

Organs and Characters in different Orders of Arachnids.

By

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(With Tab. II—V).

Introductory Remarks.

Several years ago I had already made observations on some new, or little known organs in *Pedipalpi*, but a publication was constantly postponed. In October 1892 I read the voluminous work of Gaubert, quoted in the following; I was struck by a complete want of reference to the Danish literature, and in examining some large specimens of *Phrynidæ* and *Scorpiones* I soon discovered that his statements on the occurrence of the so-called lyriform organs were very deficient. This gave me the wish to spend some time on the study of these and several other organs in the higher orders of Arachnids.

The study of many publications on the anatomy and the embryology of Insects and Arachnids has shown me that but few of the authors of those essays are acquainted with any greater number of genera (and species) of the order in question, that they often do not know the characters that are pointed out as being

essential by the systematic authors, and that they often ignore even systematic papers of the greatest importance. This one-sidedness occasions the imperfectness on often even essential points in the before named works. By studies at an earlier period, the results of which have been published in 1883—84, I was tolerably acquainted with the types of and the literature on *Aranææ*, *Chelonethi* (*Pseudoscorpiones*) and *Opiliones*; in order not to be guilty of the same one-sidedness, I have asked permission of the Director of the Entomological department of the Copenhagen Zoological Museum to determine our collections of *Solifugæ*, *Phrynidæ* and *Thelyphonidæ*; the permission was not only granted and the task carried out, but Dr. Meinert left to me a series of very valuable types for dissection, for which I owe him my best thanks. A little more than half of the dissected material belonged to the Museum, the rest is taken from my own private collection of types of Arthropods in spirit.

With regard to system the *Aranææ*, *Opiliones* and *Scorpiones* are comparatively well worked out; but the treatment of *Solifugæ*, *Phrynidæ* and *Thelyphonidæ* (*Tartarides* included) is not satisfactory. The Museum possesses but one genus of the last order, for which it has been impossible for me to elicit systematic characters. The material of *Solifugæ* and *Phrynidæ* is too small for undertaking a new revision of the genera, but still sufficient to render it possible to me to point out, especially in the first mentioned order, new structures of systematic value. Supported by new materials, which Dr. Meinert has collected on his journey in Venezuela during the years 1891—92, I have been able to undertake a revision of *Chelonethi* with alterations and additions to my previous paper on this order.

A very large section of Gaubert's voluminous and valuable essay treats the lyriform and other sense-organs, but this section, the one I chiefly have investigated, is rather defective. The sole order in which he has found the most part of the existing lyriform organs is *Araneæ*, and even here his description is not full. He has found but a small portion of the existing organs in *Phrynidæ*, *Thelyphonidæ*, *Opiliones* and *Pseudoscorpiones*, and he is denying their existence in *Solifugæ* and *Scorpiones*, though they are found in both orders and in the last-named attain a great development. This becomes still more disastrous because he makes use of the existence or not existence of the organs etc. to the exhibition of a »tableau». — The treatment of the characteristic »tactile hairs« is much too short, and he does not appear to know their existence but in *Araneæ* and *Scorpiones*; he has not seen the characteristic sense-organs in *Scorpiones*, *Chelonethi* etc. The other sections of his essay are omitted or but occasionally mentioned here, as they do not touch upon the territory of this paper.

I shall begin by emphasizing, that it has not at all been my intention in this little essay, written down occasionally, to give anything like a complete representation of the sense-organs of *Arachnida*, as the examination of a material many times larger, especially of the order of the *Thelyphonidæ* and *Opiliones*, would be required for such a task; neither I have carefully studied the histological structure of the discovered organs. It has only been my intention to point out a great number of hitherto unnoticed sense-organs and other organs, and I do not doubt that (especially in *Opiliones* and *Acari*) there may be found many hitherto unknown organs. I have taken great pains in searching for the lyriform organs, but I do

not vouch that I have not overlooked any important fissure or a little group of fissures, as is often connected with the greatest difficulty to examine carefully from all sides under the microscope all the different joints of a leg; and a small rotation of a joint is sufficient to render it impossible to see all fissures, as the portion towards the edges cannot be seen distinctly. My searching for the sense-organs led me to the discovery of the remarkable supplementary spiracles on the tibiæ in Phalangioïdæ. I have almost entirely omitted the great order of the *Acari*, being in want of material of and sufficient knowledge to the numerous and most different families; I have not seen any specimen of *Palpigradi* (*Koenenia* *) and also entirely omitted *Linguatulida* and *Tardigrada*.

The succession in which the 8 orders are mentioned is chosen of practical regards. I have quoted a number of works, essentially or exclusively systematical, but as few as possible not to get into prolixity. I mention a smaller number of anatomical papers, partly those which have been omitted by Gaubert or have been published later, partly a few that required a direct reference. Readers wanting a more additional information f. ex. about the history of the sense-organs are referred to the work of Gaubert. Of practical reasons I mention the papers that are quoted by one order, as a rule, in the beginning of its treatment, while the few works

*) In June this year I have taken a series of this extremely interesting form in forests in Calabrien, in the neighbourhood of *Palmi* and *Scilla*), but the plates belonging to this paper was then engraved, and the study must be postponed to a subsequent occasion.

which are of any importance to more than one order are mentioned here.

Literature for several or all orders:

Simon, E.: Les Arachnides de France. T. VII (Chernetes, Scorpiones et Opiliones). Paris 1879.

Wagner, W.: Des poils nommés auditifs chez les Araignées (Bull. de la Soc. Impér. des Naturalistes de Moscou, Nouv. sér. Tome II, 1888, p. 119—134).

Gaubert, P.: Recherches sur les organes des sens et sur les systèmes tegumentaire, glandulaire et musculaire des appendices des Arachnides (Ann. des Scienc. Natur. Zool., sér. VII. Tome XIII, 1892, p. 31—185, Pl. 1—4).

Pocock, R. I.: On some Points in the Morphology of the Arachnida (s. s.) with Notes on the Classification of the Group (Ann. and Mag. Nat. Hist., ser. 6, Vol. 11, 1893, p. 1—19, Pl. 1—2).

Bernard, H. M.: On the Terminal Organ of the Pedipalp of Galeodes and the Discovery of a Homologous Organ on the Pedipalp of the Phrynus (Ann. and Mag. Nat. Hist. ser. 6, Vol. 11, 1893, p. 28—30).

I. Scorpiones.

Thorell, T.: On the Classification of Scorpions (Ann. and Mag. Nat. Hist, ser. 4, Vol. 17, 1876, p. 1—15).

A. Lyriform Organs.

Gaubert states hereon (op. cit. p. 86) »les Scorpions . . . en sont dépourvus«. P. 119, and 157, he states that he has examined respectively the different organs of the mouth and the limbs of *Buthus australis* L., and then I suppose that he has also searched for lyriform organs in just this species. I chosed a large specimen

of the common large, East-Indian species *Pandinus cyaneus* C. Koch for my study, thinking that a good magnifying-glass would be sufficient at least to a preliminary examination of such a large dark-coloured form, and I succeeded without any great difficulty to find on each leg no less than 9 groups of these organs. Now, *Pandinus* (see Thorell, op. cit. p. 12) is belonging to quite another family than *Androctonus* (*Buthus*); Thorell even places the families concerned in each end of his system; therefore I subsequently undertook an examination just of *Andr. australis* L. with magnifying-glass and microscope. The result is shown in the succeeding; but I feel obliged directly to state, that as I have not found any important differences in the number nor in the quality of the organs on the 4 different pairs of ambulatory limbs, I shall treat them all together.

1. *Pandinus cyaneus* C. Koch.

Ambulatory limbs.

2d joint. On the anterior side near the upper side a little above the apophysis of the apical margin a group with 3 or 4 fissures, and behind these a longer longitudinal fissure, all slightly apart from each other (Tab. II, fig. 1). On the apical margin of the posterior side above the apophysis 5 or 6 longitudinal fissures a little removed from each other, the uppermost one being the longest, as well as a few (c. 5) very short fissures at the lowest end (Tab. II, fig. 2) of the group.

3d joint. On the posterior side close behind the apex 1 or 2 long and 2 or 3 short fissures in a little group.

4th joint. On the anterior side at the base close outside the basal apophysis a most remarkable, curved

band, the fissures of which, going in the same direction as the band, are almost vertical and situated close together; there are more than 20 fissures, and being much shorter than the band they partially become almost the prolongation of each other. — On the posterior side close behind the apex above the apophysis one single very long and below this one 2 or 3 very short longitudinal fissures.

5th joint. Apically on the upper side a transverse area with numerous, closely placed longitudinal fissures; the front one being the longest. On the posterior side slightly removed from the margin 2 rather short, somewhat oblique fissures rather removed from each other.

6th joint. On the anterior side near the apex close above the apophysis an organ composed of 14 fissures, the lowest of which are long and curved, the upper ones getting little by little short and almost straight (Tab. II, fig. 3). On the posterior side, near the apex, a little above the middle, one single, very long fissure.

The maxillary palpi.

2d joint. On the apical margin of the upper side a little behind the apophysis a row with 7 or 8 longitudinal fissures of middle length, partly rather removed from each other.

3d joint. On the apical margin of the outer side 2 groups, the one close below the upper, the other close above the lower apophysis; in the upper group c. 4, in the lower one 5 or 6 longitudinal or oblique fissures, all removed from each other and of very different length.

The whole rest of the animal, that is to say the coxæ and tarsi of the members, the mandibles, the dorsal and the ventral side of the cephalothorax and

the abdomen, as well as the tail, have been examined with the magnifying-glass but without result. The sternite, in which the first pair of spiracles is situated, and considerable parts of the upper side of the 4th and 5th joints of the legs have been cut off and examined with the microscope to find, if possible, similar small fissures, which hereafter are shown in several other orders; not one fissure, however, has been found. No better result was gained from the dissection of the sternites and the mandibles of *Centrurus biaculeatus* Luc.

The expansion of the fissures for the apex of the nerve is always situated at the one end; except in the organ lying at the basis of the 4th joint all the fissures are almost parallel with the longitudinal direction of the joints of the legs, or placed in an oblique direction in proportion to them, and the expansion is always at the proximal end.

2. *Androctonus australis* L.

Ambulatory limbs.

2d joint. On the anterior side close above the apophysis one fissure of middle length, and at a small distance from it a small group of 3 tiny fissures. Nothing on the posterior side.

3d joint. On the posterior side close behind the apex above the apophysis 4 fissures, partly of middle length, partly shorter, and more or less removed from each other.

4th joint. Nothing at the basis. On the posterior side close to the apex above the apophysis one single long fissure, and below this one 3 extremely short fissures.

5th joint. Apically on the upper side one very long fissure and semicircularly behind it 4 short longitudinal fissures. On the posterior side near the apical

margin 2 fissures slightly removed from each other, rather short and oblique.

6th joint. On the anterior side near the apex just above the apophysis a lyriform organ consisting of but 6 rather long fissures, less regular, however, and not so beautifully curved as in *Pandinus*, chiefly answering to the lowest and most vigorously developed part of the organ in this genus. — On the posterior side close to the apex a little above the middle 1 single, very long, longitudinal fissure.

Maxillary palpi.

2d joint. On the apical margin of the upper side a little behind the apophysis a row of c. 11 tiny fissures, rather removed from each other.

3d joint. On the outside near the apical margin below the upper apophysis 3 fissures of middle length, and above the lower apophysis 2 similar longitudinal fissures.

This list states, that the chief difference between *Androctonus australis* and *Pandinus cyaneus* is, that the latter form possesses an organ with some fissures on the posterior side of the 2d joint of the legs, besides the remarkable organ at the basis of the 4th joint, while *Androctonus* is devoid of both these organs.

I consider it evident, from the proceeding, that the lyriform organs exist on the legs and probably also on the maxillary palpi of all Scorpions. — It has been, however, no part of my plan to study their occurrence in the numerous genera.

B. Tactile Hairs.

Gaubert informs us (op. cit. p. 45) that he has found 2 rows of »poils sensitifs« on the last but one joint of the legs of *Buthus australis*; these hairs being

but slightly touched with »un pinceau très fin«, the animal immediately draws back the leg, while it remains imperceptible if you »promène le pinceau sur le reste du corps.« »Du reste, les poils du Scorpion sont presque tous sensitifs, et se trouvent que sur les appendices; le reste du corps en est totalement dépourvu«.

To begin with, this last observation cannot be applied to all Scorpions, for in *Pandinus cyaneus* f. ex. we meet with well developed setiform hairs on the front margin and the anterior part of the lateral margin of cephalothorax, on the sides of the 5 hindmost abdominal segments and on all segments of the tail. His remarks on the occurrence of »les poils du Scorpion« strike me as rather general; he ought to have accented that he was speaking of *B. australis*, and that his observations did not concern the order of the *Scorpiones*, but this is neglected, following the example of so many anatomists. — Secondly, I do not doubt that the mentioned hairs on the last but one joint of the legs are sensitive (they are, however, not ranged in 2 rows, as only one dorsal row is long and regular, while the other setæ are dispersed in several, chiefly ventral, less regular and shorter rows); but it is not possible to me to discover the slightest difference between these setæ and those found on the other joints of the legs, neither in shape nor in insertion: they all appear to me quite simple, rather long setæ. It is very probably that all such setæ are more sensitive to a slight touching than the naked, thick dorsal skin of the animal, as the chitine is perforated at their insertion, but they can hardly be called »tactile hairs«. Thirdly, there is found on the large chelæ and on the 4th joint of the maxillary palpi of *Andr. australis* (the maxilla as usual counted as first joint) quite differently shaped and inserted hairs, most like those, which later on in this treatise are

mentioned as discovered and described by Croneberg on the chelæ of *Chernes*. The real tactile hairs, overlooked by Gaubert, appear in *Andr. australis* less numerous and are less easily found than in *Pand. cyaneus*. In this last species I have found 10 such sense-hairs situated irregularly in a row on the immovable finger in a little distance from the outer margin of the upper side, 2 on the same finger near the inner margin of the upper side and 2 on the lower side near the inner margin; on the outside of the hand near the insertion of the movable finger 2 hairs above, 2 below and further back on the outside 1 hair; on the lower side 1 hair a little out on the basis of the immovable finger, near the basis of the hand on the outside and chiefly on the upper side altogether 6 hairs in an irregular transverse row — in all 26 on this, the 5th, joint of the maxillary palpi. On the movable finger I have found none; on the 4th joint of the palpi, however, all in all 17 hairs on the upper side and on the upper part of the outside and the inside, and finally 3 hairs at the basis of the 3d joint. The single hairs are long, but are easily distinguishable from the surrounding, ordinary setæ, being much finer than these in proportion to their length, and because their real insertion cannot be seen, as they disappear through a comparatively large, circular aperture, which they cannot fill by far. In a transverse section this aperture is seen leading into a cave, much wider than its exterior outlet, and on the bottom of this cave the insertion of the hair is seen. The transverse section shows also other peculiarities in the shape of the surrounding chitine, and reminds much of »poil à chapelets«, exhibited by Wagner (op. cit. p. 125), but still there are several essential differences, of which I shall particularly point out that the exterior wall of the cave does not rise as a semi-globular eminence, but is

almost lying in the same plane as the other chitine, and that the inside of the cave is not smooth (as by those of the hairs of *Aranæ* described by Wagner), but the bottom and the sides are covered with a thinner, most remarkable stratum of chitine-formations. These appear to be lamellæ, projecting almost vertically and coalesced to form a more or less irregular, sixangular cavity, giving you the impression, that the cave is covered with a stratum of prismatic »cells«, very much reminding of the cells in a honeycomb. I shall, however, leave to others the more minute histological study of these beautiful formations.

C. Other Sense-Organs.

Nothing but the eyes and crests is known; relative to the latter ones I refer to the work of Gaubert. I shall, however, call attention to a new organ, that undoubtedly must be a sense-organ. An oval, slightly convex spot is seen in *Pandinus cyaneus* C. Koch on the upper side of the last joint of all 4 pairs of legs close to and slightly behind the basis of the median process. If this spot besides some of the surrounding integument is cut off and examined with the light falling through, a shape is seen almost like Tab. II, fig. 4. It is seen that the area of a clear greyish tone, given in the figure, is much richer provided with pore-channels (a) than the surrounding integument, and that these channels, of which but a few are indicated in their whole extension, converge towards the centre of the area. Moreover there are in the area 9 rather large cavities (b), converging likewise towards the centre, shaped like a truncated cone with a large interior aperture and ending externally in a much smaller area, much larger, nevertheless, than an ordinary pore-channel. This small area is covered by a thin membrane, from

the centre of which projects down in the cavity a small hollow (?) chitin-tack, which does not, however, rise above the area and which is, I suppose, connected with the nerve. Thus 9 organs are collocated in one group.

In *Androctonus australis* L. is found not one large area, but 2 small ones, which are situated at intervals rather oblique behind each other; each little area has 2 organs.

Considering their structure, certainly as yet but preliminary and insufficiently studied, I suppose that these organs are a kind of sense-organs, but I can say nothing at all about their functions. I have found quite similar but scattered organs on the large chelæ of *Chelifer* (see *Chelonethi*).

II. Phrynidæ.

Karsch, F.: Ueber eine neue Eintheilung der Taran-
tuliden (Phrynidæ autt.). (Arch. f. Naturg. 45. Jahrg.
1. B., 1879, p. 189—197).

Thorell, T.: Arachnidi Arthrogastri Birmani (Annali
del Museo Civico di Storia Natur. di Genova, ser.
2, Vol. VII, 1889, p. 521—729, Tav. V).

Simon, E.: Remarques sur la classification des Pédipalpes (Ann. de la Soc. Entom. de France, Vol. LXI, 1892, p. 45—51, Pl. 2, fig. 9—16).

Bruce, A. T.: Observations on the Nervous System of Insects and Spiders and some Preliminary Observations on Phrynus (John Hopkins Univ. Circulars, Vol. VI, Nr. 54, Dec. 1886, p. 47).

A. Lyriform Organs.

Gaubert has (op. cit. p. 85) only found one single, but highly developed organ lying on the posterior side (ought to be the anterior side) near the apex of the

second joint of the legs. He has examined *Damon Grayi* (a misscript for *Charon Grayi*), a species I am sorry not to know.

I have examined a species of the genus *Phrynichus*, I suppose it is *Ph. nigrimanus* C. Koch, but I must add that, according to my judgment, it is not possible to determine with certainty this and several other species described by C. Koch. My species is common on Vellore (in the neighbourhood of Madras). Next I have examined a specimen of *Damon medius* Hbst. under a good magnifying-glass, and I have been able to find the fissures on the apical margin of the coxæ, on the lower side of trochanter, on the anterior side of metatarsus and on the exterior and interior side of the mandibles. I do not doubt that this species possesses most of, if not all, the organs found in the following. I shall, moreover, point out, that I have taken the third pair of legs as a type for the 3 posterior pairs of legs, these being very much alike and offering no differences worth mentioning in the lyriform organs, while the strongly transformed first pair of legs is treated separately.

3d. pair of legs.

1st joint. Near the middle of the apical margin c. 5 (3 longer and 2 shorter) irregular, spread oblique fissures.

2d joint. On the anterior side near the apical margin close above the apophysis the lyriform organ described by Gaubert, having here 16 or 18 closely placed fissures. On the posterior side in a raised place, near the apical margin and a little above the apophysis an organ (Tab. II, fig. 5), consisting of c. 18 longitudinal fissures, lying behind each other in several irregular rows; the fissures in the distal row are very long and partly oblique, in the other rows short or even very short. Next closer to the basis of the joint on the

limit between the anterior and the lower side, a pair of spread transverse fissures.

6th joint. On the anterior side near the apex 3 longitudinal fissures (as shown on Tab. II, fig. 15 in *Admetus marginemaculatus* C. Koch).

1st pair of legs.

1st joint. On the lower side near the apex c. 10 larger and smaller oblique fissures in an irregular group.

2d joint. On the anterior side (upper side) a regular, lyriform organ, and on the posterior side (lower side) a group of fissures, almost like those on the third pair of legs.

3d joint. In a little distance from the basis one single, rather short, a little oblique longitudinal fissure.

5th joint. On the upper side upon the end of the apophysis a small group of 5 longitudinal fissures. (The existence of this group on the 5th joint (tibia) suggests that tibia on the 1st pair of legs answers to tibia plus metatarsus on the 3 other pairs of legs.

Maxillary palpi.

2d joint. On the upper side behind the apophysis 3 spread, small longitudinal fissures. On the lower side behind the apophysis a group with c. 21 short and long longitudinal fissures.

Mandibles.

On the 1st joint, near the apex on the interior side close behind the apophysis, a curved transversal line with 10 longitudinal fissures, the 5 superior ones double as long as the 5 inferior ones; on the exterior side behind its apophysis a transverse band with 5 longer fissures, at the one end of these 5 fissures more spread and but half as long, and in a little distance from the other end of the band 2 similar small fissures.

The cephalothoracic shield
with but a small number of short, even very short,
oblique fissures, especially placed not far from the
lateral eyes and from the hindmost lateral angles.

Sternum and labium
without fissures.

The dorsal side of the abdomen
1st and 2d tergite without fissures.

3d tergite on each half with 2 small oblique
fissures standing apart from each other along the posterior
margin and a little removed from the median line; to-
wards the lateral margin, somewhat closer to the posterior
than to the anterior margin c. 5 oblique fissures, one
pair of which is longer, the others very short.

4th, 5th and 6th tergite having on each half c. 6
slighter, oblique fissures, spread along the posterior
margin, further inwards on the tergite a pair of very
small fissures, finally in a distance from the lateral
margin and almost half way between the anterior and
the posterior margin one single or 2 tiny fissures.

7th, 8th and 9th tergite almost as the precedings,
but with fewer fissures along the posterior margin, only
3 or 4 on each half.

10th tergite has in a similar way reduced the
number to 3 on each side, 2 of which near the posterior
margin.

11th and 12th tergite with 2 fissures on each
half.

The ventral side of the abdomen.

1st sternite without fissures. (I have to mention
that I consider the plate situated close behind the
sternum (Tab. II, fig. 13, f.) as the 1st sternite, an opi-
nion I shall prove in the 1st section of *Thelyphonidæ*).

2d sternite with a group of 4 rather oblique
transverse fissures somewhat removed from each other,

the 3 of which are rather long. The group is placed near the posterior margin, in a little distance from the median line.

3d sternite on each half with a group of 3 comparatively long, slightly oblique longitudinal fissures near the posterior margin in a little distance from the median line.

4th sternite on each side with c. 3 middle-long oblique fissures dispersed between the median line and the lateral margin.

5th sternite on each half with c. 3 fissures along the posterior margin, 3 along the lateral margin and 1 further inwards on the sternite, slightly more removed from the lateral margin than from the anterior and the posterior margin.

6th, 7th, 8th and 9th sternite almost as the 5th, on each half, however, with c. 5 fissures of very different length along the posterior margin, finally with 1 or 2 fissures rather removed from the posterior margin.

10th, 11th and 12th sternite almost as the preceding, the number of the fissures is, however, reduced in the same way as on the corresponding tergite.

The difference between the distribution of the lyriform organs in this order and in the Scorpions is great and most interesting. In *Phrynichus* but few organs are found on the legs, as femur, patella, tibia (3—5th joint) and tarsus are perfectly devoid of organs (the 3d (and 5th) joint of the 1st pair of legs excepted); but in return they are spread as single fissures nearly on the whole body and appear also on the mandibles. The dilatation for the nerve is situated in the not too short

longitudinal fissures on the mandibles and legs near the centre.

I shall, moreover, add that I have found a great number of small, both short and long, transverse bands composed of very small longitudinal fissures, both on the upper and lower side (Tab. II, fig. 6) of the proximal half of tibia; I have not met with any on the other joints; I shall, however, not deny the possibility of their existence, as it may be difficult to catch sight of them. I do not feel competent to express an opinion of their nature; they have most likely nothing to do with lyri-form organs; but still this little remark may perhaps be put in here.

B. Tactile Hairs.

Such hairs are not known in *Phrynidæ*. I have found 2 very different forms, the one on the tarsus of the 1st pair of legs, the other form on the 3 other pairs of legs.

Tarsus of the 1st pair of legs.

It is notorious that it is prolonged and divided into numerous, small joints. Not quite the outmost third part of tarsus is, besides the ordinary setæ, furnished with very characteristic hairs, that appear very numerous on the last joints (Tab. II, fig. 7, s). These sense-hairs are very small, short, clavated (fig. 7 and fig. 8), they remind very much of the form found by Wagner in *Mygale* sp. which he terms »poil cucurbitiforme« (op. cit. p. 129, fig. 4); the stem is stouter and the distal part but little swollen, while the hair figured by Wagner has a shorter and slender stem and a distal swelling comparatively many times larger. Their insertion is extremely reduced in size, and the most minute examination under high magnifying powers is necessary to notice those slight particularities, which remind of tactile

hairs. This description is founded on *Phryn. nigri-manus*, but I have found simular hairs in *Damon medius* Hbst., *Admetus* and *Charinus*, of which the 2 last genera belong each to their own of the 2 other subfamilies in the new system of Simon. Their existence may surely be considered as a character for this order.

In *Damon medius* Hbst. are found peculiar, considerably long setæ on a long part of tarsus (wanting in both ends), winged on 2 sides (Tab. II, fig. 9), getting thus the shape of a narrow spear-blade. These setæ, of which often 1, sometimes 2 are found on each joint, are quite as long and stouter than the other setæ, being, however, inserted like the latter. Their function is unknown to me.

It might perhaps be put in here, that I have found in *Phrynichus* a characteristic formation, probably transformed claws, on the apex of the last joint of the tarsus of the 1st pair of legs. It consists of a thick, short basal portion and 2 unequally long, gradually acuminated branches (Tab. II, fig. 10), the one of which has a peculiar seta. I have found a similar formation in *Admetus marginemaculatus* C. Koch.

The 3 posterior pairs of legs.

On patella of the 3 posterior legs is found 2 most remarkable tactile hairs, placed a little behind the insertion of tibia and slightly down upon each side of the eminence, caused by this insertion; they are easily seen under a magnifying-glass. Each of these 2 hairs is long, very fine, smooth and goes as usual into a considerable cave, shaped like a jar with a constricted mouth, in comparison to which, however, the hair is very thin (Tab. II, fig. 11); but it is still more striking, nevertheless, that a comparatively large part of the integument, surrounding this mouth, shows a most peculiar structure, as if it were scaled (fig. 11), which seen under

the magnifying-glass has a dim appearance and forms a contrast to the surrounding chitine. These 2 tactile hairs seem also to be characteristic to the order of *Phrynidæ*.

In *Phr. nigrimanus* is seen on the metatarsus of the 3 pairs of legs, on the upper side, close to the basis 4 or 6 dark, small rings (Tab. II, fig. 12, a), towards the distal end similar rings arranged in 2 longitudinal rows (b), in the beginning converging, then close together, subsequently diverging and bending down the sides; close outside and between the distal end of the rows 3 further rings. On the upper side of tibia, in a little distance from the apex is found one single, similar ring. These darker rings surround a comparatively large hole, out from which rises one long, exceedingly thin, often worn sense-hair, the darker colour of the ring is partly owing to the darker tone of the surrounding chitine, partly to the circumstance that the scaly formations on the surface, otherwise spread, become smaller and placed more closely together round the hole. I have found similar tactile hairs in *Admetus* and *Damon*, reminding by their site of similar hairs in *Aranææ*. They are most likely found in all *Phrynidæ*, but I have not examined if in their distribution systematic characters (for the genera or the species) may be found.

C. Other Sense-Organs.

Of these hitherto but the eyes have been known. In January 1893 Bernard (op. cit. p. 29—30) has published a preliminary note on an organ he has found in the proximal part of the claw of the maxillary palpi. I do not mention this but for the sake of completement, as Bernard holds out a prospect of further particulars; I shall observe, however, that at all events it is not

homologous with the retractile organ discovered by Dufour, in *Solifugæ*, if an homology is existing it must be with the interior sense-organs discovered by Gaubert and Bertkau; this homology, however, appears as yet very questionable to me, on account of the occurrence of a fine row of hairs in *Phrynus* (see a few more remarks on this subject under *Solifugæ*).

Bruce writes 1886 (op. cit. p. 47): »On the coxal joint of the fourth appendage [2d pair of legs] a sense-organ was very conspicuous in the young pedipalp. The hypodermic cells of that joint become columnar, unlike other hypodermic cells, which are of irregular contour. These elongated cells are continued externally to form filaments, several of which enter a single pair, which is the external part of the sense-organ.« — I have not seen nor searched for this organ, but I have thought it convenient to copy the whole description; for the rest the entire note seems to me to be immature.

D. Systematic.

The first attempt, worth mentioning, of a classification of *Phrynidæ* in strictly limited genera is owing to F. Karsch (op. cit.) but, strange to say, he has but found and made use of one single character, viz., the numbers of the joints in the hindmost tibia. In the year 1889 Thorell (op. cit.) draws attention to several new characters; I shall point out the division of the claw of the palpi in 2 joints in some of the forms, and above all, the occurrence of arolium on the apex of the tarsus of the 3 posterior pairs of legs in *Charon* and *Catageus* in opposition to its absence in other genera; in the description of the species he mentions that 5 joints are found in the tarsus of *Catageus* and *Charon*, 4 in *Phrynus Goësi* Thor., but he does not use this excellent feature as a character for genera. —

In the year 1892 Simon gives a revision of the systematic of the order upon his gigantic material, divides the order into 3 sub-families and points out characters for these and for the genera, altogether 8, 2 of which are new. He uses the number of joints in the tarsus together with the occurrence of arolium as the character for the one sub-family (*Charontinæ*) and introduces a new character derived from the structure of the sternum as the chief difference between the 2 other sub-families: *Phryniscinæ* (ought to be written *Phrynichinæ*) and *Tarantulinæ*. The sternum offers, no doubt, so great differences in the 2 last groups, that it is most astonishing they have not been made use of before, but the description and especially the drawings of Simon (Pl. 2, fig. 14 and 15) are not sufficiently correct.

Simon delineates the median plates of the sternum in the *Tarantulinæ* (fig. 15) as lying far apart from each other and the anterior very distant from the labium. In *Admetus* I have found them (Tab. II, fig. 13, a) almost meeting, and the anterior one reaching the basis of the labium; what Simon figures as the whole plate is a darker chitinous centre-part of the same. It will be easy to prove the correctness of my interpretation by examining an adult specimen under a magnifying-glass, and still more, to be depended upon, when the sternum is cut off and examined with the light falling through the chitine. The 3 pairs of lateral plates are sharply defined from each other and from the surroundings. It may further be remarked that labium is narrowly triangular, but slightly dilated at the basis, which is a little broader than the median plates. In *Phrynichus* and *Damon*, the median plates (chiefly in *Phrynichus*) are broader than long (Tab. II, fig. 14), the latera plates are narrower, with comparatively thinner chitine and much less sharply limited from the

surroundings; the labium is chiefly in *Phrynichus* strongly dilated at the basis. Unfortunately my material of *Charontinæ* is so limited (only 2 specimens, the one of which is very small, the other with a destroyed sternum) that I cannot undertake an investigation of its structure in this group.

Simon states that *Phrynichinæ* and *Tarantulinæ* have 4 joints in the tarsus of 3 pairs of legs, while 5 joints are found in *Charontinæ*. That is correct. But on closer examination of my 2 specimens of *Charontinæ* (1 *Charon Hoevenii* Karsch, 1 *Charinus Australianus* L. Koch) I have found, that the articulation between the 2d and 3d joint in the tarsus is a little lesser developed than between the 3d and 4th or 4th and 5th joint. Examining a rather large material of several species of the genus *Admetus* I perceived, that the 2d joint always showed on the lateral sides and on the dorsal side a little from the apex a rather narrow, but very distinct, clear, transverse stripe (Tab. II, fig. 15, a), in its site answering to the articulation between the 2d and 3d joint in *Charontinæ*, that is to say: a rudimentary articulation, in the last-mentioned group appearing as a developed articulation. I do not know from autopsy the very closely connected genus *Tarantula*, but I do not suppose, that it differs on that point from *Admetus*, and therefore I do not hesitate to admit this commencing articulation as a character for the sub-family. — No trace of a transverse division of the 2d joint of tarsus is found in *Phrynichus nigrimanus* C. Koch and *Damon medius* Hbst.

If we add the new character to several of the older ones, we see that the classification of Simon: *Charontinæ*, *Phrynichinæ*, *Tarantulinæ*, is not natural, as the 1st sub-family is closer connected with the 3d than with the 2d family. I presume undivided hind tibiæ,

The sole breach in a plain row according to these characters is made of *Charon* and *Catageus*, the first have 4-jointed tibia and 1-jointed claw on the palpi, the latter having 3-jointed tibia, but 2-jointed claw on the palpi. I have considered the division of the claw of the palpi as a more important character than the number of joints in the hind tibia.

It may as yet be pointed out that in the forms known to me there is found an oblique, clear stripe on each side of the last joint of the tarsi (fig. 15, b), and that a clear, longitudinal furrow (fig. 15, c) on each side of the last joint limits the narrow dorsal part, which as a free process prolongates itself over the insertion of the claws.

E. Specific Characters.

Most of the species are very badly described, and probably it always will be impossible to recognize several of them. In trying to determine the material of our Zoological Museum, I perceived that no author has undertaken the closer examination of the great variability, which in several external structures and dimensions, according to the size of the animal, asserts itself in the same species; I likewise found on a comparatively good material of several of the species of the genus *Admetus* a couple of specific characters, the one of which appears to be new. In most of the species there is found below the centre of the anterior margin of the cephalothoracic shield a process, which I shall call the frontal process. This process proceeds in *Adm. palmatus* Hbst a little behind the anterior margin of the cephalothoracic shield from its lower side and is chiefly directed forward as a rather small cone. In a not described species of *Admetus* from Venezuela it looks like, as if the frontal margin were flexed down-

wards in a large triangular process, broad at the basis, flat on the anterior side, prolonged below in a small, somewhat forward directed apex and situated between the basis of the mandibles. *Adm. marginemaculatus* is devoid of every trace of frontal process, etc. Together with these changes in the frontal process we find other changes in the formation of an edge along the anterior margin of cephalothorax. These species are, nevertheless, very closely connected f. ex. in the armature with spines on the palpi; it is possible, however, by a more profound study of a rich material to find a few small reliable points in these structures. Thus I arrive to the second character, that is to say, the armature with spines on the upper margin of the 5th (claw-bearing) joint of the palpi, which just shows an important difference in certain species of *Admetus* (f. ex. *A. fuscimanus* C. Koch in opposition to *A. palmatus*).

Concerning the variability according to age I have found but one remark in the literature, viz., by Karsch, who says (op. cit. p. 191—92) that the length of the palpi in proportion to the length of the body changes according to the age of the animal. I have the fortune of possessing a rich material of *Phrynichus nigri-manus* C. Koch in almost all sizes, and I am able perfectly to confirm this declaration. I shall state the following, founded on the measuring of 3 specimens.

	The length of the cephalothoracic shield.	The breadth of the cephalothoracic shield.	The trochanter of the palpi and femur together.	The trochanter of the 2d pair of legs and femur together.
1st spec.	8 mm.	15,3 mm.	28,8 mm.	17 mm.
2d -	5,1 mm.	8,4 mm.	11,2 mm.	10,1 mm.
3d -	3,2 mm.	4,7 mm.	4,4 mm.	6,3 mm.

It is evident from these measurements 1) that the cephalothoracic shield increases considerably more in

breadth than in length at the gradual growth of the animal, 2) the legs increase comparatively but a little more than the length of the cephalothoracic shield (in the largest specimen the trochanter + femur is but a little more than double the length, in the smallest ones almost double the length of the cephalothoracic shield) 3) the palpi are growing quite disproportionately in length in proportion to the body and the legs (in the largest specimen the trochanter + femur together are more than $3\frac{1}{2}$ times as long, in the smallest specimen not $1\frac{1}{2}$ times as long as the cephalothoracic shield) which makes an exceedingly great difference in the appearance of large and small specimens.

But I have discovered some, if possible still more bewildering age-differences. In the largest specimen only two spines are to be found on the upper interior margin of the tibia of the palpi, they are very long and placed closely together on the forecorner. In the middlemost specimen a little behind those 2 spines, on the same upper interior margin is a 3d spine, the length of which is about $\frac{1}{3}$ of the diameter of the tibia at the basis of the spine; in the smallest specimen this last spine is almost as long as the diameter of the tibia, and more removed backwards, and on the same margin is still a couple of small spines a little apart from each other. It is seen from my rich material consisting of c. 25 specimens of all sizes from the same locality that this reduction of spines on the upper interior margin of tibia according to the growth of the animal is a rule in this species. The 3 posterior of the 5 spines found in the small specimens on the interior lower margin of tibia, are lost quite in the same way. On the contrary, on the following joint of the palpi there are in all ages only 2 spines, one above

and one below. On the femur of the palpi is found a similar reduction of spines, but while the proximal ones are lost on tibia, the distal ones are lost on femur; in small specimens the armature with spines goes almost along the upper and the lower margin of the whole anterior side, while in large specimens it hardly occupies the proximal half. — Great changes in colour of the animals take place together with these transformations.

Similar changes in the length of the palpi compared with the cephalothoracic shield seem also to take place in the genus *Damon* and most likely also in several other genera; in *Admetus* the changes are comparatively much slighter, sometimes even rather small.

The observations mentioned about *Phrynichus nigrimanus* prove that great caution must be applied to the determination after most of the hitherto published descriptions and chiefly to descriptions of new species. It would be very desirable if an able Zoologist soon would undertake a thorough monographic revision of this order on a very rich material; the material of one rich museum is by far not sufficient. It will be necessary to prepare a quantity of exactly executed figures of the palpi, partly accompanied by a contour of the cephalothorax and the half of the 2d pair of legs, if the monograph has to be but somewhat easily made use of.

III. Thelyphonidæ.

Stoliczka, F.: Notes on the Indian Species of Thelyphonus (Journ. of the Asiatic Soc. of Bengalen, Vol. XLII, 1873, II, p. 126—43, Pl. XII).

Marx, G.: Notes on Thelyphonus Latr. (Entomologia Americana, II, N. 2, 1886, p. 38—40, Pl. I.) — Quoted after Ph. Bertkau's Bericht üb. d. wiss.

Leist. im Gebiete der Entomologie währ. d. Jahr. 1886.

Thorell, T.: Pedipalpi e Scorpioni dell' Arcipelago Malese (Annali del Museo Civico di Storia Natur. di Genova, Ser. 2a, Vol. VI, 1888, p. 327—428).

Tarnani, T.: Ueber die Thelyphoniden aus den Sammlungen einiger russischen Museen (Horæ Soc. Entom. Ross. T. XXIV, 1890, p. 511—40, Tab. III).

A. The Segmentation of the Abdomen.

It will be necessary to make a few remarks on the segmentation of the abdomen before going on to the different organs.

In an interesting paper R. I. Pocock states (op. cit. p. 3) about *Thelyphonus* »the obliteration of the sternite and appendages of the second abdominal somite by the enlargement and backward extension of the sternite of the first«. I consider, however, this interpretation to be a mistake. Pocock asserts himself that the 1st and 2d sternite in the *Scorpiones* is lodged far forward, the 2d carries the pectines, »the first in all probability constitute the genital operculum«. The interpretation of the 2d sternite is undoubtedly correct; as to his view on the genital operculum being the 1st sternite, it must remain doubtful, but at all events its place has to be sought far forward between the basal part of the hind coxæ; the 3d sternite has become much longer than the preceding and following ones. In *Thelyphonus*, exactly underneath 1st tergite, a considerably long, transverse, chitinous plate is found, which is seen very plainly, particularly when the abdomen is bent upwards forming an angle with the cephalothorax; the plate is separated from the sternum by a broad, soft integument, furnished with strangely inspissated wrinkles, and to my convic-

tion it is most decidedly the 1st sternite. Thus it must be the 2d sternite that is very long, and then there are 12 abdominal segments, each with a tergite and a sternite of its own. Comparing the *Scorpiones*, having their 2 abdominal sternites situated far forward, with *Thelyphonus* (s. str.) this interpretation appears to me much more natural than the statement of Pocock (I have not seen any specimen of the aberrant family *Schizonotoidea*). Similar features are met with in *Chelonethi* (see later on) where the 1st sternite also formerly has been pointed out by Croneberg and myself.

The structure in *Phrynidæ* has most likely to be explained in the same way. The 1st tergite forms the dorsal side of the peduncle, that connects the thorax and the abdomen, while the 1st sternite, I think, is formed of a chitinous plate bipartite along the middle (Tab. II, fig. 13, f), lying between the basis of the posterior coxæ, fitting itself tightly to the sternum and being connected with the large 2d sternite by a broad membrane. I confess that this question appears to be much more difficult here than in *Thelyphonus*, owing to the fact that the movement of the abdomen in *Phrynidæ* is entirely placed between the 1st and 2d sternite, but it appears to me that a comparison of different orders (*Phrynidæ*, *Thelyphonidæ*, *Scorpiones*, *Chelonethi*, *Araneæ*) prove the correctness of my interpretation, according to which the nomenclature in *Phrynidæ* above is arranged.

B. Lyriform Organs.

Gaubert states that he has studied *Th. caudatus* Luc. Keeping to this statement, it is, however, impossible to have any certain opinion of which species he has studied, because the excellent arachnologist T.

Thorell describes 1888 (op. cit. p. 370—82) a species from Java as *Th. caudatus* Linné («Non dubito, quin sit species nomine Linneano *caudati* potissimum vocanda) and makes good this assertion (p. 377—78), but is doubtful if this species is the same as the one described by Lucas; most likely the species of Lucas cannot with certainty be recognized except by means of the original specimens. The next year Tarnani believes that a West-Indian species from Haiti shall answer to the name of *Th. caudatus* L., while he gives the name of *T. Thorelli* to the species described by Thorell. I should not at all have entered into all these synonymical difficulties, if it had not been of the greatest importance to be quite sure of which species Gaubert has examined. The fact is that his statements on the lyriform organs very badly agree with my results from the study of *Th. indicus* Stol., and under a magnifying-glass I have been able to discover the largest of the organs found in *Th. indicus* on the real *Th. caudatus* (L.) Thor. from Java, viz., the fissures on the posterior and dorsal side of the 2d joint of the legs, on the anterior side of the 3d joint and the transverse fissure across the dorsal side of the 4th joint, thence I suppose that *Th. caudatus* (L.) Thor. does not to any considerable extent differ from *Th. indicus*. Considering the 2 preceding and several of the following orders I shall not lay any stress on that Gaubert has not found the numerous fissures on the body, as well as on the mandibles and maxillary palpi, but he has not either found any of the organs at the apex of the joints of the legs, and he expressly remarks (p. 86): «les fentes se trouvent sur les cinq premiers articles des pattes (Pl. IV, fig. 4) . . . elles sont disposées au hasard tout en étant parallèles à l'axe des articles et sans ordre déterminé.» And later

on »Les unes sont grandes, les autres beaucoup plus petites.« Not considering the fissures which are collected in groups at the distal ends of the legs, being without exception overlooked by Gaubert, I have found but very short and, moreover, not very numerous fissures spread on the dorsal side of some of the joints, which do not agree with Gaubert's statement. Such a difference between the species of the same genus strikes me as being very unlikely, and thence it becomes deplorable that we do not know which species he has examined; most of the species are, moreover, so closely connected, that it is difficult to distinguish and describe them well, a fact sufficiently proved in the literature. — We have no right to assert that the long fissures, mentioned by Gaubert, do not exist in any species, but as an object of curiosity I shall still point out that he, in the above quoted lines, refers to Pl. IV, fig. 4, which is a figure of a leg of *Th. caudatus*, but on this figure the above mentioned fissures are marked not »sur les cinq premiers articles des pattes« but only on the 3d and 5th joint, and the relative length of the joints is exceedingly wrong.

The following representation of the lyriform organs is founded on the study of an adult female of *Th. indicus* Stol. Of the same reason as by *Phrynidæ* I have studied the 3d and 1st pair of legs.

3d pair of legs.

1st joint. On the lower side a few spread, short transverse fissures.

2d joint. On the upper side close to the posterior side at the apical margin behind the apophysis numerous longitudinal fissures of very unequal length, the undermost ones collected in a large irregular group (Tab. III, fig. 1), in which the proximal fissures are short, the

distal ones long. On the posterior side above the apophysis a number of shorter longitudinal fissures.

3d joint. On the anterior side on the apical apophysis 3 long, slightly oblique longitudinal fissures. On the apophysis of the posterior side one single longitudinal fissure. Across the dorsal side on the middle of the joint one single transverse fissure.

4th joint. Across the dorsal side, slightly removed from the apical margin, one single, very long transverse fissure.

5th joint. On the anterior side at the lower margin of the apophysis one single, long oblique fissure.

6th joint. On the anterior side at the apical margin below the large, oblique, dorsal apophysis 3 longitudinal fissures lying rather close together. Immediately behind the same apophysis on the limit between the dorsal and the posterior side 4 similar fissures. — Besides on the dorsal side of the anterior basal part of the same apophysis a lyriform organ of c. 10 regular, slightly arched, close longitudinal fissures, some of which are very long and partly quite lying on, partly reaching to the upper side of the apophysis, while the basal parts and the remaining fissures are found on its lower side, vaulting like a roof above the 7th joint.

9th joint (last tarsal joint). On the anterior side at the apical margin 1 rather long and higher upward 1 shorter longitudinal fissure. On the posterior side 2 similar fissures.

On the dorsal side of the distal part of the 3d joint, on the 4th and 5th joint and on the 4 tarsal joints a slighter number of short longitudinal fissures.

1st pair of legs.

1st joint. On the lower side a few short and spread, partly longitudinal, partly transverse fissures.

2d joint. On the upper side behind the apophysis

at the apical margin c. 8 spread longitudinal fissures. — On the posterior side above the apophysis numerous longitudinal fissures of different size; more above towards the dorsal edge one single longitudinal fissure.

3d joint. Near the apical margin on the anterior side close to the upper side a group with 6 longitudinal fissures of very different size.

4th joint. On the posterior side one single, short longitudinal fissure.

5th joint (very short). On the anterior side in a short distance from the apical margin c. 5 spread, short longitudinal fissures. On the posterior side c. 4 small, spread longitudinal fissures.

6th joint. On the anterior side at the apical margin one long longitudinal fissure, higher up towards the upper side and a little removed from the apical margin a couple of spread, short longitudinal fissures. — Not quite at the basis towards the dorsal side a middle-sized, transverse fissure.

At all events there seems to be but very few, spread, dorsal fissures on the different joints; I have only found a few on the distal part of the 3d joint.

The maxillæ and their palpi.

1st joint (maxilla) with a few spread, short fissures; on the foremost, large process 3 transverse fissures on the lower side.

2d joint. On the upper side a little behind the middle 2 long, very oblique fissures removed from each other. Moreover spread over the whole joint and going in different directions some very short fissures.

3d joint. On the upper side close behind the apophysis a group of 5 good-sized longitudinal fissures, visible even under the magnifying-glass; at the apical margin slightly down on the interior side a rather

large transverse fissure; below on the exterior side straight above the lower apophysis 3 longitudinal fissures.

4th joint. On the interior side towards the basis of the large process a rather long transverse fissure.

5th joint. On the upper side a little behind the basis of the large process a rather long transverse fissure; at the corner between the process and the distal margin of the joint 1 slighter longitudinal fissure; towards the middle of the upper side of the process 3 spread, short longitudinal fissures. On the interior side close to the lower side at the apical margin 1 rather long longitudinal fissure; on the limit between the lower and the exterior side at the basis 2 rather long transverse fissures.

6th joint. All around, partly a little removed from the basis, partly towards the apex, some spread, middle-sized transverse fissures; close to the basis on the upper side one shorter and some very short longitudinal fissures not much removed from each other.

Some of the before mentioned very short fissures on the 2d joint, going in all directions, are moreover found spread on all the joints.

Owing to the enormous thickness of the maxillary palpi, and a magnifying-glass not being sufficient, it is most difficult to give a complete list of the more characteristic fissures, as it is not possible to examine the palpus in its entirety with the compound microscope on account of its thickness and shape. It is possible only by dividing every joint into several parts and examining each separately, and this manner of proceeding has been attempted here. The palpus must beforehand have been prepared with caustic potash; I shall come back to this question in the concluding remarks of this treatise.

The mandibles.

On the exterior side of the 1st joint behind the apophysis an irregular group of c. 17, partly middle-sized, partly very short, rather oblique longitudinal fissures (Tab. III, fig. 2). On the interior side behind the apophysis a similar group with c. 15 fissures. Besides several very short fissures spread about on the surface of the joint.

The cephalothoracic shield.

A small number of mostly very short fissures, going in different directions, spread round about.

Sternum antierius.

With very few spread, very short fissures.

Sternum posterius.

With but a couple of short oblique fissures towards the front.

Abdomen.

All here mentioned fissures are short, having, however, a very great mutual difference according to length. The 12th segment and the telson are to be treated at last.

Ventral side.

1st sternite with a small number of very small fissures, going in different directions and spread over the surface.

2d sternite. Some spread transverse fissures, almost all in the proximity of the posterior margin and chiefly out towards the sides; very few, indeed, towards the centre of the plate.

3d and 4th sternite. c. 14 transverse fissures on each half along the posterior margin, a couple along the lateral margin and some spread over the surface of the plate.

5th, 6th, 7th and 8th sternite almost like the 4th, having, however, not more than c. 13 or 11 trans-

verse fissures along the posterior margin, but a number over the surface of the plates.

9th sternite with less fissures than the 8th one, several of which are very oblique.

10th sternite with c. 15 or 20 on each half, mostly longitudinal and oblique fissures, fewer longitudinal fissures.

11th sternite very much like the 10th one, but more of the fissures are comparatively longitudinal or oblique fissures.

The dorsal side of the abdomen.

Fissures are found on all the tergites, but not quite as many as on the sternites; the distribution almost like that on the sternites.

In the membrane between the tergites and the sternites numerous chitinous, small plates, on some of the largest of which I have found one single fissure.

12th abdominal segment. At the posterior margin on the middle of the exterior side a group of 3 or 4 large longitudinal fissures, visible under the magnifying-glass, besides towards the dorsal side one longer fissure; the whole segment, especially towards the posterior margin, is besides furnished with numerous, small fissures, many of which are longitudinal fissures.

The caudal file (telson).

I have found on this some of the common, very short, spread fissures, but very few indeed.

From the above long list it is evident that *Thelyphonus* is exceedingly richly furnished with these sense-organs, having the shape of fissures, that on the legs there is an organ (on the 6th joint) built like the highly developed organs on the members of *Aranæ*, but that on the other hand there are found less regular groups with some, even up to many fissures on several joints

of the legs and the maxillary palpi, as well as on the mandibles and the 12th abdominal segment, that besides the entire body, the mandibles, maxillary palpi and some of the joints of the legs are furnished with spread, mostly very short fissures. These latter fissures appear as pore-channels on the thick integument of the body, the outlets of which have become fissure-shaped, with a slight dilatation in the centre. The dilatation lies, however, in the longer fissures placed in groups a little removed from the proximal end, in the shorter fissures close to or in the centre (Tab. III, fig. 1 and fig. 2), and consequently as in *Phrynidæ*.

C. The Eyes.

The usual description is that the animals have 2 centre-eyes and 3 eyes in a group on each side. Marx has in the year 1886 pointed out (op. cit.) that in an American species there are found 2 small eyes between the 3 large lateral eyes, and later it is used as a specific character by Tarnani, if »Nebenaugen« are found or not. I believe they are present in all species, they can often with certainty be recognized under a strong magnifying-glass, but even that being impossible, they are easily seen if the lateral eye-protuberance with the surrounding integument is cut off and examined from the interior side with the light falling through. Tab. III, fig. 3 represents the 5 lateral eyes in *Th. indicus* Stol., and I shall but add that in proportion to the other eyes their position differs a little according to the species, but owing to their littleness these differences will, as practical characters, not easily be of any use by the definition of the species.

D. Tactile Hairs.

On all 4 pairs of legs at the apex of tibia immediately in front of the dorsal edge there is a comparatively rather large and deep depression, out of which mounts a very conspicuous, semiglobular eminence with a hole in the centre. From this projects a long and very fine tactile hair not filling out the aperture by far, and enters into a smooth, jar-like cave with a narrowed outlet. Inside the jar the hair appears to be articulated. It is easy to find these 4 tactile hairs, and I can find none more neither on the limbs nor on the palpi. They are most likely characteristic for *Thelyphonoidæ* Thor. (op. cit. p. 367); I leave it to the future to decide, if they are also found in *Schizonotoidæ* Thor., a family unfortunately completely unknown to me.

E. Luminous Organs?

Systematic authors, as Stoliczka, Thorell, Tarnani, mention light yellow spots on the exterior side of the last abdominal segment in the family *Thelyphonoidæ* Thor. Most of the species have but 1, some (genus *Tetrabalius* Thor.) have 2 on each side. Thorell, the only author who has given really good descriptions of some species of *Thelyphonus*, uses the number of the spots as a character for the genera; and their shape as characters for the species. Tarnani mentions besides spots on the lower side of the rings of the telson (caudal file). These spots are found, no doubt, in all species, but their development is partly most different on the different joints of the same animal, and partly the shape and size of the spots are different according to species on the corresponding joints. In an adult female of *Th. indicus* Stol. the telson is consisting of 29 joints, the 5

proximal of which are entirely devoid of spots, while, however, a little spot was found on the 6th joint; further out on the telson they become larger by degrees, and the largest ones are found on the 16th—18th joint, whereupon they are redecresing little by little in size, but still found on the very last joint. Only one spot is found on each joint, lying close to the basis (Tab. III, fig. 4, m).

I have found nothing in the literature about the structure and significance of the telson-spots; Stoliczka, however, has declared the spots on the 12th abdominal segment to be glands, whereupon Thorell makes the striking remark: »nescio qua ratione« (op. cit. p. 364).

It is a positive fact that the mentioned spots are organs and not common colour-spots. It remains a question, however, if the organs of the 12th abdominal segment and of the telson are of the same or of a different nature; my investigations issued in the result that as to structure no essential difference is existing, and i am thus going to treat it in one. In *Thelyphonus* the chitine is very thick and its 2 layers (see Gauhert op. cit. p. 34—42) very readily observed; cuticula is often even scaling off very easily. The cuticula (Tab. III, fig. 5, c) is several times thinner than hypodermis (fig. 5, h); on the mentioned light spots the cuticula is exceedingly transparent, clear, faint light yellow and without pores, while hypodermis is totally wanting. On segments cleaned in caustic potash the edges of hypodermis are seen to be projecting inside above the thuswise shaped cavity in such a way that the aperture on the interior side (fig. 4 and fig. 5) is smaller than the light spot of the cuticula. The entire cave is replenished with a peculiar mass (fig. 5, m) similar to connective tissue, not showing neither ganglionic nor glandular structure; an excretory duct through the cuticula does not at all exist. Of what nature are

these organs, found only in this group within the Arachnids? I do not suppose that they are neither any kind of sense-organs nor glands; I dare, however, advance the hypothesis that they are able to produce light, and the whole structure, the thin, clear, faint yellow cuticula, looking like a pane of glass, seems most perfectly to agree with this theory. As far as I know, there is no observation present in the literature proving that the animals are able to produce light; some years ago I applied myself to the Danish missionary *E. Løven-thal* in Vellore (Madras), who had sent numerous specimens, caught by the wood-cutters, to Copenhagen, and begged him to find out, if the living animals were shining in the dark, but he answered that he had not been able to observe anything of that sort. Notwithstanding I cannot abandon my hypothesis, knowing from own experience that specimens of *Lampyris* are hardly or not at all shining, when shut in a bottle they do not feel well, and it is also possible to collect a multitude of *Lampyris* and their larves in the daytime, not thinking for a moment that they are able to shine with the white-yellow lower side of the last abdominal segments. — On that account I conclude these remarks inviting readers, obtaining an opportunity of seeing living specimens of *Thelyphonus*, to examine more closely this circumstance; but care must be taken that the animals are quite well and live undisturbed in a terrarium or the like.

IV. Solifugæ.

Kittary, M.: Anatomische Untersuchung der gemeinen (Galeodes aranoides) und der furchtlosen (Galeodes intrepida) Solpuga (Bull. de la Soc. Impér. des

- Naturalistes de Moscou, T. XXI, 2, 1848, p. 307—371, Pl. VI—VIII).
- Dufour, L.: Anatomie, physiologie et histoire naturelle des Galéodes (Mém. prés. par divers savants à l'Acad. des Sciences; Sc. Math. et Phys. T. 17, 1862, p. 338—446, 4 Pl.).
- Simon, E.: Essai d'une Classification des Galéodes (Ann. de la Soc. Entom. de France, sér. 5, T. IX, 1879, p. 93—154, Pl. 3).
- Karsch, F.: Zur Kenntniss der Galeodiden (Arch. f. Naturg. 46 Jahrg. B. I, 1880, p. 228—243, Taf. X, Fig. 1—25).

A. Lyriform Organs.

Gaubert states (op. cit. p. 86) that *Galeodes* is completely devoid of these organs. I have with the microscope examined limbs and parts of the integument of the body of *Gal. orientalis* Stol. and of a species of the genus *Rhax*, which is either identical with or closely related to *Rh. annulata* Sim., and I shall here, and always in the following, call it *Rh. annulata*? I have, however, in spite of a careful investigation, found such organs only on the mandibles. I discovered them under a very good magnifying-glass on a very large female of *Solpuga fatalis* Licht. which is taken as type and described in the following.

On the lower side of the last joint of the mandibles slightly removed from the basis (the place is shown in some measure by »a« on Tab. III, fig. 8), where the basal, flatter, lower side is changing into a sharper edge, is seen outside a smaller, oblique depression, the bottom of which being rather uneven. By cutting a thick layer of the chitine, being very thick at this place, and by examining it magnified c. 100 times, it will be seen that

the chitine of the depression is perforated by 5 channels rather spread from each other (Tab. III, fig. 6, l), and that they are mutually very different in width, the widest 10 or 15 times larger than the common pore-channels (p). These holes have inside almost a circular section, little by little, however, becoming very flat towards the exterior side, showing themselves on the exterior side of the chitine as the common narrow fissure with a small dilatation in the centre. I have also tried on the figure to reproduce the shape of this channels perforating the chitine, in the way the are seen, with the light falling through. Undoubtedly we here have lyriform organs in a somewhat modified shape.

On the lower side of the 1st joint *) a little behind the articulation between the 1st and 2d joint (Tab. III, fig. 8, b) a small group of tiny, stripe-like depressions is seen under a magnifying-glass. This portion is drawn in fig. 7 (the enlargement is $2\frac{1}{2}$ times smaller than by fig. 6). The figure shows 15 fissures (and a couple of common pore-channels) of very different size and very irregular position; the structure is the same as in the above mentioned organs on the 2d joint. The size of the fissures may be estimated by the thickness of a few neighbouring setæ, the basal portions of which are seen in the figure (s).

I have not been able to find more than these 2 remarkable groups. I have also found them in *Galeodes orientalis*, *Rhax annulata*? and *Cleobis Cubæ* Luc.,

*) In his endeavour to procure as many common characters as possible for the orders of the Arachnids Pocock (op. cit. p. 10) believes that he has found a basal joint, unknown hitherto, which is said to be fused with »the cephalic shield.« — Not being able neither to sanction nor to deny it, I make use of the old mode of designation.

that is to say on representatives for 3 genera very divergent from each other, and they are, in all probability, found in all forms of the order. The organ on the lower side of the 1st joint appears always to be in the same place; the depression on the lower margin of the 2d joint is, on the contrary, sometimes changing its position to the inner side of the lower edge (*Galeodes*).

B. Other Sense-Organs.

Gaubert and shortly after Bertkau (see Gaubert op. cit.) have described remarkable sense-organs in the interior of the apical part of the palpus and of the 1st pair of legs. I have not myself examined these organs, but I am mentioning them here, partly for the sake of completeness, partly because Bernard (op. cit. p. 29) mentions the protrusible organ discovered by Dufour on the apex of the palpi, and according to his own statement he wishes to follow C. Koch and believes it to be »a sensory organ, probably olfactory«, without having, however, been acquainted with Gaubert's preliminary communication and later work (see Gaubert p. 151—52) and not in the slightest calling attention to the existence of the organs placed at the side of the protrusible organ. I have examined the protrusible organ more closely, but I have not been able to understand it. Its movements ought to be observed and studied on living animals. It is, undoubtedly, a kind of fixing cup, and, as stated by Gaubert (op. cit. p. 152), »il est incontestable qu'elle ne sert au Galéode que pour s'accrocher ou grimper.« The terminal face of the palpi is showing great difference as to structure f. ex. in *Solpuga* and in *Rhax*, and I look upon it as most likely that beautiful

characters for groups of genera may be found by the study of the apical portion of the palpi on a large material.

Of other sense-organs we only know the eyes and »les raquettes coxales« (see Gaubert op. cit. p. 96—98), 3 pairs of which are found in *Zombis* Sim. and 5 pairs in all the other genera. It may be noticed about the eyes that in animals preserved in spirit the cornea is very often closely studded with small, irregular depressions which probably are owing to contraction and suggest a peculiar structure, differing from that in the other Arachnids.

C. Respiratory Organs.

L. Dufour states (op. cit. p. 404—7) that *Galeodes* possesses 1 pair of spiracles on the thorax and 2 pairs on the abdomen, respectively at the posterior margin of the 2d and 3d sternite. Subsequently this number, found by Dufour, is always reprinted in the literature, also of Pocock (op. cit. p. 8 and p. 16) in the year 1893. The statement, however, is defective, as a much smaller, unpaired spiracle is found in the median line at the posterior margin of the 4th sternite; that is already discovered by Kittary (op. cit. p. 343 and 345), but Dufour denies its existence. I have examined the spiracles of the abdomen, and the basal portions of its tracheal trunks in *Cleobis Cubæ*, *Galeodes orientalis*, *Solpuga fatalis* and *Rhax annulata*? in the following simple manner. The dorsal half of the abdomen is removed with a pair of scissors, the ventral side put into a strong solution of caustic potash, and 24 hours later all the bowels can be easily removed and nothing is left but the ventral integument and the tracheæ. Thus in all 4 forms I found a rather small

spiracle in the membrane between the 4th and 5th sternite, now quite back at the anterior margin of the 5th sternite (*Galeodes*, *Solpuga*, *Cleobis*), now nearer to the 4th than to the 5th sternite (*Rhax*). From the spiracle issues an unpaired, rather slender tracheal trunk, as a rule splitting itself shortly after into 2 branches, each of which is as wide as the main-trunk. In *Cleobis* only I have found a longer main-trunk, that even was broken off before its division.

The 2 anterior pairs of abdominal spiracles are uniformly constructed in the same animal, but present some differences in the 4 genera.

In *Galeodes orientalis* the 2d and 3d sternite are hardly bipartited along the median line, their posterior margin is slightly projecting at the middle where it is ending in the well known combs. The spiracles are lying like longitudinal fissures, at a very little distance from each other, almost in the middle of the membrane between 2 sternites, they are diverging only a little from in front backwards.

In *Rhax annulata*? the 2d and 3d sternite are very distinctly bipartite in the median line; posteriorly the median, thin integument gets little by little broad and is even folded up under the posteriorly broadly rounded corners of the 2 halves of the sternite, so that 2 oblique folds arise, at the bottom of which the large, oblique spiracles are found. These are thus placed in a considerable distance from each other under the before mentioned submedian corners and are strongly diverging in the direction from in front backwards.

Solpuga fatalis is about of the same structure as *Rhax*. The 2 sternites are visibly divided in the median line, and the integument, uniting the 2 halves of the same sternite, is posteriorly widely expanded and makes a smaller, triangular compartment, but the rather oblique

and comparatively small spiracles are placed in the sides of the triangle and are only overlapped so much that the immovable chitine of the sternite projects enough to make their apertures turn towards the median plan of the animal. The structure in *Cleobis Cubæ* is almost similar to that in *Solpuga*, the spiracles, however, diverge respectively much lesser and are relatively much longer, about half the length of the sternite.

D. About the Systematism of the Order.

Of older authors, having published systematical contributions of any importance, may be mentioned C. L. Koch and L. Dufour (op. cit.). The above mentioned work of Simon, published in the year 1879, marks a great systematic progress; a large material (with a number of new forms) afforded to him the means of valuing the characters pointed out by older authors, and of finding several new ones, leading him also to establish several new genera. Next year Karsch published his above mentioned paper; he promises (p. 228) »neue Gesichtspunkte« but — besides some synonymic, the establishing of 4 new genera and several new species — it strikes me that there is nothing new but his pointing out the importance of the number of joints in the tarsi of the 2d and 3d pair of legs, which Simon has neglected to state. The author says besides p. 234: »nach dem Ergebnisse der vorausgegangenen Untersuchungen ist die Zeit der Schöpfung einer natürlichen Eintheilung doch lange nicht reif; es ist noch viel zu wenig bekannt, und das Bekannte noch viel zu oberflächlich erforscht«, and in this point he is undoubtedly quite right. After this paper only a few new genera and species have been described, but not one has tried to arrange the now rather numerous genera in groups.

I am not myself in the case to be able to undertake a grouping, not having representatives for more than half of the genera; I mean, however, to be able to point out several new structural features of systematic value. These are: 1) occurrence and structure of the stridulating apparatus, 2) structure of the basis of tarsus of the 3 pairs of ambulatory limbs, 3) shape of the rostrum, 4) size of the anal aperture; in the following they are separately described.

E. Stridulating Apparatus.

A large portion of the interior side of the mandible is, as well known, taken up by a naked, shining, square plane, being mostly a little shorter, sometimes (*Cleobis*) as long as high, the anterior margin of which is curved a little backwards at the middle. In *Solpuga fatalis* Licht. (Tab. III, fig. 8) sharp keels, about 12 in number and turning backwards, issue from the uppermost $\frac{2}{3}$ of this anterior margin, the top one but three of which is the longest, and from thence they decrease in length both upwards and downwards; the inferior ones becoming thus very short. Some very short keels are seen in the bottom of the rather deep furrows near the anterior margin. This structure is uniform on both mandibles and in both sexes. — I took a very large specimen of *S. fatalis*, placed my fingers on the centre of the exterior side of the mandibles, pressed them against each other and moved them in this way alternately up and down in the vertical plane, just as the animal must be able to move them; the result was that the 2 furrowed parts of the 2 inner surfaces rubbed against each other and produced a sound that could be heard in a room at a distance of more than 3 metres. Though I do

not know any statement that the animals stridulate, I still look upon it as unquestionable that we here have a stridulating apparatus, built, indeed, very differently from those which, as far as I know, are found in *Insecta*, *Araneæ*, *Sphærotherium* and *Decapoda*; because in *Solpuga* we find 2 similarly rifled planes rubbing against each other, a structure occurring nowhere else. I may still add that the naked plane is slightly arched.

A similar development of the stridulating apparatus is found in the other species of the genus *Solpuga* known to me. In *Galeodes* (*G. orientalis* Stol., *G. araneoides* Pall., *G. græcus* C. Koch, *G. scalaris* C. Koch) it is considerably slighter with shorter keels, occupying but about the half of the anterior margin of the naked plane; in *Datames* (*geniculatus*? C. Koch) and in a species of the genus *Zombis* almost as in *Galeodes*. In *Rhax annulata*? (unfortunately the only species of the genus known to me) the interior side of the mandibles is much flatter than in the former genera, and the naked plane comparatively shorter with uniformly and strongly curved anterior margin, the c. 10 keels are all rather short, but vigorous, the middle ones the longest. In *Cleobis Cubæ* Luc. (the sole species of *Cleobis* known to me) the apparatus attains a very high development (Tab. III, fig. 9). The naked area is almost as long as it is high, the furrowed portion occupies but little more than the upper half, but in contrast to the former genera more than $\frac{2}{3}$ of its length, owing to the uncommon length of the c. 9 keels. Furthermore the naked area is uncommonly arched thuswise that the top one but three keel becomes the most prominent at the same time as it is the longest and thickest; henceforth the keels decrease slightly in length downwards. In a very

small specimen of *Gluvia dorsalis* Latr. (hardly 11 mm. in length) I have found a stridulating apparatus furnished with very long keels forming an intermediate link between the organs in *Cleobis* and *Solpuga*. Every trace of keels is wanting on the naked area in an animal from Apscheron (Baku), belonging to *Gluvia* according to the definition of Simon; and owing to a supposition based on the locality (it has not been possible for me to procure the treatise of L. Koch) I believe this animal to be *Gl. caucasica* L. Koch; it ought hereafter and especially in regard to the abnormous structure of its rostrum (see later on) to be separated as a particular genus.

It may still be quoted that L. Dufour has mentioned and figured (op. cit. p. 393, Pl. 2, fig. 6 b and fig. 8 a) »six ou sept traits parallèles, stries ou cannelures« in some species, without adding further explanations.

F. The Tarsus of the 2d—4th Pair of Legs.

In *Solpuga fatalis* Licht. we find on the basal portion of the tarsus close to the insertion upon the metatarsus a rather small, arched, transverse area, stretching a little down upon the anterior and posterior side of the joint, where it is raising like a lower, blunt protuberance (Tab. III, fig. 10). This area (a) is trimmed with c. 24 sharp furrows and interjacent keels, radiating towards the extreme basis of the tarsus. The portion at the basis between this area and the articular membrane (c) is a smooth plane, being on the 2 anterior pairs of legs stronger arched and raised like a smaller process, on the hindmost pair of legs it is, however, less arched and not raised towards the basis (b). Metatarsus projects on the dorsal side and slightly down upon the sides freely and rather considerably like a

roof above the articulation. The latter is very free, allowing the tarsus to be bend slightly upwards and strongly downwards in the vertical plane and besides considerably forwards and backwards in the horizontal plane, when it is bent so much downwards as not to touch the roof of metatarsus. The importance of the furrowed area and of the roof is quite inconceivable to me. A similar structure is found in the few other species of *Solpuga*, known to me.

In *Galeodes* (*orientalis* Stoll., *araneoides* Pall; *græcus* C. Koch) on the 4th pair of legs the roof of the metatarsus is much shorter, the transverse area of the tarsus rather faintly furrowed, whereas the smooth area between the transverse area and the articular membrane projects like a proximal, rather taplike vault. On the 2d and 3d pair of legs the transverse area is rudimentary and the smooth area projects still more as a large, blunt tap. The movement is on all pairs of legs very well developed in the vertical plane, but horizontally weaker than in *Solpuga*.

The roof of the metatarsus on the 4th pair of legs in *Datames geniculatus* C. Koch? is very short on the dorsal side, while the apophysis on the sides are rather projecting; the transverse area is very narrow and lacking fissures, the smooth area broad and evenly arched; the movement as in *Galeodes*. The apex of metatarsus is filled up on the upper side and a little down the sides with numerous, rather fine longitudinal furrows, which may also be found less developed down towards the apophysis in other genera; I have examined them with the microscope without result. The 2d and 3d pairs of legs are, on the contrary, built almost as in *Galeodes*; the furrows on the transverse area are, however, more distinct.

A specimen of the genus *Zombis* Sim. has shown in all respects great accordance with *Galeodes*.

In *Rhax annulata*? the transverse area on all 3 pairs of legs is very weakly developed, having but on the hindmost pair of legs some irregular furrows, the smooth area at the basis narrow, not much raised, the roof of metatarsus very short. The movement very well developed in the vertical, slightly in the horizontal plane.

In *Gluvia caucasica*? (see above) the articulation is simple, without transverse area and discernible roof, appearing, however, very movable in both planes.

In *Cleobis Cubæ* Luc. the smooth area makes an intermediate link between the form in *Solpuga* and *Galeodes*; the transverse area is exceedingly slightly developed on the 2d and 3d pair of legs, more strongly on the 4th, seeming, however, all over to be lacking furrows; the roof short. The movement is well developed in both planes, the foot remarkably capable of bending upwards.

I have no doubt that the differences stated here must be of some importance to the movement of the foot, and thereby to the nature of the walk of the animals, in that way being of systematic importance. The examination is in the easiest way executed with a strong magnifying-glass on as large specimens as possible.

G. Rostrum.

This most remarkable organ represents a considerable difference in form in the genera known to me. It is not my intention to give a closer anatomical representation of the structure of the rostrum; it suffices to give names to the parts, necessary to illustrate my object. The rostrum tapers in front into an unpaired, dorsally

placed, at the basis broad, shorter or longer lobe which I will name the dorsal lobe (Tab. III, fig. 11, d); this bears on the lower margin the remarkable formation which repeatedly has been described by anatomists, and which I shall name the setal plate (l). Below on each side issues a lobe turning forwards and downwards, the basis of which almost meets at the top with the lower basis of the dorsal lobe; these 2 ventrally situated lobes I shall call the lateral lobes (v).

Each lateral lobe carries, besides several common hairs, 1 thick, long, plumose seta which I shall name the plumose seta (s).

In *Galeodes (orientalis* and several other species) the tolerably long dorsal lobe projects somewhat in front of the lateral lobes (fig. 11); the setal plate is very high, the foremost, lowest end projects in a rather long, triangular apex, and its anterior margin is very concave, and very well defined from the upper margin. The plumose setæ extend to the extreme apex of the setal plate.

In *Datames geniculatus?* the rostrum has a similar form, the dorsal lobe is shorter and the lateral lobes longer, the 3 lobes accordingly stretching equally far. The anterior margin of the setal plate is still more concave than in *Galeodes*, but the lower apex is somewhat shorter, and the plumose setæ reach far in front of this apex.

In *Zombis* sp. I have found a rostrum similar to that in *Datames*; the lateral lobes are, however, a little shorter, and the plumose setæ reach but a little outside the apex of the setal plate.

In *Solpuga (fatalis* and several other species) the dorsal lobe is a little shorter than the lateral lobes, the setal plate rather lower than in *Galeodes*, with a slightly concave anterior margin (almost as in

Cleobis) leading smoothly into the short upper margin, the lowest, foremost end rather rounded, somewhat shorter than the plumose setæ.

In *Cleobis Cubæ* (Tab. III, fig. 12) the lateral lobes are broad at the basis and longer than the short, dorsal lobe; the setal plate lower with the anterior margin rather concave below at the triangular apex; the plumose setæ reach far beyond the latter.

In *Rhax annulata*? (Tab. III, fig. 13) the dorsal lobe is rather long, being, however, not as long as the uncommonly long but only middle broad lateral lobes; the setal plate has an equally and slightly concave anterior margin, but hardly any discernible excavation above the short, blunt, lower apex; the plumose setæ reach a little in front of the apex.

In *Gluvia dorsalis* Latr. rostrum is in all main points like rostrum in *Cleobis*, the broad lateral lobes are, however, comparatively a little longer.

In *Gluvia caucasica*? (see above concerning the determination) we find a rostrum of quite a different form. The dorsal lobe is long and stretches far beyond the middle-size lateral lobes; but the most remarkable is the setal plate, being a very long and narrow triangle with the dorsal line straight almost all the way, the apex is narrow and blunt, and far back on the lower side at the basis of the lateral lobes the plate projects in a small, triangular apex turning in an oblique direction both forwards and downwards, stretching a little further than the lateral lobes and morphologically corresponding with the foremost, triangular apex in the other genera. The plumose setæ are but half the size of the interval between the apex of the lateral lobes and the setal plate. (It may once more be

mentioned that this remarkable species is devoid of stridulating apparatus).

H. Anus.

In *Rhax annulata*? the anus takes up hardly the lowest third of the height of the last segment; in the other, before mentioned forms, known to me, it takes up from at least $\frac{2}{3}$ till almost the total height of the whole segment.

I suppose that, if the characters pointed out here for some of the genera (respiratory organs, stridulating apparatus, the basis of the tarsus, rostrum and anus, besides the but indicated difference in the structure of the apical part of the maxillary palpi) together with the formerly known characters are going, seconded by a sensible valuation of the characters, to be examined on a large material, a basis may be gained sufficiently extensive to the establishing of an improved system of this interesting order. I find grounds to believe that the shape of rostrum, in particular, will become of the greatest importance to the natural arrangement of the genera, often much more important than the number of joints in the tarsi.

V. Opiliones.

Sørensen, W.: Opiliones Laniatores Musei Hauniensis (Naturh. Tidsskr. 3. R. B. XIV, 1884, p. 555—646).

A. Lyriform Organs.

Gaubert (op. cit. p. 82—83) has studied *Phalangium opilio* and has found these organs only on the 1st and 3d

joint of the ambulatory limbs and on the basal joint of the mandibles, but he has in those places found almost all that exist. He denies their occurrence on the palpi, remarking »ce qui distingue les Phalangides des Ara-néides«. Now I shall describe what I have found in the female of the same species, which ought rather to be called *Phal. cornutum* L. For the rest it is difficult to examine this animal owing to the nature of the integument; of the same reason I have not tried to go into details in describing the organs of the body; but I have minutely described the organs in *Nemastoma lugubre* O. F. Müller, belonging to a small family, *Nemastomoidæ*, standing between the *Phalangioidæ* and *Troguloidæ* (see W. Sørensen op. cit. p. 577—78), it being much easier to observe them with certainty in this form. *Trogulus* has also been examined by Gaubert, who has found organs on the mandibles and ambulatory limbs, yet the position of the fissures on the ambulatory limbs has not been further described.

1) *Phalangium cornutum* fem.

1st pair of legs.

1st joint. At the basis c. 3 closely placed oblique fissures. At the apex of the apophysis of the posterior side a tolerably long transverse fissure.

2d joint. On the anterior side close to the lower side a group of 6 shorter oblique fissures. Far down on the posterior side close to the apical margin about 9 parallel, slightly oblique, closely lodged longitudinal fissures.

3d joint. On the anterior side near the basis an irregular group of c. 10 short transverse fissures, most of which are strongly curved; on the posterior side a similar group. Besides some long transverse fissures spread over the joint quite to the apex.

Maxillary palpi.

3d joint. On the interior side of the basal portion a small, irregular group of 4 arched, transverse fissures; on the exterior side a similar group. On the dorsal side and slightly round upon the exterior side a group of 5 oblique longitudinal fissures of most unequal length, one of them very long.

Mandibles.

On the exterior side (not the interior side, as stated by Gaubert) of the 1st joint, towards its dorsal side slightly outside the middle an irregular group of c. 4 longer and several very short longitudinal and oblique fissures. (On the exterior side of the 2d joint a belt, narrow at the basis and getting by degrees broader towards the apex, of numerous, irregular, very small longitudinal fissures; similar fissures are found also on the whole lower side of the same joint and on the exterior side of the basal portion of the 3d joint. I must leave to future to make out the true nature of these fissures; I am still doubting as to them being in any way connected with the lyriform organs).

Body.

On the 1st sternite 2 pairs of fissures are found, the foremost pair is situated about where the sternite is tapering to form the median lobe under the ovipositor, and towards the lateral margins the second pair, with about the same mutual distance of the fissures as the 1st pair, is situated a little in front of the posterior margin of the sternite. All 4 fissures are oblique, almost radiating towards a point in the centre.

I have also found solitary fissures on other sternites of the abdomen and on the cephalothorax, and no doubt they are found in a small number spread over the whole body, but, as I said before, they are difficult to point out, whereas *Nemastoma* easier provides a

more complete and correct exhibition of these organs in a type of *Opiliones*.

2) *Nemastoma lugubre*.

1st pair of legs.

1st joint. On the lower side a little removed from the basis a group of 3 long transverse fissures, placed partly behind each other.

2d joint. On the anterior side near the apical margin 1 long and c. 6 shorter transverse fissures; the small ones outside the longer ones. On the limit between the posterior and the lower side a group of 5 long, slightly oblique longitudinal fissures; behind the apophysis 1 long and 1 shorter transverse fissure.

3d joint. On the basal portion of the anterior side c. 11 short transverse fissures; on the basal portion of the posterior side a somewhat lesser number. A little behind the apex 1 dorsal, good-sized transverse fissure and slightly down each side a similar one, 3 in all.

Last joint of tarsus. A little removed from the apex towards the dorsal side 1 single, rather long transverse fissure.

The 3 other pairs of legs essentially as the 1st pair. Maxillary palpi.

1st joint. On the upper side somewhat behind the apex 1 single transverse fissure, on the lower side at the middle 1 single, short, oblique fissure.

2d joint. On the anterior side close to the apical margin behind each other 2 long and 1 shorter transverse fissure (Tab. III, fig. 14, 1).

3d joint. On the basal portion, partly on the upper, partly on the exterior side and a little down the interior side some more or less arched, often very oblique, transverse fissures. Slightly behind the apex on

the dorsal side a group of 3 middle-size, oblique longitudinal fissures.

6th joint. On the exterior side slightly behind the apex 1 short transverse fissure (Tab. III, fig. 15, l).

Mandibles (in the male).

1st joint. 2 spread transverse and 3 longitudinal fissures on the distal half of the exterior side, besides an oblique fissure on the exterior side of the distal, dorsal process.

2d joint. On the exterior side at the basis 3 very short, closely placed, oblique fissures, a little outside these 4 spread longitudinal fissures and on the distal half 4 spread transverse fissures.

The ventral side of the abdomen (in the male).

1st sternite. Foremost on the median, narrower portion on each side 2 fissures a little removed from the lateral margin, the one a longitudinal, the other a transverse fissure; a little more backwards and removed from the lateral margin on the one side 2 oblique fissures, on the other 2 transverse fissures; near the posterior margin 3 transverse fissures on the one, 2 on the other half.

2d sternite. On each side 1 longitudinal fissure at the lateral margin, and from thence towards the median line all in all 3 transverse fissures; the inmost one the longest.

3d, 4th and 5th sternite. 1 longitudinal fissure at the lateral margin (and from thence 2 transverse fissures towards the median line).

6th sternite (the foremost anal plate) devoid of fissures.

The lateral anal plates.

Each with 1 fissure.

The 4 movable tergites of the abdomen.

Generally each with 2, partly transverse, partly longitudinal fissures on each side; the hindmost, 4th tergite (hindmost anal plate) altogether with 2 transverse fissures.

Cephalothorax and the foremost coalesced abdominal tergites.

With some spread fissures going in different directions and situated quite forward at the anterior margin, at the posterior margin and at the lateral margins.

The mentioned fissures occurring on the body are all comparatively large.

Phalangium and *Nemastoma* are, however, by far not sufficient to give a full idea of the occurrence of these organs in this order, the numerous types of which differ from each other according to manifold structural features. I am, however, bound to leave this rather difficult investigation to others who are disposing of a richer material of different forms (*Sironoidæ*, *Troguloidæ* etc.) I shall merely add that I have found a great number of small longitudinal fissures spread on the upper side of the tibia in *Mastobunus tuberculifer* Luc., and the animal does even belong to the same family as *Phalangium cornutum*. In *Pachyloides uncinatus* W. Sør., belonging to *Opil. Laniatores*, we find other structures differing much from the examined *Opil. Palpatores*; thus very small, spread longitudinal fissures on the metatarsus; but owing to the peculiar, thick integument it is very difficult to examine them.

B. Other Sense-Organs.

Of such are known but the eyes in this order (not counting the sense-organs on the ovipositor of the female). In two types I have found very remarkable hairs deserving to be treated more closely and of

which at least the one form possibly may be a sense-organ.

1) *Nemastoma*.

Systematic authors state that the palpi in a series of species of this genus are furnished with clavated hairs. I have studied them in *Nem. lugubre* O. F. Müller. They are situated between the common setiform hairs and found on the lower side of the 3d, 4th and 5th joint, on the distal half of the whole 5th joint and on the entire 6th joint (Tab. III, fig. 15). They are much shorter than the other hairs, and much more slender, straight and gradually getting finer towards the apex that is ending in a globe, on the upper side of which traces of a continuation of the hair is to be noticed; the globe is largest on the hairs sitting on the upper side of the penultimate joint. The globe is hollow and the exterior wall seems to be pierced with small holes (Tab. IV, fig. 7, b); the hair itself is hollow and lengthens into the globe, where it takes the shape of a bowl (fig. 7, a) the lateral margin of which is in all probability the united with the interior surface of the globe. That is what I mean to have seen with my, not very modern, microscope, but I am quite unable to set forth any reasonable hypothesis about their significance. It is just possible that they are a kind of sense-organs, but in all cases they seem to differ much from those known hitherto.

2) *Phalangium parietinum* De Geer.

In my treatises quoted later on under *Chelonethi* I have shortly described and figured some remarkable tufts of hairs, found in the male of this species on the lower side of metatarsus and some of the proximal joints of tarsus of the 3 foremost pairs of legs, but are lacking

on the 4th pair and on all the legs of the female. Seen even under a strong magnifying-glass they appear to be but very small, clavated hairs, but making use of the microscope it is evident that each »hair« consists of fewer or several very fine hairs, collected at the basis in a compact bunch, issuing from a hollow in the centre of a small eminence (Tab. IV, fig. 8 and fig. 9). These bunches are placed in 2 or 3 irregular longitudinal rows. The single hairs are slightly dilated near the tip and they split in several rather short, pointed branches (fig. 9). The integument of the leg is thick, but on a properly cleaned specimen the hairs can be seen passing through it, and exceedingly small, partly clear chitinous formations issue from the basis of the hairs. By dissecting the leg it is evident that from the basis of each bunch there issues a kind of radiation of the surrounding, soft tissue and that this radiation takes up almost $\frac{1}{3}$ of the diameter of the leg; but I have not entered into the histological study of this tissue. The chances are that the whole formation is a kind of sense-organ; it being striking, however, that these hairs are wanting in both sexes of *Phal. cornutum* L. and in the other *Phalangioidea* living in Denmark.

C. Supplementary Spiracles on the Legs.

In the larger species of the genus *Phalangium* is easily seen a small, dark ring on the posterior side of tibia of all 4 pairs of legs close to the basis (Tab. IV, fig. 1, a), and a smaller ring is found on the upper side of tibia a little in front of the tip (fig. 1, b). It is proved by closer examination that these rings are spiracles. Fig. 4 and the diagrammatic fig. 3 show the structure of the proximal spiracles. The exterior integument (a) is towering slightly up, having in the centre a round

hole (b) and is radiately striped from this hole; the immediate surrounding of the hole is very light, succeeded by a darker, not distinctly limited ring. The hole is leading into a respiratory cave (fig. 3, d), the interior wall of which consists of an integument, fastening itself round along the edge of the elevated portion of the integument of the leg; the exterior wall being thus convex and the interior one concave into the leg, a real cave has arisen. A tracheal trunk is opening itself through the interior wall, the aperture (fig. 4, e) is a little larger than the aperture of the spiracle itself and situated closer up to patella. The distal spiracle is constructed quite in the same way (fig. 6), the outlet of the tracheal trunk (e) is, however, nearer to metatarsus than the aperture of the spiracle. On both spiracles the interior wall of the respiratory cave (fig. 5) is studded with numerous larger and numberless very small spines, all radiating towards the outlet of the tracheal trunk.

I had for some time examined *Phal. cornutum* L., but did not succeed to make out this structure, before I had taken to the study of the spiracles in the large females of *Phal. propinquum* Luc. which I recommend as an excellent object for this examination.

Next arises the question as to the relation of these spiracles to the tracheal system of the animal. In the literature it is stated that *Phalangioidæ* have but one single pair of spiracles, lodged almost behind the middle of the coxæ of the hindmost pair of legs, and from each spiracle a very wide tracheal trunk issues forward in the body, dividing itself into several thick branches. 2 tracheal trunks go into each leg and are easily seen especially inside the femur, the one is a little wider than the other; they do not unite towards the basis, but issue each from its own branch of the main trunk

in the body. Towards the end of femur the one trunk is increasing in thickness and is turning to the side at the distal end of patella and goes to the spiracle lying in the basis of tibia (Tab. IV, fig. 2, g). It is considerably narrowed in the last, short piece; a trunk (h) is rising where the narrowing is commencing, being much narrower than the main trunk and running nearly through the whole length of tibia about to the metatarsus where it seems to be dissolved into fine branches. Before the entering of the main trunk into the spiracles is taken place fine, recurrent branches (i) issue from it. I have found them recurrent on preparations cleaned in caustic potash, and in August this year I have examined a fresh specimen of an *Acantholophus* (with the tracheal trunks filled with air) and have also found them to be recurrent. The proximal spiracle appears chiefly to supply fresh air to the main trunk in patella and the distal portion of femur, besides partly to tibia, and only appears as an aperture, establishing a connection by a short lateral tracheal branch with the widest of the 2 normal trunks of the leg which issues from the central tracheal system, while the distal spiracle possesses a special tracheal system which but secondary communicates with the other of the main trunks and which doubtless, to no small extent, provides with air the distal portion of tibia, besides metatarsus and tarsus. Making use of dissection of tibiæ cleaned in caustic potash I have studied the structure as well as possible, but I abstained from giving any figure, as several of the tracheæ were collapsed and I was afraid of not being sufficiently exact in the representation of details. The direction and ramification of the tracheæ I have later (in August) studied on fresh specimens (of *Phal. cornutum*), put into glycerine which does most excellently preserve the

air within them in such a way that they are easily followed. In *Phal. propinquum* I have found that from this distal spiracle proceeds an independent tracheal trunk strongly narrowed at the spiracle and shortly after becoming very wide, running to the apex of the tibia, and not far from the origin it sends forth 2 large branches, the narrower of which is recurrent and dissolving little by little towards the middle of the tibia into finer branches; the other is somewhat wider, at first running laterally, but not far from the spiracle it is (according to the examination of præparations cleaned in caustic potash) connected by a very narrow and exceedingly short lateral branch with the one of the 2 main trunks which (fig. 2, k) is not connected with the proximal spiracle. I have had no difficulty in following the 2 trunks through the tibia, a fact I wish to point out, on account of the remark above.

Of the 2 spiracles the proximal one is almost always found at the same place, while the distal one is a little moved in the different genera of the fam. *Phalangioidæ* W. Sør. It may immediately be stated that the size and structure of the spiracles, besides the distance of the distal spiracles from the apex of tibia, is almost equal on all 4 pairs of legs of the same specimen. Tab. IV, fig. 1 gives an exhibition of their position in *Phal. propinquum* Luc. and the Danish species, *Ph. cornutum* L. and *Ph. parietinum* De Geer. An almost similar position I have found in *Phatybunus corniger* Herm., *Mitopus morio* Fabr., a species of the genus *Egænus*, even by the rather short-legged *Acantholophus ephippiatus* C. Koch. In *Liobunum rotundum* Latr., an East-Indian species of the genus *Gagrella* and in *Pantopsalis Listeri* White the distal spiracle is somewhat longer removed from the apex of tibia.

Simon divides (op. cit.) the European forms of his family *Phalangiidae* into 2 sub-families: *Sclerosomatinae* and *Phalangiinae*; all the above mentioned genera belong to the lately mentioned group. Of the small group *Sclerosomatinae* which consists of 3 European genera I have examined the 1st and 2d pair of legs of *Mastobunus tuberculifer* Luc. The proximal spiracle is hardly lying so close to patella, the distal one on the tibia of the 2d pair of legs, is placed hardly $\frac{1}{3}$ of the length of the tibia from the apex close behind the distal of the 2 secondary articulations; the tibia of the 1st pair of legs is not quite half as long as the one of the 2d pair of legs, and the spiracle is even situated a little closer to the basis than to the apex.

While thus the spiracles are pointed out in so many of the most divergent genera of the fam. *Phalangioidea* W. Sør. (*Phalangiidae* Sim.), they are completely wanting in *Ischyropsaloidae*, *Nemastomoidae*, *Troguloidae* and *Sironoidae*, of which I have examined one species of each family, certainly not having dissected any specimen of the first and last one. Next they are wanting in *Opil. Laniatores*, of which I have examined both short and long-legged species of some families. Thus they are solely found in *Phalangioidea* which typically have the longest and most slender legs of all *Opiliones*, and it is the only family of *Opil. Palpatores*, whose spiracles at the anterior margin of the abdomen are »hiantia« (W. Sør.), while in all other, closely examined forms they are »cancellata« or able to be closed in one way or another. (As to the spiracles in *Opil. Laniatores* I refer the reader to W. Sørensen (op. cit.) The existence of supplementary spiracles becomes thus a family-character which may be added to the characters mentioned by Sørensen (op. cit. p. 578).

I shall not undertake to set forth an hypothesis

about the question how these strange spiracles may have arisen and how their relation to the normal tracheal system is brought about. The appearance of such supplementary respiratory organs on the limbs is quite unique within the Arthropods. Of course they are performing a part of the supply of air of the long, slender legs. Dr. Sørensen has verbally put the question, if their existence might not be brought in connection with the well known and astonishing capacity of the limbs of *Phalangioidea* to be able to make violent movements a considerable time after they have been pulled off from the animal; this vitality should, in that way, be connected with the excellent renewal of oxygen which these spiracles are able to furnish to the legs. I set forth this idea as a hypothesis to be further proved by experiments on living animals; especially it has to be tried if the limbs of other Opiliones, as *Ischyropsalis*, *Nemastoma*, *Trogulus*, which are devoid of these spiracles, have an equally well developed capacity of making movements in a torn state.

(I cannot quit *Opiliones* without mentioning that Gaubert has neglected to make use of and quote a work by W. Sørensen: Om Bygningen af Gonyleptiderne, en Type af Arachnidernes Classe (Naturh. Tidsskrift, 3. R. B. XII, 1879—80, p. 97—222, pl. II), although this paper is of great importance. *Gonyleptidae* (*Opiliones Laniatores*) constitute a chief-division of *Opiliones* in opposition to *Op. Palpatores*; the work of Sørensen is the only newer complete anatomical monograph of a form of Opiliones, and it is not possible to give a general representation of a series of structural features in *Opiliones*, as Gaubert has tried, without paying attention to the one of the two sub-orders. Inter alia we find in Sørensen's papers a detailed representation of the structure of the integument, the segments of the body

and the limbs. The negligence becomes still more aggravating, because W. Sørensen in several of his works about *Opiliones* is examining much more carefully than Gaubert, according to the impression I have received of his examination of the existence of the lyri-form organs and others. I shall, however, in the treatment of the next order mention several similar questions).

VI. Chelonethi (Pseudoscorpiones).

Stecker, A.: Ueber neue indische Chernetiden (Sitzungsber. d. Kaiserl. Akad. d. Wiss. in Wien, Math.-Naturw. Classe, LXXII. B, I, 1875, p. 512—26, Taf. I—IV).

Hansen, H. J.: Arthrogastra Danica. En monographisk Fremstilling af de i Danmark levende Meiere og Mosscorpioner, med Bidrag til sidstnævnte Underordens Systematik (Natur. Tidsskrift, 3. R. B. XIV, 1884, p. 491—554). — The paper is not accompanied with figures, but references are made to the contemporary revision of the same author of Arthrogastra Dan. in »Zoologia Danica«, 4de Hefte, Spindeldyr, of which Pl. VII contains numerous original figures of Chelonethi, while the accompanying text is popular.

Bertkau, Ph.: Ueber den Bau der Chernetiden oder Pseudoscorpione (Sitzungsber. d. Niederrh. Gesellsch. f. Nat. u. Heilkunde, 1887, p. 112—117). — The treatise is quoted after Bertkau's Jahresb. f. 1887, p. 35—36.

Croneberg, A.: Beitrag zur Kenntniss des Baues der Pseudoscorpione (Bull. de la Soc. Impér. des Naturalistes de Moscou. Nouv. Sér. T. II, 1888, p. 416—61, Taf. X, XI, XI a).

Balzan, L.: Revisione dei Pseudoscorpioni del Bacino dei Fiumi Paraná e Paraguay nell' America meridionale (Ann. del Museo Civico di Storia natur. di

Genova, Ser. 2a, Vol. IX, 1890, p. 401—54, Tav. XIII—XVII).

- Voyage de M. E. Simon au Venezuela. Arachnides, Chernites (Pseudoscorpiones) (Ann. de la Soc. Entom. de France, Vol. LX, 1891, p. 497—552, Pl. 9—12).
- Bernard, H. M.: Additional Notes on the Origin of the Tracheæ from Setiparous Glands (Ann. and Mag. Nat. Hist. 6 ser. Vol. 11, 1893, p. 24—28).

A. Lyriform Organs.

Bertkau seems to be the first who has found such organs in *Chelonethi*; he writes in the quoted »Jahresbericht«: Von Sinnesorganen sind spaltförmige Hautporen und die Augen zu nennen.« Gaubert has overlooked Bertkau's treatise, he has, however, himself found organs on the legs and palpi, certainly in a very small number, viz., a group of 3 fissures on the upper side of the 4th joint of the palpi and a similar group with 3 or 4 fissures on the 3d joint (surely a misprint for the 2d joint) of the legs. Yet he states also, p. 84, that he has seen them on »le thorax«, but by discussing them further he no more mentions thorax, what there might have been great reason in doing, as he has not found them else on the cephalothorax in any order, except on the sternum in *Araneæ*, but sternum is wanting in most of the *Chelonethi* and is exceedingly small in the others. I shall now fully communicate what I have found in representatives for 2 of the genera which are most divergent from each other, *Chelifer* and *Obisium*.

1) *Chelifer granulatus* C. Koch (male).

1st and 2d pair of legs.

1st joint. On the limit between the lower and posterior side close to the apex 1 single oblique fissure.

2d joint. On the dorsal side a organ with c. 5 longitudinal fissures of very different size.

4th joint (femur). 3 shorter longitudinal fissures lengthwise the dorsal side of the joint.

5th joint (tibia). On the dorsal side 2 longitudinal fissures, the one somewhat removed from the basis, the other from the apex, besides sometimes 2 fissures close to each other at the middle.

6th joint (tarsus). On the dorsal side 2 longitudinal fissures, the one somewhat removed from the basis, the other from the apex.

3d and 4th pair of legs.

1st and 2d joint as on the 2 first pairs of legs.

3d joint (trochantin). On the lower side 1 long, arched transverse fissure.

4th joint. On the dorsal side c. 5 short longitudinal fissures, spread lengthwise on the joint. On the lower side near the apex 1 rather long longitudinal fissure.

5th joint. On the dorsal side 4 short longitudinal fissures spread lengthwise on the joint.

6th joint. On the dorsal side 3 short longitudinal fissures spread lengthwise on the joint.

Maxillæ.

On the exterior side 3 slightly oblique longitudinal fissures.

Maxillary palpi.

2d joint (trochanter, as the maxilla has to be counted as the 1st joint of this appendage). On the exterior side towards the apex 5 longitudinal fissures of most different length, the one very long.

3d joint. On the exterior side c. 8 short longitudinal fissures, spread lengthwise on the joint.

4th joint. On the upper side down on the interior side and slightly removed from the basis 3 rather large

longitudinal fissures; slightly removed from the apex 1 small longitudinal fissure. On the lower side near the apex 1 small longitudinal fissure.

5th joint. On the upper side at the basis 2 well developed longitudinal fissures removed from each other; at the basis of the immovable finger 1 similar longitudinal fissure. On the lower side of the basis of the immovable finger 1 large, arched oblique fissure.

6th joint. On the lower side somewhat removed from the apex 1 middle-long longitudinal fissure.

Mandibles.

On the middle of the lower side of the hand towards the anterior margin 1 single, arched transverse fissure (Tab. IV, fig. 10, 1). On the upper side 1 large longitudinal fissure almost above the fissure of the lower side.

The ventral side of the abdomen.

3d sternite. From the median line to half way towards the lateral margin c. 2 irregular transverse fissures on each side.

4th sternite. On each side towards the posterior margin 2 rather large transverse fissures; the one slightly removed from the median line, the other a little removed from the lateral margin; on the one side 1 small fissure near the lateral margin.

5th sternite. As the 4th, but with 1—3 fissures of different form and length near the lateral margin.

6th, 7th, 8th, 9th and 10th sternite almost as the 5th.

11th sternite. Only c. 2 longer fissures (mostly longitudinal) on each side, but along the whole posterior margin a broad belt with a great number spread, very tiny fissures, only visible being magnified 3 or 400 times.

The dorsal side of the abdomen and the cephalothorax. The cephalothorax all in all with

c. 23 spread fissures; the dorsal side of the abdomen almost like the ventral side, but for the rest the drawing (Tab. IV, fig. 12) gives so full an idea of the distribution of the fissures that most likely a further description would not be necessary.

2) *Obisium muscorum*, Leach.

1st and 2d pair of legs.

1st joint. On the posterior side near the apical margin 1 rather long longitudinal fissure.

2d joint. On the dorsal side 4—6 long longitudinal fissures converging towards the apex and collected into one organ (Tab. V, fig. 1).

3d joint (pars basalis femoris, see later on). On the dorsal side near the apex 1 long longitudinal fissure, at the middle or towards the basis 1 shorter and a little removed from the basis 3 short, spread fissures.

4th joint (pars tibialis femoris). On the dorsal side slightly removed from the apex 3 unequally long longitudinal fissures, situated at a distance from each other.

5th—7th joint. No fissures are found.

3d and 4th pair of legs.

1st and 2d joint with the same fissures as on the 2 foremost pairs of legs.

3d joint (trochantin). On the proximal half of the lower side 2 or 3 shorter longitudinal fissures spread lengthwise on the joint.

4th joint (femur). On the dorsal side somewhat removed from the apex 3 long longitudinal fissures of a similar form and almost relative position as on the pars tibialis femoris of the 2 anterior pairs of legs.

Maxillæ.

On the lower side towards the exterior side

about at the middle 4 large, strongly curved fissures, making together almost a circle. Near the outmost anterior edge 4 long, rather oblique longitudinal fissures.

Maxillary palpi.

2d joint (compare *Chelifer*). On the exterior side near the apex 3 long longitudinal fissures placed far from each other; towards the middle in the midst of the exterior side 1 small transverse fissure.

3d joint. On the lower side towards the exterior side c. 4 shorter longitudinal fissures, 2 of which are placed a little apart from each other at the basis, the others spread lengthwise on the joint. On the exterior side near the apex 1 small oblique fissure.

4th joint. On the upper side near the apex of the joint 1 short transverse fissure, towards the basis 1 middle-size longitudinal fissure, closer to the middle and towards the interior side 1 very long, rather oblique longitudinal fissure and in the neighbourhood of this on the interior side still 1 longitudinal fissure. On the lower side towards the exterior side near the apex 1 middle-size transverse fissure.

5th joint. On the upper side near the basis 2 shorter longitudinal fissures far removed from each other; at the basis of the immovable finger close to the articulation of the movable finger 1 longitudinal fissure on the exterior side, a little out on the upper side of the immovable finger 1 middle-size longitudinal fissure.

6th joint. On the exterior side 3 longitudinal fissures spread along the distal half on the joint, the proximal very short, the other 2 longer.

Mandibles.

On the lower side near the basis of lamina interior (see later on) 1 single oblique fissure (Tab. V, fig. 9, 1); on the upper side immediately above this fissure 1 longitudinal fissure.

The ventral side of the abdomen.

4th and 5th sternite. 1 short transverse fissure on each side of the median line.

6th, 7th, 8th, 9th and 10th sternite. As a rule 1 short transverse fissure on each side of the median line; at times on the hindmost sternites, none on the one side, 2 on the other. Besides near the lateral margin 1 large, rather oblique transverse fissure (compare Bernard, op. cit.; see later on).

11th sternite and tergite (coalesced to form a ring, see later on). About 8 longitudinal and transverse fissures around on the 12th segment.

The dorsal side of the abdomen.

1st tergite. 1 middle-size transverse fissure almost half way between the median line and the lateral margin on each side.

2d—3d tergite. No fissures found with certainty.

4th—10th tergite. 1 longer and at times besides 1 short fissure near the lateral margin and more or less towards the anterior edge; besides 1 shorter, now oblique, now transverse fissure on each side almost half-way between the median line and the lateral margin (sometimes the one seems to disappear).

Cephalothorax.

Slightly inside the foremost eye 3 or 4 small, irregular oblique fissures, partly removed from each other. Towards the lateral posterior edge 2 or 3 irregularly situated small fissures.

As a rule on specimens treated with caustic potash there is in *Chelonethi* no distinctly limited dilatation for the nerve in most of the fissures, which have the shape of shorter or longer button-holes. The group on the upper side of the trochanter in *Obisium* is the largest and most regular, the fissures of which are showing, in contradistinction to the preceeding orders,

the mentioned dilatation more or less close to the distal end of the fissures (Pl. V, fig. 1).

I cannot quit these organs without adding some remarks upon the paper of *Bernard*, quoted above, in order to throw a light upon one of the most remarkable »discoveries« touching this subject. — Unfortunately I shall be obliged to copy a rather long piece in order to be able to exhibit the therein contained not few theories that must be real tit-bits to the now-a-days so remarkably large public of fantastical speculative phylogeneticians. — He has examined »a small Chernetid, apparently an *Obisium*«, and he says (p. 26). »The stigmata of the tubular tracheæ on the second and third abdominal segments are followed by a complete row of segmental apertures running along each side to the end of the abdomen. Their position corresponds exactly with those of the stigmata, and I think it is impossible to doubt that they are homologous with these latter. In this interesting Arachnid, then, there are nine pairs of apertures on the nine posterior abdominal segments. The two anterior pairs are stigmata. The function of the other seven, for want of sufficient material, I have not yet made out. It is well known that the Chernetidæ spin webs, and there seems to be no very clear idea where the glands are situated. Cronebergs claim [here he quotes the above mentioned work of Cr.] that the spinning-gland opens in the mandibles is probably correct. I find a very distinct aperture on a small prominence behind the point of the movable piece of the mandibles. In that case these »stigmata« may be purely rudimentary and functionless. If, on the other hand, these seven pairs of apertures following on, and evidently homologous with, stigmata prove to be the openings of spinning-

glands (a point I hope soon to investigate), we should have a remarkable confirmation of my suggestion that the lung-books or tracheæ and the spinning-glands of the Araneids are homologous structures as common derivatives from setiparous glands. We learn also from these nine pairs of abdominal apertures in *Obisium* that the limitation of the number of stigmata in *Scorpio* is not original, i e. inherited from a *Limulus* ancestor, but is due to a secondary reduction of what where originally segmental structures along the whole abdomen.«

Nobody will be able to deny that considering the length of the quotation we find in this as many ingenious speculations as may fairly be expected; I am sorry, however, to be obliged to state that they are false one and all.

1) The spiracles in *Chelonethi* are not found on the 2d and 3d, but on the 3d and 4th segment, as stated by Croneberg p. 444 in the treatise quoted by Bernard himself: »jederseits in dem Winkel zwischen 3ter und 4ter resp. 4ter und 5ter Bauchschiene«. Bernard might have avoided this mistake by reading Croneberg properly; Pocock reports (op. cit. p. 6) the correct about at the same time as Bernard, saying: »the stigmata are situated in the third and fourth abdominal somites.« 2) B. says that there are 9 pairs of spiracles on the 9 »posterior segments«; it seems thus evident that he counts but 10 segments in the abdomen, if the 1st segment only is devoid of spiracles, but 11 segments have already long ago been pointed out by several authors. 3) The 7 hindmost pairs of »stigmata« found by B. are the above mentioned lyriform organs (I have found these fissures only on 5 of the sternites, but the number mentioned by B. is perhaps found in some of the specimens or in another species); he has not seen that similar shorter or longer fissures are found towards

the middle of the segments, on the dorsal side of the abdomen, on the cephalothoracic shield and on all the limbs; and the existence of »spaltförmigen Hautporen« has been mentioned by Bertkau several years before in a small treatise about *Obisium* itself and mentioned in »Jahresberichte«. Thus the little observation of some fissures is reduced to be of much less morphological interest, because that a few of the numerous fissures of the lyriform organs just appear at the lateral margin of the sternites is not of as great an importance, as the calling attention to 7 new pairs of »stigmata«. — But the whole proud edifice of theories about these »stigmata« and about *Scorpio* tumbles down hopelessly, at the same time as disappears the possibility of proving that these fissures »evidently homologous with stigmata« should be »the openings of the spinning-glands«. — Bernard needs not trouble himself with the further investigations he announces; it is, moreover, quite inconceivable to me, how threads could be spun through these rather long fissures; to spin tapes would no doubt better agree with their shape! 4) Finally may be remarked that what he is calling »a very distinct aperture« at the apex of the movable finger in *Obisium* does not at all exist; as to the true structure of this place I refer to my communications below, though they are but fragmentary.

I find grounds to add that the remainder of Bernard's treatise is about of the same value as the here criticised piece (compare herewith his above mentioned interpretation in the other, earlier quoted treatise of the protrusible organ at the apex of the palpi in *Solifugæ* as »probably olfactory«). I should not so long have dwelt on a publication such as this, in which the authors examinations of nature, his knowledge of the forms of animals and of the literature is just as miserable, as is unlimited his audacity in setting forth new, wild

speculations; but it appears to me that he is only an uncommonly splendid specimen of a tendency, that threatens to render Zoology a science incumbered with an immense, partly humbug-like literature. It swarms with small (now and then even large) papers and preliminary reports, the authors of which are soon betraying their ignorance of the forms of animals and of the literature and contributing but very few solid observations of true value, but often setting forth one or several dead-born interpretations or theories — and attention has to be paid to this literature quite as well as to comparatively much fewer solid works executed with care and ability!

The excellent author of the monograph on the *Caprellidæ*, Prof. Dr. Paul Mayer at Naples, has lately written to me: »Wie soll man Alles das lesen und verdauen. Es giebt viel zu viele Zoologen!« and this may seem to be quite right, but if all zoological authors would work with conscientious solicitude and feel real interest in the science, the extent of literature would decrease much more than by half, and still the progress of Zoology become much more rapid. It would be easy to point out numerous examples from the literature of different countries.

It would on the whole be fortunate, if a great number of the younger authors, in particular, were not so anxious to publish a preliminary report or a treatise of 1—5 pages, whenever believing that they have found a hitherto overlooked »petitesse«, they ought much rather try to make themselves more familiar with the forms and the systematic of the class or order inside the territory of which their publication is found, before publishing their embryological, anatomical, systematic or faunistical communications. — Theories are necessary in all science, but it ought not to be allowed, what is seen but too

often, to set forth whatsoever fancy as a theory or an interpretation, evincing no doubt a lively imagination, but neither knowledge nor sound thought. A small number only of the theories and interpretations, published during the last 20 year have proved and will prove to be right, and about more than half of them it may be said that they would never have been published, if their authors had been examining less superficially and studying with more forethought.

B. Tactile Hairs.

Such are found, described and drawn by Croneberg (op. cit. p. 431—32, Taf. X, fig. 11—12) on the fingers of the large chelæ in *Chernes Hahnii* C. Koch. They are found in all genera known to me. They are easily discernible as well by their articulation into large pitchers as by being very much longer and relatively thinner towards the basis (Tab. V, fig. 14, t) than the common setæ.

C. Other Sense-Organs.

1) Stecker writes (op. cit. p. 514) about a formation on the lower side of the 1st joint of the mandibles in *Ectoceras*: »Die Geruchsorgane kammartig aufgereiht (T. II, Fig. 7 a), von jenen des *Chernes cimicoides* Steck. (T. II, Fig. 3 a, 4) nur durch die äussere gespaltete Form der Riechstäbchen verschieden«. P. 520 is stated: »Die Zahl der Riechstäbchen wechselt bei den *Chthonius*-artigen Scheerenspinnen zwischen vier und sechs.« »Manchmal sind die Riechstäbchen nicht kammartig aufgereiht, sondern bilden (wie bei *Chthonius Rayi* L. Koch (T. II, Fig. 11) einen kleinen Büschel«. Looking at the quoted figures it is evident that the author distinguishes himself in bad examination just as much

as in boldness in setting forth an interpretation. — All over he figures a rather thick, longer or shorter stalk, carrying in *Chthonius* and *Megathis* rather thick, hairy branches on the one side towards the apex, and some of these branches are, f. ex. in *Chthonius Rayi*, branched once more. As seen in my figures of *Chthonius Rayi* (Tab. V, fig. 12), *Obisium muscorum* (Tab. V, fig. 9), *Chelifer granulatus* (Tab. IV, fig. 10) a. s. o. we find but a row or a tuft (that is to say 2 short, close rows) of setæ (on the quoted figures marked f.) which are either rather thin and ciliated (fig. 12) or a little flattened with exceedingly short hairs along the one edge or along both edges at the apex, but a stalk is never existing at all. Stecker's figures are altogether extraordinarily unlike reality, as well as the interpretation »Riechstäbchen« appears to me most audacious.

Simon gives (op. cit. p. 4) the name of »flagellum« to these »Riechstäbchen« and notes on his drawing of the mandibles of *Chthonius Rayi* (Pl. XVII, fig. 8) the flagellum figured by Stecker (op. cit. Taf. II, fig. 11), while I am unable to find this unlucky loan mentioned in his work, Stecker's figure being so most startlingly false that it would have been impossible for Simon to make his drawing of »flagellum« to be even up to details like the not existing ramification figured by Stecker, if it had not been a copy. I do not understand, however, how Simon has effected flagellum on the mandible of *Garypus litoralis* L. Koch shown on Pl. XVII, fig. 7. In Arthr. Dan. I have criticised (p. 525) Stecker and Simon, I have asserted that Menge in his ancient work »Über Scheerenspinnen«, 1855, has seen and drawn these setæ, that likewise Tömösváry Ödön, 1882, has figured them, and in Zoologia Danica I have given a correct delineation of these setæ in *Chelifer* and *Obisium*. Croneberg has later on (op. cit. p. 432, Taf. X, fig. 7)

fairly correctly shown the »flagellum« in *Chernes Hahnii* C. Koch, but quotes in good faith the strange flagellum of Stecker in *Ch. cimicoides* F., being in reality the same as *Ch. Hahnii* (see Simon op. cit. p. 39, and Arthr. Dan. p. 544), a fact he ought to have been aware of (see later on); Balzan above all has given descriptions and drawings (Rev. dei Pseudosc.) of it in a quantity of forms and has carefully described »flagellum« of most of the species in »Voy. d. M. E. Simon«.

Hereupon it is somewhat startling to see Gaubert in the year 1892 (op. cit. p. 122) writing about »flagellum«: »formé par un tige mince qui se ramifie en plusieurs branches, simples ou ramifiées, recouvertes par des poils disposés régulièrement.« Thus Stecker's fanciful formation is reappearing once more, most likely copied from Simon (op. cit. p. 4) without, however, informing us of it; in any other way it is not possible to agree so fully in so obvious a mistake. An author as Gaubert, the treatise of which pretending all along to be based on own investigations, ought not to do such a thing, and he does, moreover, display his ignorance both of Croneberg quoted by himself (p. 84) and of the representation, right in the main, of the above mentioned systematic authors.

In this treatise I have carefully drawn »flagellum« in 5 main genera (*Chelifer*, *Olpium*, *Ideobisium*, *Obisium* and *Chthonius*); I consider a further description of the different forms to be superfluous.

I take it for more than improbable that »flagellum«, according to its structure, can be an olfactory organ; on the contrary, it is possible that these setæ are a kind of tactile hairs, but the proof must be delivered by exhibiting a nerve to their basis.

2) On the large chelæ of *Chernes cimicoides* F.

I have found hitherto unknown organs (Tab. V, fig. 14, o). Their appearance and structure are exactly answering to the above mentioned organs situated in *Scorpiones* on the upper side of the last tarsal joint, being, however, different in as much as the single organs, in *Scorpiones* collected in 1 or 2 groups, are spread here on both fingers on the proximal half of the side, turning towards the median plane, and slightly backwards on the distal portion of the interior side of the hand.

These organs are probably found in a series of species of the sub-genus *Chernes*. I have also found them in *Chelifer granulatus*, but not more than 2, both on the movable finger. I have, however, sought them in vain in *Chiridium* and *Garypus*, and I do not believe they are having any; *Obisium* is most decidedly devoid of them.

Other sense-organs are unknown, excluding the eyes.

D. Remarks on the Systematic.

In Arthrog. Dan. p. (517—29) I have discussed the value of the generic characters hitherto made use of and of some specific characters, besides I have given a detailed representation of some new characters for families, genera and species of this order, and p. 531—34 is found a »Conspectus systematicus« of the then described main genera. Balzan has later on, not being acquainted with my treatise, described in his 2 quoted works highly interesting new genera, necessitating alterations in the system set up by me

In his last work Balzan has divided the orders into 2 sub-orders, solely according to the one sharp character, if »serrula« on the movable finger of the mandibles is coalesced to its complete extent with the finger, or if it is free at the distal end (this division answers fully

to my former division into 2 families); these sub-orders are again divided into families, sub-families, genera and sub-genera. I shall for the rest refer the reader to his system and to his reasons for it (Voy. d. M. E. Simon p. 501—5), adding, however, that I do not agree with him as to his further division, to which I shall come back, and it seems to me that of more essential generic characters, not used by Simon, he has only produced one, viz., the serrula. Croneberg and Bertkau (op. cit.; I have found no reason to quote Croneberg's preliminary paper) have almost simultaneously pointed out large glands situated in front in the cephalothorax, with the ducts opening at the apex of the 2d joint of the mandibles, and they believed them to be most likely spinning-glands. It is certainly correct; it ought to be examined, however, if the animals actually do spin with these organs. In Zoolog. Dan. I have followed Menge and interpreted the remarkable hairs, arranged in a row along the median anterior edge of abdomen in *Chelifer*, as spinning-taps, but a new and more minute investigation has convinced me that my supposition was wrong; concerning the other forms (as *Obisium*) I have contented myself in this popular paper with an indirect quotation of Menge. The matter is mentioned here because the interpretation of the 2 authors is of importance as to the understanding of the practical systematic character, taken from the existence or not-existence of »galea«.

(I may perhaps here put in a remark. I have very carefully examined the supposed place of disembugement for the spinning-glands in *Obisium muscorum*, the result has, however, not been satisfactory. No single aperture is found on the foremost, exterior portion of the movable finger; on the contrary, I have found 6 very small apertures situated in 2 rows which take an

oblique direction; from each of the apertures issues into the joint a very thin, cylindrical, more firmly chitinised, rather short funnel, and from each funnel goes back into the finger a less chitinised, very thin duct (Tab. V, fig. 11). Outside the apertures is seen a row of small, dark dots, the meaning of which is unknown to me. On preparations cleaned in caustic potash I believe to have seen what is stated above with an enlargement of about 1000 times).

In the following I shall set forth a repetition, supplied with additions and a few alterations, of my earlier statements which appear to have been unnoticed by the later authors, except Thorell. I have a special reason for so doing, as now I accompany the representation with rather numerous new figures. I shall conclude by setting up a system which, I presume, answers better than the earlier systems to our present knowledge, paying attention to all hitherto known more important genera.

E. The Segmentation of the Body.

In Arthr. Dan. (p. 517) I have shown that the abdomen in *Chiridium* as in the other *Chelonethi* consists of 11 segments; the same statement was almost simultaneously given by W. Sørensen in his treatise (Opil. Laniat. p. 562), quoted by *Opiliones*. Menge, Simon and Tömösváry have indicated 10 abdominal segments in *Chiridium*, and after the publication of the 2 above mentioned papers, the error has been repeated by Croneberg (op. cit. p. 419) and Balzan (Rev. dei Pseudosc. p. 409).

Pocock writes (op. cit. p. 6): »Moreover, in such a form as *Garypus litoralis* the same number of somites can be made out in the abdomen as are seen

in this region in the Pedipalpi, namely twelve. Furthermore, there is the same inequality in the number between the tergites and sternites, the former being one in excess of the latter«. — And in an appertinent footnote: »The last somite has not, so far as I am aware, been previously recognized as such. It is, except in distended specimens, almost entirely concealed inside what is apparently the last, namely the eleventh, but which is in reality the last but one.« This representation is, however, not quite correct, and if Pocock had read Arthr. Dan. and the work of Croneberg, which are both known to him, he would hardly have written quite so. I do not indeed know *Garypus litoralis*, but in Arthr. Dan. p. 517—18 I have mentioned a similar large (not described) species of *Garypus* from St. Thomas, and I have stated that I have found the foremost, counted from behind the 11th, sternite by flexing the abdomen into an angle with the cephalothorax, this method being necessary, because the sternite is narrow and almost overlapped by the sternum and the last pair of coxæ. Croneberg states (op. cit. pag. 420) that he has found in *Chernes* »eine leichte quere Chitinverdickung«. — Later I have found on a microscopical preparation of *Obisium muscorum* a distinct 1st sternite between the basal portion of the posterior pair of coxæ. In Arthr. Dan. I remarked (p. 525—26) about the 11th segment ¹⁾: In *Obisiinæ* the dorsal and ventral sternite are, however, coalesced into a completely undivided ring,

¹⁾ As the general representation in Arthr. Dan. is written in Danish, a language which the arachnologists of the great nations seem to regard quite as difficult to read as Japanese and accordingly not pay any attention to, I shall translate this and the following quotations of my work in English, while the other quotations are given in the original language.

on which it is impossible, even after the most careful cleaning in caustic potash, to discern the slightest trace of softer integument at the sides; this ring has posteriorly a circular hole as opening for the intestines, the edge of which forms a rather firmly chitinous ring in the mentioned hole.« It is the last mentioned ring which Pocock regards as the 12th segment, and he is right, no doubt; after a closer examination the wording of the 2 last of my sentences is not quite satisfactory, because the little »ring« consists of a half-moon like tergite and a similar sternite, each furnished with 2 setæ and separated on the sides by a narrow, but very distinct membrane.

Croneberg says (op. cit. p. 442) that anus »bildet eine schmale Querspalte auf einer ovalen Analplatte, deren beide Lippen je ein paar kleine Borsten tragen«, and this is just the 12th segment.

In Arthr. Dan. I have stated (p. 525) about the *Cheliferinæ* that the tergite and the sternite of the 11th segment on the sides are connected with a soft, light articular membrane. This is correct as to the genera *Chiridium*, *Chelifer* and *Garypus*; in *Olpium Hermannii* Sav. the lateral membrane is on each side a short way interrupted by more solid chitine, the whole structure, however, bears but little resemblance to *Obisium*; in *Olpium furciferum* Balz, an animal at that time unknown to me, the tergite and sternite are, on the contrary, coalesced as in *Obisium*, the lateral chitine is, however, a little lighter than the rest of the segment.

It is evident from this representation that the sternite answering to the 1st tergite is mentioned several years before Pocock's paper by me in *Garypus*, by Croneberg in *Chernes*, that the 12th segment is seen by the same authors, but not interpreted as an abdominal segment,

that thus 12 complete segments are found in the abdomen in *Chelonethi*, as the 1st sternite can be proved in several main genera.

F. Ambulatory Limbs.

Of the ambulatory limbs I have in Arthr. Dan. (p. 518—20, with corresponding figures in Zoolog. Dan.) given a detailed representation, in a main point differing much from the interpretations set forth both before and after. By renewed study I have found a new striking feature to confirm the correctness of my interpretation. The matter being of importance I shall resume the essential, in referring to my new drawings of the 2d pair of legs in *Chelifer*, *Garypus* and *Obisium* (Tab. IV, fig. 13—15).

The 2 hindmost pairs of legs are in the main uniform in all *Chelonethi*. Each of these legs consists of coxa, trochanter, femur, tibia and tarsus. The basal portion of femur is more or less distinctly cut off by a weak articulation, allowing a slight or no curving in the horizontal plane, and this joint has been called trochantin, a name not well chosen, as it has been formerly used by the Insects indicating a chitinous plate (a joint) between the coxæ and the body. Tarsus is 1-jointed in *Chiridium* and *Chelifer* (*Chernes*), 2-jointed in the other main genera.

The 2 anterior pairs of legs in *Chiridium* and *Chelifer* are almost like the 2 posterior pairs, yet the trochantin is particularly well cut off in *Chelifer* (Tab. IV, fig. 13, c) and completely wanting in *Chiridium*; form et cet. show plainly that femur in *Chiridium* is homologous with the trochantin (c) plus femur (d), together marked f in fig. 13. Tarsus is 1-jointed. In *Garypus latus* H. J. H. femur (fig. 14, f) is almost twice as long as tibia (g), which is comparatively short, close

by the basis it increases in thickness almost out to the apex and is divided into a longer basal joint, *pars basalis femoris* (d), and a shorter distal joint, *pars tibialis femoris* (e), being but a little shorter than the tibia; the articulation between the 2 parts of femur is in all essential points of the same structure as between femur and tibia, that is to say, allowing a movement in the vertical plane, but the articular membrane is not $\frac{1}{3}$ as broad as that between femur and tibia. In *Obisium* (Tab. IV, fig 15) we find a similar structure as in *Garypus*, showing, however, a further development in the tendency that *pars tibialis femoris* (e) is working as a supplementary tibia, for we find that the articular membrane on the lower side between the 2 parts of femur is broader than in *Garypus*, that according to the shape *pars tibialis femoris* does not appear to be a part of femur and is not thicker than *pars basalis*, and tibia is less tapering at the basis. The tarsi are 2-jointed in *Garypus* and *Obisium* (fig. 14 and fig. 15, h). The structure in *Chthonius* is developed in such a way that I deem it impossible to understand it but by means of the preceeding genera, of which *Garypus* (*Olpium*) also in other respects makes an excellent intermediate form between *Chelifer* and *Obisium-Chthonius*. *Pars basalis femoris* is twice as long as and a little thicker than *pars tibialis*, it is as long as, or but a little shorter than tibia; the articulation between the 2 parts of femur is quite as developed to movement in the vertical plane as the articulation between femur and tibia; tarsus is 1-jointed, much longer than tibia and very slender towards the apex.

This interpretation differs quite from that of other authors. Simon and Balzan take *pars tibialis femoris* for tibia, and thus tarsus becomes 3-jointed in *Garypus*

and *Obisium*, 2-jointed in *Chthonius*. That femur in *Chiridium* and trochantin plus femur in *Chelifer* are homologous may be considered as doubtless, that femur in *Chiridium* and the whole femur in *Chelifer* are homologous with pars basalis and pars tibialis femoris together shall, I suppose, be proved by the above mentioned facts and by a further examination of my figures, showing: 1) that the articulation between pars tibialis femoris and tibia in *Garypus* is shaped as the articulation between femur and tibia in *Chelifer*, but vastly differing from the articulation between the 2 parts of femur in *Garypus*; 2) that these 2 parts in *Garypus* together have almost the same form as a femur; 3) that tibia in *Chelifer* as to the shape is in accordance with tibia in *Garypus*, not with pars tibialis femoris. I have found a further confirmation of this interpretation by seeing that the 3 characteristic fissures of the lyriform organs, found in *Obisium muscorum* on the dorsal side somewhat before the apex, of the 2 hindmost pairs of legs, are found again on the upper side of the pars tibialis of the 2 foremost pairs of legs, not on the pars basalis. I look upon it as doubtless that the structure in *Obisium* is the most primitive, but from practical reasons I have chosen the used representation.

Gaubert has attempted such a study (op. cit.). He makes use of the names given by Milne-Edwards to the joints in the limbs of the *Decapoda*, excluding, however, »ischiopodite« and adding a »second dactylopodite«. I have not myself inspected if Milne-Edwards has used these names by the Arachnids, which seems most likely from what Gaubert says, but at all events I consider them as being, at least at present, most unappropriated, and besides I do not understand the omission of the ischiopodite. Gaubert says (p. 177): »les membres des

Arachnides, bien que présentant en général le même nombre d'articles, ceux-ci ne sont pas homologues, à l'exception des deux premiers.» I look upon this statement as very meritorious indeed, but I think that thereby the reasonableness for using these names has been strongly reduced. In fact the names are in succession used for the joints in *Aranææ*; but according to Gaubert himself they cannot be used in the same way for most of the joints in *Scorpiones*. We are lacking every evidence of that the joints in *Aranææ* and *Decapoda*, supplied with the same names, are homologous, and it will always be impossible to prove this homology, but why making use of just these names in *Aranææ* and not rather in *Scorpiones*, for if they cannot at the same time be used according to the number of the joints in both these orders and thus mark homologous portions, it appears to me that it would be more correct to use them in the *Scorpiones* which, in consequence of their whole structure and extraordinary early appearance in the development of the earth, are much more primitive than *Aranææ* and must on the whole be looked upon as being closer connected with *Crustacea*. If these names shall mark homologous joints, it would be impossible to use them in *Aranææ* and *Decapoda* after number with an arbitrary omission of ischiopodite, and beginning by this false starting-point we should be forced to mark the 4th joint in the legs of the *Scorpiones* as answering to carpopodite and propodite (patella and tibia) in *Aranææ* (op. cit. p. 148), and then the 3 last joints in the leg of *Scorpio* must answer to the 1st and 2d dactylopodite in *Aranææ*, an interpretation the uncorrectness of which may easily be seen by means of an examination of some of the forms. These names ought to be rejected as being both superfluous and misleading, if they not always shall indicate

homologous joints or portions of the limbs in all *Arthropoda*.

In conclusion let us look upon his interpretation of the legs in *Chelonethi*. He says (op. cit. p. 153) about pars tibialis femoris in *Obisium* that it is »analogue a celui des Scorpions«, which, as just mentioned, should answer to patella and tibia in *Aranæ* as seen by an inspection of his description of this order, but, supported by several reasons, I have above proved that pars tibialis femoris must answer to the distal part of femur (meropodite) on the hindmost pair of legs in *Obisium* and on the legs in *Chelifer*, but when it answers to a portion of meropodite in *Chelifer*, I presume that Gaubert will admit that it also is answering to a portion of the meropodite in the *Aranæ*. Gaubert's morphological study of the limbs of the Arachnids is to a great extent wrong in the statement of the homologies, though the author expresses himself with great assurance and says in the introduction (p. 31) »j'ai pu résoudre cette question«. I shall not here undertake further to discuss this great matter and set forth new interpretations, because, among others, it would render this treatise double as long and require an expanse of time of which I am not able to dispose.

G. The Mandibles.

The representations of these remarkable organs by Stecker, Simon, Gaubert and others are defective, the only good one I have found in the literature is that of Croneberg (op. cit.). I shall here short exhibit a few main types.

Chelifer granulatus C Koch (Tab. IV. fig. 10 and fig. 11). In an adduced position the 2 fingers leave a large space between each other, because the anterior

margin of the hand is broad, and the movable finger is inserted in the one end, while the immovable finger is comparatively narrow at the basis and issues far from this insertion. The movable finger has close to its distal end a »galea« (g), branched at the apex, on the side that is turned towards the median plane of the animal and slightly removed from the interior margin a »serrula« (s), grown fast the whole length and furnished with c. 16 comb-teeths, the hindmost being the longest. The immovable finger carries along almost the whole exterior margin a smaller, thin, half transparent plate, lamina exterior (a), on the interior side a broad, large plate of the same kind, lamina interior (b), being in front peculiarly lobated and dentated.

Olpium furciferum Balz. (Tab. V, fig. 2—4). The space between the fingers, when closed, smaller than in *Chelifer*. The movable finger with galea; serrula (fig. 4) grown fast the whole length, with numerous (c. 27) comb-teeths, posteriorly a little broader than anteriorly. The immovable finger with a well developed lamina exterior (fig. 3); lamina interior has become narrower than in *Chelifer*, in the full length with commencing transverse partitions from the free margin towards the basis, so much as to render the margin posteriorly crenated.

Ideobisium crassimanum Balz. (Tab. V, fig. 5 7). The distance between the closed fingers a little smaller than in *Olpium*, as the immovable finger becomes very broad towards the basis. The movable finger with galea; serrula free in the anterior end, with numerous (c. 23) comb-teeths, being narrower at the basis than outside the middle. The immovable finger (fig. 6) without lamina exterior; lamina interior transformed as a serrula, being free at the distal end and having numerous (c. 21) comb-teeths, which are

narrowly triangular and to a great extent serrated along the posterior margin.

Obisium muscorum Leach (Tab. V, fig. 8—11). In a closed position the 2 fingers almost touch each other in the whole length; at the basis the immovable finger is very broad and thereupon it decreases very evenly and rapidly in breadth about the first $\frac{2}{3}$ of the length. The movable finger without galea; serrula free more than $\frac{1}{3}$ of its length, with very numerous (c. 30) comb-teeths, posteriorly narrower than a little outside the middle. The immovable finger without lamina exterior, and lamina interior (b) formed as a serrula which is free in more than $\frac{1}{3}$ of its length and provided with numerous (c. 29) comb-teeths.

Chthonius Rayi L. Koch (Tab. V, fig. 12—13). The hand uncommonly large and thick compared with the shorter fingers which, owing to the curving of the movable finger, leave a small space between each other. Serrula small, more than half of its length free, with c. 17 comb-teeths, posteriorly narrower than a little outside the middle. Lamina interior (b) small, formed as a serrula, being free more than half its length, with c. 15 comb-teeths.

In this short description I have only made use of the points that are essentially serving my object; a look at my drawings will show several other interesting differences in »flagellum« (f) et cet.

H. A System of the Chelonethi.

Balzan has established (Voy. d. M. E. Simon, p. 504—5) a system of all described genera. Based on the above mentioned structural features and on a couple of other characters that do not, I presume, demand any further explanation, I shall try to establish a new arrangement,

setting forth, however, beforehand a few remarks. Balzan's subgenera are entirely omitted, as I believe them to be correctly referred to genus. The differences between *Garypus*, *Minniza* and *Olpium*, being very closely connected in the essential structural features, are not taken into consideration. Of his sub-family *Chthoniidae* I only know *Chthonius*, but *Megathis* Steck. and *Lechytia* Balz. do not appear to present differences of any importance, and I find grounds to believe that the same is the case with the genus *Heterolophus* Töm. which by Balzan is placed between *Megathis* and *Chthonius*. According to the description of Balzan I suppose that his subf. *Microcreagrinae* does not differ in any capital character from *Pseudobisiinae*, and I believe his family *Tridenchthoniidae* to be a *Chthonius* with a most remarkable galea.

I divide the order into 2 sub-orders (I make use of the name introduced by Balzan, though in this case I believe that it says a little too much) answering altogether to those of Balzan, and I use his names, though, indeed, they are rather long.

I. *Panctenodactyli*.

The mandibles small, the distance between their exterior hind corner hardly more than half as large as the breadth of the posterior margin of the cephalothorax and mostly much shorter.

Serrula on the movable finger grown fast the whole length and posteriorly broader than anteriorly.

The immovable finger of the mandibles with lamina exterior, lamina interior plate-formed, at most with slight incisions.

The lower side of the maxillæ lying in the same plane as the coxæ of the legs.

Cephalothorax considerably narrowed anteriorly, without median tooth on the anterior margin.

(The 11th abdominal segment mostly plainly divided into tergite and sternite or at least with an indication of such a division).

II. *Emictenodactyli*.

The mandibles large; the distance between their exterior hind corner at least as long as $\frac{2}{3}$ of the posterior margin of cephalothorax.

Serrula on the movable finger free at the distal end, posteriorly narrower than outside the middle. The immovable finger of the mandibles without lamina exterior; lamina interior profoundly divided into numerous free comb-teeths, altogether formed as an anteriorly free serrula.

The lower side of the maxillæ situated in a higher plane than the coxæ, so that its hindmost portion, looked at from below, goes so under the coxæ of the first pair of legs.

Cephalothorax slightly or not at all narrower anteriorly than posteriorly; the frontal margin with a median tooth.

(11th abdominal segment forming a ring without any trace of a division into *tergite and sternite*).

Panctenodactyli are divided into 2 families, bounded by several very sharp characters, namely

1. *Cheliferidæ*.

The femora of the 2 anterior pairs of legs undivided or having but a basal trochantin.

All tarsi 1-jointed.

None or 2 eyes.

2. *Garypidæ*.

The femora of the 2 anterior pairs of legs divided into a longer pars basalis and a shorter pars tibialis.

All tarsi 2-jointed.

4 eyes.

The family *Cheliferidæ* is redivided into 2 sharply limited subfamilies, distinguished thus:

- a. Chiridiinæ. Femora of the 2 anterior pairs of legs undivided, without trochantin.
- b. Cheliferinæ. Femora of the 2 anterior pairs of legs with a sharply defined trochantin.

The sub-order *Emictenodactyli* is divided into families and subfamilies in the following way:

The tarsus of 2 fore-most pairs of legs 2-jointed	Fam. <i>Obisiidæ</i>	{	The mandibles with galea. Subf. <i>Pseudobisiinæ</i> .
			The mandibles without galea. Subf. <i>Obisiinæ</i> .
The tarsus of 2 fore-most pairs of legs 1-jointed	Fam. <i>Chthoniidæ</i>	{	The mandibles with galea. Subf. <i>Tridenchthoniinæ</i> .
			The mandibles without galea. Subf. <i>Chthoniinæ</i> .

In the Latin »Conspectus« (p. 531—34) in Arthr. Dan. I have made use of several more characters, considering, however, these which are omitted here as being not so important and too uncertain, as the existing descriptions and drawings of *Chelonethi*, as a rule, do not exhibit the concerned features, at least not in such a way that they can be picked out and used as generic characters. Here I shall only refer to, if tibia always is longer than tarsus in *Cheliferidæ*, shorter than tarsus in *Garypidæ*, if the shape of the abdomen can provide a good character between *Chiridiinæ* and *Cheliferinæ*. After the study of some American species I do not approve of the old character, taken from the existence of sternum in *Garypidæ* and its absence in *Cheliferidæ*, as in a large *Chernes* I have found a sternum just as developed as in an *Olpium*. I presume besides that on a large material of *Emictenodactyli* several good characters for its groups may be found in the form of femur on the posterior pair of legs, in tarsus and perhaps above all in serrula, lamina interior and »flagellum«; it is also necessary to settle if these characters coincide with the number of the eyes.

J. Specific Characters.

In Arthr. Dan. I have called attention to a couple of these characters which have but partly been used by earlier and later authors, and therefore I shall shortly repeat them.

1) Arolium renders in the fam. *Garypidæ* an excellent specific character, being in some species much longer, in others much shorter than the claws. It appears to be shorter than the claws in all the other *Chelonethi*.

2) The large chelæ of the maxillary palpi show a

considerable difference in the dentition on the interior side of the fingers, but of practical reasons they are often not easily employed.

In *Chelifer granulatus* C. Koch both fingers are furnished with a close row of uniform teeth, which are alike on both fingers. In the Danish species of *Chernes* we find on both fingers the close row on the interior margin, and behind this, both on the exterior and on the interior side (not indeed as mentioned in Arthr. Dan. only on the interior side) some large teeth (Tab. V. fig. 14, b), placed far apart the slightly removed from the interior margin; there is, moreover, in certain species (as *Ch. nodosus*) some difference in the teeth on the interior margin of the 2 fingers*).

*) Croneberg has overlooked the secondary teeth (op. cit. p. 428, Taf X, fig. 11.). Judging from the representation of the structure of the skeleton the paper of this author appears to be worked out more carefully and skilfully than most of the anatomical essays about the *Arachnida*, notwithstanding, however, in spite of his numerous, perhaps not even always necessary quotations, it furnishes concerning the literature a proof that in order to be able to undertake the anatomy of a representative of an order, the author must be provided with a much greater knowledge of the literature and of the main forms, than is the case as a rule. Croneberg shows that he is ignorant of 3 works of the greatest importance to him since Menge (1855) in the little literature just about this order, namely Lubbock, J.: Notes on the Generative Organs, and of the Formation of Eggs in the Annulosa (Philos. Transact. Vol. 151, 1861, p. 595-627, Pl. XVI, XVII), besides the above mentioned works of Simon and myself. In the work of Lubbock, p. 614-619 and fig. 27-36, the structure (of the eggs and) of the generative organs both in the male and the female of *Chelifer*, *Obisium* and *Chthonius* is treated, and most interesting informations are given. In Simon's paper he

In *Obisium muscorum* Leach there is a great difference between the teeth on the 2 fingers; on the movable finger they are all low, half as long as they are broad and of the same form; on the immovable finger 2 kinds of teeth are found, thuswise that most of them are hardly as broad, but double as high as those on the movable finger, and cut off at the end, while each 4th or 5th tooth is slightly broader at the basis, conical, pointed and almost double as high as its neighbour; finally the teeth on both fingers are largest at the middle, smaller towards both ends (see Zool. Dan., Spindeldyr, Tab. VII, fig. 6. g.). Other features are found in species of *Roncus* and *Blothrus*. The teeth in *Chthoniidæ* are used a little, but by far not exhaustingly, by the systematists; it is comparatively easy to observe them here, and they seem to vary from species to species.

K. Sexual Characters.

Croneberg has pointed out (op. cit. p. 448, Taf. X, fig. 1—2) essential sexual differences even visible with the magnifying-glass in the surroundings of the genital aperture in *Chernes Hahnii*. Similar differences are also found in *Chelifer*, *Olpium*, *Obisium* and most likely in all *Chelonethi*, but are not equally conspicuous everywhere. Balzan has pointed out sexual

would have seen that *Chernes Hahnii* C. Koch is identical with *Ch. cimicoides* Fabr., of the „flagellum“ of which Stecker has given his poetical representation. In Arthr. Dan. he would have been aware of that secondary teeth are found on the large chelæ of *Ch. Hahnii*, that *Chiridium* has 11 abdominal segments et cet — If such be the case with an author otherwise very carefull, it is less to be wondered at all the offences of the numerous less carefull authors.

differences in the shape of galea in species of *Chelifer*, *Garypus* and *Olpium*, but he has not always been certain in determining the sex.

In several species of *Chelifer* a very great and obvious sexual difference, known long ago, is found in the tergites of the abdomen, and in all species of *Chelifer* and *Chernes*, examined by me an almost always overlooked difference is seen on the large chelæ. The fingers of the females, when tightly closed, are touching each other the whole length, while the fingers of the males are touching each other only at the basis and in a short extent at the apex, but in the remaining space they are gaping slightly in some species and very much in other species, as *Chelifer depressus* (Arthr. Dan. p. 529). This gaping is slight, but yet visible in the males of the Danish species of *Chernes*; the greatest gaping I have found in a species of *Lamprochernes* which does not appear to be rare in the Brazils, where it is living in small colonies under the elytra of large beetle *Acrocinus longimanus* F. (fam. *Longicornia*). Its occurrence on this animal has already been mentioned by H. Hagen in the year 1859; in Zool. Anzeiger of 30. Jan. 1893, p. 37, again by F. Leydig, who has determined it as *Chelifer americanus* Degeer.

VII. Araneæ.

Gaubert spends (op. cit.) more than 20 pages on the representation of the lyriform organs in the representatives of the different families of this order. His representation is much more complete here than by the other orders; he has, nevertheless, overlooked a not inconsiderable number of fissures. It is not my intention to follow him in his investigation of a series of

different types, it suffices to take one single form, namely the male of *Epeira diademata* Clerck. Partly this animal has a suitable size, and partly it is exactly the species, on which Gaubert dwells most fully (p. 65—71; a preliminary view p. 64; and the organs on the sternum p. 59). He points out altogether 13 compound organs on each leg and mentions the occurrence of some isolated fissures, next several organs on the palpi, mandibles and sternum, consequently a very considerable number. I have not searched for the compound organs on the legs and palpi exhibited by him, supposing his representation to be correct, but I directed my attention to find organs or fissures, overlooked by him, on the abdomen, cephalothorax, mandibles et cet. Thus I produce but a supplement to his representation, making the remark, however, that of isolated fissures he has found on the legs 1 on the lower side of the 6th joint, and he writes about the 7th joint (p. 64): »Pas organes, cependant on trouve quelquefois des cordes isolées«.

1st pair of legs. On the anterior side towards the dorsal side of the longer distal portion of the 3d joint and on the 4th joint very few, tiny, spread longitudinal fissures. On both sides from the middle and upwards on the dorsal side of the 5th, 6th and 7th joint several, spread, short longitudinal and oblique fissures, having almost the length of the diameter of the insertion of the small setæ; the longest are found on the distal portion of the 7th joint. This joint carries besides on the posterior side and on the lower side, close by the distal end 2 good-sized transverse fissures placed almost in the prolongation of each other.

2d pair of legs as the 1st, but besides on the posterior side of the 3d joint, almost in front of the

apex 1 isolated transverse fissure, being c. 3 times longer than the short, spread longitudinal fissures.

3d pair of legs chiefly as the 1st; the transverse fissures at the apex slightly apart from each other.

4th pair of legs chiefly as the 1st, with fewer fissures, however, on the posterior side and only 1 fissure in front of the apex of the 7th joint.

Palpi. On the interior side, lower side and upper side of the 6th joint (of the hairy plate) a great number of spread, short, partly longitudinal, partly oblique fissures.

Maxillæ. On the lower side several, spread short fissures of somewhat different size and direction.

Mandibles. On the anterior side of the basal joint in the greater part of its length several, spread, small fissures, going in very different directions, on the posterior side (the side turned towards the body) almost none. On the anterior side towards the exterior margin near the apex the 2 lyriform organs, found by Gaubert (op. cit. p. 70—71), on the posterior side towards the exterior margin 2 organs corresponding to those and of a similar structure.

Cephalothoracic shield. A small number of very short, spread fissures, most of them towards the lateral margins; 1 single, somewhat larger, oblique fissure in the neighbourhood of the posterior lateral eyes.

Labium sternale. On each half 3 small and 1 longer fissure (longitudinal, transverse or oblique fissure) towards the apex and the lateral margins.

The stalk between cephalothorax and abdomen. On each side a compound lyriform organ with numerous fissures and outside of this besides c. 10 irregularly situated fissures.

The lower side of the abdomen. Slightly in

front of the mammillæ, not so far from the median line on each side 1 long and 1 shorter fissure; a little in front of these 2 transverse fissures placed near each other; then spread on the lower side of the abdomen, except on the portion lying in front of and between the lungs, c. 20 very small transverse fissures being partly longer than the diameter of the insertion of the hairs. (I have found nothing on the dorsal side of the abdomen).

*The mammillæ. On the anterior (lower) side of the basal joint of the foremost mammilla c. 5 spread, very short longitudinal fissures. on the posterior side at least 1 fissure.

On the anterior side of the hindmost mammilla at least 1 short longitudinal fissure.

This supplement to Gaubert is, as may be seen, rather considerable; the most important point is, however, the discovery of a true compound lyriform organ on the stalk of the abdomen, besides the pointing out of both long and short fissures on the lower side of the abdomen and of short fissures on the mammillæ, the cephalothoracic shield and labium. This supplement is, I think, of great importance for a comparison between *Araneæ* and the above discussed orders.

VIII. Acari.

Gaubert denies the occurrence of lyriform organs in this order. I have quite in vain searched for them in *Ixodes ricinus* L. and in a large African *Trombidium*. I believe that I have found some spread, very tiny fissures on the shield of an *Oribates* (s. lat.) and a most remarkable transverse fissure on the legs. Thus

I find grounds to believe that they appear as single fissures in this family, at the least; but lacking a particular material and knowledge to the literature, I have not further carried out the examination. An investigation might very likely be worth the trouble to a zoologist who is conversant in this large and difficult order.

Concluding Remarks.

I consider it as being unnecessary to work out a resumé of the very miscellaneous contents of this little treatise. The numerous headings and the table of contents on the last page will prove to be a sufficient guidance to everyone who wishes to find information about a subject discussed here. I shall only set forth some remarks on the lyriform organs.

These organs gain the highest development in *Araneæ* which have real compound organs on the stalk of the abdomen, the mandibles, the maxillary palpi and in greater number on the legs, besides the spread fissures all over the body, except on the upper side of the abdomen (always devoid of organs?). Next to *Araneæ* come *Phrynidæ* and *Thelyphonidæ*, where the fissures are spread partly over the whole body, partly on the limbs, and appear as more irregular groups, but these groups are less numerous than in *Araneæ*, or they are replaced by 1 single or only 2—4 fissures as on several joints in *Thelyphonidæ*, and only 1 compound lyriform organ is found on each ambulatory limb, that is to say, on the 2d joint in *Phrynidæ*, and on the 6th joint of the 3 last pairs of legs in *Thelyphonidæ*. In *Opiliones* and *Chelonethi* they are, as in the 2 preceding orders, spread as single fissures on the whole body, but more spread on the limbs, the groups

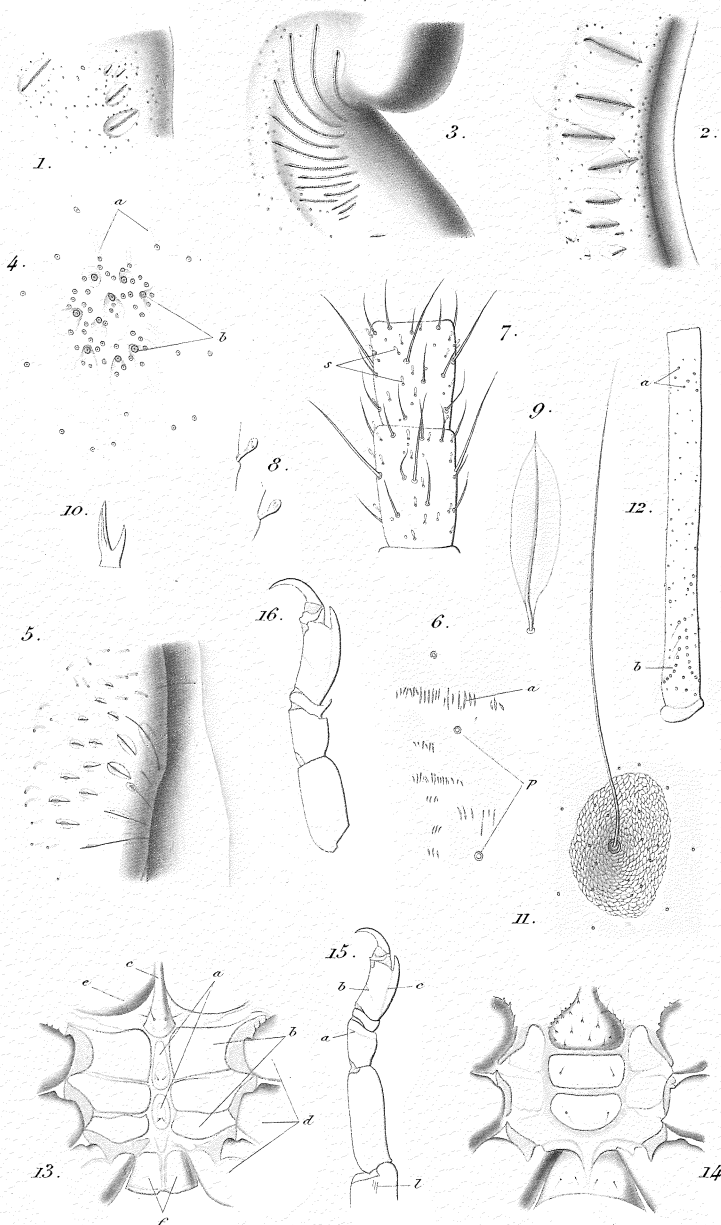
are not numerous, and their fissures mostly also few, a $\frac{2}{3}$ compound organ with fissures lying closely and regularly together as in *Aranæ* is to be found only on the 2d joint of the legs in *Chelonethi*, and this organ is even small and the fissures a little removed from each other. In *Scorpiones* the body and the mandibles are quite devoid of fissures; groups of fissures are, however, found on the 2d—6th joint of the legs, besides on a couple of the joints of the palpi, but only one single group, namely the one on the anterior side of the 6th joint, is bearing considerable resemblance to a compound organ. In *Solifugæ* not more than 2 irregular groups seem to exist situated on the lower side of the mandibles. (*Koenenia* is not examined).

Thus there is a great difference as to the occurrence and arrangement of these organs in the 7 orders of Arachnids more closely examined; moreover, I have pointed out but a few leading features, many more peculiar features might be deduced from my special representation, but on the other hand, it must not be forgotten that many more types of the different orders must be thoroughly investigated before trying to give a more special picture of the occurrence and structure of the organs in the single orders in relation to each other.

Almost all searching for the lyriform organs is undertaken on animals treated with cold caustic potash. The generally used method, viz., the boiling in caustic potash, I consider as not at all suitable to the purpose, the influence becoming easily too great, and consequently it becomes difficult to discover the organs. Here, as in all minute examinations of the parts of the chitine in *Arthropoda*, I prefer to clip a hole in the

animal, to put it into a strong, but cold dissolution of caustic potash, leaving it there, according to circumstances, from 10 to 48 hours. The interior organs have, as a rule, to be dissolved to such a degree that they partly or altogether can be washed out by putting the animal into water and treating it with a pincet or the like. All depends on watching the right moment, as the chitine of many forms get a peculiarly loose consistence, becomes decoloured, even shrinks at times et cet., if left too long in the strong dissolution. The examination under the microscope is generally performed in glycerine which, in this case, is preferable to water; of colouring I have made no use at all

Copenhagen, the beginning of March 1893.



Explanation of the Tables.

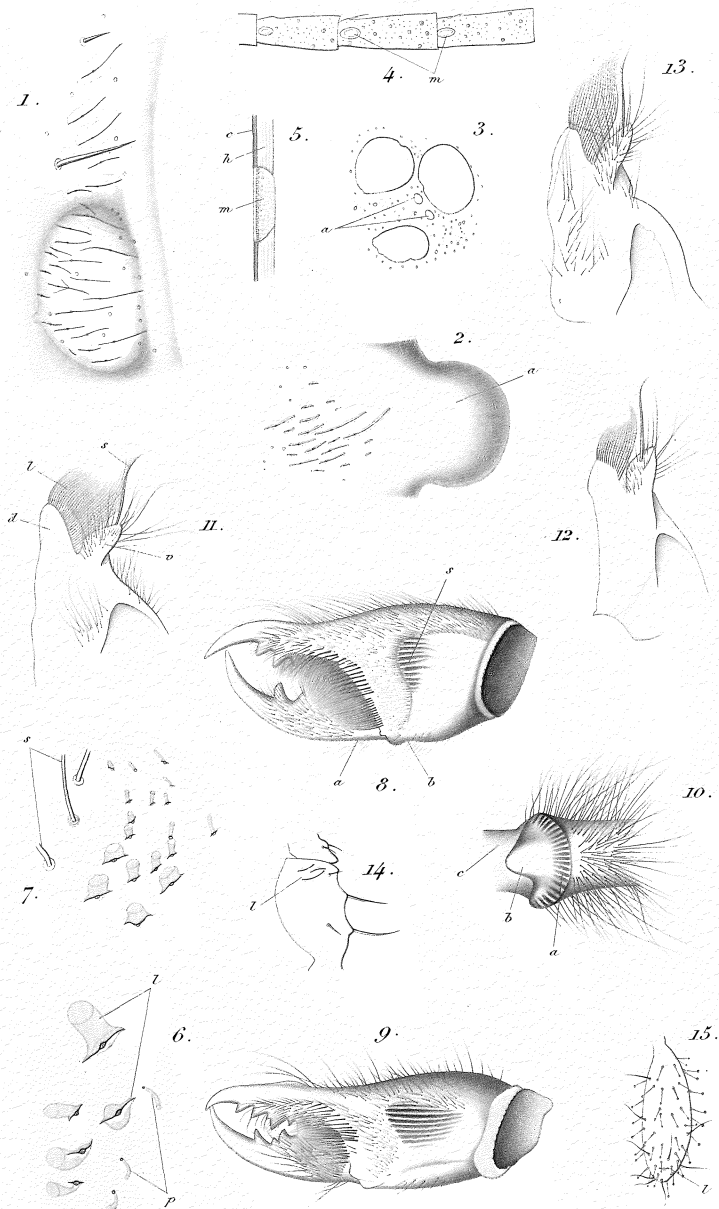
Tab. II.

- Fig. 1. Lyriform organ on the anterior side of the 2d joint of the 3d leg from the right side of *Pandinus cyaneus* C. Koch ($^{28}/_1$).
- Fig. 2. Lyriform organ on the posterior side of the 2d joint of the 4th leg from the right side of the same species ($^{28}/_1$).
- Fig. 3. Lyriform organ on the 6th joint of the 2d leg from the right side of the same species ($^{43}/_1$).
- Fig. 4. Area with sense-organs on the upper side of the last tarsal joint of the 4th right leg of *Pand. cyaneus* C. Koch ($^{80}/_1$); a. pore-channels, b. single sense-organs.
- Fig. 5. Lyriform organ on the lower side of the 2d joint of the 3d leg from the right side of *Phrynichus nigri-manus* C. Koch ($^{75}/_1$).
- Fig. 6. A piece of the integument on the lower side of the 5th joint (tibia) of the 3d pair of legs of the same species ($^{190}/_1$); a. the peculiar fissures, p. pore-channels.
- Fig. 7. The 3d and 4th outmost joint of the tarsus of the 1st pair of legs of the same species ($^{66}/_1$); s. sense-hairs.

- Fig. 8. Sense-hairs of the joints exhibited in the previous figure ($^{300}/_1$).
- Fig. 9. Foliaceous seta on the tarsus of the 1st pair of *Damon medius* Hbst ($^{29}/_1$).
- Fig. 10. Claws on the tarsus of the 1st pair of legs of *Admetus marginemaculatus* C. Koch ($^{300}/_1$).
- Fig. 11. A piece of integument with the long tactile hair on patella in *Phrynichus nigrimanus* C. Koch ($^{102}/_1$).
- Fig. 12. Metatarsus of the 4th leg from the left side of *Phryn. nigrimanus*, seen from above ($^9/_1$); a. the proximal group of the insertions of the tactile hairs (the hairs are omitted), b. the distal group of the tactile hairs (some are drawn, of most of them only the insertion is indicated).
- Fig. 13. The lower side of cephalothorax of *Admetus marginemaculatus* C. Koch ($^8/_1$); a. the median sternal plates, b. the lateral sternal plates, c. labium, d. the basal joints of the coxæ, e. the basal part of the maxilla, f. the 1st sternite of the abdomen.
- Fig. 14. The lower side of cephalothorax of *Phrynichus nigrimanus* C. Koch ($^8/_1$).
- Fig. 15. The tarsus of the 2d right leg of *Admetus marginemaculatus* C. Koch, seen from in front ($^{11}/_1$); a. transverse fissure on the 2d joint, b. oblique fissure on the 4th joint, c. fissure, limiting the dorsal portion that runs out into an apical process, l. lyriform organ at the end of tibia.
- Fig. 16. The tarsus of the 2d right leg of *Phrynichus nigrimanus* C. Koch, seen from in front ($^{11}/_1$).

Tab. III.

- Fig. 1. Lyriform organs on the upper side near the posterior edge behind the apophysis of the apical margin



of the 2d joint of the 3d leg from the right side of *Thelyphonus indicus* Stol., somewhat pressed ($71/1$).

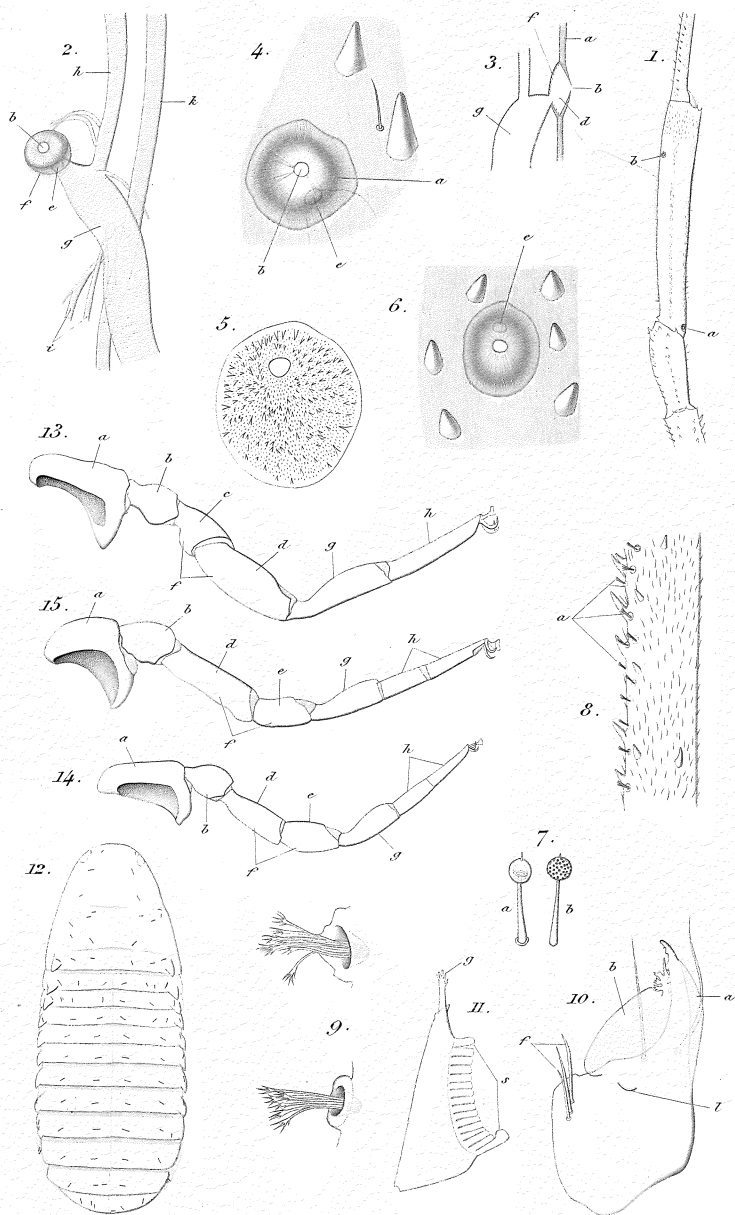
- Fig. 2. The superior, distal portion of the exterior side of the mandible of the same species, showing the apophysis (a) and a lyriform organ ($68/1$).
- Fig. 3. The right lateral eye-group of the same species, showing the 3 large and the 2 small eyes (a) ($33/1$).
- Fig. 4. The 16th—18th joint of the caudal file of the same species, seen from below ($13/1$); m. luminous (?) spots.
- Fig. 5. Diagrammatic longitudinal section of one of the luminous spots on the caudal file; c. cuticula, h. hypodermis, m. the contents of the luminous spot.
- Fig. 6. Lyriform organ on the lower side of the movable finger of the right mandible of *Solpuga fatalis* Licht. ($81/1$); l. the single organs, p. the pore-channels.
- Fig. 7. Lyriform organ on the lower side of the hand of the right mandible of the same species ($33/1$); s. the basal portion of the setæ.
- Fig. 8. The right mandible of a female of *Solpuga fatalis* Licht., seen from the inside ($11/5$); a. the place of the lyriform organ on the movable finger, b. the place of the lyriform organ on the lower side of the hand, s. stridulating apparatus.
- Fig. 9. The right mandible of *Cleobis Cubæ* Luc., seen from the inside ($17/2$).
- Fig. 10. The basal portion of the tarsus of the 3d right leg of *Solpuga fatalis*, ♀, seen from above ($13/1$); a. the furrowed transverse area, b. the smooth area, c. the membrane between tarsus and metatarsus.
- Fig. 11. Rostrum of *Galeodes orientalis* Stol., ♀, seen from

the right side ($8/1$); d. the dorsal lobe, l. the setal plate, s. the plumose seta, v. the lateral plate.

- Fig. 12. Rostrum of *Cleobis Cubæ* Luc. ♀ ($12/1$).
 Fig. 13. Rostrum of *Rhax annulata* Sim.? ($9/1$).
 Fig. 14. The 2d joint of the right maxillary palpus of *Nemastoma lugubre* O. F. Müll., ♀, seen from the outside ($66/1$); l. lyriform fissures.
 Fig. 15. Last joint of the right maxillary palpus of *Nemastoma lugubre*, ♀, seen from the outside ($66/1$); l. lyriform fissure.

Tab. IV.

- Fig. 1. The median portion of the 1st leg from the right side (apex of femur, patella, tibia and the basis of tarsus) of *Phalangium propinquum* Luc., ♀, seen obliquely from above and from behind ($7/1$); a. the proximal spiracle on the tibia, b. the distal spiracle.
 Fig. 2. The proximal spiracle and the tracheæ in patella and the basal portion of tibia of the 1st right leg of *Phalang. cornutum* L., ♀ ($138/1$); b. the aperture of the spiracle, e. the opening of the trachea in the respiratory cave, f. the interior wall of the respiratory cave, g. the large tracheal trunk going up to the spiracle, h. the narrower continuation in tibia of the same trunk, i. recurrent tracheal branches, k. the 2d tracheal trunk of the leg, standing in secondary connection with the distal spiracle.
 Fig. 3. Diagrammatic longitudinal section through the proximal spiracle in *Phal. cornutum*; a. the exterior wall of the leg, d. the respiratory cave; the other letters as in fig. 2.
 Fig. 4. A piece of integument of the tibia with the conical spines and the proximal spiracle in *Phal. propin-*



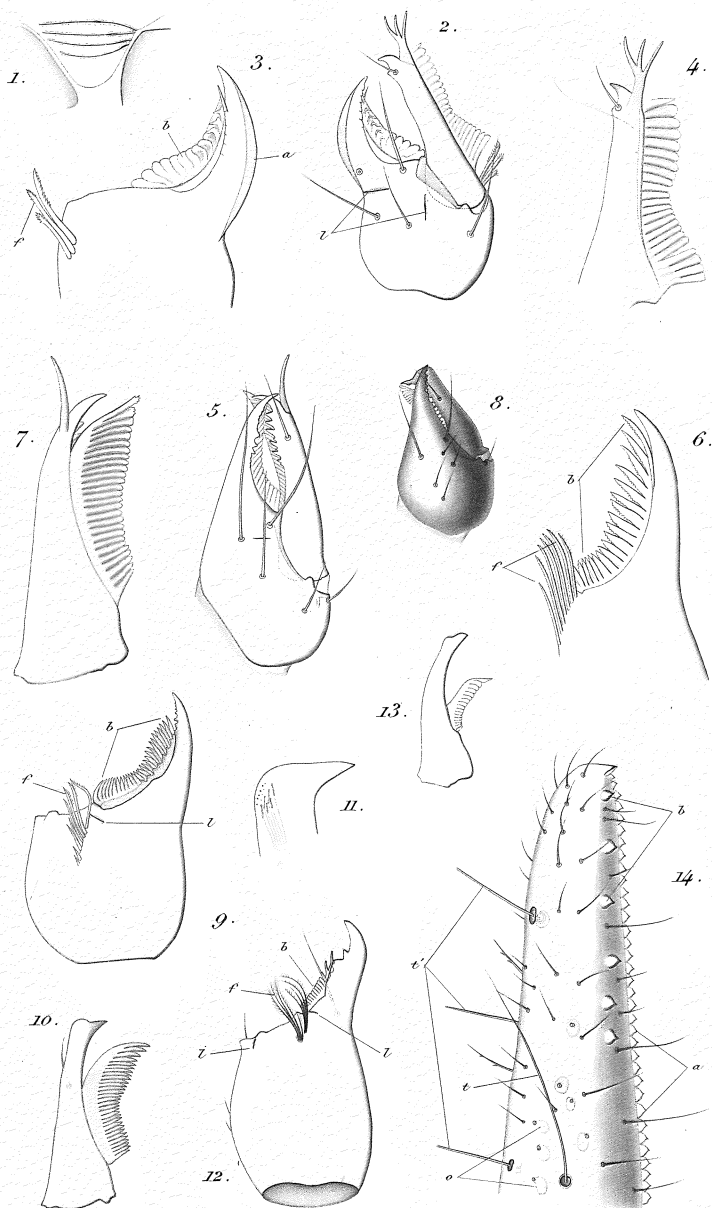
quum, ♀ (¹⁰⁸/₁); a. the exterior, radiately striped wall of the spiracle, b. the aperture of the spiracle, e. the opening of the trachea in the respiratory cave shining faintly through.

- Fig. 5. The interior wall of the respiratory cave of the distal spiracle in *Phal. propinquum* (¹⁹⁷/₁).
- Fig. 6. A piece of integument of tibia with the conical spines and the distal spiracle (in *Phal. propinquum* ♀) of the same pair of legs as the proximal spiracle exhibited in fig. 5 and drawn with the same enlargement. The conical spines on these two figures may give an idea of the relative size of the different portions of the spiracles, and both figures being drawn with the same enlargement, you get at the same time a correct conception of the relative size of the 2 spiracles on the same leg. c. the opening of the trachea in the respiratory cave.
- Fig. 7. 2 clavated hairs from the last joint of the palpus in *Nemastoma lugubre* O. F. Müller (c. ⁴⁰⁰/₁) exhibited Tab. III, fig. 15; a. hair showing the interior structure, b. hair, showing the surface.
- Fig. 8. A piece of the metatarsus of the 3d right leg of *Phalangium parietinum* Degeer, ♂, seen from in front (⁴²/₁); a. bunches of particular hairs, each of which bunch is like a clavated hair when seen with a slight enlargement.
- Fig. 9. 2 bunches of hairs from the metatarsus of the 1st pair of legs in the male of *Phal. parietinum* (²³⁵/₁).
- Fig. 10. The basal joint of the mandible in the male of *Chelifer granulatus* C. Koch, seen from below and from the inside (¹⁴²/₁); a. lamina interior, f. »flagellum«, b. lyriform fissure.
- Fig. 11. The 2d joint of the same mandible as in the former figure (¹⁴²/₁); g. galea, s. serrula.

- Fig. 12. Cephalothorax and abdomen in the male of *Chel. granulatus* C. Koch to show the numerous, spread lyriform fissures, which are drawn relatively too large ($^{17}/_1$).
- Fig. 13. The 2d right leg of *Chelifer granulatus* C. Koch, seen from above ($^{37}/_1$); a. coxa, b. trochanter, f. femur, divided into: c. trochantin and d. the true femur, g. tibia, h. tarsus; hairs and lyriform organs omitted in this and the 2 following figures.
- Fig. 14. The 2d right leg of *Garypus latus* H. J. H., seen from above ($^{40}/_1$); a. coxa, b. trochanter, f. femur, divided into: c. pars basalis femoris and d. pars tibialis femoris, g. tibia, h. tarsus.
- Fig. 15. The 2d right leg of *Obisium muscorum* Leach, seen from above ($^{37}/_1$); the signification of the letters as in the former figure.

Tab. V.

- Fig. 1. Portion of the upper side of the 2d joint of the 2d right leg of *Obisium muscorum*, to show the lyriform organ ($^{195}/_1$).
- Fig. 2. Right mandible of *Olpium furciferum* Balz., ♀, seen from above and from the outside ($^{109}/_1$); l. lyriform fissures.
- Fig. 3. The largest portion of the basal joint of the mandibles from the former figure, seen from below and from the inside ($^{146}/_1$); a. lamina exterior, b. lamina interior, f. »flagellum«; lyriform fissures omitted.
- Fig. 4. The 2d joint of the mandible exhibited in fig. 2, seen from below and from the inside ($^{146}/_1$).
- Fig. 5. Right mandible of *Ideobisium crassimanum* Balz., seen from the outside and from above ($^{103}/_1$).
- Fig. 6. The immovable finger of the mandible exhibited



in the former figure, seen from below and from the inside ($^{132}/_1$); the signification of the letters as in fig. 3.

- Fig. 7. The movable finger of the mandible exhibited in fig. 5, seen from below and from the inside ($^{132}/_1$).
- Fig. 8. Right mandible of *Obisium muscorum* Leach, seen from above ($^{48}/_1$).
- Fig. 9. The 1st joint of the mandible exhibited in the former fig., seen from below and slightly from the inside ($^{81}/_1$); b. lamina interior, f. »flagellum«, l. lyriiform fissure.
- Fig. 10. The 2d joint of the mandible exhibited in fig. 8, seen from below and slightly from the inside ($^{83}/_1$).
- Fig. 11. Apex of the movable finger of *Obisium muscorum* treated with caustic potash and seen from below (see the text p. 219—20).
- Fig. 12. The 1st joint of the right mandible of *Chthonius Rayi* L. Koch, seen from below and from the inside ($^{63}/_1$); the signification of the letters as in fig. 9.
- Fig. 13. The 2d joint of the right mandible of *Chthon. Rayi*, seen from below and from the inside ($^{63}/_1$).
- Fig. 14. The largest portion of the immovable finger of the large chela in the male of *Chernes cimicoides* J. C. Fabr., seen from the inside ($^{129}/_1$); a. the teeth placed in a close row, b. the teeth placed inside the margin, o. particular, spread sense-organs, t. tactile hair, drawn in full, t'. tactile hair, of which only the basal portion is drawn.

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