

Infestation with *Collembola* insects and *Rotifera-like organisms* in a woman

II. Parasitologic investigations

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SUMMARY. The parasitologic investigations made on the epidermic material obtained through scraping, collected weekly, for eight weeks, from a 80 years old woman, who was complaining of a cutaneous "attack of bugs", displayed:

- a) an adult insect pink-reddish from the *Collembola* order whose dimensions were 810 x 270 μm ;
- b) six eggpiles which contained 4-22 spherical eggs endowed with a circular discoloured area of 17,6 μm at a pole. The eggs, measured 35.2-123.0 x 140.8 μm with an average of 78.86 x 88.0 μm . The dimensions of the egg piles were of 144-306 x 162-368 μm ;
- c) fibrilar structures similar to the cocoons made up of long, smooth, equally callibred and of different colours: white, green, brown, blue, brown-reddish, grey etc. The fibres had a homogenous structure but on the fracture they were formed from fibrils. The diameter of the fibres was of 10.0-36.6 μm ;
- d) an exuvium with a very complex structure, especially in the area of the neck and of the collar;
- e) an oval pupa of 2286 x 720.0 μm , brown, endowed with eight appendices arranged on two lines and of different lengths: the first appendices were thick, opaque, rigid of 324 μm in length and the next were transparent, foliaceous, smooth, thin of 1170 μm in length.

After two years of progress of the infestation, in the scraped epidermic material have been found:

- a) oval eggs of 37.0 x 57.8 μm , with SI 1.56;
 - b) round cysts of 18.2 μm with SI 1.0;
- five genera of parasitological organisms, each type having two forms: cysts and flexible forms, differentiated through form and dimensions, somehow similar with the rotiferum.

Key words: woman, *Collembola*, egg pile, egg, cyst, cocoon, exuvium, pupa, flexible parasitological organism.

The skin is the target organ of the attack of the ectoparasitological insects such as over 40 species of acaridians (21 species), ectoparasitological crustaceans (two species). These species of ectoparasitological arthropods live permanently, temporarily or come accidentally in contact with the human skin, being hematophagous or histophagous [7, 21, 27, 35].

hematophagous and have incomplete metamorphosis. Their vital cycle develops only on the human body.

The temporary parasitological insects attack the skin either only in their adult stage, when they are hematophagous or in their larvae state, when they are usually histophagous.

The permanent parasitological insects, as those of the genera *Phthirus* and *Pediculus*, are

There can be differentiated the following groups in the category of the ectoparasitological adult insects:

- a) insects with free life which live in people's houses, as well, such as the species from the genera: *Triatoma*, *Panstrongylus*, *Rhodnius*, *Cimex*, *Leptocimex*, *Melanolestes*, *Pulex*, *Tunga*, *Ctenocephalides*, *Xenopsylla*, *Nosopsyllus* etc. [7, 11, 12, 27, 35, 39, 41, 44, 45]. These species attack people only to feed on their blood;
- b) insects with free life outside homes or in homes, such as species from the genera: *Culex*, *Aedes*, *Anopheles*, *Phlebotomus*, *Culicoides*, *Simulium*, *Glossina*, *Stomoxys*, *Tabanus*, *Leptoconops* etc. [11, 42];
- c) insects from free life in all the stages of their vital cycle and which don't need blood or tissues, for their food [10, 25, 26, 36], but which were quoted as ectoparasites on people and animals. This is the case of the insects from the *Collembola* order, *Lepidocyrtus* and *Seira* genera – ectoparasites on people, the *Podurhippus* genus (*Hypogastrura*) – ectoparasite on horse and the *Isotomes* genus – ectoparasite on birds [24].
- d) insects with free life from the *Hylesia* genus which produce cutaneous wounds through the bristles on their body, if these insects come accidentally in contact with the skin [14].

The group of the temporary parasitological insects only in their larvae state contains species with complete metamorphosis, which are not ectoparasites in their adult stage but which need a vertebrate host, people or animals or their larvae evolution. This host is obligatory for the species from the genera: *Dermatobia* [6, 11, 22], *Hypoderma* [8, 11, 12, 17, 21, 22, 34], *Oestrus* [21, 38], *Auchmeromyia* [21], *Cordilobia* [6], *Chrysomya*, *Cuterebra* [6, 11, 22], *Metacuterebra* [6], *Titanogrypha* [11], *Callitroga* [11], *Neocuterebra* [6], *Anthomyia* [34] etc. Many larvae of this species attack people and animals [16].

The larvae of these species are histophagous, feeding on alive tissues and their evolution in the

layers of the skin can last from a week to several months.

There are also species of insects whose larvae don't need a vertebrate host for their evolution, but which can colonize cutaneous wounds. In this group we have species from the genera *Calliphora*, *Lucilia*, *Sarcophaga* etc. who lay their eggs on the cutaneous wounds and their larvae feed on dead tissues [12, 21, 22, 35].

The acaridians which attack the skin can be grouped in:

- a) acaridians specific to people, permanent parasites of the skin, such as *Sarcoptes scabiei* var. *hominis* [1, 2, 3, 13, 18, 23, 31, 46]; *Demodex folliculorum* and *D. brevis* [4, 15, 21, 43];
- b) acaridians which parasitize the animals, but which can permanently parasitize humans as well, such as: *Sarcoptes scabiei* var. *canis* [2, 19] or temporarily such as: *Ornithonyssus bacoti* [20], *Ornithodoros moubata* and *O. hermsi* [11], *Cheyletiella dermatitis* [29, 30, 40, 44], *Cheyletiella parasitivorax* [28], *Trombicula autumnalis*, *T. mansonii*, *T. batata*, *T. akamushi* [11];
- c) acaridians which accidentally attack the human skin such as *Dermatophagoides schereemetewskyi*, *D. pteronyssus* [5];
- d) acaridians from the *Amblyomma*, *Dermacentor* and *Ixodes* genera which attack in all their evolutionary stages (larvae, nymph and adult) humans and animals only to feed on their blood [44].

There are, in this paper, the results of the parasitological investigations concerning the infestation with *Collembolae* and Rotiferan-like organisms in human beings.

Material and method

The parasitological investigations have been made on the epidermic material scraped twice a week in the initial period of infestation from the affected cutaneous areas of an 80 years old woman who talked about an "attack of bugs" on the skin. At the same time, the epidermic material obtained through grating by the sick person was examined through the microscope.

The scraping and the grating were repeated after two years of the cutaneous area, as well evolution realized because of the inefficiency of the applied treatments. The cutaneous areas with wounds (the lumbar area, the right lateral dorsal thoracic area) were scraped twice a week for eight weeks. For the scraping were chosen both the cutaneous areas, in which the sick person had unpleasant feelings, during the clinical exam and other areas. From the same areas three cutaneous biopsies were made. The epidermic material obtained through scraping was collected in a bowl with ethylic alcohol and was submitted to the parasitologic exam on the day of scraping, this means twice a week for eight weeks. The epidermic material obtained through daily scraping every week, for eight weeks was collected in bowls with sanitary alcohol and examined through microscope at every week-end. Immediately after each samples taking, through scraping or grating the bowls were closed with a cork. The elements, alien from the normal skin, encountered in the epidermic material were examined through the microscope, were submitted to micrometry, and the shape index (SI) (which represents the rapport length/width) was calculated.

Results

The microscopic parasitologic investigations made on the epidermic material obtained through scraping, but also on that obtained through grating in the initial period of the cutaneous wound made clear the presence of some alive elements alien from the normal human skin, such as: an adult insect, eggs, eggpiles, cocoons, an exuvium and a pupa.

The adult insect was found in the scraped material in the fourth week. The other elements were found both in the scraped epidermic material and in that obtained through grataj.

The parasitologic exam of the epidermic material obtained through scraping and grating after two years made clear the presence of some eggs, cysts and some alive, flexible parasitical organisms.

The adult insect was of a pink reddish colour, had an approximately cylindrical body, with a curve dorsal line and the abdomen was elongated in the posterior area with a conic body. The dimensions of the insect were 810 x 270 μm . The

antennas were strong, massive, hairy each formed of four articles and measured 396 μm in length. The first three segments of the antennas were cylindrical and the fourth segment was bigger, longer, flattened with the superior margin straight and the inferior margin curved, with a sharp apex, having the form of a scalpel.

The head of the insect was flattened, in the form of a shield, a little convex in the anterior part measured 216 μm in height and 126 μm in width and was covered with short chitinous bristles, thick, grouped in tuft which had a common basis. The bucal apparatus could not be noticed but one cannot say that this was atrophied or absent. A separate distinction between the thorax and the abdomen was not noticed. On the anterior part of the ventral face of the body there were three pairs of long and strong legs. The dorsal thoracic-abdominal area was covered with nine chitinous plates well individualized, opaque and prolonged on the lateral parts of the body. The abdomen, narrowed in the posterior part ended in two rounded, short massive protuberances, oriented towards the posterior-inferior part. On the extremity of the abdomen and in the posterior-ventral area was the apparatus for somersaults called "pitchfork". The pitchfork was made up of two parallel, long, biarticular blades, covered with long smooth rare chitinous bristles. The dorsal margin of the last article of the pitchfork was curve and denticular (like a saw). The length of the pitchfork was equal with 2/3 of the abdomen's length. The pitchfork was oriented towards the oblique posterior-anterior subabdominal part.

The egg pile. Six egg piles were found, close, fixed on a crust elongated or round with a small, short flattened prolongation. The egg piles measured 144-306 x 162-378 μm and were composed of 4-22 eggs.

The egg. In the initial stage of the illness the eggs were round, spherical, black due to some similar structures to the scales on their walls. The eggs fixed in the eggpile were hemispheric and sometimes oval. The dimensions determined on 53 eggs were of 35.2-123.2 x 35.2-140.8 μm with an average of 78.86 x 88.0 μm and SI 1.1. At the opposed pole of the one fixed in the eggpile, the egg had a circular area of a light colour with a diameter of 17.6 μm , similar to a micropil from the oocysts of the species from *Eimeria* genus.

The cocoons. These had variable forms and sizes and were formed of fibres either of the same colour or of different colours wriggled or twisted around a imaginary axis. In the cocoon no parasitical elements were found. The fibres were long, thin, smooth, equally calibrated and of brown, white, blue, dark-green, brown-red, grey, grey-green, purple, pink, grey-green colours etc. At the optic microscope, with objective x10, x20, x30 the fibres had a uniform thickness (10.0-36.4 μm) and did not present any visible structure or they had granular aspect. On the fracture the fibres appear made up of more fibrils.

The red fibres are of two kinds: some smooth, thin with a diameter of 15.0-20.0 μm , with a homogenous structure and some thick, of 36.4 μm diameter, with a scalariform structure, an aspect given by the alternance in the structure of the fibres of some light red areas with dark red areas.

The transversal diameter of the fibres varied according to colour, thus: the green ones measured 12.5-16.5 μm , the white ones 10.0-15.0 μm , the pink ones 10.0-20.0 μm , brown 15.0-22.5 μm , blue 12.5-15.0 μm , light blue 12.5-22.5 μm , grey 12.5-25.0 μm , purple 22.5 μm , grey-green 18.2 μm .

The exuvium. It was transparent thin, and smooth like a veil, made up of four distinct areas: apical pole, neck, collar and body.

The apical pole was globular, membranous, without a visible internal structure at the microscope and prolonged towards the anterior part with some long and thin threads. These threads did not have a structure, but on their surface one could notice small curved threads which gave the impression of an exfoliation of the cuticula of these threads.

The neck was long, narrow, uncoloured, made up of two kinds of plates (some were wide, others were narrow), dense, opaque, rectangular, long, with a rough surface, granular, well defined and of various widths. Their posterior end was articulated with some plain structures of the collar.

The collar was brown-yellow, had the form of a crown and was constituted of 42 chitinous pieces, of different forms and arranged on four

lines. These pieces, according to their form, could be grouped in four genera.

- a) The first type was made up of six small pieces, almost squares which composed the first line, the anterior one, of the neck. On their posterior margin two thick and cylindrical pedicules could be found. These plates were articulated with the narrow plates of the neck.
- b) The second type of pieces was made up of eight big putty plates, of an oval rectangular form, arranged horizontally and constituted the second line of the collar (the middle line in the anterior-posterior direction). These pieces were articulated in the anterior part with the wide plates of the neck.
- c) The third type contained 24 chitinous pieces with a sharp apex, of an elliptical form, arranged in pairs, each having an anterior prolongation in the form of a round, short and thick pedicule. The pedicules of a pair of elliptical pieces were united and formed a common, thick pedicule which inserted itself on a posterior margin of the small pieces, from the first line of the collar to a plate from the first line corresponded two pairs of elliptical pieces of the third type. The groups of two pairs of elliptical pieces were separated between them through a massive, almost rectangular piece, with concave lateral margins and plain extremities. The anterior extremity was wider than the free posterior one and was articulated with the big pieces from the second line of the collar.
- d) These separate pieces constituted the fourth type of pieces from the structure of the collar and were eight. These together with the elliptical pieces constituted the third line (the posterior one) of the collar.

In the interior, the collar had some piramidal, small, sharp, brown-yellowish protuberances.

The body was big, cylindrical, membranous, very smooth, like a veil. The posterior limit of the body seems cut which gave the impression that there would be a posterior part of the body. This last part was not found.

Pupa was brown, measured 2286 x 720 μm and had at the anterior extremity a tronconical

prolongation of 144 in length and at the opposed extremity had a thinned appendix, 540 μm in length. At the limit between the anterior third of the body and the middle one the pupa had two genera of cuticular appendices.

The first type was made up of four chitinous, burly, opaque, rigid appendices, having the length of 324 μm . The second type was made up of four transparent, flexible, pointed, thin, foliaceous, appendix and each having the length of 1170 μm . The latter were longer than the caudal apex of the pupa's body. Both genera of appendix were oriented to the posterior part of the pupa. When using an intense lightning we can see through the traverse of the wall of the pupa, the abdominal segments of something that seemed to be an adult insect.

In the histological sections of the bioptics samples of skin there have been found four structures situated in the epidermis which seem to be former evolution stages of the pupa.

After two years of evolution of the infestation there have been found parasitological elements, different from those found in the initial stage of the disease. Thus, there have been found eggs, cysts and some genera of alive organisms with a particular structure.

The eggs were oval, had no colour, with an obvious, smooth shell and their germinal mass was in different stages of segmentation. Thus, in one of the eggs there were the germinal mass, two small granules, translucent and situated under the anterior pole, and on the opposite side there was a structure that linked the germinal mass to the egg's shell. At another egg, the shell had a small flat area situated on a prominence of the wall of the egg's anterior pole. The dimensions of these eggs were: 31.8-55.5 x 63.6 μm , with an average of 37.0 x 57.8 μm and SI 1.56.

A structure similar to the egg was met in the interior of an evolution stage of the parasitological organisms which were found. In another evolution stage of these organisms was found another structure similar to an egg but larger.

There has also been found a structure similar to an egg having the poles rounded and a granular polar calotte that covered almost a third of the entire shell of the egg. The half of egg opposite

to the calotte was black with the superior edge straight.

The cyst: there have been found a lot of spherical cysts with a diameter of 18.2 μm and SI 1.0 with a thin cystic wall, a germinal mass that filled the entire cyst and a central round nucleus. In some of the cysts the germinal mass was segmented in two halves and each half contained a nucleus. These cysts formed large agglomerations.

The parasite organisms group was divided after the form, the structure and the mobility into five types.

Type I – included cystic structures almost spherical of 54.5 x 63.6 μm with SI 1.17 and a thin wall with a polar, flat drop at the beginning and then conic with a thin, membraneous, polar cupola. At the opposite side, the cyst's wall was, initially thin and under this area there was a rectangular excavation. This wall became thicker and on it appeared two incisions. It seems that from cyst appeared, by a mechanism similar to all types, a mobile organism – which couldn't be totally caught.

Type II – included both immobile cystic and mobile forms (organisms).

The cysts – were immobile and generally had an oval form with truncated poles and measured 45.5-72.7 x 63.6-118.2 μm , with an average of 61.0 x 88.8 μm and SI 1.46. During their evolution there have appeared changes in both their form and especially in the inside structure. Thus, the cyst became larger, longer and looked like an egg truncated at both poles.

At the anterior pole the wall was flat, rippled and under it, it was formed a tunnel. The posterior pole has suffered changes that appeared more rapid than the changes of the anterior pole. Thus, on the posterior pole appeared a convexity of the wall and then this pole became longer and initially having a conic form and in its interior there was formed a tunnel. This conic prolongation became right-angled, with tunnels and within it developed the caudal segment of the mobile form of this parasitological organism. The caudal segment glides through this tunnel and ends with two sharp ends. In the same time the middle segment became darker in colour, more dense, and the anterior pole became longer and

wider out at the mouth. Through the tunnel in the anterior pole the cephalic segment of the body glided. At this pole, the first organic structure which appeared was the rotator apparatus of the mobile form. The cephalic segment of the mobile form was moving forward to outside and backwards in the body. At this stage the parasitological elements measured 45.5-81.8 x 81.8 x 154.5 μm with an average of 63.3 x 122.2 μm with SI 1.93.

The mobile form of this type of organism had the body made up of three segments:

- a) The cephalic segment, cylindrical ends with a rotator apparatus, is made up of a thin, membranous round structure and a crown of crochets, very mobile which were rounding from right to left. This segment of body was very mobile and was quickly moving forward and backwards from the middle segment, and also lateral movements: to the right and to the left.
- b) The middle segment was immobile and non-deformable and preserved the form of the cyst they proceeded from. This segment had a dense cuticula at the anterior opening of the tunnel through which the cephalic segment of the body glided and inside which there were a mandible apparatus made up of three straight rods, surrounded by a semi-circle. The mandible apparatus had a fixed place inside and at the base of the cephalic segment.
- c) The caudal segment of the body was cylindrical-conic and ended with two sharp, conical ends. The caudal segment was gliding towards outside and fixing itself on the substrate, being able to execute movements on the lateral: to the right or to the left, according to the movement needs of the whole body of the parasite. In unfavourable conditions (for example, in the presence of Lügol solution) this organism, which was very mobile, lost its mobility and withdrew in the middle segment, totally or partially, the cephalic segment, and the caudal segment was withdrawn less, and leave outside only the bifid apex of it.

This mobile form measured 35.4-63.6 x 100.0-227.3 μm , with an average of 62.7 x 160.0 μm with SI 2.55. The smallest mobile

form measured 45.5 x 81.8 μm with SI 1.80 and the biggest 63.6 x 154.5 μm with SI 2.43.

Type III consists of both immobile cystic and mobile forms.

The cysts were oval-elliptic, they had no colour and had the size 36.4-45.4 x 63.6-72.7 μm , with an average of 42.2 x 67.3 μm , SI 1.6. The wall of the cyst was thin, solid, but as the cyst was developing, this grew and there appeared internal, structural changes resembling those encountered at cysts of type II. The elongation of the two poles was made step by step: first, the posterior pole was elongated and then the anterior, one. In the middle segment of the body a spot of dark color appeared, approximately like a rectangular with the concave margins.

The mobile form had a body formed of three segments:

- a) The cylindrical cephalic segment finished with the rotatory set which had a similar structure with that from type II. At the basis of this segment there was the mandibular apparatus made up of two harsh, curved close pieces forming the figure "3" with its convexities oriented towards the anterior part.
- b) The middle segment was a right, thick cuticle, of an elliptic form going towards the anterior part and towards the posterior part with a cylindrical formation through which the cephalic and caudal segments were gliding.
- c) The caudal segment was more like a cone and ended in three sharp cone peaks and was shorter than the cephalic segment. The mobile form was of 45.5-63.6 x 54.5-100.0 μm with an average of 50.0 x 72.7 μm with SI 1.45. The vivid elements of these flexible organism made similar movements with those of type II.

Type IV. Unlike the anterior types included cysts and mobile, big forms, whose dimensions changed during their development.

The cysts were of 36.4 x 63.6 x 72.7-163.6 μm with an average of 53.6 x 116.4 μm and SI 2.17. The internal changes of these cysts were similar to those encountered at the anterior genera,

beginning with the changing of the posterior pale. In a following phase the anterior pole suffered structural changes. Thus, the gliding channel of the cephalic segment was much wider and limited by two rounded nipped structures.

The mobile form was like a massive large organism, made up of the same three segments. The cephalic segment had a cylindrical form, more dilated towards the basis, where there was also the mandible apparatus made up of two rigid, oval pieces, surrounded by a semicircle. The caudal segment was massive, almost equal in length, with the cephalic segment and ended in two sharp, conic, massive peaks. The surface of the body of the mobile form was granular. This mobile form had 36.4-72.7 x 109.1-218.2 μm with an average of 59.1 x 180.0 μm and SI 3.05.

The movements made by these organisms were similar to those of the mobile forms of the previous types.

Type V. In this type there were included cysts in the form of an amphora and their flexible forms.

The cyst measured exactly 36.4-54.5 x 63.6-90.9 μm with an average of 43.6 x 75.5 μm and SI 1.73. Their development led to internal structural changes, the form was preserved but the size grew reaching the dimensions of 45.5-72.7 x 63.6-127.3 μm SI 1.94.

The mobile form had the cylindrical caudal segment a little narrowed towards the apex and ended with two sharp conic peaks. This segment was presenting laterality movements (right and left). The cephalic segment was cylindrical and had a similar structure with that of the previous genera and the mandible apparatus was formed of three pieces and the central piece was double. These mandible sets were connected among them. At some items the mandible sets had an aspect of butterfly wings.

The dimensions of this form were 45.5-72.7 x 90.9-154.5 μm with an average of 61.4 x 138.1 μm and SI 2.15.

Discussions

The ectoparasitological arthropods on a human being produce well-known cutaneous diseases [6, 14, 21, 27, 39] but sometimes the arthropods are responsible, on a real or imaginary basis, for the

genesis of some psychic problems (delusions and phobias) [29, 32, 36].

The investigated subject incriminated the insects for producing the cutaneous wounds. The anamnesis, the clinical examination, the place of the wounds on the body (places in which the sick person could not reach with his hands for scratching), the displaying of the wounds in the injured areas suggested a possible intervention of some biotic causal agent in the genesis of these cutaneous wounds. This hypothesis proved real after the microscopic exam of the cutaneous scraping twice a week, for eight weeks. After these perseverant and successive exams, there appeared many genera of parasitological elements, which colonized the skin, like an adult insect, cocoons, eggs, eggpiles, exuvium, pupa. These were found in the first stage of the illness. As the sick person had clinical signs and cutaneous wounds after a period of two years, time in which the applied treatments gave no results, the exam of the cutaneous scraping was repeated, for two weeks, one a week. At this parasitological exam eggs, cysts and alive, mobile organisms were found, but different from those found in the first stage of the illness.

The adult insect was put, on the basis of its external morphological characteristics, in the *Collembola* order.

It is known that the species from this order lead a free life in obscure habitats, such as caves, the soil of forests, the bark of trees, cellars, feeding on organic substances that decompose [25, 26] and that they don't have metamorphosis or that their metamorphosis is non-typical, this means that the insect appears in the egg and its releasing is made through the breaking of the egg.

The presence of this insect in the epidermic scraping could be an accident, but followed by its adaptation to the parasitological life. This adaptation could have been followed by other changes of the vital cycle. This is only a hypothesis.

The fact that the insect makes somersaults could explain the intermittent linear aspect of the encountered cutaneous wounds. We cannot give any hypothesis on the source of infection on the ways and modalities of contamination of people on the aptitudes of the insect of living in clothes

or in homes or on the duration of contamination with this insect.

Still, we know from literature that the infestation was of 6 years at the infested subjects, who were from the city or from the country and who had good, hygienic conditions [24, 34]. This specification could suggest the idea of adaptation of collembole insects to the parasite life and to the biotope represented by man and his home.

The fact that the collembole insects were quoted as ectoparasites on animals [24, 34] doesn't exclude a possible role of the domestic animals as well as those from flats in transmitting the infection to human beings or a possible role as a guest helpful in the adaptation of the collemboles to the parasitological life. It may be that the collemboles adapted first on animals and then on people.

As long as the insect is mobile, making somersaults like a flea, the interhuman, direct transmission of this infestation is possible.

The enlisting of this insect in the *Collembola* order doesn't allow us to state that all the other parasite elements found in the cutaneous scraping belong to this arthropode, especially that these insects don't have metamorphosis [24, 25, 26] but we specify that all the elements alien from the skin quoted in this paper were found on the same infested human subject.

The eggs, isolated or in eggpiles, through their scaly appearance through the clear area from the pole, with an aspect of micropil, through the spherical form and through their dimensions would be different from the eggs of the collemboles, although these eggs also present various parietal ornaments. Through the same characteristics, the eggs found by us are different from the eggs of other species of insects and acarians, species known as ectoparasites.

At cavern, forestry and earthly collemboles the developing of the insect is made in the egg. The eclosion is made through the breaking of the egg's wall and not through micropil. Out of the egg comes an aptere insect whose external organs are similar to those of the adult insect. The postembryonic development produces, without the modification of the form of the body, without metamorphosis. This is made only through a repeated all the insect's life, which

leads to the knowing of more stages of development and only one adult stage [10, 24, 37]. We haven't met the eclosion or other stages of development of the insect, in the case in which this would have maintained the vital cycle from the free life. If we admit the case that the adaptation to parasitological life attracted other changes of metamorphosis as well, it would have been possible to appear other work hypothesis, as well.

The cocoons are formed from fibres, either of one colour (black, pink, blue, purple, grey, green, grey-green, brown-red etc.) or of a mixture of fibres of different colours. Some cocoons appear like a bunch of parallel fibres, but twisted around an imaginary central axis, and other appear formed from spiralled fibres. Cocoons have different forms. We don't know the origin of these fibres (we met similar fibres on the apical pole of the exuvium) or the reason for the existence of this variety of colours and we cannot say anything about their role or about their chemical structure. It is interesting to notice that these fibres have homogenous structure and not very often granular (the brown fibres) and on the breaking they appear made of very thin fibrils. Only the red, thick fibres have a scalariform structure due to the alternance of the light-red area with the dark red area inside the fibre.

The presence of the exuvium suggests the idea of the existence of an evolutionary stage of hair shedding but this stage hasn't been encountered in the examined epidermic material.

We notice the structural complexity of this exuvium and the fact that in the consulted literature we haven't met anything similar and we don't know any species of insects or acarians which are permanent ectoparasites or have complete metamorphosis on or in the skin [6, 7, 8, 11, 12, 22, 25, 26, 27, 35, 39, 44]. We don't support or deny that exuvium would belong to the collemboles.

One could notice the same things about the pupa, as well. Nevertheless, we state that it is a pupa, because when intensely illuminated on the microscope we can notice – through the traverse of its membrane – something that seems to be abdominal segments of an insect. Moreover, at the basis of the fore cone of the pupa there have been noticed small dark structures, positioned similarly to the collar of the exuvia.



Figure 1
Adult insect, *Collembola*



Figure 2
Cocoons of various shapes and dimensions



Figure 3
Exuvium

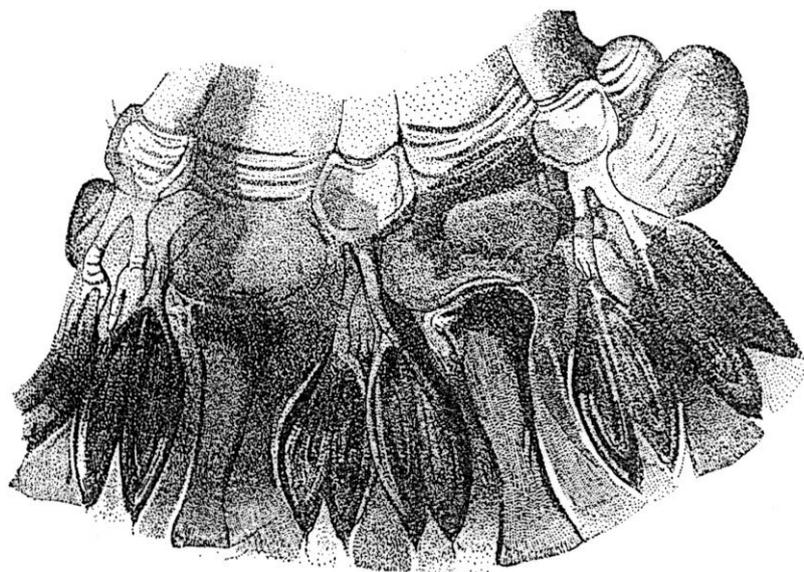


Figure 4
Exuvium. The collar's pieces

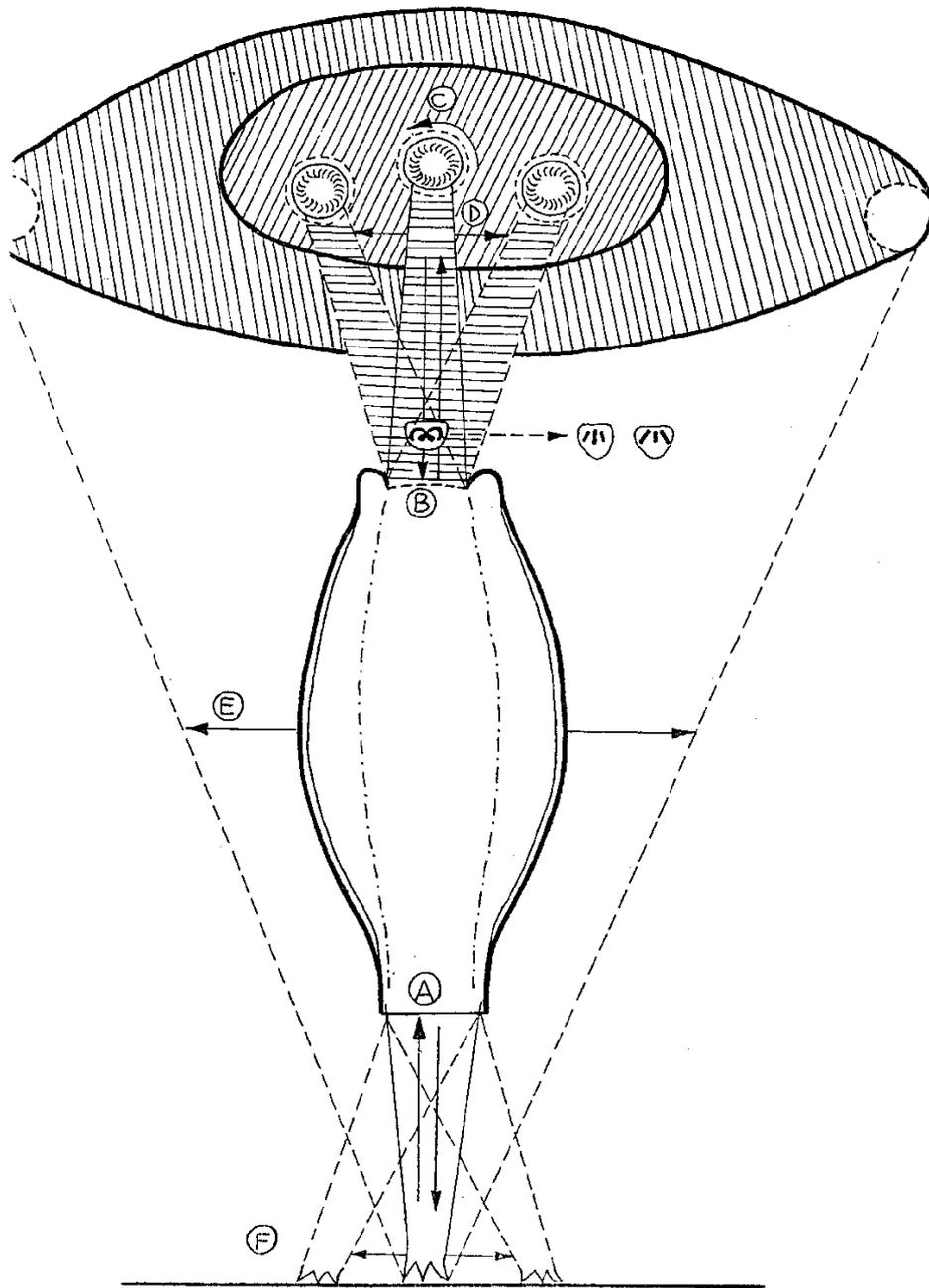


Figure 5
The movements of mobile form and their chronological order

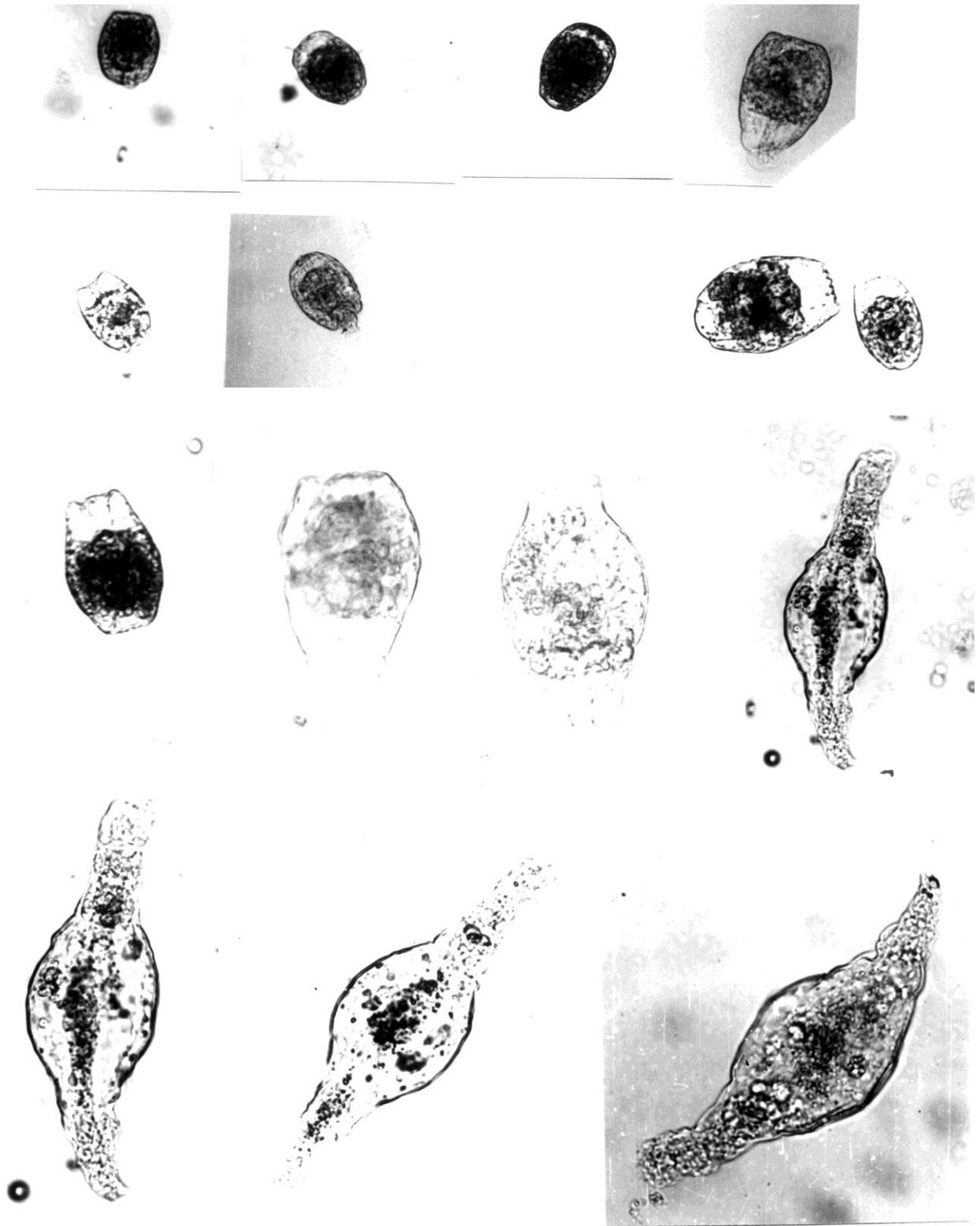


Figure 6
Parasitological elements of type III. Cysts and development of the caudal segment

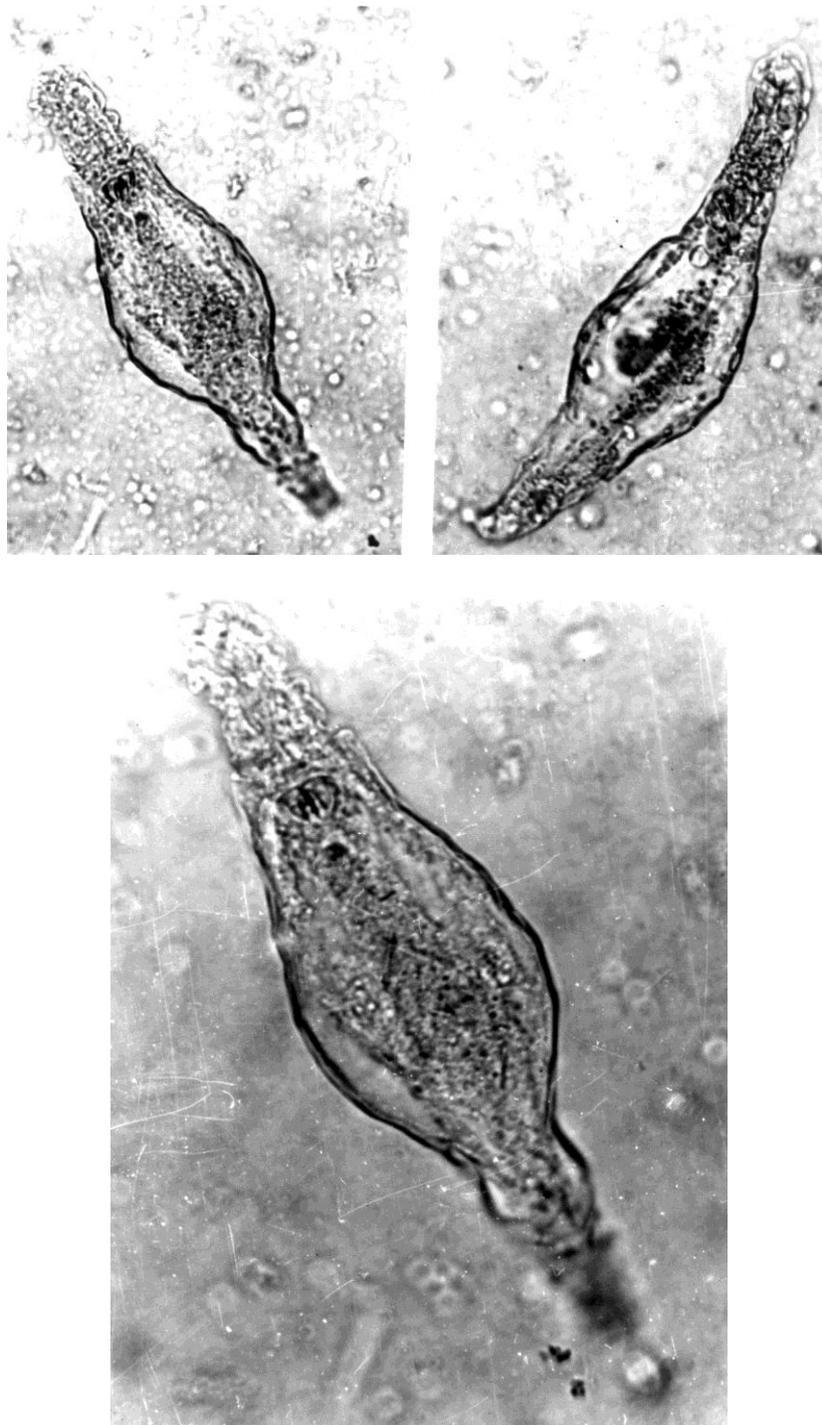


Figure 7
Parasitological elements of type III. Development of the mobile form

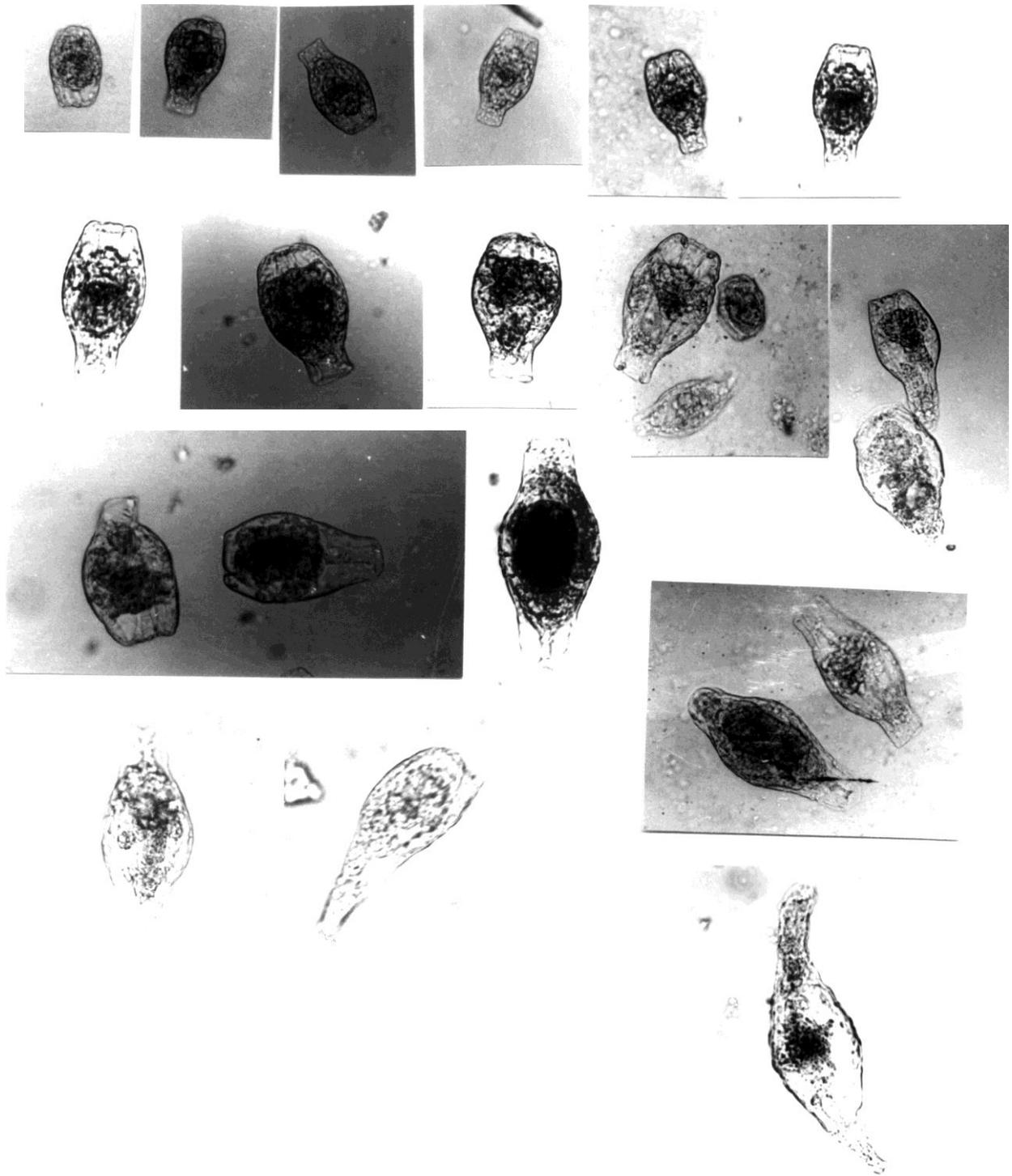


Figure 8
Parasitical elements of type V. Cysts

In addition, we found structures in the histologic sections that appear to be precursory stages of a pupa or even a pupa. We have not met anything similar after consulting speciality literature, fact that does not contest the existence of this pupa. It is possible that this pupa structure does not belong to a species of insects known as temporarily, permanently, or accidentally ectoparasites on human skin.

There are few species of insects that lead a permanent parasitical life, without leaving the skin [27, 35, 39, 44], but these have an incomplete metamorphosis, and their vital cycle does not include pupa stage. Yet, there are species of insects that are temporarily ectoparasites, only at adult stage; they have a complete metamorphosis, but their metamorphosis develops only in an external environment [41, 45].

Another group of insects that parasite the skin or even other organs – but only in the adult stage – have a pupa stage, but these exist in the superficial layer of the soil only, and have different form, structure and colour [6, 8, 11, 12, 21, 38, 42]. None of these species have has a pupa stage in or on the skin.

The presence of this pupa could imply: a) that it belongs to an unknown species of insects, that parasites permanently, temporarily or accidentally, but that has a complete metamorphosis only on or in the human skin; b) that it could belong to other species of beings (animals or plants), and thus it is not a pupa. Its origin remains unknown.

We dare think that the first assumption is more real, its main arguments being the structure of the pupa and the existence of some elements somehow similar within the inner structures of the skin (into Malpighi epithelium).

Insects' larvae and larvae, nymphs and adults of the acarions that parasites the skin have external morphological characters that individualize and differentiate them. For example, insects' larvae that live in the skin have segmented cuticule, stigmas and big mandible parts, with a peculiar structure; they are big, histophagus eating living or dead tissues [6, 34, 35]. These larvae are located either on the skin, or they actively penetrate through the intact skin towards the

subcutaneous tissues and even more profound tissues [8, 11, 12, 21, 22, 27, 33].

It is not yet known any parasites insects' larva that is located only in derm or epidermis and that is histophagus and produces lesions to derm or epidermis, with centrifugal radial development (towards the horny layer of the epidermis).

Ectoparasite acarions larvae are similar to nymphs and adults, but they are hexapods, while nymphs and adults are octopods.

Under these circumstances, the parasite elements found two years after the infestation – when no pupae, exuvia, eggpiles or adult insects were found – have a different role, these looking as an element that complicated the collembole infestation. Considering the histologic character of the epidermis and the way they move, as well as the structure of the mobile forms found after two years, we are eligible to establish a connection between these – cause and effect relationship – and we can state that these mobile forms have been there from the beginning of the infestation, but they were not noticed either because of their small number, or because of a too superficial scraping.

We cannot state that the eggs, cysts and mobile elements belong to collembole, but neither can we certainly assign them to a zoological taxon. At a rough guess we can consider them to be very much alike rotifers. This supposition should be proved by credible arguments, because none of the known species of rotifers that parasite the human skin. There are species of parasitical rotifers, but they parasite mainly aquatic animals [11].

Anyway, the eggs found after two years are different from those found in the initial period. They seem to belong to rotifera because two similar eggs were met within some stages of the mobile forms.

Living parasitical organisms were very mobile and they successively moved different bodily segments. Thus, the first bodily segment that slipped towards the exterior was the caudal segment. This anchored itself to the sublayer with the two or three cone-shaped tips on its extremity. The caudal segment can move laterally, to the right or to the left, depending on the necessity to find the food, when the parasite

moved from one place to another. The second segment that starts to move is the cephalic segment. This slipped towards the exterior through the tunnel placed at the fore pole of the cyst and that was the moment when it started its round movement of the rotative apparatus to the left. With this rotative apparatus, the parasite took the food consisting of living tissues. Searching the food, the cephalic segment moves laterally and longitudinally with an impressive speed and at very short periods of time. Thus, this living parasite organism creates initially a derm-epidermis lesion tunnel-shaped and then, by means of lateral movements it creates other tunnels or it enlarges the initial lesion. If the parasite cannot reach the food moving longitudinally the cephalic segment (being anchored with its caudal segment in a fixed point on the substrate), it can move laterally its body or only the caudal segment, thus changing the anchoring point. The result is a lacunary lesion within the epidermis that could progress towards the horny layer of the skin. This type of lesion was met in the histological sections made of the cutaneous biopsy.

Shape index (SI) implies: a) an initial length growth of the cyst, maintaining its form; later on, this growth will develop only on the basis of the caudal and cephalic segments; b) the increasing of the cyst's transversal diameter and then of the mid-segment takes place with the preservation of the shape; c) a stage development of these organisms.

It is worth noticing that the complete development of the living and mobile organism occurs only within what we considered to be a cyst, without the abandoning of the cyst and without this cyst moulting.

We cannot estimate whether these mobile organisms represent the larva stage or the adult stage. Neither could we study the internal morphology of these parasitic elements. The fact that in several forms of growth we have found an egg could represent an argument to consider the mobile organism as being an adult stage and that at the moment when these eggs appear the cephalic and caudal segments definitively withdraw inside the mid-segment. This is only a hypothesis based on a single real fact.

The evolutive character of the invasions, the lasting and sharpness of the symptoms, the

spread and reiteration of the fortuitous or discontinuous linear infestation of cutaneous areas, the feelings of quick and repeated bites, the impossibility to discover immediately the real cause (the parasitical elements found have dimensions smaller than 1 mm, thus being invisible for the human eye) after the medical examination and even after the parasitologic examination – without repeating the microscope examination of the profound cutaneous scraping, without making the cutaneous biopsies for several times, once a week or in a fortnight, without monitoring the patient – these are facts that can lead to the parasitical delusions diagnosis. Nevertheless, we share the opinion that “not every subject with parasitical delusions is a psycho” [36]. Our arguments are the parasitic elements found at this 80 years old patient and the duration of the evolution of the infestation (more than 5 years). It is true that such a long disease could be a starting point for the genesis of psychological manifestation, whose etiology is difficult to expose, but this exists, it is real at least in the case of some subjects whose diagnoses were “parasitic delusions”.

Conclusions

1. In a 80 years old woman with the diagnosis of parasitical delusions, there have been shown, through the exam of cutaneous scraping and through cutaneous biopsy, a various range of parasitical elements like an adult insect from the *Collembola* order cocoons, eggs, egg piles, an exuvium, a pupa and after an evolution of two years there were found: another type of eggs, cysts and alive, mobile organisms which could resemble the rotifers.
2. The adult insect was pink-reddish and measured 810 x 270 μm , covered with short and thick bristles and had a pitchfork.
3. The egg piles contained 4-22 eggs, measured 144-306 x 162-368 μm . The egg was spherical, endowed with a circular area of light colour situated at a pole, was covered with ornaments in the form of scales and measured as an average 78.86 x 88.0 μm .
4. The exuvium was made of four segments: an anterior, membraneous segment, a neck composed of two kinds of plates, a collar

- with a very complex structure and the membranous body, thin like a veil.
5. The pupa was oval, brownish, measured 2286 x 720 μm with conic poles and endowed with two genera of four appendices each.
 6. The eggs found after two years were oval, with thin shell and measured 37.0 x 57.8 μm and SI 1.56.
 7. The cysts were round 18.2 μm diameter and with SI 1.0.
 8. There have been encountered five genera of parasitological organisms with two forms each: cysts and mobile forms of different size and dimensions. It looks like the mobile forms resemble the rotifers.
 9. All these parasitological elements were found on one sick subject, after a parasitologic, microscopic exam of the cutaneous scraping, repeated eight times, once a week, in the initial monitoring period and twice a week after two years of evolution of the illness, years in which the applied treatments did not have any results.
 10. The severity, the duration of the infestation and impossibility of discovering the etiologic agents by clinical examination or even by the parasitological examination of the cutaneous scraping that is not repeated several times could lead to errors in the diagnosis.
 11. We consider that the parasitic delusions at least some of the sick subjects, have a real cause represented by the infestation with *Collembola* insects and with organisms similar to the rotifers.

Bibliography

1. ARLIAN, L.G., RUNYAN, R.A., ESTES, S.A. – Cross infestation of *Sarcoptes scabiei*. **J. Am. Acad. Dermatol.**, 1984, 10, 6.979-986.
2. ARLIAN, L.G., RUNYAN, R.A., ACHAR, S., ESTES, S.A. – Survival and investivity of *Sarcoptes scabiei* var. *canis* and var. *hominis*. **J. Am. Acad. Dermatol.**, 1984, 11, 2, 1.210-215.
3. ARLIAN, L.G., ESTES, S.A., VYSZENSKI-MOHER, D.L. – Prevalence of *Sarcoptes scabiei* in the homes and nursing homes of scabietic patients. **J. Am. Acad. Dermatol.**, 1988, 19, 5, 1.806-811.
4. ASHACK, R.J., FROST, M.L., NORINS A.L. – Papular pruritic eruption of *Demodex* folliculitis in patients with acquired immunodeficiency syndrome. **J. Am. Acad. Dermatol.**, 1989, 21, 2, 1.306-307.
5. AYLESWOTH, R., BALDRIDGE, D. – Feather pillow dermatitis caused by an unusual mite *Dermatophagoides schereemetewsky*. **J. Am. Acad. Dermatol.**, 1985, 13, 4.680-681.
6. BAIRD, J.K., BAIRD, C.R., SABROSKY, C.W. – Nord american cuterebrid myiasis. **J. Am. Acad. Dermatol.**, 1989, 21, 4, 1.763-772.
7. BILBIIE, Ionela, NICOLESCU, Gabriela – Insecte vectoare, generatoare de disconfort. Edit. Medicala, Bucuresti, 1986.
8. BOULARD, C., ARGENTE, G., HILION, E. – Hypodermose bovine. **Point Vet.**, 1988, 20, 111, 17-30.
9. BURNETT, J.W., CARGO, D.G. – Cutaneous irritation induced by crab larvae. **J. Am. Acad. Dermatol.**, 1979, 1, 1.42-43.
10. CERNOVA, N.M., STRIGANOVA, B.R. – Opredelel Collembol fauna S.S.S. R. Nauka, Moskva, 1988, 5-55.
11. CHENG, T.C. – General Parasitology, 2nd ed. Academic Press Inc., Orlando, Florida, 1986, 622-673, 725-727.
12. COSOROABA, I. – Entomologie veterinara. Edit. Ceres, Bucuresti, 1992.
13. DHWAN, S.S., WEITZNER, J.M., PHILIPS, M.G., ZAIAS, N. – Vesicular scabies in an adult. **Cutis**, 1989, 43, 3.267-268.
14. DINEHART, S.M., ARCHER, M.E., WOLF, J.E., GAVRAN, M.H., REITZ, C., SMITH, E.B. – Carapito itch; Dermatitis from contact with *Hylesia moths*. **J. Am. Acad. Dermatol.**, 1985, 13, 5, 1.743-747.
15. DOMINEY, A., ROSEN, T., TSSCHEN, J. – Papulonodular demodicidosis associated with acquired immunodeficiency syndrome. **J. Am. Acad. Dermatol.**, 1989, 20, 2, 1.197-201.

16. DULCEANU, N., TERINTE, Cristina, POLCOVNICU, Carmen, MITREA, L. – Dictionar enciclopedic de parazitologie. Edit. Acad. Romane, Bucuresti, 2000.
17. ENESCU, Alexandra, CEIANU, Cornelia – Muste sinantropice. In: "Insecte vectoare generatoare de disconfort" de Balbaie, I., Nicolaescu, G., Edit. Medicala, Bucuresti, 1986, 147-171.
18. ESTES, S.A., ARLIAN, L. – Survival of *Sarcoptes scabiei*. **J. Am. Acad. Dermatol.**, 1981, 5, 3.343.
19. ESTES, S.A., KUMMEL, B., ARLIAN, L. – Experimental canine scabies in humans. **J. Am. Acad. Dermatol.**, 1983, 9, 3.397-401.
20. FISHMAN, H.C. – Rat mite dermatitis, **Cutis**, 1988, 42, 5.414-416.
21. GENTILINI, M., DUFLO, B. – *Medicine tropicale*. Ed. Flammarion, Paris, 1986.
22. GEORGI, J.R. – *Parasitology for veterinarians*. 4th ed. Saunders Co., Philadelphia, 1985.
23. GLOVER, R., YOUND, L., GOLTZ, R. – Norwegian scabies in acquired immunodeficiency syndrome. Report of a case resulting in death from associated sepsis. **J. Am. Acad. Dermatol.**, 1987, 16, 2, 1.396-398.
24. GRASSE, P.P. – *Traite de Zoologie*. Tome IX, Masson, Co., Paris, 1949, 113-159.
25. GRUIA, Magdalena – *Collembole subterane din Romania*. Teza de doctorat. Institutul de Studii Biologice, Bucuresti, 1986.
26. IONESCU, M.A., LACATUSU, M. – *Entomologie*. Edit. Did. si Ped., Bucuresti, 1971.
27. KRINSKY, W.L. – *Arthropods and leeches*. In: "Cecil Textbook of Medicine", edited by Wyngaarden, J.B., Smith, L.H. Jr., Saunders Co. 1985, Philadelphia.
28. LYELL, A. – Cutaneous artifactual disease. **J. Am. Acad. Dermatol.**, 1979, 1.5391-407.
29. LYELL, A. – Delusions of parasitosis. **Seminars in Dermatology**, 1983, 2, 3.189-195.
30. LYELL, A. – Delusions of parasitosis. **J. Am. Acad. Dermatol.**, 1983, 8, 6.895-897.
31. MARTIN, W.E., WHEELER, C.E. – Diagnosis of human scabies by epidermal shave biopsy. **J. Am. Acad. Dermatol.**, 1979, 1, 4.335-337.
32. MUNRO, A. – Delusional parasitosis a form of monosymptomatic hypochondrial psychosis. **Seminars in Dermatology**, 1983, 2, 3.197-202.
33. MURESAN, D. – Dermatite produse de insecte. In: "Insecte vectoare cauzatoare de disconfort", de Balbaie, I., Nicolescu, G., Edit. Medicala, Bucuresti, 1986, 332-340.
34. NEVEU-LEMAIRE, M. – *Traite d'entomologie medicale et veterinaire*. Vigot Freres, Paris, 1938.
35. NITZULESCU, V., GHERMAN, I. – *Entomologie medicala*. Edit. Acad. Rom., Bucuresti, 1990.
36. NOVAK, M. – Psychocutaneous medicine; delusions of parasitosis. **Cutis**, 1988, 42, 6.504.
37. PALISA, A. – Apterygota. Urinsecten. In: "Die Tierwelt Mittelwelt. Insekten, I, Teil Apterygota", edited by Brohmer, P., Erhmann, G., Verlag Von Quelle und Meyer, Leipzig, 2-12.
38. PASARE, Gh., VICEA, I. – Sur un cas de myase case par *Oestrus ovis* dans une tannerie. **Ann. Parasitologie**, Paris, 1969, 44, 1.101-106.
39. RADULESCU, Simona, MEYER, E.A. – *Parazitologie medicala*. Edit. ALL, Bucuresti, 1992, 268-271.
40. RIVERS, J.K., MARTIN, J., PUKAY, B. – Walking dandruff and *Cheyletiella dermatitis*. **J. Am. Acad. Dermatol.**, 1986, 15, 5, 2.1130-1133.
41. SANUSI, I.D., BROWN, E.B., SHEPHARD, T.G., GRAFTON, W.D. – Tungiasis: report of one case and review of the 14 reported in the United States. **J. Am. Acad. Dermatol.**, 1989, 20, 5, 2.941-944.
42. SUTEU, I., COZMA, V. – Boli parazitare la animalele domestice. Edit. Ceres, Bucuresti, 1998, 467-512.
43. VULCAN, P., WOLFSHAUT, A., BOGDAN, C. – *Bolile parului si unghiilor*. Edit. Medicala, Bucuresti, 1989.
44. WEARY, P.E. – *Ectoparasites*. In: "Principles and practice of infectious diseases". 2nd ed. Edited by Mandell, G.L., Douglas, R.G., Bennett, J.E., Churchill Livingstone Inc., New York, 1986.
45. WENTZELL, J.M., SCHWARTZ, B.K., PERCE, J.R. – Tungiasis. **J. Am. Acad. Dermatol.**, 1986, 15, 1, 1.117-119.
46. WOLF, R., KRAKOWSKI, A. – Atypical crusted scabies. **J. Am. Acad. Dermatol.**, 1987, 17, 3, 434-436.