

## Further contributions towards the comparative morphology of the Mesostigmata. IV.

By

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With 25 Text-figures.

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In 1915 Halbert described the new genus, *Thinozercon*, from Ireland, where he had found it in several localities under stones on the sea-shore between the tide-marks (1915, p. 82—84, fig. 26). In his first paper H. created a new family, the *Thinozerconidae*, for the genus, which he considered related both to the *Zerconidae* and to the *Uropodina*. But in a second paper (1920, p. 128) he revised his opinion and writes: »There is considerable justification for making this most remarkable form the type of a separate family; for the present it is included in the *Zerconidae*.» In the meantime Berlese had included the genus in the tribus *Polyaspidini* of the *Uropodina*. Subsequently v. Vitzthum (1931, p. 143) refers the family *Thinozerconidae* to the subcohors *Sejina* of the *Gamasides*, but is cautious enough to add: »könnte wohl auch zu den *Uropodina* gerechnet werden.»

In connection with my investigations of the comparative morphology and classification of the *Mesostigmata* (1938) the systematic position of *Thinozercon* intrigued me and, thanks to the great courtesy of dr. Halbert, I obtained three females from him. The systematic position of *Thinozercon* has, in the meantime been discussed by the author (1941, p. 354—356) who advanced the opinion that the genus, although probably in some respects related to the *Trachytina* is yet too remote to be referred to that cohors.

One of the facts revealed by my investigations quoted above was that the *Zerconidae* (also called *Ascaidae*) was a very heterogeneous family, containing three genera, *Zercon* (*Asca*), *Polyaspis* and *Epicrosejus* which were not at all related to one another but belonged to quite different groups (l. c. p. 127—131). This discovery must obviously affect the systematic position of *Thinozercon*, which could not very well be related both to the *Zerconidae* and the *Uropodina*. Because these groups differ as regards some very important features, amongst which the most conspicuous are that in the *Zerconidae* the epigynial shield has one pair of hairs, whereas in the *Uropodina* it has none, and

that in the former family the metasternal shield is not fused with the other sternal shields and poorly developed, its presence being indicated only by the metasternal hair, while in the *Uropodina* the metasternal shield is obliterated except for the metasternal hairs which sometimes persist in the posterior angles of the genital aperture (comp. Trägårdh 1942, fig. 6 and 7).

The *Zerconidae* not being at all related to the *Uropodina* it would be of great interest to study more in detail the organisation of *Thinozercon*. As a matter of fact this genus proved even more interesting than I had anticipated, some of its features in my opinion throwing light on some fundamental questions bearing on the system of the *Uropodina* and of related groups. For this reason the scope of this investigation, primarily undertaken only in order to study the systematic position of *Thinozercon*, has been widened as to embrace the comparative morphology of the dorsal shields of the *Mesostigmata*. The investigations have been confined to forms of which I had enough material to dissect them after treating them with hot lactic acid. This is according to my experience the only way to ensure, that no structural details are overlooked.

### I. On the number of dorsal shields.

In order to understand the very varying number and shape of the dorsal shields in the *Mesostigmata* it is necessary to have some working hypothesis and I use the same one formulated by me in 1912 (p. 2—6). My contention was that the single shield was derived from the coalescence of a number of shields which indicated traces of an earlier segmentation. As evidence for this assumption I emphasized the fact that in some undoubtedly primitive genera, as f.i. *Sejus*, not less than six dorsal shields persist in the female, and that in the nymphae of many species, the adults of which had only one (or two) dorsal shields, there frequently occurred several shields. Furthermore I pointed out that there occurred a small posterior dorsal shield which I homologized with the posterior shield of *Sejus*. I used on purpose the rather vague expression »indicate traces of earlier segmentation» because too little is known about this phenomenon to enable us to decide whether any shields actually correspond to primary tergites.

v. Vitzthum (1931, p. 26—27) writes: »Die dorsalen Panzerplatten sind ziemlich sicher nicht primärer Natur: sie sind keine Verschmelzung primärer Tergite. Allenfalls könnte dies für das Prosomataalschild (»Scutum») bei den Larvae und beim Weibchen der *Ixodidae* gelten; die beim Männchen sich mit oder ohne Beibehaltung einer sichtbaren Abgrenzung anschliessende Verhärtung der übrigen Rückenfläche (»Alloscutum») ist unbedingt eine sekundäre Neuerwerbung. Manche *Liponissus*-Protonymphae, mit ihren Interskotalplättchen zwischen



einem vorderen und einem hinteren Rückenschild, zeigen, wie sich die Dorsalfläche stückweise panzert, bis nur ein vorderes und ein hinteres Rückenschild (Notocephale und Notogaster) übrigbleibt oder bis auch diese Teile zu einer Einheit verschmelzen. Auch bei solchen *Uropodina*, wo die Rückenpanzerung der Adulti ziemlich oder ganz einheitlich ist, entsteht die Panzerung bei den Jugend-Stadien, indem sich Einzelteile mosaikartig zu einem einheitlichen vorderen und einem 3-geteilten, hinteren Schild zusammenfügen. Eine Andeutung primärer Tergite ist niemals vorhanden.»

But even if we admit that we do not yet know how to interpret these shields there is nothing to prevent us from studying them in detail in the different groups in the hope of finding evidence of the relationship of the groups. It is my intention in this paper to make a comparative study of the dorsal shields, especially of the *Uropodina* but also of some other groups.

Berlese in his monographic treatment «Acari Myrmecophili» (1904, p. 323) gives a detailed account of the external morphology of the *Uropodina*. He recognizes only two dorsal shields, «scutum dorsuale medium» and «scutum marginale», but he mentions also that the former is sometimes composed by two shields, the posterior one of which is much the smaller, and that at the anterior end of the body there is sometimes a triangular blade, called the «vertex». As a matter of fact this conception of the dorsal side of the *Uropodina* is altogether too simplified and does not do justice to a number of structural details, revealed by a minute investigation. As an introduction to this study the dorsal side of *Thinozercon* is very well suited (fig. I A). As already pointed out by Halbert, it is very peculiar in some respects. The anterior margin of the body is as far backwards as to the stigmata covered by a narrow, marginal shield, separated from the central shield by a strip of soft cuticle. The shield projects forwards into a kind of rostrum, bearing one pair of rather stout, curved, vertical hairs, and along its posterior margin there is a row of 8 pairs of hairs, beside two pairs, one behind the other, behind the vertical hairs and two pairs at the shoulders. Along the very edge of this shield the peritremata run as far forwards as to the base of the rostrum.

How are we to interpret this shield? There are several possibilities to take into consideration. The first question to settle is whether the whole antero-marginal shield, in the shape it is present in *Thinozercon*, is of uniform origin or produced by the fusion of the peritrematic shields with an independent, anterior mucro, carrying the vertex-hairs. In order to answer this question it is necessary to examine other genera with more or less similar structures and see what conclusions may be drawn from such a comparison. The following genera have been examined for this purpose: *Pergamasus*, *Macrocheles*, *Eviphis*, *Sejus*, *Polyaspinus* *Trachytes* and several *Uropodina*.



In *Eviphis* (fig. 1 B) there is on the ventral side, outside the legs, a narrow, band-shaped peritrematic shield, extending from the posterior edge of the ventral shield to the front of coxae I. It is not attached to the dorsal side. In *Macrocheles*, on the other hand (fig. 1 C), there is a long, band-shaped peritrematic shield, which is free for the greater part of its length but is fused with the dorsal shield at the anterior end, forming a kind of collar, the surface structure of which is different from the rest of the usually polygonal structure of the dorsal shield. The peritremata run along the very edge of the peritrematic shield and immediately on leaving the stigmata form a loop very similar to that of *Thinozercon*. In the middle of the anterior edge there is a central part carrying two pairs of vertex hairs and set off from the rest by a small incision.

*Pergamasus* (fig. 1 D) is fundamentally very similar to *Thinozercon* and *Macrocheles*, only in the female the whole peritrematic shields are fused with the dorsal shield, forming the slope of the notocephale and an anterior collar round the base of the gnathosoma. At the anterior end the median portion, the fused mucro, is set off by a transverse ridge from the anterior edge of the notocephale and carries a pair of long hairs. The peritremata form the margin of the shield and extend far forwards. If the dorsal side of a *Pergamasus* female is dissected and flattened out as in fig. 1 D the peritrematic shields, which in situ are bent downwards, become almost horizontal and recall vividly those of *Thinozercon* (fig. 1 A), the only difference between both genera being that in *Pergamasus* they are fused with the dorsal shield, whereas they are free in *Thinozercon*.

In *Sejus* (fig. 2 A) there is a pair of distinct peritrematic shields, extending backwards as far as the anterior central shield. Only the anterior half of the shield is, however, dorsal, the rest of the shield bending downwards so that only the lateral edge is visible from the dorsal side. In the middle it is fused with the anterior tip of the dorsal shield, forming a kind of collar, the central portion of which bears a pair of stout vertex-hairs: the anterior ends of the peritremata are visible above legs I on the dorsal side.

In *Polyaspinus* (fig. 2 C) we encounter an antero-marginal shield which resembles very much that of *Thinozercon* in being distinctly dorsal. It is fused anteriorly with a central, mucro-shaped shield which itself is fused with the anterior end of the central shield and has three pairs of hairs, but as far as I have been able to perceive on the nymphae and females found by me in Sweden, the peritremata do not run along the lateral edge of this shield, and for this reason it is not a peritrematic shield. Both in *Polyaspinus* and in *Thinozercon* the true independent nature of the anterior mucro or vertex is very distinct.

The most remarkable genus as regards the development of the vertex-shield is *Trachytes*, which also in other respects holds a most

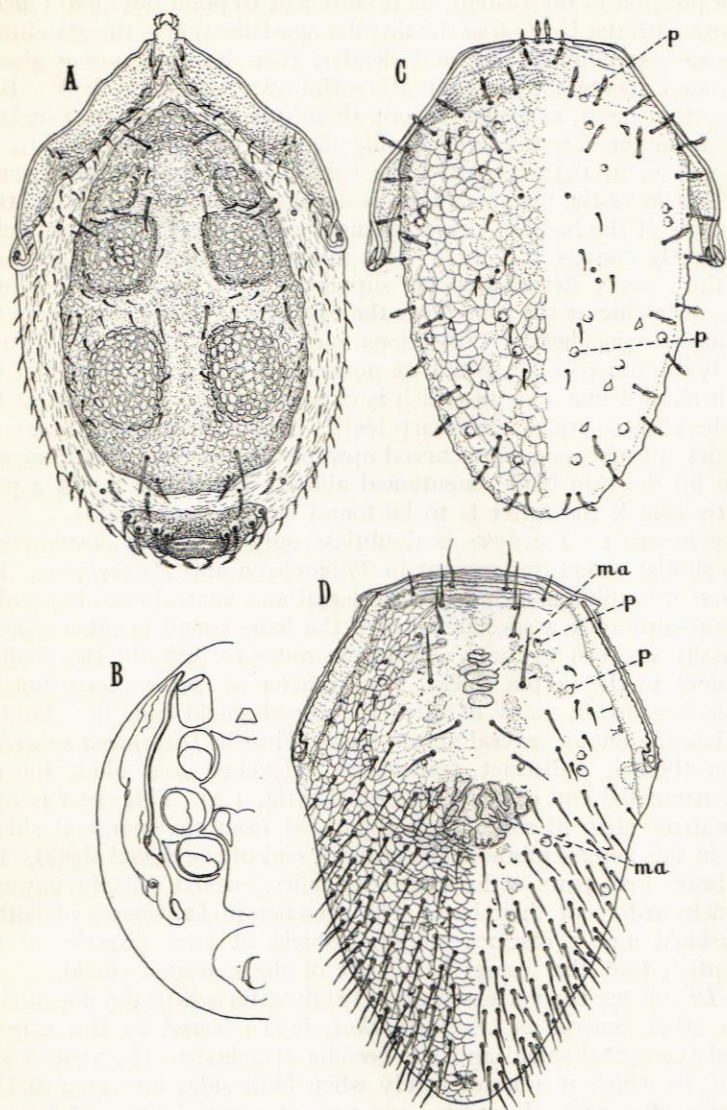


Fig. 1. A *Thinozercon michaeli* Halbert. ♀. Dorsal side. B *Eviphis ostrinus* K. ♀. Ventral side, right half. C *Macrocheles tridentinus* Can. ♀. Dorsal side. D *Pergamasus crassipes* L. ♀. Dorsal and peritrematic shield.



unique position in the system. It is sufficient to point out that *Trachytes* shares with the *Uropodina* the singular specialisation of the mandibles, which are exceedingly long and slender, their base extending almost to the anal aperture when they are withdrawn within the body. But, on the other hand, as I pointed out already in 1910 (p. 447) *Trachytes* differs from the *Uropodina* in having distinct metasternal shields, for which reason in 1938 I created the cohorts *Trachytina* for this genus.

In *Trachytes* the median mucro is developed to such an extent that the outline of the body is almost triangular, the posterior margin being only slightly convex (fig. 2 B). This mucro is on both sides bordered by a thin, easily detached blade supported by transverse ridges, the blades coalescing at the top. Near the top, on the dorsal side, there are two small, semispherical projections each bearing a hyaline, flexible hair. If the mucro is dissected we notice that the anterior part of the body is shaped like a snout which is curved slightly downwards at the top where there are several sharp teeth. At the anterior end there are two pairs of leafshaped hairs curved upwards and backwards and mostly hidden by the thin blade, mentioned above. This blade is not a peritrematic shield: the latter is to be found on the ventral side.

The mucro of *Trachytes* is doubtless only a further development of the similar structures present in *Thinozercon* and *Polyaspinus*. The presence of two kinds of hairs, both dorsal and ventral ones is peculiar but represents only a specialisation of the hairs found in other genera.

Finally we turn to the *Uropodina* in order to find out the possible equivalent to the vertex shield. As a matter of fact we have not far to look, because in many of them the dorsal shield ends in a kind of crest, bearing one or several vertex hairs. Thus in *Discopoma splendida* Kramer there is a distinct, transversal, thickened crest along the anterior, truncated end of the dorsal shield (fig. 4 A). This crest is by a very narrow strip of soft cuticle separated from the marginal shield, which in this genus embraces the anterior end of the dorsal shield. The crest bears four pairs of long, slender hairs, curved sharply upwards and backwards near their base. The presence in *Discopoma* of both a vertexshield and a distinct marginal shield at once disposes of the assumption that the former be a part of the marginal shield.

In *Discopoma* the vertex-shield is firmly attached to the dorsal side, but in other genera, as f.i. *Oodinychus*, it is covered by the anterior edge of the dorsal shield and has become attached to the ventral side instead, to which it adheres firmly when both sides are separated by dissection (fig. 3 G). It carries one pair of vertex-hairs and forms a kind of protecting roof to the so-called «tectum», with which structure it has consequently nothing to do.

In *Phaulodinchus* the vertex hairs are terminal and visible both on dorsal and ventral view. If the mite is disserted, however, they are found to belong to the ventral side.

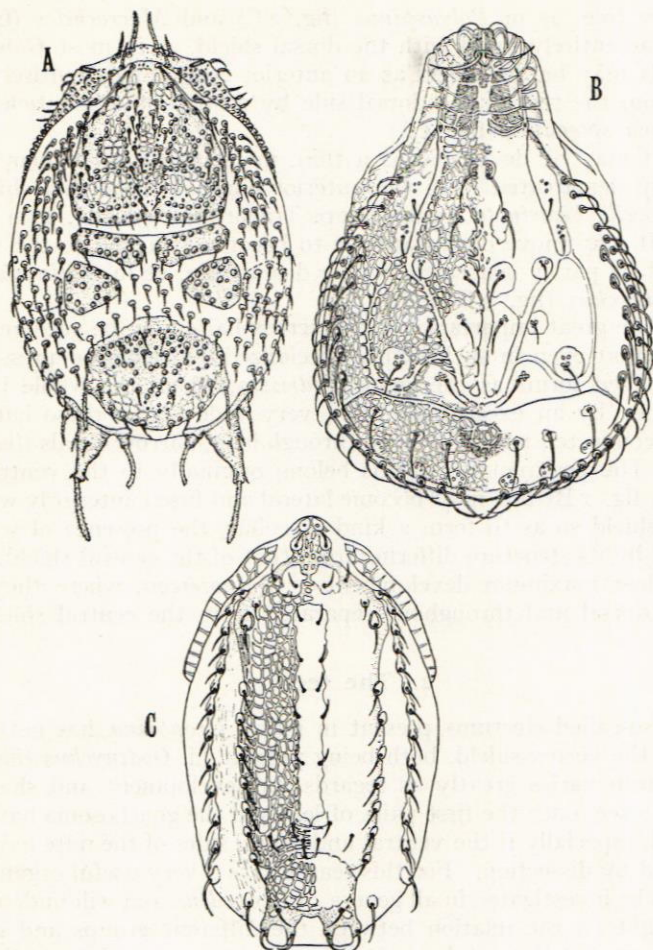


Fig. 2. A *Sejus togatus* K. Dorsal side. B *Trachytes agrota* K. ♀. Dorsal side.  
C *Polyaspinus cylindricus* Berl. Nympha, Dorsal side.

From this short survey the following conclusions may be drawn:

I. In the *Mesositgmata* a vertex-shield exists, bearing at least one pair of more or less specialized hairs, sometimes also some additional hairs. The function of the shield is probably to act as a prow and also to carry the sensorial hairs.

II. The vertex-shield may be developed in several ways:

A. It may be fused with the peritrematic shields, in which case both may remain entirely free from the dorsal shield (*Thinozercon*)



or partly free, as in *Polyaspinus* (fig. 2 C) and *Macrocheles* (fig. 1 C) or become entirely fused with the dorsal shield, as in most *Gamasides*.

B. It may be developed as an anterior crest, almost entirely separated from the rest of the dorsal side by a strip of soft cuticle, as in *Discopoma splendida* (fig. 4 A)

C. It may be developed as a thin, more or less triangular shield, distinctly demarcated from the anterior edge of the dorsal shield, as in *Urobovella bicarinata* Tgdh (comp. Trägårdh, 1931, fig. 151).

D. It may move downwards as to become attached to the ventral side and be partly concealed by the dorsal side, as in *Oodinychus* and *Phaulodinychus* (fig. 3 G & C).

E. The great importance of the vertex-hairs may be gathered from the fact that even in such highly specialized, extremely depressed and shield-shaped forms as the genus *Fedrizzia*, where the whole body is surrounded by an exceedingly thin, very wide blade, these hairs still persist, connected with the body through long, narrow canals (fig. 3 H).

III. The peritrematic shields belong originally to the ventral side (*Eviphis* fig. 1 B) but may become lateral and fused anteriorly with the central shield so as to form a kind of collar, the presence of which is revealed by its structure differing from that of the central shield. They attain their maximum development in *Thinozercon*, where they have become dorsal and throughout separated from the central shield.

## 2. The tectum.

The so-called »tectum», present in many *Uropodina*, has nothing to do with the vertex-shield, both being present f.i. *Oodinychus* (fig. 3 B). The tectum varies greatly as regards its development and shape. It is easy to see, once the first pairs of legs and the gnathosoma have been removed, especially if the ventral and dorsal sides of the mite have been separated by dissection. For this reason it is a very useful organ which ought to be investigated in all genera of *Uropodina* and will undoubtedly throw light on the relation between the different groups and genera. In order to test its usefulness for taxonomic purposes I have dissected some representatives of the different groups.

Since the *Polyaspidae* and the *Trachytidae* have been removed from the *Uropodina*, the remaining families are according to the generally accepted view: *Prodinychidae*, *Phaulodinychidae*, *Trachyuropodidae*, *Urodinychidae* and *Uropodidae*. The *Uropodina* may be said to represent a type of organisation for defensive purposes very similar to that of the tortoises. Both are protected both on the ventral and the dorsal side by a thick armour, formed in the mites by strongly chitinized shields, and in both the head and the legs can be withdrawn and more or less hidden. In the *Uropodina* this is achieved in two ways; the gnathosoma is completely covered by the large, horizontal coxae I which meet in



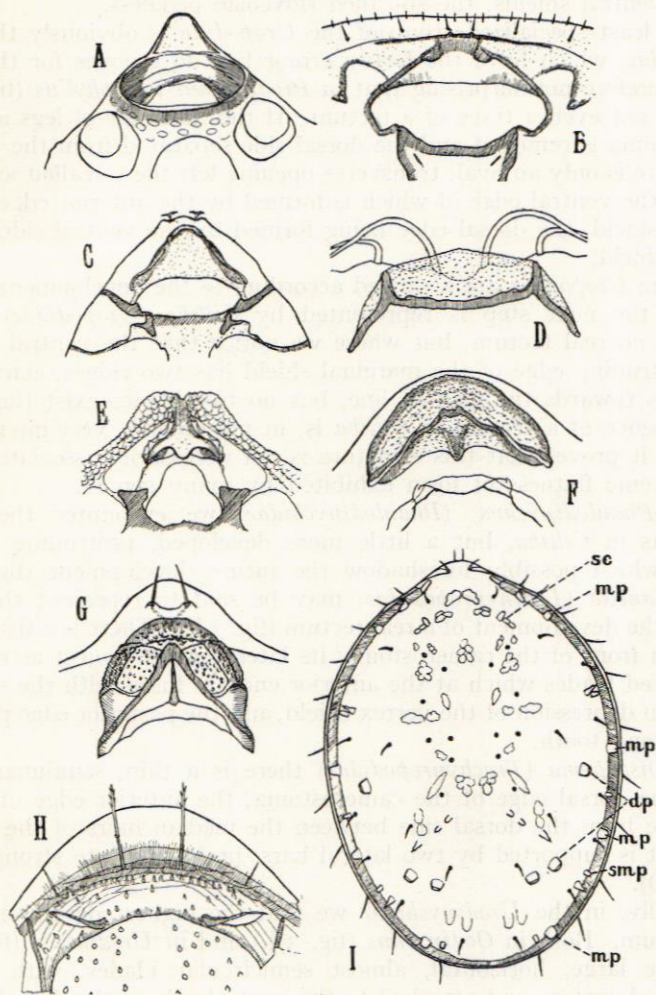


Fig. 3. A—F Camerostoma and tectum of different *Uropodina*: A *Prodinychus tetraphyllus* Berl. B *Cilliba cassidea* Herm. C *Phaulodinychus repletus* Berl. D *Discopoma splendida* Kr. E *Urojanetia* sp. F *Urodiaspis foraminifera* Tgdh. G *Oodinychus Thorianus* Berl. ♀. Tectum, ventral view. H *Fredrizzia* sp. Anterior end of dorsal shield with vertex hairs. I *Eviphis ostrinus* K. ♀. Dorsal shield.

the median line, and the legs can be bent and concealed in special grooves of the ventral shields, the so-called »foveolae pedales».

The least specialized group of the *Uropodina* is obviously the *Prodinychidae*, which have the heavy armor but no grooves for the legs. It is therefore not surprising that in *Prodinychus tetraphyllus* (fig. 3 A) there is not even a trace of a tectum. If the first pair of legs and the gnathosoma is removed and the dorsal side separated from the ventral side there is only an oval, transverse opening left the so-called »camerostoma» the ventral edge of which is formed by the anterior edge of the sternal shield, the dorsal edge being formed by the ventral side of the vertex-shield.

If the *Uropodina* are arranged according to the development of the tectum the next step is represented by *Cilliba* (*Uropodidae*) where there is no real tectum, but where we notice that the ventral side of the protruding edge of the marginal shield has two ridges, converging forwards towards the median line, but no free blades exist (fig. 3 B). The absence of a tectum in *Cilliba* is, in my opinion, very interesting, because it proves that this structure is not necessarily associated with the extreme flatness of form exhibited by many genera.

In *Phaulodinychus* (*Phaulodinychidae*) we encounter the same ridges as in *Cilliba*, but a little more developed, protruding as low blades which possibly foreshadow the future development (fig. 3 C).

*Urojanetia* (*Trachyuropodidae*) may be said to represent the next step in the development of a real tectum (fig. 3 E). There is a triangular shield in front of the camerostoma; its lateral edges project as narrow, corrugated blades which at the anterior end are fused with the sides of a median depression of the vertex shield, and the posterior edge projects as a strong tooth.

In *Discopoma* (*Trachyuropodidae*) there is a thin, semilunar plate along the dorsal edge of the camerostoma, the anterior edge of which is visible from the dorsal side between the median hairs of the vertex shield; it is supported by two lateral bars, projecting into strong teeth (fig. 3 D).

Finally, in the *Urodinychidae* we find the highest development of the tectum. Both in *Oodinychus* (fig. 3 G) and in *Urodiaspis* (fig. 3 F) they are large, horizontal, almost semicircular blades, with highly sculptured surface and attached to the ventral side of the dorsal shield only along a triangular area.

This short investigation of the tectum has revealed, that it is absent in *Prodinychus*, that in *Cilliba* and *Phaulodinychus* there are structures present which may be considered as the initial stages of this structure, that in *Discopoma* and *Urojanetia* the tectum is developed to a certain extent and that in *Oodinychus* and *Urodiaspis* the most specialised stage is reached. Further investigations are necessary in order to ascertain, whether the genera here examined are typical of their resp. families and



whether a system based on the development of the tectum will turn out to be more satisfactory than that now accepted.

### 3. The microsculpture of the dorsal shields.

If a special preparation is made of the dorsal shields of the *Mesostigmata* after having treated them with hot lactic acid many structures will be visible which otherwise are difficult to detect. These structures may provisionally be divided into the following categories.

I. Polygonal areas, separated from one another by minute ridges or by rows of very minute granules.

II. Scars or more or less linear areas, where the cuticle is quite thin and transparent.

III. Pores of different shape and size, sometimes isolated, sometimes closely associated with hairs and associated either with glands or with sense organs.

IV. Pores which are nothing else than minute depressions or pits in the cuticle.

V. Areas where the cuticle is thin, not because there is any depressed area but because the cuticle is excavated from within.

It is not my intention here to describe in detail all these different structures, because to do so would involve a minute investigation of a great number of different forms, before any general conclusions could be reached. But during my investigations on the comparative morphology of the dorsal shields some of these structures could not fail to attract my attention, and for this reason they will be briefly described here in order to stimulate the interest of other acarologists to more extensive researches.

#### I. *Polygonal areas.*

As already suggested by Vitzthum the polygonal structure of the cuticle so conspicuous in many *Mesostigmata* may be due to the fact that the surface depicts the walls of the polygonal, hypodermic cells. If this be true the polygonal microsculpture is a primitive feature and the highly polished surface of many forms is a secondary specialisation. As a matter of fact a closer examination of many forms with highly polished surface, as f.i. *Eviphis* and many *Uropodina*, reveals traces of a polygonal structure, a fact which seems to corroborate this view.

The polygonal sculpture may be due to several different causes:

A. Sometimes these more or less polygonal areas are larger and the pattern is built up by rows of minute, spherical granules. This pattern is most conspicuous in *Sejus* (fig. 2 A), but is also plainly visible in *Zercon* and *Epicrius* (Trägårdh, 1942, fig. 6) a.o. and is pro-

bably not of any taxonomic value. Nevertheless it is important to study this microsculpture, because it may be useful in assisting us to detect when different shields have coalesced. Thus, to give only one instance, in *Macrocheles* (fig. 1 C) the peritrematic shields have coalesced with both the vertex shield and the dorsal shield in front of the shoulder; but the sculpture of this portion differs from that of the dorsal shields to such an extent, that its nature as a separate shield seems evident. On the other hand, there is nothing in the sculpture of the dorsal shield of *Macrocheles* which indicates that it consists of a fused notocephale and notogaster.

B. Sometimes the sculpture may be said to be scaly, the areas being shaped more or less like scales and the posterior edge of one area overlapping the anterior edge of those behind it. Such a sculpture is characteristic for *Pergamasus* (fig. 1 D). In this genus there is, behind the central group of light-coloured areas indicating where muscles are attached to the cuticle, a narrow, curved band where the polygonal areas are, as it were, pressed closely together and this band probably indicates the fusion line of the notocephale and the notogaster.

II. *Scars or more or less linear areas where the cuticle is quite thin and transparent.*

Such scars occur for instance in *Eviphis* (fig. 3 I) far forwards forming an irregular line parallel to the anterior margin (sc). In *Disco-poma* (fig. 4 A) the vertex shield is separated from the marginal shield by such a line of thin, transparent cuticle.

These scars may possibly be considered as indicating that the fusion between different shields has been incomplete, probably because this ensures a certain degree of flexibility.

### III. *Pores.*

There is a great diversity of pores on the dorsal shields and they seem to be most conspicuous in those forms which have a thick and highly polished cuticle. This seems to imply that at least some of them are orifices of glands which secrete some oily fluid, lubricating the thick shield. Without an anatomical and histological investigation of the cuticle it is, however, obviously impossible to make a proper study of them. For this reason I merely call attention to their presence in some genera. In *Eviphis*, for instance, there seems to be three pairs of big glands in the posterior half of the dorsal shield, viz. one lateral pair a little behind the middle and two pairs fairly close together further back (dp). Beside these there are other pores of two different kinds, viz. four larger marginal ones (mp) and five smaller submarginal ones (smp).

Also in the dorsal shields of *Macrocheles* (fig. 1 C) and *Pergamasus* (fig. 1 D) similar, although smaller pores occur which seem to be the orifices of glands (p).



Very often the pores are associated with hairs. This is for instance a very conspicuous feature in *Discofoma splendida* (fig. 4 B) where the hairs both of the dorsal and marginal shields are associated with pores and pores also occur on the eighth small, hairbearing shields near the posterior margin.

#### IV. Circular depressions.

In many genera there are small, circular depressions or pits in the cuticle which are not pores at all. This is a most conspicuous feature in *Prodinychus* (fig. 4 D) and in *Urojanetia* these depressions are so close together that the entire surface seems to be wrinkled.

#### V. Muscular attachments.

In many species the cuticle is thinner and as a consequence, more light-coloured, not because there are any depressions but because the inner layer of the cuticle is thin. Properly speaking they do not belong to the external microsculpture, but on macerated and dissected specimens they are very conspicuous, if the microscope tube is lowered sufficiently. These areas are the places where muscles are attached to the cuticle.

In *Pergamasus* (fig. 1 D) there is in the centre of the dorsal shield a group of five pairs of irregular areas close together, which indicate the places where muscles are attached to the integument. Further forwards there is an elongate, median group of 6—8 oval, transverse areas, indicating the attachment of other muscles (ma).

In *Prodinychus* there are not less than four separate groups of such areas (fig. 4 D). Three pairs of round areas form a row parallel to the anterior margin of the dorsal shield. Behind them there are two pairs of large areas presumably corresponding to the anterior, median group of *Pergamasus*. The central group of *Pergamasus* probably corresponds to the longitudinal median group of 8—9 small, rounded areas. The fourth group is situated far backwards in a transverse row and indicate the place where the trunk of the mandibular sheaths are attached.

#### 4. The central, dorsal shield.

As pointed out above (p. 93) Berleses conception of the dorsal side of the *Uropodina* as being composed by only two shields, the median shield and the marginal shield, does not do justice to the real conditions which present quite a number of structural details which have to be interpreted.

The information accumulated since 1912 has only strengthened my conviction that the presence of several dorsal shields in the adults is a primitive feature, associated with traces of segmentation also of the sternal shields and only occurring in the most primitive group, the

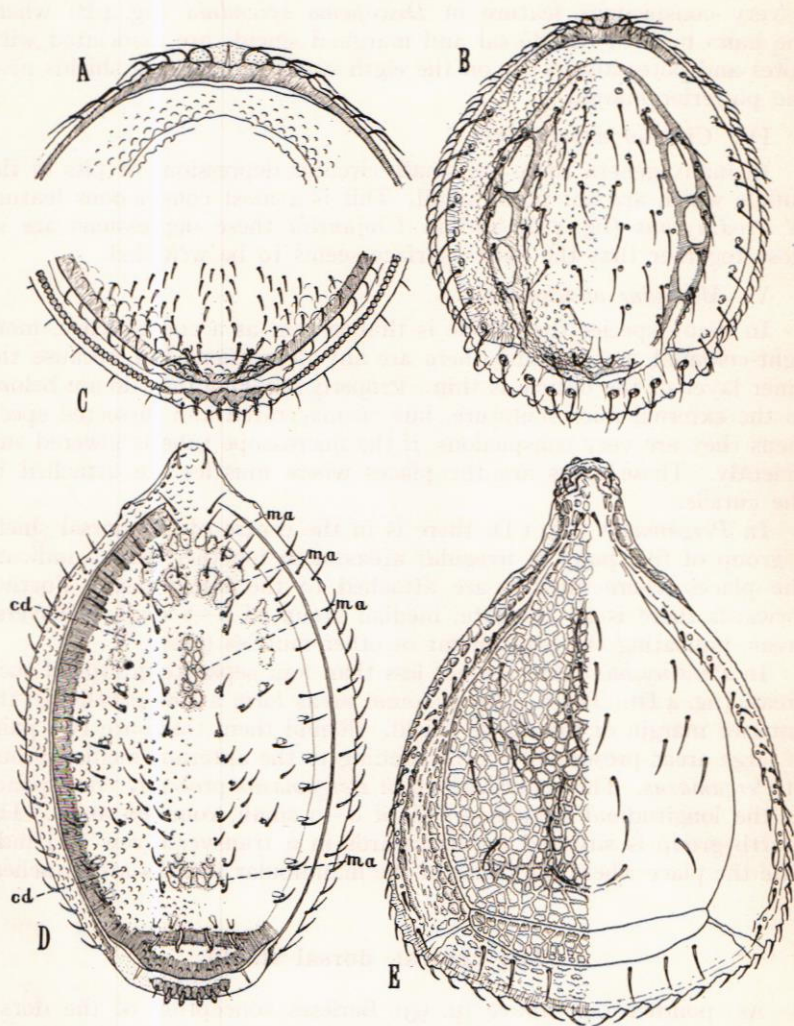


Fig. 4. A *Discopoma splendida* Kr. Anterior end of dorsal shield. B *Discopoma splendida* Kr. ♀. Dorsal shields. C *Oodinychus thorianus* Berl. Posterior end of dorsal shield. D *Prodinychus tetraphyllus* Berl. ♀. Dorsal side. E *Trachytes* sp. from N. America.



*Sejina* (comp. Trägårdh 1938, p. 154—157 and 1942, p. 120—133). If this be true we may look for traces of segmentation even in forms which to all appearance have only one single dorsal shield or one surrounded by a marginal shield.

In my two earlier papers (1912 and 1938) I strongly emphasized the importance of the position of the four pairs of sternal hairs when attempting to understand the often bewilderingly diverse combinations of the ventral shields. The new system of the *Mesostigmata*, outlined by me, is, as a matter of fact, mainly based on a new interpretation of the ventral shields, greatly with the help of the sternal hairs. Hence there is every reason to look for any evidence offered by hairs of special structure also when studying the composition of the dorsal side.

In the last mentioned paper I also pointed out, that sometimes the surface sculpture of the shields offered evidence of an earlier segmentation, as f.i. in *Ologamasus* (l.c. p. 24) and in *Pachylaelaps* (l.c. p. 29). Even the surface sculpture of the dorsal shield may offer some evidence regarding the fusion of the shields and, besides, there are other features which may be useful for taxonomic purposes such as scars or depressions in the cuticle. A short survey of the most important of these features has been given above.

After these introductory remarks I pass on to the central dorsal shield of *Thinozercon* (fig. 1). It seems to be undivided and by a fairly broad strip of soft cuticle to be separated from the edge of the body. A closer investigation of the surface reveals, however, that all the dorsal shields present in the nympha according to Halberts', description and drawings (l.c. fig. 26 m) are present also in the adult female as well defined areas with a texture different from that of the rest of the shield. In the anterior half of the shield there are two pairs of rounded, depressed areas, called »dorsal pits» by Halbert, and in the posterior half there is a pair of somewhat larger, oval areas. These are very peculiar structures, quite different from the generally uniform surface of the dorsal shields of the more specialized *Uropodina*.

In *Sejus* (fig. 2 A) we find, however, rather similar structures. Thus on the anterior dorsal shield the semispherical granules are arranged in a pattern which leaves two pairs of rounded areas free; these areas very likely correspond to those of *Thinozercon*. The presence of two transverse rows of hairs in *Thinozercon* behind the posterior of these areas and the presence of a similar transverse row at the posterior margin of the notocephale of *Sejus* suggests that the great central shield of *Thinozercon* consists of the notocephale of *Sejus* fused with the following two pairs of shields of *Sejus*.



### 5. The posterior dorsal shield.

This is in *Thinozercon* (fig. 1 A) a narrow, crescent-shaped shield, with the median portion of the posterior edge finely striated. It is separated from the central dorsal shield by a narrow strip of soft cuticle and bears four pairs of pectinated bristles on semispherical tubercles.<sup>1</sup>

Such a shield Berlese considers to be a rare exception but, as a matter of fact, it occurs both in *Polyaspinus* (fig. 2 C), and *Trachytes* (fig. 2 B) and *Sejus* as well as in many *Uropodina*. In a previous paper (1912, p. 4—6) I discussed briefly the dorsal shields of the *Mesostigmata* and suggested that the small size of this shield, when present in the *Uropodina* signified that it is not a true notogaster, such as occurs in the *Gamasides*, when the dorsal side is covered by two shields of nearly the same size, as f.i. in many nymphae of the *Parasitinae*, but that it is rather homologous with the posterior shield of *Sejus*.

It is not easy to tell whether the posterior dorsal shield is of the same origin in different groups, because nobody has so far tried to state what constitutes the postero-dorsal shield. There are two alternative views to choose between: the shield must be contiguous with the central dorsal shield, but not with the posterior margin of the body; or its most characteristic feature is that its posterior edge actually forms the posterior edge of the body. An investigation of some forms may enable us to decide this question.

In *Prodinychus tetraphyllus* Berl. (fig. 4 D) the posterior end of the central shield is set off from the rest by a transverse ridge behind which the surface slopes downwards more steeply. Immediately in front of the ridge there is a transverse row of four, rod-shaped bristles, different from the other hairs of the central shield. This posterior part of the central shield I unhesitatingly homologize with the posterior shield of *Sejus* in spite of their different size, because none of them is contiguous with the posterior edge of the body. In *Prodinychus* there is a narrow, transverse shield behind the posterodorsal shield, carrying four short, thick hairs, flanked by two fine hairs (fig. 3 B).

In *Sejus* (fig. 2 A) this posteromarginal shield is represented by the two pairs of projections which have a common base and are in reality nothing else than an highly modified postero-marginal shield.

The occurrence of two shields in *Prodinychus* one postero-dorsal and one postero-marginal, gives us the answer to the question how to characterize the postero-dorsal shield: it must be contiguous with the central, dorsal shield but not with the posterior edge of the body, and in front of the fusion line between the central and the postero-dorsal shield there is generally a transverse row of specialized hairs. Accord-

<sup>1</sup> HALBERT only mentions and delineates three pairs, having apparently overlooked the lateral pair which is indeed placed a little further forwards and does not project beyond the posterior edge of the body.



ding to this interpretation the posterior shield of *Thinozercon* is homologous with the posterior projections of *Sejus* and with the postero-marginal shield of *Prodinychus*. As a consequence there is no postero-dorsal shield in *Thinozercon*, presumably because it has coalesced with the central shield.

An examination of the genera *Prodinychus*, *Oodinychus* (fig. 4 C) a.o. clearly demonstrates that the postero-marginal shield, as the name choosen by me implies, is nothing else than a specialized part of the marginal shield. In both these genera the great central shield is fused with the small postero-dorsal shield and both are surrounded by a marginal shield, the posterior end of which is developd as a special shield with hairs differing from the other marginal hairs.

A further investigation of other genera reveals the fact that these two posterior shields vary greatly in shape; sometimes the postero-dorsal shield is by far the largest, sometimes it has dwindled to an almost obsolete shield, moreover coalesced with the postero-marginal shield, only the surface structure revealing its existence. In the genus *Trachytes* we have a most beautiful series of differently developed postero-dorsal shields. In an American species collected by me i Asheville N.C. in 1928 (fig. 4 E) the postero-dorsal shield is by a very fine but distinct line separated from the central shield, being contiguous with the entire posterior margin of the latter.

In *Trachytes minima* Tgdh, on the other hand, the postero-dorsal shield is greatly reduced in size (fig. 5 A) and has been almost absorbed by the postero-marginal shield, which surrounda it on three sides. Finally in *Trachytes aegrota* K the shield seems to have disappeared, but on closer inspection (fig. 2 B) we notice that this species represents still another step in the amalgamation of the postero-dorsal shield with the postero-marginal one, the former being only present as a small, round area, distinguishable only through its different surface sculpture.

Even in other *Uropodina* there are traces of a postero-dorsal shield, but it is absolutely necessary to treat the mites with hot lactic acid and separate the dorsal from the ventral side in order to discern them. As far as I have been able to find the fusion line is very often characterized by a transverse row of 2—4 more or less specialized hairs in front of it. Perhaps it would be permissible to use these hairs as evidence that the part of the central shield behind them represents the postero-dorsal shield even when all other traces of the fusion have been obliterated.

As mentioned above this shield occurs also in the *Trachytidae* and the close relationship of this family with the *Polyaspidae* is evident from the fact that also in the latter family a postero-dorsal shield is well developed. Thus in the nympha of *Polyaspinus cylindricus* Berl. (fig. 2 C) we notice at the posterior end of the great central shield a

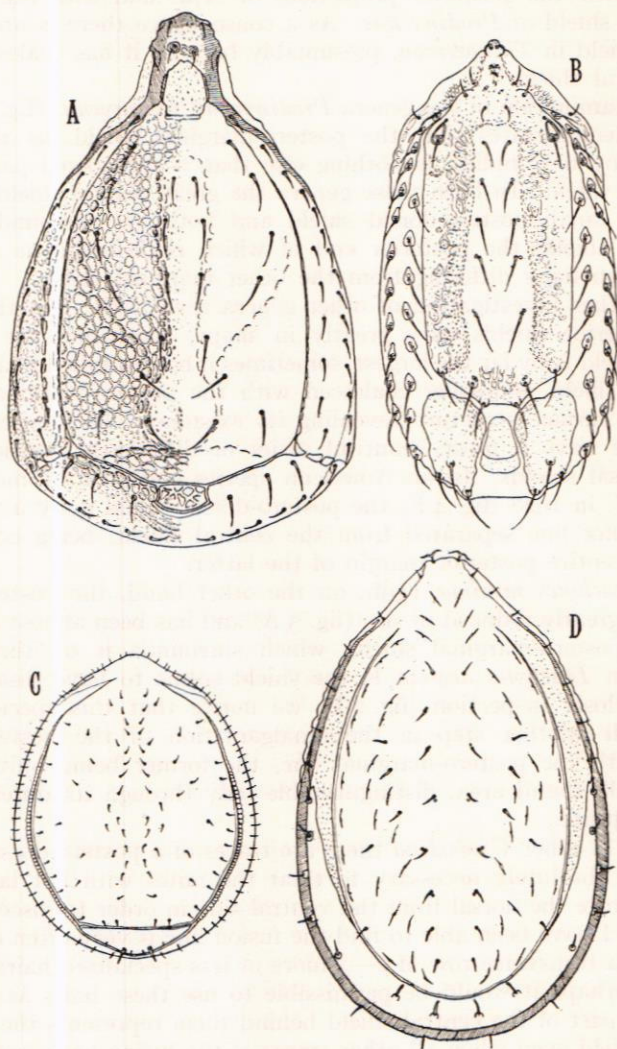


Fig. 5. A *Trachytes minima* Tgdh. ♀. Dorsal side. B *Polyspinus cylindricus* Berl. ♀. Dorsal side. C *Urodiaspis foraminifera* Tgdh. ♀. Dorsal shields. D *Phaulodinychus repleta* Berl. Dorsal shields.



distinct, oval transverse shield. Behind this there are two bifurcated projections carrying curved bristles. These I identify with the postero-marginal shield, which in *Sejus* (fig. 2 A) is similarly developed, indicating a certain relationship between the *Sejina* and the *Polyaspidæ*.

In the adult female these parts are differently shaped. The postero-dorsal shield, present in the nymph, has disappeared, the space behind the dorsal shield being occupied by two large lateral and one small median shield, which vividly recall the three shields of *Trachytes infirma* Berlese. The position of the hairs on the lateral shields seems to indicate that they are the postero-marginal shields of the nymphæ, in which case the median shield would be the postero-dorsal shield.

#### 6. The marginal shield.

It remains to consider the so-called *marginal shield*, concerning which there seems to be great confusion, this name having been applied indiscriminately to shields of different origin. Theoretically speaking the marginal shield may be either a detached portion of the central dorsal shield or originally a distinct shield, perhaps formed by the coalescence of numerous small, hair-bearing shields. Or finally it is possible that, at least in some instances, the marginal shield originally belonged to the ventral side but has moved upwards as to become dorsal. This is not any more remarkable than that the peritrematic shields of *Thinozercon* from their originally ventral position have moved upwards. Until the mite has acquired a sharp lateral edge such a movement is easily accomplished. For my own part I feel strongly inclined to derive the marginal shields present in so many *Uropodina* from coalescing, minute hair-bearing shields such as occur in the *Polyaspidæ* (fig. 2 c). The investigation of the marginal shield is impeded by the difficulty of determining what parts belong to the ventral resp. the dorsal side. When the edge is very thin the outline of the ventral shield is often to be seen surrounding the edge of the marginal shield and mistakes are easily made, unless the mite is dissected after proper maceration.

In the genus *Trachytes* the marginal shield consists, according to my opinion, of two lateral and one posterior shield (fig. 2 B), all well developed, the former with a row of 16 marginal hairs and 6 pairs of submarginal hairs inserted on semispherical projections, the latter with 8 pairs of marginal hairs and 3 pairs on its dorsal side.

In *Polyaspinus* (fig. 2 B) the future development of a marginal shield seems to be foreshadowed by the two linear shields formed by the coalescence of the 13 pairs of semispherical projections, the postero-marginal shield being represented by the two bifurcated appendages, mentioned before.

It is possible that the marginal shield is formed originally by two lateral and one posterior shield, such as exist in *Trachytes*. If this be

the case the peculiar postero-marginal shields of *Prodinychus* (fig. 4 D) and *Oodinychus* (fig. 3 B) may be a primitive character, not a new departure. But, on the other hand, if the postero-marginal shields of these genera were a primitive feature it is strange that it is quite isolated and not correlated with any other primitive traits since it occurs both in the more primitive *Prodinychus* and in the highly specialized *Oodinychus*. For this reason it is open to doubt whether the postero-marginal shield in the *Uropodina* is homologous with those of *Sejus*, *Thinozercon* and *Trachytes*.

The marginal shields have a very different shape in different genera. The following types may be distinguished:

A. Marginal shield divided in two lateral and one posterior shield: *Trachytina*.

B. Marginal shield surrounds the whole central, resp. central and postero-dorsal shield.

I. Marginal shield uniform, no postero-marginal shield having been developed: *Urodiaspis* (fig. 5 c).

II. Marginal shield not uniform, its posterior end being developed as a postero-marginal shield bearing specialized hairs: *Oodinychus* and *Prodinychus*.

III. Marginal shields do not surround the whole central shield but leave the posterior part of the space between the central shield and the edge of the body protected by a thin, hyalin cuticle.

a. Marginal shields extend backwards almost to a level with the posterior end of the central shield: the uncovered area bears small circular shields with hairs and pores: *Discopoma* (fig. 4 B).

b. Marginal shield tapering backwards from a little in front of the middle, the unprotected hyalin part as a consequence widening gradually backwards and bearing a certain number of perpendicular hairs: *Phaulodinychus* (fig. 5 D).

In both instances the actual edge of the mite is formed by the external margin of the ventral shield.

IV. Only the posterior part of the marginal shield is developed: *Sejus*, *Polyaspinus*, *Thinozercon*.

It is too early yet to discuss the question of the relation between these different types of marginal shields, because a great number of genera must be carefully investigated, before any conclusions can be drawn. The same applies to the different structures, exhibited by the marginal shields of different genera. Sometimes the marginal shield seems to be divided into a very great number of very minute, square shields, each carrying a small hair (*Oodinychus* fig. 4 C), sometimes they are undivided and carry only few hairs. I have only touched on this problem in order to stimulate other acarologists to continue these studies.



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