are preserved in a single specimen. They are shorter and much thicker than in any of the preceding species. The basal joint is slightly longer

than thick, and the glabrous setæ in the subapical whorl are moderately long and robust. The figure exhibits an anomaly in structure described on p. 211, to which the reader is referred.

Sexual characters. Female. The ventral surface of the second segment (fig. 1 f) has five pairs of longer hairs, and the two anterior pairs are arranged in a transverse line, a feature which offers an excellent specific character. The sexual lobe has close to and on the margin four pairs of short hairs.

Length. The specimen drawn in fig. 1 a is .84 mm. long, the longest specimen is .94 mm. long (the abdomen .63 mm. long and only .15 mm. thick).

Locality. Island Koh Chang in the Bay of Siam, under stones, Jan. 7. and 17. 1900 (Dr. TH. MORTENSEN leg.).

5. *Koenenia siamensis* n. sp.

Pl. 4, fig. 2 a—2 i.

Material. One adult female and two immature ones, one larger and one rather small; all were well preserved, but the flagellum almost totally wanting.

Head. The frontal sense-organ is very robust, certainly larger and thicker than in *K. angusta*, the branches with the end more or less obtuse, but it was impossible to measure the organ (without undertaking a dissection). The lateral groups with three organs shaped as in *K. angusta*. — The large sternum with seven hairs (fig. 2 a) which may be said to be arranged in four transverse rows: posteriorly two hairs near to each other, considerably in advance thereof one hair, and then two pairs obliquely in advance of each other, and the distance between the hairs of the same pair very much longer than in the posterior pair.

Chela. Each finger has nine normal, rather slender spines and a rudimentary one; the distal spine is conspicuously larger than the following, and most of the spines with an accessory small apex on the proximal margin.

Palpi (fig. 2 b). They are rather thick. The tibia is slightly more than twice as long as thick. The second meta-

tarsal joint is somewhat longer than the first and a little longer than thick; the first tarsal joint is conspicuously longer than the second, the third joint is considerably shorter than the first and the second together.

Legs. They are more slender than in *K. angusta*. The first pair (fig. 2 c) has the tibia two and a half times longer than thick; the third metatarsal joint is slightly longer than the fourth, with its stiff seta (s) inserted at the middle: the last joint is scarcely three and a half times longer than thick. — The last pair of legs (fig. 2 d) has the metatarsus as long as the second tarsal joint plus the half of the first, its sensory seta (s) is inserted equidistant from the base and the middle of the joint and reaches a little beyond its distal end; the first tarsal joint is about two thirds as long as the second.

Abdomen (fig. 2 e and 2 f). Ventral sacs are wanting. The ventral side of the fourth, fifth and sixth segments has two pairs of longer hairs and two pairs of short sublateral hairs; the longer hairs of the pair nearest to the median line are very distant from each other, in the fourth and fifth segments about three times further from each other than the distance between the two longer hairs on the same side. — The three posterior segments have a seta in the median line; the last segment has ten setæ. (Even in the largest of the immature specimens the hairs and setæ are reduced in number: the lateral pair of short hairs is wanting in the fourth, fifth and sixth segments, the three posterior segments have no median ventral seta, and the last segment has only eight setæ).

Flagellum. It is quite wanting in the adult, but in the largest of the immature specimens the basal joint (fig. 2 g) is present: the length (without the basal subjoint) exceeds the thickness by one half.

Sexual characters. Female: The ventral surface of the second segment (fig. 2 f and fig. 2 i) has five pairs of longer hairs, and the first pair is inserted considerably in advance of the next; besides five pairs of very short hairs are found at the apical part of the sexual lobe.

Length. The adult specimen is about 1 mm. long.

Locality. Island Koh Chang (off Siam), under stones, Jan. 7, 1900 (Dr TH. MORTENSEN leg.).

6. **Koenenia Grassii** (SILVESTRI in litt.), n. sp.

Pl. 4, fig. 3 a—3 f.

Material. Of this small species an adult female and a young specimen are examined; both were intact (save the want of the flagellum), but the integuments of the legs and the sternum were partly wrinkled (probably owing to the influence of strong alcohol) and therefore the thickness of some of the joints could not be measured and the arrangement of the hairs on the sternum could not be understood. Only the adult is described.

Head. The frontal sense-organ (fig. 3 b) is elongate, almost three times longer than broad, and the rami with very acute apex. In each lateral group (fig. 3 a) three sense-organs, which are very long and slender, about six times longer than thick and partly acuminate with acute apex. — On the sternum eight hairs were present (fig. 3 c), but judging from the irregular arrangement two or three were probably broken off; the irregular folding of the skin prevented a precise comprehension of this part, and the figure exhibits the hairs in the position observed, it being too dangerous to attempt a reconstruction of their normal arrangement.

Chela (fig. 3 d). Each finger has nine slender spines; the distal one is scarcely larger than the following; all have the apex obtuse and none of them an accessory apex; on the fixed finger there is besides a quite rudimentary spine.

Palpi (fig. 3 e). They are very robust. The second metatarsal joint is shorter than the first and about as long as thick. The first tarsal joint is conspicuously shorter than the second; the third tarsal joint is much longer than the first and the second together.

Legs. They are more robust than in any of the other species. The first pair has the third metatarsal joint somewhat shorter than the fourth, and the stiff seta is inserted near its base; the last tarsal joint is a little more than three and a half times longer than thick. — The last pair has the metatarsus as long as the first tarsal joint plus the half of the second, its sensory seta is

inserted equidistant from the base and the middle of the joint and reaches very little beyond its distal end; the first tarsal joint is one fourth shorter than the second.

Abdomen (fig. 3 f). Ventral sacs are wanting. Fourth and fifth segments on the ventral side with four pairs of long and two pairs of short hairs, the sixth segment with only three pairs of rather long and two pairs of short hairs; in all three segments the long hairs are on each side arranged regularly in a transverse line, and the distance between the hairs of the pair next to the median line is scarcely twice as long as between two of the hairs on the same half. The three posterior segments have no seta in the median line; the last segment has only seven setæ.

Flagellum. It is wanting in my specimens, but the drawing given me by Dr. SILVESTRI and inserted on p. 211 conveys a satisfactory idea to the reader. The flagellum is very robust and contains only nine joints. The three proximal joints and the fifth and the seventh joints possess a subapical whorl of comparatively long glabrous setæ, while the fourth, the sixth and the eighth joints have a subapical whorl of much shorter setæ; the terminal joint as in *K. mirabilis* with two whorls of very long setæ, those in the subapical whorl as usual shorter than the others.

Sexual characters. — Female (fig. 3 f). The ventral surface of the second segment is adorned with seven pairs of longer hairs, the anterior pair is inserted considerably in advance of the second, and on each side four of the hairs are arranged almost in a row which is very oblique, directed forward and strongly towards the median line. Besides four pairs of short hairs at the end of the sexual lobe.

Length. The adult female is only .65 mm. long.

Locality. Tacuru Pucú (Alto Paraná, in Paraguay), July 1900 (Dr. F. SILVESTRI leg.).

Postscript.

In October a colleague showed me a note in »Nature» for Sept. 26. 1901, where it was stated that Miss A. RUCKER had

published further information on *Koenenia* in »The American Naturalist» for August. I attempted in vain to procure the number in question in due time. But later on (Nov. 2) I received a separate copy kindly sent me by Miss Rucker, and I am now able to insert a review just before the manuscript is sent to Stockholm. In the treatise itself I have only altered the name of the founder of *K. Wheeleri* and added the footnote on p. 198.

Miss AUGUSTA RUCKER's paper is entitled: The Texan *Koenenia* (The Amer. Naturalist, Vol. XXXV, August 1901, No. 416, p. 615—630; with six figures in the text). Miss R. proposes the name *K. wheeleri* for the species to which the larger specimens described by Prof. WHEELER belong, and her paper being published about one month before that of Mr. C. BÖRNER, the species must be named *K. Wheeleri* RUCKER instead of *K. Wheeleri* BÖRNER. (This alteration is made in my text, but the plates being finished before I saw the paper I could not alter the name on pl. 2 and pl. 3). Furthermore she proposes the name *K. parvula* for the small specimen described and partly figured by Prof. WHEELER and mentioned above on p. 195, but no further information is given on this curious species.

Miss RUCKER writes on p. 616: »In the beginning I may say we have been more fortunate than Drs. HANSEN and SÖRENSEN in being able to distinguish the two sexes. It hardly seems possible that the males of GRASSI's species could be so rare when they are so abundant in our species.» But this mode of writing is, speaking gently, rather bold. Prof. WHEELER believed that the male was the female; already in May, shortly after the arrival of the six specimens from Texas, I discovered the differences between the two sexes in *K. Wheeleri*. All the specimens of *K. mirabilis* seen by me are females, and Mr. BÖRNER, who has collected a rich material (several times more than I had secured) of this species in Southern Italy, has not found any male specimen. But if I should obtain new material with males and females of *K. mirabilis* (or any other of my species), I think to be able to distinguish the sexes. — Miss RUCKER writes besides on the same page: »A young Danish zoologist has recently found in Siam a distinct species of *Koenenia* which Dr. HANSEN

is to describe.» But when the author publishes this extract from one of my letters as a contribution to the knowledge of the distribution of the order, it had been very proper to publish more details from my letters to Prof. WHEELER and herself.

On p. 615—16 the author says: »*Koenenia* has since been found in Siam and Paraguay and, like all archaic types, it will doubtless be found to be cosmopolitan in its distribution.» Many curious things have been written on types supposed to be »archaic». It has not been proved by any palæontological fact that the order *Palpigradi* is a very old type, and I for one can not see that it necessarily must be so. Furthermore it is quite impossible to draw a conclusion as to the age of a type from the fact that it is cosmopolitan, or to conclude from the age to the extent of geographical distribution. Such groups as *Muscidæ*, *Oniscidæ* and other types have a world-wide geographical range, and they are scarcely considered as archaic forms. Several authors believe that the restricted distribution of some types is well explained by the assumption, that they are remnants of a comparatively ancient or even archaic fauna. The order *Symphyla* is perhaps a very old type, but I can scarcely believe that this is the case with the order *Pauropoda*; both types contain only small animals which live on the same localities, and both are probably almost cosmopolitan in their distribution. At the present time we know too little or nothing about many things, which it is necessary to be acquainted with before we are able to draw inferences as to several questions of this kind.

The major part of the paper deals with the internal anatomy of *K. Wheeleri*. Of this chapter no extract will be communicated here — with exception of some criticism of the statements on the ventral sacs and two other points — and I refer the reader to the treatise itself. When Mr. BÖRNER has published his paper on the anatomy of *K. mirabilis*, and when we have obtained more complete information on the internal structure of the *Pedipalpi* etc., it will be possible to compare the internal structure of the various orders of Arachnids.

MISS RUCKER spends about five pages on the description of the »external» anatomy of *K. Wheeleri*, especially pointing out the differences between the two sexes and most of the differences

between *K. Wheeleri* and the description (with figures) of *K. mirabilis* published by Dr. SÖRENSEN and myself. I will mention all main points as briefly as possible.

The author points out the existence of eight teeth on each finger of the antennal chela (p. 621), but when she describes the teeth on the fixed finger as very different in shape from those on the movable finger it is quite erroneous. It may be sufficient to refer the reader to my description above and to fig. 2 c on pl. 2. — On each side of the head she has discovered »three sensory rods», which are shown in fig. 4 (p. 621); they are figured as pillars of very different length and with their distal end shortly conical (rather like stalactites, as a colleague remarked), but this is very incorrect. I have found four organs on each side, and each of them is shaped almost as the lateral organ in *K. mirabilis*; the organs are shown in fig. 2 b on pl. 2.

The »lung sacs» discovered by Prof. WHEELER are mentioned (p. 620); the apertures, which are seen when the sacs are invaginated, have been observed, and in the chapter on the internal anatomy further information has been given. Here she writes (p. 626): »They are evidently evaginated through the internal blood pressure. For each pair of sacs there is a pair of dorso-ventral muscles, corresponding to the dorso-ventral muscles of *Thelyphonus*, which have the function in *Koenenia* of drawing in the everted sac appendages.» But in fig. 5 she has drawn four pairs of dorso-ventral muscles; without dissection I have been able to discern five pairs in *K. Wheeleri* (which has three pairs of sacs) and I have also found these muscles in *K. angusta*, a species without ventral sacs. The dorso-ventral muscles, which exist in almost all and perhaps in all orders of Arachnids, have in reality nothing to do with the sacs, but the contraction of all the pairs in the abdomen may perhaps cause a blood pressure which evaginates the sacs in *K. Wheeleri* and *K. chilensis*. Furthermore she writes that the sacs »possess on their inner surface (inner when they are evaginated) granular bodies . . .»; above I have written that I have been unable to discover any contents within them. On my material some of the sacs are evaginated as much as possible, and each contains a number of »granular bodies» spread very irregularly on the inner surface;

sometimes the number is very small, sometimes much larger; I considered them to be blood-corpuscles and other bodies of accidental origin, and they cover a small or an exceedingly small part of the inner surface. Therefore I did not consider them as contents really belonging to the sacs. Finally I will say that the interpretation of these pouches as lung sacs is not very probable, and that a new and more detailed study of them on fresh material is very desirable.

The author describes and figures the surroundings of the genital aperture in both sexes. But the description and the figure of the anterior genital lobe in the female is not correct; the essential fault is that too numerous setæ have been drawn, and that their position is partly erroneous. (I regret that I have not figured the distal part of the anterior genital lobe of almost all the species with a high degree of enlargement and in the same depressed position.) I am not able to understand the description and the figure of the ventral portion of the second abdominal segment in the male; both are misleading, and the author mentions only »ten papillæ», each terminating in a »spine», but I have discovered fourteen: my fig. 1 b on pl. 3 exhibits the seven processes belonging to the left side in their natural position, and the terminal portion of the lobe is also seen. Her description of the arrangement of the hairs on the second segment is wrong; the reader is especially referred to my mention of the ventral hairs on p. 224. — The description of the hairs and setæ on the ventral side of the fourth, fifth and sixth abdominal segments is correct; her fig. 1 exhibits the arrangement of these hairs rather well, but most of the hairs are drawn too long, and on the ninth, tenth and eleventh segments too few have been indicated. I mention these details because they offer specific characters.

Perhaps these critical remarks will be found a little too lengthy. But I have wished that the base, which I hope to have laid down for the systematic study of the forms of this difficult order, should be as solid as possible in all respects.

The author writes (p. 626): »I have succeeded in tracing the pair of tubular glands, »tapezzata d'un semplice strato di cellula epiteliali», of which GRASSI speaks. According to him,

these glands extend through a large part of the cephalothorax, and perhaps have their orifice in front of the third pair of limbs. These excretory organs in reality arise in the second segment of the abdomen, and after forming one or two convolutions run into and straight through the thorax, to terminate between the second and third pair of appendages. There being no Malpighian tubules in the small animal, this simple pair of coxal glands would seem to represent the only excretory organs, unless . . . » But she does not mention the following particulars. In the explanation of the plates GRASSI writes (p. 171): »glandola cefalotoracica (dorsale) omologa alla glandola del Krohn dei Falangidi». In the text and in footnotes on p. 234—235 HANSEN and SÖRENSEN have mentioned that the gland »which generally, though incorrectly, is called the Krohnian gland» in *Opiliones* is a stink-gland; it was discovered in *Op. Laniatores* and its secret mentioned by P. GERVAIS already in 1849; in 1867 it was ascertained by KROHN with regard to *Op. Palpatores*; later on W. SÖRENSEN and LOMAN have written on the gland. Furthermore we have said: »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 »*Arthrogastri*») just have their orifices on the sides of the cephalothorax and not — like the Malpighian tubes of the Insects — in the rectum». »And the structure of the afore-mentioned glands in *Koenenia* seems to be exactly the same as the excretory ones in *Opiliones*». It is clearly shown by these quotations that Miss RUCKER has only added some observations on the length and the place of the orifice of these glands, which certainly have been discovered by GRASSI, but incorrectly interpreted by him, while they have been mentioned and correctly interpreted by HANSEN and SÖRENSEN.

Miss R. mentions a pair of small diverticula from the thoracic and five pairs of larger diverticula from the abdominal part

of the intestine, and furthermore she writes: »The intestine and diverticula are invariably filled with food particles, which have the appearance of yolk granules». Dr. SÖRENSEN has asked me to state that at least as to the diverticula in the abdomen this is certainly incorrect (and I share his opinion). In his extensive treatise on the anatomy of *Opiliones Laniatores* (Naturh. Tidskrift, 3 R. B. XII, 1879) he has proved (p. 170—71) that the four pairs of large diverticula in *Op. Laniatores* are glands and not besides reservoirs for food; TULK (referred to by Dr. S.) has found no particles of food in the diverticula in *Op. Palpatores*. We think that the diverticula in question never contain food in any order of Arachnids.

Copenhagen, Nov. 4. 1901.

Explanation of the Plates.

Pl. 2.

1. *Koenenia mirabilis* GRASSI (et CALANDRUCIO); female.

- Fig. 1 a. Posterior part of the large cephalic sternum with its hairs, $\times 120$.
 — 1 b. Ventral surface of the second abdominal segment and the distal part of the genital lobe of the third segment (shaded with grayish tint), seen from below, $\times 165$. (From a preparation treated with caustic potash).
 — 1 c. Complete flagellum in contracted state of preservation, $\times 87$. Of the very long setæ in the whorls on the thickest part of the joints only two are drawn in each whorl.
 — 1 d. Sixth to tenth joint of the same flagellum, $\times 196$. The retraction of the basal part of the joints into the preceding joints is clearly seen, but the apical subjoints of the seventh and the ninth joints retracted into the main joint could not be drawn, and the suture between the basal part and the main joint in the eight and tenth joint is also omitted.
 — 1 e. The three last joints of the same flagellum, $\times 196$. The plumose clothing is omitted.
 — 1 f. Fourth to sixth joint of an extended and slightly flattened flagellum, $\times 145$; *p*. apical subjoint (with some of its glabrous setæ) separated by a narrow membrane from the main part (*a*) of the fifth joint; *q*. basal subjoint separated by a suture from the main part (*b*) of the sixth joint, which is somewhat longer than the fifth.

2. *Koenenia Wheeleri* A. RUCKER⁴; female.

- Fig. 2 a. Head seen from below, $\times 70$. The basal joint of the three anterior pairs of appendages on the left side of the figure and the coxæ of the fourth pair are drawn, but the limits between the sternal plates and the membranous skin are not indicated; *s*¹. frontal sense-organ.
- 2 b. The left group of lateral sense-organs seen half from the side, half from above, $\times 310$.
- 2 c. Distal half of the right antennal chela, seen from below (or behind), $\times 290$; *p*. process on the dorsal side adorned with a long seta, which is omitted.
- 2 d. Left palpus seen from the outer side (from behind), $\times 172$; *m*. metatarsus, *ta*. tarsus.
- 2 e. Left leg of first pair seen from the outer side (from behind), $\times 172$; *m*. metatarsus, *s*. its stiff seta, *t*. tactile hairs.
- 2 f. Biramous hair from the fourth metatarsal joint of the first pair of legs, $\times 390$.
- 2 g. Left leg of the last pair, seen from the anterior side, $\times 172$; *m*. metatarsus, *s*. its sensory seta, *ta*. tarsus.
- 2 h. Abdomen seen from the left side, $\times 52$; *p*. ventral sacs.
- 2 i. Abdomen seen from below (the first segment omitted), $\times 50$; *p*. ventral sacs.
- 2 k. Complete flagellum, $\times 78$; most of the very long setæ are omitted.
- 2 l. The two last joints of the same flagellum, $\times 184$.

Pl. 3.

1. *Koenenia Wheeleri* A. RUCKER (contin.).

- Fig. 1 a. Environment of the genital opening in the female, seen from the left side, $\times 200$; 2. second segment, 3. third segment.
- 1 b. Environment of the genital opening in the male, seen from the left side, $\times 200$; 2-4. second—fourth segments, *p*. ventral sac.

2. *Koenenia chilensis* n. sp. (probably immature).

- Fig. 2 a. Sense-organs of the lateral group on the left side of the head, $\times 350$.
- 2 b. Portion of the large cephalic sternum with the hairs, $\times 177$.
- 2 c. Distal part of the right palpus, seen from the outer side, $\times 116$; *m*. metatarsus, *ta*. tarsus.
- 2 d. Distal part of the left leg of the first pair, seen from the outer side (from behind), $\times 116$; *m*. metatarsus, *s*. the stiff seta on its third joint.

⁴ As to the name on the plates the reader is referred to the post-script, p. 232.

- Fig. 2 e. Distal part of the left leg of the last pair, seen from the front, $\times 116$; *s.* sensory seta on the metatarsus, *ta.* tarsus.
- 2 f. Abdomen in considerably flattened condition seen from below, $\times 67$; *p.* ventral sacs.
- 2 g. Complete flagellum, $\times 58$; the joints, especially the proximal one, somewhat flattened from pressure and many of the very long setae omitted, only their place of insertion being indicated.
- 2 h. Distal part of the fifth joint and the sixth to eighth joints of the same flagellum, $\times 140$; the very long setae omitted.
- 2 i. The three last joints of the same flagellum, $\times 140$; only the basal part of the terminal seta is drawn, the other very long setae are omitted.

3. *Koenenia angusta* n. sp.; female.

- Fig. 3 a. Frontal sense-organ of the head seen from above, $\times 430$.
- 3 b. The left group of lateral sense-organs, seen half from above, half from the side, $\times 430$.
- 3 c. Portion of the large cephalic sternum with the hairs, $\times 233$.
- 3 d. Right antenna seen from the inner side, $\times 156$.
- 3 e. Left palpus seen from the outer side, $\times 156$; *m.* metatarsus, *ta.* tarsus.
- 3 f. Left leg of the first pair seen from the outer side (from behind), $\times 156$; *m.* metatarsus, *s.* the stiff seta on the third metatarsal joint.
- 3 g. Left leg of the third pair seen from the front, $\times 156$.
- 3 h. Left leg of the last pair seen from the front, $\times 156$; *m.* metatarsus, *s.* its sensory seta, *ta.* tarsus.

Pl. 4.

1. *Koenenia angusta* n. sp.; female (contin.).

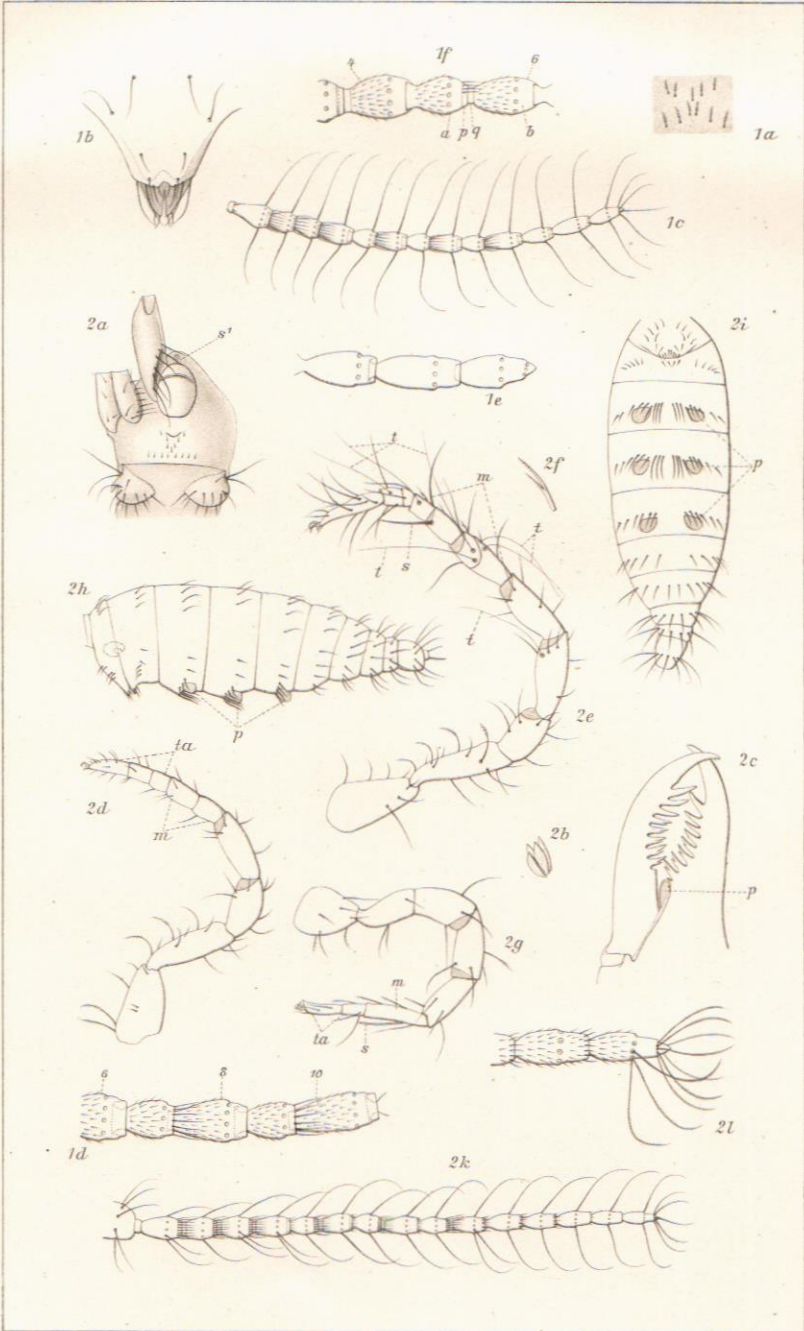
- Fig. 1 a. Body of a specimen with the cephalothorax contracted, $\times 50$; the basal joints of all appendages, with exception of the three posterior ones on the right side, and the proximal joints of the flagellum are also drawn.
- 1 b. Anterior part of the body of another specimen with the cephalothorax extended, $\times 80$; *s*¹. frontal sense-organ, *s*². lateral sense-organs of the head.
- 1 c. Distal part of the right chela, seen from below, $\times 366$.
- 1 d. Fourth to seventh abdominal segments, seen from below, $\times 70$.
- 1 e. Distal part of the abdomen with five joints of the flagellum, $\times 150$; third and fourth joints of the flagellum misshapen.
- 1 f. Median ventral part of second and third abdominal segments with the genital lobes, seen from below, $\times 200$.

2. *Koenenia siamensis* n. sp.; female.

- Fig. 2 a. Portion of the large cephalic sternum with the hairs, $\times 210$.
 — 2 b. Distal part of the right palpus, seen from the exterior side (from behind), $\times 130$; *m.* metatarsus, *ta.* tarsus.
 — 2 c. Distal part of the right leg of first pair, seen from the outer side (from behind), $\times 130$; *m.* metatarsus, *s.* its stiff seta.
 — 2 d. Distal part of the right leg of the last pair, seen from the front, $\times 130$; *s.* sensory seta on the metatarsus, *ta.* tarsus.
 — 2 e. Abdomen seen from the left side, $\times 48$.
 — 2 f. Abdomen seen from below, $\times 48$; the first segment is not marked off.
 — 2 g. End of the abdomen with the basal joint of the flagellum of an immature female, $\times 134$.
 — 2 h. Genital lobes seen from the side, $\times 150$.
 — 2 i. Median ventral part of second and third abdominal segments with the genital lobes, seen from below, $\times 125$.

3. *Koenenia Grassii* (SILVESTRI in litt.), n. sp.; female.

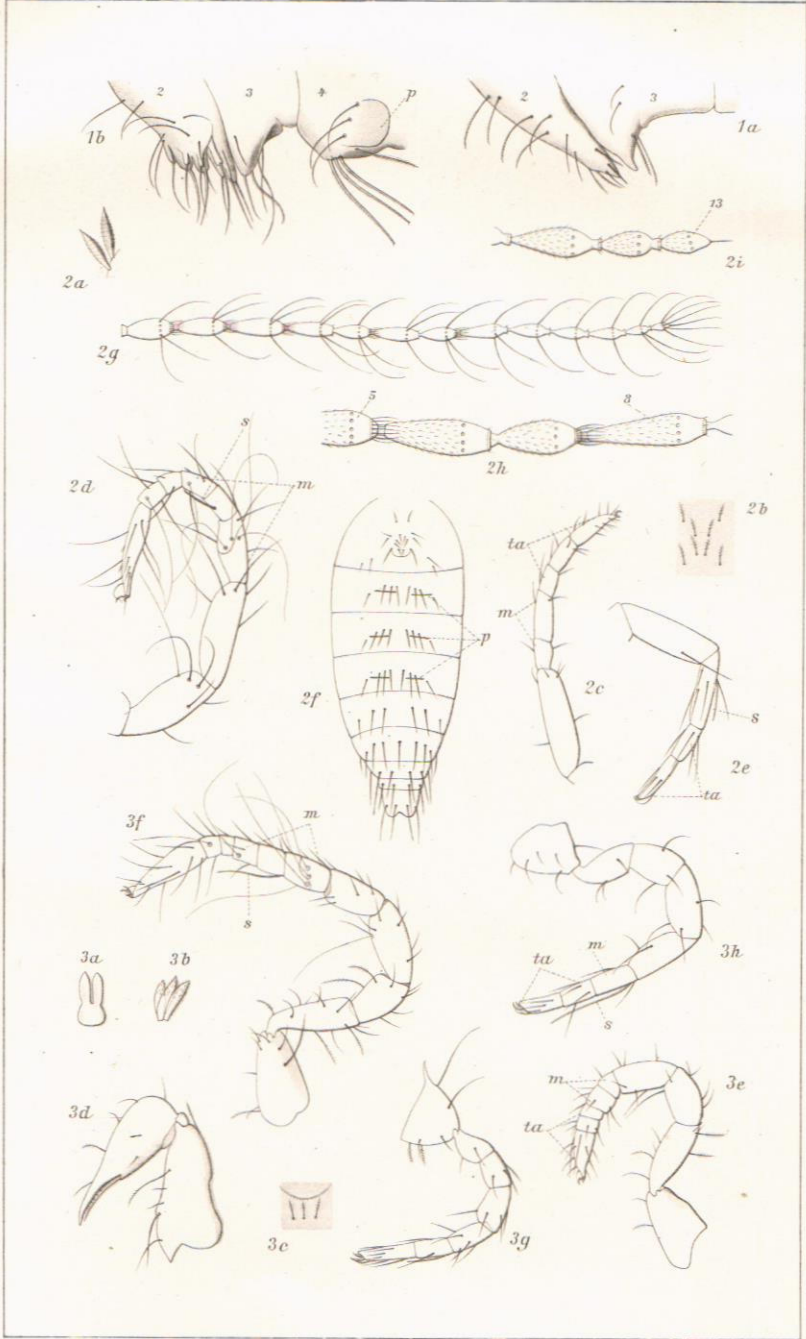
- Fig. 3 a. The left group of lateral sense-organs, $\times 340$.
 — 3 b. Frontal sense-organ, seen from above, $\times 340$.
 — 3 c. Portion of the large cephalic sternum with the hairs, $\times 230$; on their irregular arrangement see above on p. 230.
 — 3 d. Distal part of the left chela seen from below, $\times 356$.
 — 3 e. Distal part of the left palpus seen from the outer side (from behind), $\times 186$.
 — 3 f. Abdomen, seen from below; the first segment is not marked off.



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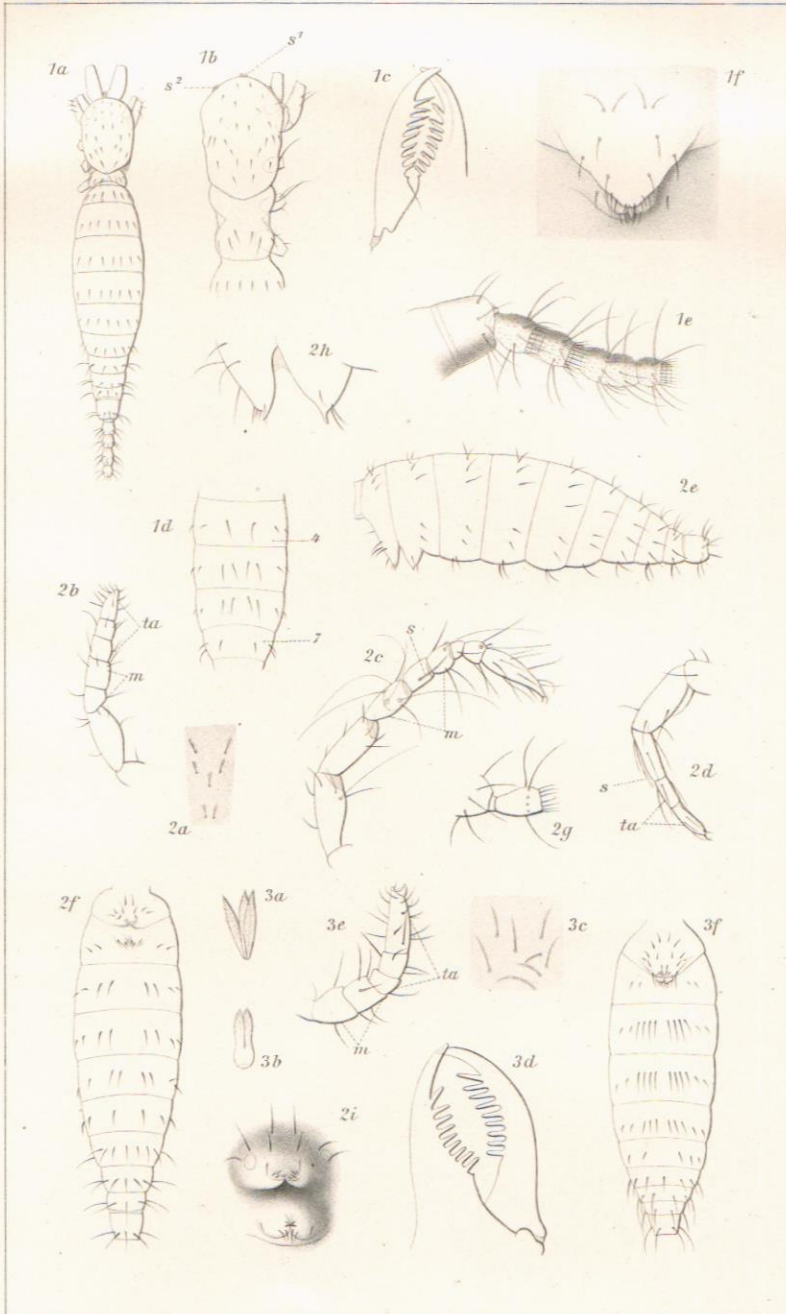
1. Koenenia mirabilis Grassi. 2. K. Wheeleri Börner.



H. J. Hansen del.

Lith. Anst. v. E. A. Funke, Leipzig.

1. *Koenenia wheeleri* Börner. 2 *K. chilensis* n.sp. 3. *K. angusta* n.sp.



H.J.Hansen del.

Lith Anst. v. E.A. Fünke, Leipzig.

1. *Koenenia angusta* n.sp. 2. *K. siamensis* n.sp. 3. *K. Grassii* n.sp.