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Tworzenie się blastodermy i błon płodowych u *Polydrosus impar* Gozis (*Coleoptera, Curculionidae*)

The formation of the blastoderm and embryonic membranes in *Polydrosus impar* Gozis (*Coleoptera, Curculionidae*)

napisała

BARBARA WĘGLARSKA

Introduction

In the joint researches upon the early developmental stages of different species in the genus *Polydrosus* (*Coleoptera, Curculionidae*) carried out in the Zoological Department of the Jagiellonian University, I undertook the investigation of the formation of the blastoderm and embryonic membranes in *Polydrosus impar* Gozis. I especially took into consideration the appearance of the protoplasm and the changes occurring in it. Comparative research upon the early developmental stages in the different species of the same genus of insects had not previously been undertaken on a large scale. It may contribute to a better understanding of the differences between the most nearly related species and answer the question as to whether and to what degree the systematics of the species in a genus, based only on the differences in the imago's characteristics, have their foundation in the embryonic development. The literature of the embryonic development of the weevils is comparatively poor. It has been gathered in a paper by Krzysztofewicz [8].

Material and methods

P. impar Gozis appears on conifers (spruce, pine) from the middle of May till the end of June. The sexual dimorphism

of the beetles is visible in their size and shape; the females are bigger and have a larger abdomen, and the males are smaller and more slender. I collected the material for my work in the neighbourhood of Kraków (Zabierzów, Bielany) and bred it in a glass jar on fresh twigs of spruce. If the beetles have a sufficient quantity of food and suitable humidity, they become acclimatized very quickly and begin to lay eggs. I failed to observe where *P. impar* Gozis lays its eggs in nature. I only noticed that the beetles stayed most willingly on the lower branches touching the litter, of the young trees. When cultured they lay eggs on wet pieces of rag, paper and lignin placed in small glass jars. During oviposition the beetles bury themselves completely in the wet objects therefore the observation of the moment of oviposition is very difficult.

The newly-laid eggs are white, oval, with a smooth and shining surface. The average length of the egg is 476.24μ, the width 341.25μ. In the first 40 minutes when observing the eggs *in vivo* no difference can be seen between the anterior and posterior poles. The orientation of the egg is possible only 40-60 minutes from the moment of oviposition because the first polar body is extruded nearer the anterior pole, shining through the chorion like a small colourless knob. The female lays about 60 eggs, not forming layers but dispersing them all over the litter. Every egg is covered with a substance coagulating on the surface into a thin film surrounding the chorion; this film differs from the analogical covering of the eggs in other species of the genus *Polydrosus* Germ. in that it does not exhibit the property of viscidity. I observed part of the eggs *in vivo*, and fixed the others at intervals of one hour. Before fixing them I rinsed the eggs off the litter into a small glass jar and then I shifted them with a pipette on to small bits of dry blotting-paper. Then I put the eggs thus prepared into Bouin's fluid warmed to a temperature of $+80°$C. After one minute I poured out the fixed material on to a glass dish and stabbed every egg with a minutia-pin. I moved the stabbed eggs to fresh cold fixative, in which they remained for two days. Then after having rinsed them several times with 80 per cent alcohol and after they had become dehydrated I embedded them in the

usual manner in paraffin and cut them into sections 9μ thick. For staining the eggs *in toto* I used borax carmine and the sections were stained with Delafield's haematoxylin and eosin.

Cleavage

Sections through the newly-laid eggs show the following conditions: on the outside the egg is surrounded by a thick chorion and by a very thin yolk membrane adhering tightly to the superficial plasma. In the egg the plasma forms two networks: a dense superficial network and a loose internal network in the meshes of which the yolk spheres are found. The superficial plasma covers the deutoplasm with an uniform layer about 9μ thick. The posterior pole is the only exception; there the finely alveolated plasma forms a distinct lens of about 40μ in diameter and 18μ thick. A similar thickening was observed in other representatives of the weevil family: in *P. sericeus* Schall., *P. pterygomalis* Boh. and *Otiorrhynchus ligustici* L. B u t t has given the name of oösome to this thickening and considers it to be of some importance in the later formation of the primordial germ cells. I did not see in *P. impar* Gozis any of those differences in the staining of the plasma of the thickening which were observed by other authors. The thickening stained exactly like the rest of superficial plasma.

The inside of the egg is filled with yolk spheres suspended in the internal plasmatic network. As a rule the centre is filled with larger and the superficial parts with smaller spheres. The nucleus in the newly-laid egg is always in the metaphase. It lies in the superficial plasma at about $^1/_3$ of the length of the egg from the anterior pole. In this stage the plasma round the nucleus does not form any thickening and shows no differences in structure and colour. The interior of the nucleus is filled with weakly-staining karyoplasma, in which large granulated chromosomes are suspended.

This state does not last longer than 40-50 min. Later we see that in the neighbourhood of the dividing nucleus of the oöcyte the plasma forms a lenticular thickening which protrudes towards the inside of the egg, while the nucleus does not lie in its centre but has shifted towards the external surface. When

observing living 60-min. old eggs on a slide in a few drops of water we can see a darker spot nearer to the anterior pole. If we orientate the egg so that the above-mentioned spot lies on its periphery, we see that it is formed by a small hollow from which a small protoplasmatic knob protrudes. In preparations fixed at this time we see the anaphase or telophase of the first maturation division. Simultaneously with the lengthening of the division spindle the protoplasmatic protrusion moves outwards, and in this the nucleus of the first polar body is situated. This protrusion is usually inclined towards the posterior pole and is never separated from the surface of the plasma.

At this time the superficial plasma, which did not show any stratification and covered as a uniform network the whole surface of the egg, becomes markedly vacuolized in its external part; owing to this a fine network is formed between its unchanged internal layer and the chorion. Under the influence of the fixative, this coagulates into a flocculent envelope. After the first karyokinesis I did not see in my preparations any resting stage such as that observed by Krzysztofowicz in *P. sericeus* Schall. The result of the second mitosis is the formation of the second polar body and of the mature nucleus of the egg. The second polar body becomes situated in the superficial plasma at the base of the protoplasmatic protrusion, and is quickly transformed into the resting nucleus while the mature nucleus of the egg, pressing through the yolk spheres, migrates surrounded by the small quantity of the plasma towards the centre of the egg, where at the level of the polar bodies karyogamy takes place. The result of the conjunction of the haploid nuclei is the formation of a big spherical synkaryon, the division of which gives rise to the blastomeres.

An hour after the copulation of the nuclei great changes can be observed within the superficial plasma, namely all the external vacuolized layer and part of the thick internal layer become as if divided into cells and resemble in their appearance a newly formed blastoderm (fig. 1). These changes are visible not only in the preparations but also in the living embryos. Further mitoses lead to the appearance of a group of cells in the centre of the egg. The dense plasmatic envelopes of the cells are joined by numerous short protrusions to the internal

network. In *Hydrophilus* Geer (H e i d e r), *Musca* L. (B l o c h m a n n), *Platycnemis* Charp. [10], *Ephestia* Gn. (S e h l), a strict synchronism of the divisions during the whole cleavage process was observed. Neverthelless synchronism is not a rule. Some new embryological researches carried out upon the weevils *Phyllobius glaucus* Scop. (S m r e c z y ń s k i), *P. sericeus* Schall. (K r z y s z t o f o w i c z), *P. pterygomalis* Boh. (B i e l e n i n), and upon *Agelastica alni* L. (W ę g l a r s k a) have shown that there is no complete synchronism of divisions. Its absence is already marked in *P. impar* Gozis at the stage of 16 blastomeres; this is shown in the following table.

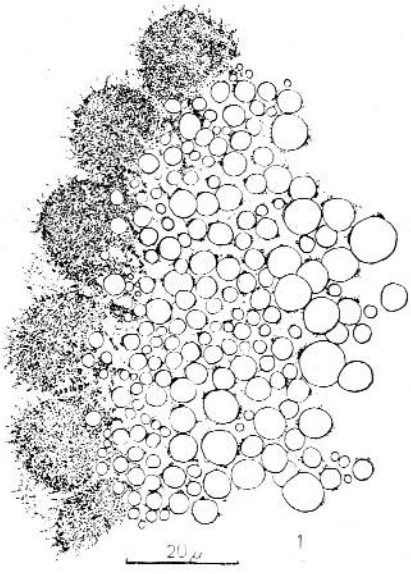

Fig. 1. The superficial plasma of the 4-hour old embryo, resembling the young blastoderm in appearance.

S e i d e l has distinguished two types of cleavage: *Hydrophilus* and *Platycnemis*. The cleavage in *P. impar* Gozis, as in *Otiorrhynchus* Germ, *Calandra* Clairv., *Phyllobius* Schn., *P. sericeus* Schall. and *P. pterygomalis* Boh., resembles the conditions in the type *Hydrophilus* with the difference mentioned by S m r e c z y ń s k i in *Ph. glaucus* Scop.

Age of egg	Temp.	Pro-phase	Meta-phase	Ana-phase	Telo-phase	Resting stage	Number of cells
6 hours	20°C	2	4	2	—	8	16
8 „	„	24	2	1	10	39	76
9 „	„	6	—	1	8	110	125

that the migration towards the surface occurs rather early and begins with a comparatively small group of cells. The blastomeres tending towards the surface form as a whole the figure of a rotary ellipsoid, the radius of which increases while the cells divide.

Formation of the blastoderm

Before the blastomeres emerge on the surface, as in *P. sericeus* Schall. and *P. pterygomalis* Boh., the karyokinetic spindles of the last mitosis range themselves with their longer axes parallel to the surface of the egg. The vertical placing of the axes was observed by Inkmann in *Calandra granaria* L. The penetration of the blastomeres into the superficial plasma occurs simultaneously over the whole periphery of the yolk. Much attention was paid to the process of reaching the surface by the polar bodies where the fairly large concentration of the plasma is maintained. In *O. ligustici* L. in this place few blastomeres appear and the formation of their cell walls is delayed. Contrary to this in *P. sericeus* Schall. the first blastomeres appear just on the site of the degenerating polar bodies. In *P. impar* Gozis, as in *P. pterygomalis* Boh., the shifting of the cells is rendered difficult by the plasmatic thickening which surrounds the polar bodies. As a result of this the blastomeres in this place shift somewhat later (fig. 2). I observed no differences, however, in this place during the formation of the cell walls. The blastomeres emerging on the surface are as a rule in the resting stage.

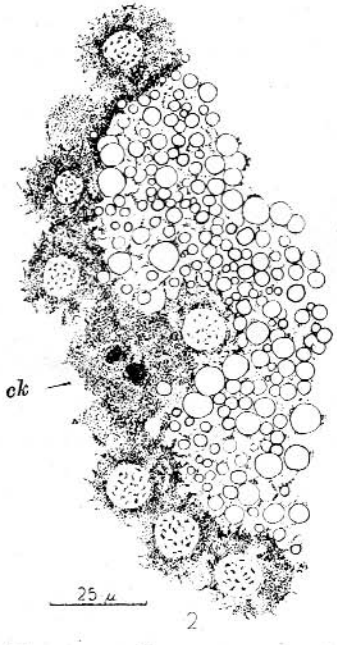

Fig. 2. A fragment of the young blastoderm. *ck.*— the degenerating polar bodies.

At first they protrude like large knobs without touching each other and are very easily visible in the embryos observed *in vivo* under small microscopic magnification (ocular 3, objective 3). At this time a layer of the superficial plasma staining more intensively with haematoxylin than the envelopes of the nuclei is present between the blastomeres. This stage is transient. In preparations made of embryos one hour older both plasmas are already completely mixed. The external surface of the envelopes of the nuclei is considerably frayed, while as a rule the plasma of the blastomeres on the posterior pole forms more and longer protrusions. The blastomeres cover the surface of the embryo with a uniform layer with the exception of the posterior pole, where the specific concentration of the so-called primordial germ cells is present. In the neighbourhood nearest the primordial germ group there are usually fewer blastomeres than on the sectors of the same area on the anterior pole or the flanks of the embryo.

The filling of the free spaces between the blastomeres is carried out not by further cells emerging from within the egg but by divisions on the surface. Sometimes, however, single blastomeres can be seen shifting towards the surface somewhat late. Although the blastomeres emerging are without exception in the resting stage as early as the first division on the surface there is no synchronism. On the periphery of nearly every section all karyokinetic stages may be observed. In the course of karyokineses, however, I observed no such undulation as appeared very clearly in *P. pterygomalis* Boh. In the 18th hour at a temperature of + 20°C the blastoderm is completely formed. It covers the surface of the egg with a uniform syncytium. The external surface of the syncytial layer is formed by vacuolized flocculent plasma forming dome-shaped covers over the nuclei. The nuclei themselves are surrounded by finely granulated plasma which changes without any sharp boundary-line into a spongy layer, which lies directly on the yolk and which is joined by numerous protrusions to the internal network. The difference between the anterior and the posterior poles is further maintained. In preparations cut more or less through the axis of the embryo, the height of the bla-

stoderm on the anterior pole is about 20 μ on the average, and on the posterior pole 17 μ. The number of nuclei on an arc of the same length amounts in the former case to about 14, in the latter to 11.

Primordial germ cells (polar cells)

In the newly-laid eggs the small thickening which Butt calls the oösome may be observed on the posterior pole. Later, this disappears in the region of the tumid vacuolized superficial network. During the formation of the blastoderm the cells

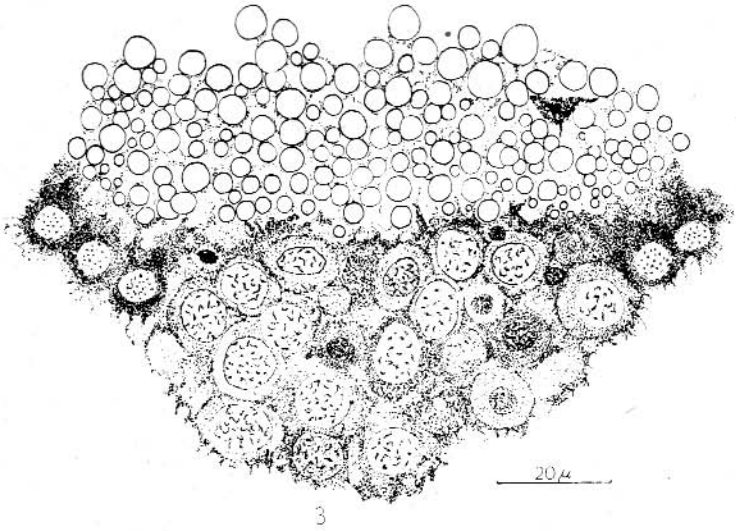

Fig. 3. Primordial germ cells (polar cells).

which have reached the region of the oösome do not become arranged in a one-layer syncytium, like that seen over the whole surface of the egg, but form a specific irregular concentration composed of blastomeres, isolated by their thin cell membranes. This in part protrudes over the surface of the embryo and in part penetrates into the yolk. The spherical nuclei of the primordial germ cells are surrounded by dense weakly-staining plasma. They are separated from the yolk by a small layer staining like the superficial plasma which is now visible between the blastomeres and at their base at this time.

In the stage of the formation of the groups of primordial germ cells, their nuclei are identical in shape, size and staining to all the other nuclei of the blastomeres. This stage does not last long. Preparations an hour older show that the chromatin of the primordial germ cells becomes gathered into larger more intensively stained clumps, and the cells, owing to the irregular divisions, are differentiated into smaller and larger while the latter, as in the other weevils observed, stain more intensively with the basic stains (fig. 3). During the differentiation of the blastoderm the primordial germ cells partly withdraw into the interior so that the external surface of the embryo's posterior pole becomes smooth. At the time when the yolk is surrounded by the one-layered differentiated epithelium of the blastoderm composed of markedly elongated cells with perpendicular walls and vacuolized plasma the primordial germ group differs very sharply from it, since its cells are placed chaotically in several layers. Their plasma is dense and finely-granulated, as in the first hours. The nuclei of the primordial germ cells continue to be spherical and somewhat larger than the oval nuclei, apparently flattened by the thick arrangement of the cells, of the part of the blastoderm which is destined to form the germ band. This group undergoes practically no change till the embryonic envelopes, i. e. the amnion and serosa, are closed.

Vitellophags

During the formation of the blastodermal syncytium not all the nuclei emerge on the surface but some remain in the yolk as the so-called vitellophags. Before the blastomeres emerge on the surface, there are no criteria enabling an estimation of the future of the separate cells, but immediately after the formation of the blastoderm the vitellophags begin to divide rapidly, so that in the stage of the formed blastodermal epithelium, they have nuclei of a smaller size than the blastomeres and the frail plasmatic envelopes. As in *Ph. glaucus* Scop., *P. sericeus* Schall., and *P. pterygomalis* Boh., *Otiorrhynchus* Germ. and *Calandra* Clairv. the vitellophags divide very intensively from

the time when the blastoderm differentiates. During the formation of the amnion the number of karyokineses diminishes and, as in the species already investigated, the vitellophags gather into clumps or form rows of several cells. The rôle of the vitellophags chiefly consists in the digestion of the yolk.

Differentiation of the blastoderm

When observing the living embryos 20 hours old, a characteristic darkening of the blastodermal epithelium of the anterior pole may be seen. This spreads on the sides and after two hours covers about half the surface of the embryo (Diagram I). When light is suitably thrown upon the object, one sees on the anterior pole a polygonal network built up of the external walls of the epithelium forming at this time for the serosa. The separate processes leading to the changes described above can be observed only on fixed material.

The differentiation of the blastoderm is preceded by the removal of the nuclei into the external protoplasmatic layer and the strong vacuolization of the spongy layer which fills the space between the lower surface of the nuclei and the yolk. After a short time a part of the plasma over the nuclei becomes vacuolized and the upper and lateral cell walls appear which consequently leads to the superficial syncytium splitting into isolate cells. The radial walls of the cells of the anterior pole, as in *Ph. glaucus* Scop., lengthen into the superficial part of the yolk. On the posterior pole the cell walls appear somewhat later, while the radial walls develop first. The plasma surrounding the nuclei in the first stage of the differentiation does not change. Only the layer adhering directly to the yolk and part of the external plasma over the nuclei become vacuolized. The latter spreads into a loose, very weakly-staining network which fills all the space between the blastoderm and the chorion.

The upper tangent cell wall, formed in the following hour, cuts off that part of the plasma which in the later stages provides the fluid of the amnion cavity. The lower cell wall appears simultaneously over the whole surface of the yolk as a thin plate separating the blastoderm from the yolk mass.

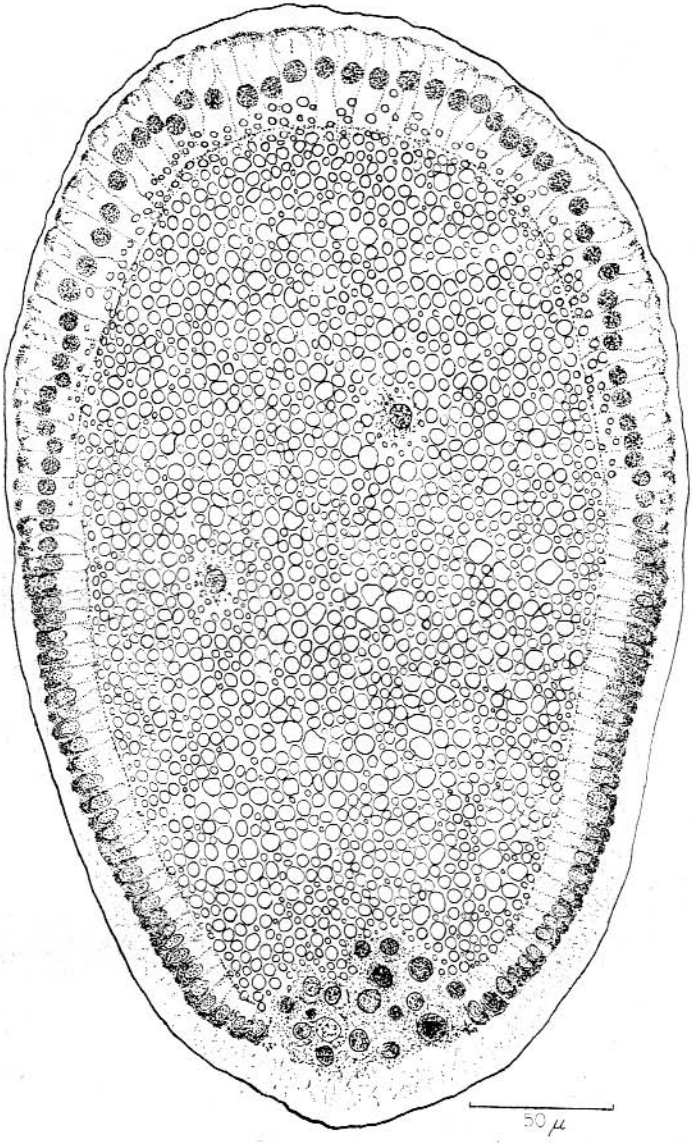

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Fig. 4. A longitudinal section through the 24-hour old embryo.

In the anterior half of the embryo it is formed not on the border of the yolk but under its surface at the height of the elongated radial walls; owing to this a number of the yolk spheres enter the cells of the serosa. The changes occurring in the blastoderm lead to its differentiation into two histologically different epithelia: the epithelium of the serosa and the material of the future germ band (fig. 4). The cells of the serosa covering the anterior surface of the embryo become vacuolized to a remarkable degree, their nuclei are spherical and they are all in the resting stage. They do not lie as before in the neighbourhood of the external surface but withdraw towards the middle taking a more or less central place in the cell. In the basal parts of the cells of the serosa are found the yolk spheres which got there during the formation of the lower tangent cell wall. The yolk in the serosa behaves in the same way as in *Ph. glaucus* Scop. till the end of the embryonical development.

The difference in the structure of the cells in the posterior part of the embryo can at once be observed. Their average height in the neighbourhood of the primordial germ group is 20 μ, while on the anterior pole the height of the cells of the serosa is the average 37 μ. The proportion of the height to the width of the cells is the same, i. e. 3 : 1 in both cases. The nuclei of the material of the future band do not change their position and so continue to be nearer the external surface; they separate the granulated intensively staining plasma of the upper part of the cell from the basal part, which is usually occupied by one large vacuole; on this account the basal parts of the cells seem empty on fixed preparations. The boundary line between the two histologically different territories runs almost exactly halfway along the egg. In the cells lying in the neighbourhood, a gradual change in size and the shifting of the nuclei from the excentric position characteristic of the cells of the future band and of the amnion to the central position which we see in the cells of the serosa can be observed.

The appearance of the cells of the serosa and the topography of the material of the germ band is very reminiscent of the conditions described in *Ph. glaucus* Scop. In *P. sericeus* Schall. and *P. pterygomalis* Boh. the dislocation of the descri-

bed parts of the blastoderm is not parallel to the axis of the egg. In the former species the cells of the band shift forwards over the equator of the embryo on its dorsal side, in the latter on the ventral side. An entirely different course of the formation of the blastoderm was observed in *Calandra granaria* L., in which the serosa is formed of the secondarily appearing dorsal syncytium and the material of the band forms a small disc on the ventral side reaching from the posterior pole to 1/4 of the length of the egg. During the differentiation of the blastoderm in *P. impar* Gozis a small number of cells leave it and return into the yolk; as a rule this occurs on the anterior pole. These cells were called „paracytes" by H e y m o n s; their presence was also observed in other representatives of the genus *Polydrosus* Germ. The rôle of the paracytes is not known.

Formation of the amnion

The processes occurring in the 24th hour lead to the described differentiation of the blastoderm. The changes which can be observed in embryos one hour older consist in the shortening of the depression in material of the band, accompanied by the pushing forward of the serosa beyong the equator of the egg towards the posterior pole (Diagram II). At this time the serosa becomes slightly flattened, so that except for a small space on the anterior pole, its cells are lower than the cells of the band, which become considerably elongated at this time. The amnion is formed of that part of the material which adheres to the serosa. At first it seems that the cells of the serosa press upon the adjoining cells of the band, owing to which the latter become somewhat deformed. The process described does not as yet provoke any changes on the surface of the embryo.

In the following stage the serosa passing towards the posterior pole over the concentration of deformed cells involves the cells on the edge of the band, which although they cannot as yet be histologically differentiated from the cells of the band, are anatomically the rudiment of the second embryonic membrane, i. e. the amnion (fig. 5). This causes a shallow furrow which is of equal depth over the whole periphery and

which increases concentrically in the following hours to appear on the surface of the band (Diagram III). At this time the relations are almost the same as those observed by Smreczyński in *Ph. glaucus* Scop. Different pictures were given by sections of the analogical stages in *P. sericeus* Schall. The amnio-

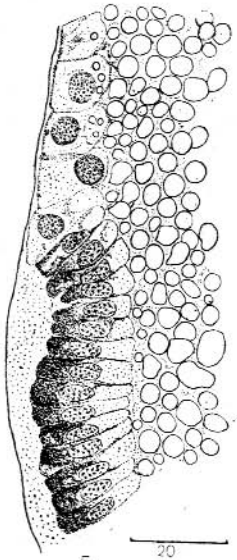

Fig. 5. Formation of the amniotic furrow.

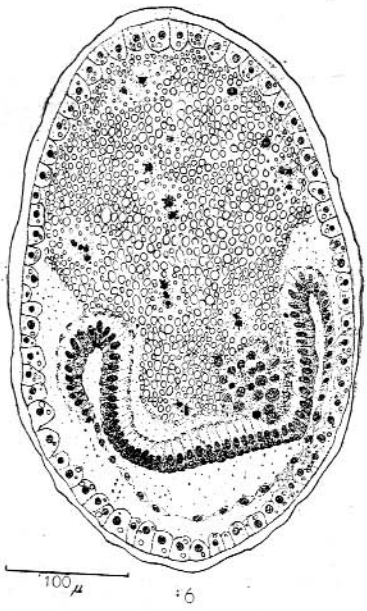

Fig. 6. A longitudinal section through the 32-hour old embryo.

tic furrow was not formed simultaneously over the whole periphery of the embryo, but at first appeared on the dorsal side, then on the ventral, and much later on the sides of the embryo.

Even during the differentiation of the blastoderm, it can be observed that the yolk spheres lose their regular outline and also that round the concentrating vitellophags within range of their protrusions, spaces free from deutoplasm are formed. Parallel with the formation of the amnion cavity, the yolk spheres begin to join each other, with the result that their bulk increases. This phenomenon occurs in all species investigated of the genus *Polydrosus* Germ. and has been fully described in *Ph.*

glaucus Scop. According to Smreczyński, the process precedes the appearance of the liquefied yolk. In *P. sericeus* Schall., *P. pterygomalis* Boh. and *Ph. glaucus* Scop. liquefied yolk of the same chemical properties surrounds the mass of unchanged deutoplasm with a layer differing in thickness and fills the spaces between the serosa and the amnion; the greatest quantity was observed in the places where the intensive shifting of the cells occurs. Similarly in *P. impar* Gozis in the corresponding parts of the embryo a dense fluid is formed which, in comparison with the unchanged yolk, takes a distinctly weaker stain.

In the next hour the posterior part of the embryo becomes narrower so that the difference between it and the anterior part is clearly marked. Simultaneously the elongated amniotic fold, together with the serosa with which it is connected by the exterior border, extends gradually over the posterior part of the embryo. Some changes in the appearance of the cells of the band may also be observed, the as yet uniform and granulated plasma which has occupied the parts over the nucleus assumes the shape of a vacuolized network. The transition of the cells of the band into the amnion is gentle. When receding from the band towards the serosa, a gradual change in shape and an increased vacuolization in the cells of the amnion may be observed. The nuclei of the cells of the amnion are oval and somewhat smaller than the spherical nuclei of the serosa.

At this time the embryonic bowl is changed by the shifting of the cells into a large zone more elongated on the dorsal side, so that the line joining the head and caudal appendages of the amnion is not perpendicular to the longer axis of the egg but runs obliquely. In the 32th hour at a temperature of +21°C the closing of the amniotic folds takes place (Diagram IV). Often the final coalescence of the amniotic folds does not occur on the posterior pole but is shifted to the dorsal side of the embryo. At the moment when the envelopes close the embryo is very much less developed than in *P. sericeus* Schall. and *P. pterygomalis* Boh. In *P. sericeus* Schall. the amnion closes at the stage when the markedly elongated posterior part of the embryo reaches the anterior pole and the developed head lobes are on

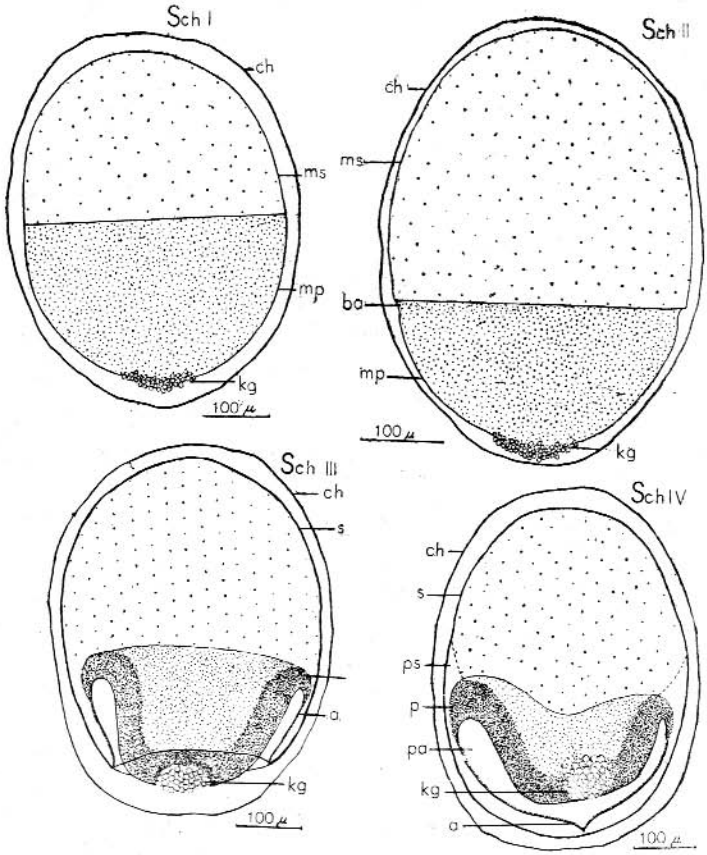

Diagram I. Position of the material of the future germ band and of the future serosa after the differentiation of the blastoderm. *ch* — chorion, *ms* — material of the future serosa, *mp* — material of the future germ band and of the amnion, *kg* — primordial germ cells.

Diagram. II. Position of the material of the future serosa and of the future germ band at the time when the amniotic furrow is formed. *ch* — chorion, *ms* — material of the future serosa, *ba* — amniotic furrow, *mp* — material of the future germ band, *kg* — primordial germ cells.

Diagram III. The stretching of the amniotic fold. *ch* — chorion, *s* — serosa, *p* — germ band, *a* — amnion, *kg* — primordial germ cells.

Diagram IV. The closing of the amniotic folds. *ch* — chorion, *s* — serosa, *ps* — fluid substance, *p* — germ band, *p'* — fluid of the amnion cavity, *kg* — primordial germ cells, *a* — amniotic folds.

a level with the equator of the egg and contain half of its periphery. The embryo itself is already differentiated into the upper and lower embryologic ribbons. Similar conditions were observed in *P. pterygomalis* Boh.

At the moment when the envelopes close in *P. impar* Gozis (fig. 6) there are in the egg the following conditions: under the swollen light-brown chorion there is the uniform sac of the serosa, composed of vacuolized cells whose external surface is nearly smooth, though the internal one is knobby. In the cells of the serosa, minute yolk spheres are visible. Under the serosa on the posterior pole lies the germ band composed of deep cylindrical cells. The germ band is coverd with the amnion over its whole surface. In the posterior part of the embryo the boundary line between the cells of the amnion and the cells of the band is distinct. On the other hand in the anterior part the transition between the two materials is gradual and the amnion cavity considerably smaller. All the gaps between the embryo and the serosa as well as the amnion cavity are filled by a thick fluid, with distinct granulations, which is of importance for the protection of the developing embryo. A small quantity of this fluid is present under the germ band in the places where stronger movements of the embryo occur. The primordial germ group recedes from the region of the band and becomes situated under its surface, in this place pushing away the spheres of the unchanged yolk, which otherwise fills the whole interior of the embryo. In the deutoplasm are vitellophags, united into groups or strings of a few cells.

The investigations for the present paper were carried out in the Department of Zoology in the Jagiellonian University, Kraków. I take this opportunity of expressing my gratitude to the Director of the Department, Professor Stanisław Smreczyński.

STRESZCZENIE

Okres rozrodu *Polydrosus impar* Gozis trwa od połowy maja do końca czerwca. Jaja o średnich wymiarach 476 × 341 są znoszone w stadium oocytu I rzędu. Protoplazma powierzchniowa stanowi jednolitą warstwę na całym obwodzie, znacznie grubszą aniżeli u innych gatunków rodzaju *Polydrosus* Germ. Na

tylnym biegunie plazma powierzchniowa tworzy soczewkowate zgrubienie (oosom). Wnętrze jaja wypełniają kule żółtka zawieszone w luźnej sieci plazmatycznej. Pierwszy podział dojrzewania, będący mejozą, ma miejsce w temperaturze 20°C, w godzinę po zniesieniu jaja. Drugie ciałko kierunkowe umieszcza się u podstawy pierwszego w obrębie plazmy powierzchniowej. Po kopulacji jąder na powierzchni zarodka pojawiają się liczne promienisto ustawione wgłębienia, tak że stadium to imituje swym wyglądem młodą blastodermę. W czasie bruzdkowania nie ma ścisłej synchronii w podziałach blastomerów. Po wyjściu na powierzchnię blastomery tworzą jednolite syncytium z wyjątkiem bieguna tylnego, gdzie znajdują się izolowane komórki prapłciowe. Po 20 godzinach blastoderma różnicuje się na pokrywający tylną połowę zarodka materiał przyszłego prążka zarodkowego i amnionu oraz na materiał przyszłej serozy, który pokrywa przednią połowę zarodka. Ściany promieniste komórek blastodermy w przedniej połowie zarodka przedłużają się w obręb żółtka. Podczas powstawania ścian stycznych do wnętrza komórek serozy dostają się drobne kulki żółtka i utrzymują się w nich do końca rozwoju embrionalnego. Protoplazma szczytowych części komórek przyszłego prążka i amnionu upłynnia się, a płyn w ten sposób powstający wypełnia jamę amnionu. Amnion formuje się ze skrajnych komórek materiału prążka zarodkowego. Bruzda amnionu zawiązuje się jako fałd okrężny mniej więcej w $^2/_5$ długości jaja bliżej bieguna tylnego. Zamknięcie się fałdu amnionu na tylnym biegunie ma miejsce w 32 godzinie (temperatura 21°C). Kształt prążka zarodkowego ulega w tym czasie szybkim zmianom: w pierwszym stadium zarodek był czaszą, która w momencie zamykania się amnionu zamienia się na szeroką taśmę, sięgającą po stronie grzbietowej do równika jaja.

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