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# The inhabitants of the galls of *Mikiola fagi* HTG.
# Part I. Materials for the morphology and development of *Mikiola fagi* HTG. (*Itonididae*), as well as of its endophagous primary parasite *Secodes coactus* RATZB. (*Chalcididae*).

[Pl. VI—X]

**Mieszkańcy galasów *Mikiola fagi* HTG.**
**Część I. Materiały do morfologii i rozwoju *Mikiola fagi* HTG. (*Itonididae*) jakoteż jej pasożyta wewnętrznego *Secodes coactus* RATZB. (*Chalcididae*)**

**Обитатели галлов *Mikiola fagi* HTG.**
**Часть I: Материалы к изучению морфологии и развития *Mikiola fagi* HTG. (*Itonididae*) а также ее эндопаразита *Secodes coactus* RATZB. (*Chalcididae*)**

## *A. Mikiola fagi* HTG.
## (syn. *Cecidomyia, Hormomyia, Oligotrophus*)

The formation of galls on the leaves of the beech (*Fagus silvatica* L.) is caused by two species of *Itonididae*, namely *M. fagi* HTG. and *Hartigiola annulipes* HTG. Below I shall discuss exclusively the insects the life of which is connected with the existence of the galls of *M. fagi* HTG. The work was performed in two stages; in the years 1947—1948 on material coming from the forest Las Wolski near Kraków, and in the years 1957—1959 on material collected in the environs of Krzeszowice, a small town lying 27 kilometres west of Kraków.

In the forest Las Wolski the years 1947—1948 were especially advantageous for such investigations, as the number of galls of *M. fagi* HTG. which then appeared on the beeches was exceptionally large. Unfortunately the work could not be completed in these years as the number of galls on the beeches diminished uncommonly. The same state lasted for the following eleven years. The number of galls in Las Wolski was constantly very small. In 1957 I decided to continue, but used material from a different locality i. e. the environs of Krzeszowice. The material from this region was supplemented by material from Zakopane; the latter was furnished by my pupil A. MADEJA, and I wish to acknowledge this here with my hearty thanks.

In all (up to 1958), I examined the interior of the chambers in 21 254 beech galls, i. e. 4150 from las Wolski, 16 804 from the environs of Krzeszowice, and 300 from Zakopane.

## 1. The formation, size, and shape of the galls

The females of *M. fagi* HTG. fly already in April; they visit the twigs of the beech with still undeveloped winter buds and lay their redcoloured eggs on these. The eggs are lain singly or in groups of several, up to twenty, sometimes even in larger numbers. Larvae hatching from these eggs attack the buds, pushing their way between the scales up to the undeveloped leaf lying inside. There they begin to suck, always near a nerve and always on the underside of the leaf-blade. As an effect of this sucking there slowly forms, on the upper side of the leaf just beside the nerve, an excrescence named gall. The galls have a characteristic lemon form.

They become visible already in the first half of May. At the beginning they are very small, they have smooth, green, soft, and juicy walls. With the time they become larger, harder, often red. In autumn they take a brown colouring and become as hard as wood.

In the gall there is one chamber. Its walls are smooth, usually they show a good polish, and until autumn keep a vivid green colour with darker streaks for the nerves. The gall chamber is filled by a gas which must approach by its composition that of the surrounding atmosphere. The air gets into the chamber in the period of gall formation; maybe it gets there even later. In an older gall one can always discern the upper part protruding over the leaf surface (regarded as the gall proper), and the tumour-like part lying under the leaf-blade, much slower than the upper part. In the upper part there is a chamber which prolongates into the under-leaf part where after a time it takes the form of a narrow channel (Pl. VI, figs. 1—4).

It is not sure it this channel is always open. According to HOUARD (1908, vol. I, p. 207) it is closed („ferme par des papilles"). However, the drawing by this author as well as that by ROSS (1916) seems to indicate that this is rather constricted than closed. The constriction is also spoken for by experiments made by myself on larger galls in 1957. The chamber of a gall lying on water may be blown through, e. g. with the help of an hypodermic syringe. During the blowing bubbles of air appear on the underside of the leaf in the place where the channel ends. In smaller galls the existence of an open channel may often be ascertained directly on the section, without blowing. HIERONYMUS (1890) and NIEZABITOWSKI (1905) mention the appearance of an opening in this place.

As the gall wall is transparent for light, and vividly green on the inside where the chamber is, we may suppose that an assimilation of carbon dioxide occurs here, and a resulting production of oxygen in the chamber. The larvae of insects living in the chamber may use this oxygen while breathing.

With the air spores of fungi may get into the gall chamber. They are usually necrophagi decomposing the bodies of dead inhabitants of the galls.

Most galls are variable. BÜSGEN (1895), and after him ESCHERICH (1942), write that the size of galls collected in autumn oscillates about 6—10 millimetres in height and up to 7 millimetres in diameter. HOUARD (1908) gives their height as 8—10 mm and the diameter 5 mm. According to ROSS (1916) their height is 10 mm, or according to ROSS & HEDICKE (1927) attains 10 mm.

These dimensions must be considered as frequent but not the only ones possible. The galls collected in Las Wolski near Kraków and in the environs of Krzeszowice showed broader size variation than given by the authors quoted.

In the second half of August, i. e. in a period when the increase in size of the galls may be taken as terminated, there could be found in the environs of Kraków and Krzeszowice, on one tree, often on one branch, galls 2—12 mm high and 1—6,5 mm diameter.

This caused the need to classify the galls of *M. fagi* Htg. into several categories. Two ways were used.

Table I

Classification of gall sizes and forms

| Method I by the use of a magnitude index (m. i.) | | Method II by the use of a formal index (f. i.) | |
|---|---|---|---|
| sm | 4— 9 mm | sl | dm < 0,5 h |
| md | 9,1— 12 mm | dp | dm = 0,5 h |
| lg | 12,1 mm and more | th | dm > 0,5 h |

Abbreviations:

sm — small
md — medium
lg — large
sl — slim
dp — dumpy
th — thick
dm — diameter
h — height

Method I leads to a classfication of the galls according to their size by applying a magnitude index (m. i.); the latter is obtained by adding together the height and the maximal diameter of the gall. Basing on this method we may discern small, medium, and large galls. The limits between the categories, as given in table I, are arbitrary and cannot therefore be completely satisfying.

Method II is more valuable as it takes the form of the gall into consideration. The form index (f. i.) is obtained by comparing the height of the gall with its diameter. If the latter is smaller than half the height, the gall is slim (sl); if it equals half the height, the gall is dumpy (dp); if it exceeds half the height, the gall is thick (th).

Method II does not consider the size, and method I the form of the gall; thus both supplement one another.

## 2. The build and development of the larva of *M. fagi* Htg.

### The first instar of the larva (L. 1)

If we look at the surface of beech leaves in the first day of their development from the winter bud, the galls are not to be seen. They do not yet appear on the upper surface, and they are so small on the underside that they are only visible by a magnifying glass. They have then the form of small mounds directed downwards with their summits, and they are placed always near one of the nerves, most frequently the principal nerve. On the summit of the mound lies the opening leading into the chamber (Pl. VI, fig. 1).

The larva of *M. fagi* Htg. (Pl. VI, fig. 2) feeds in the chamber. It is in the first instar. Now it is somewhat larger than it was when it left the chorion. I cannot give its dimensions in the earliest instar, as I had no opportunity to find it then. Once only I found a red egg of *M. fagi* Htg. on the leaf surface, containing an embryo ready to leave the chorion. This embryo measured 0,272 by 0,131 mm. The larvae found by me in the first days of May in the chambers of minute galls were already somewhat larger. Their size was about 0,318—0,646 by 0,124—0,238 mm.

In the body of the larva of *M. fagi* Htg. I discern, in accord with Hennig (1948), a mandible capsule „Kieferkapsel", provided with two short antennae (Grünberg 1910), also called the vestigial head capsule „Kopfkapsel" (Marno 1869), or „Mundkapsel" (Brauer 1869). Just behind the capsule there is a body part which Hennig (1948) calls „collare". The larva pulls the sclerotized head capsule into this „collare". In this part there appear two pigmented eye spots. In reflected light they are red, in transient light they appear black. We may conclude from their colouring that they are adapted to absorb the green rays, i. e. such as pass the walls of the gall. Except the „collare“ Hennig discerns a three-segmented thorax and a nine-segmented abdomen.

The body of the larva of *M. fagi* Htg. is covered in its first instar by a naked skin with glassy lustre, without setae. Numerous colourless fat-bodies are visible inside through the skin, as well as the alimentary tract with its coloured contents. The latter shows a red colour in its median section, there is here also a yellow globular body. In the body cavity, besides the intestine, there are not many red bodies. The red contents of the alimentary canal give the larva a red colouring.

The respiratory system is translucent through the larva's skin. Two longitudinally running tubes may be discerned; they are situated laterally and not connected by anastomoses. Both the tubes possess only one spiracle each, in the larva's first instar; both lie in the penultimate abdominal segment. Thus the larva's respiratory system is metapneustical. The spiracle is on the top of a cylindrical protuberance provided with lips. The length of the protuberance is about 0,008 mm, that of the lip — 0,002 mm. In spite of their insignificant size both are simply conspicuous at an enlargement of 200 times (Pl. VII, fig. 12a). Sen (1939) found in the larva of *Rhabdophaga saliciperda* Duf. in its first instar an amphipneustic respiratory system, thus on prothorax one pair of spiracles more than in *M. fagi* Htg. He mentions at the same time, though, that Otter (1934) observed in the larva of *Lestodiplosis alvei* Barnes, and Metcalfe (1933) in *Dasyneura leguminicola* Lint., similarly as I did in *M. fagi* Htg., a metapneustic respiratory system.

The position of the spiracles, their form, and the red body collour allow to recognize quite easily that examined larva of *M. fagi* Htg. is in its first instar. Moreover, it is very little mobile in this instar.

### The second instar of the larva of *M. fagi* Htg.

In the environs of Krzeszowice in 1958, already since the sixth day after the opening of the winter buds and the developing of leaves, i. e. in the first half of May, in some of the galls there could be found larvae of *M. fagi* Htg. in their second instar. The galls inhabited by these were still very little. Their height did not even attain 2 mm (Pl. VI, fig. 4).

In its second instar the larva of *M. fagi* Htg. has a somewhat different appearance than in the first one. It further has a similar body shape and a glossy skin, but its surface is covered by subtle spines. There are also minute setae, not found on larvae in the first instar. They are well developed on the dorsal side. On the segments of thorax and the first seven abdominal segments there are dorsally six setae dorsales on each segment, called by Kieffer (1895) after Rübsaamen „*papillae dorsales*". This nomenclature is used in the following text. The papillae may possess a seta, again, they also may not.

On the dorsal side of the larva, on both sides laterally, there appear two lateral setae on each side, the so-called papillae pleurales. One of them is less outwardly located — papilla pleuralis interna — the second is more outwards — papilla pleuralis externa. The penultimate and the last abdominal segments posses a lesser number of papillae dorsales. On the penultimate segment between the spiracles I found only two papillae dorsales and on each side externally one papilla pleuralis. On the anal segment dorsally there are four papillae dorsales (Pl. VII, fig. 14).

Ventrally the already mentioned papillae pleurales are visible on the sides. Except these, under a strong microscopical enlargement, one may see with some difficulty (besides the normal articular spines) ringed areas usually without setae, somewhat larger that the said spines. These areas correspond by their position and dimensions to the bases of the setae on the dorsal side and to papillae ventrales anteriores appearing in larger size ventrally on the larvae in their third instar. In one of the larvae examined very exactly I found on mesothorax and metathorax two papillae ventrales anteriores on each. I observed none on prothorax. On the three first abdominal segments there were 4 on each, on the fourth — 2 on the left side, only 1 on the right one, on the fifth segment there were 2 on the right side, on the sixth and seventh — 4 on each, there were none on the eighth, and 4 on the anal segment. Among the enumerated, belonging doubtlessly to papillae ventrales anteriores, there were four with setae. This is a symptom of reduction of setae, characteristic exclusively for the underside of the larva's body.

Except the named papillae ventrales anteriores I could not find in larvae in the second instar papillae ventrales posteriores which may be found in larvae in their third instar (Pl. VII, fig. 15).

On mesothorax on both sides, on the ventral part of the body of *M. fagi* Htg. there appears a comparatively large spiny tumour (Pl. VII, fig. 13 c). In transient light it shows a yellowish colour of the same hue as the head capsule. The sclerotisation of the tumours is thus of the same, extent as that of the capsule. It may be supposed that the tumours are an organ of motion for the larva in its second instar. Owing to them the larva could seemingly push its body off the chamber's smooth wall and recede backwards as it often does when disturbed.

The mobility of the larva in this second instar is much greater than in the first one. It is caused by the subcutaneous muscle fibrillae appearing in large numbers in each segment.

Through the transparent skin of the larva the internal organs are visible. The alimentary duct is prominent, closed from behind, with enormous salivary glands in the anterior section on both sides of oesophagus and two Malpighi tubes in the posterior section. In the midgut we may observe similar contents as in the first instar. However, the number of red bodies is much smaller, therefore also the body colour becomes different. On the green wall of the gall chamber it appears pink by contrast, and not red.

Numerous fat bodies distributed in the haemocoele considerably impede an observation of the nervous system. The latter is composed of the brain with a pair of lobes, a somewhat tumefied suboesophagal ganglion, passing into a tape-like ventral nerve cord. This cord extends in the larva's plane of symmetry up to the third abdominal segment inclusively.

Under the skin and the muscle layer there is a peripneustic respiratory system. Two lateral longitudinal trunks may be discerned as well as 9 pairs of siracles on each side. The first pair is on prothorax and the other 8 pairs on the first eight abdominal segments. The anal segment is without spiracles. Dorsally there are anastomoses between both trunks.

According to HENNIG (1948, I, p. 135) who bases here on the paper by RÜBSAAMEN & HEDICKE (1926—1938), in the larvae of Itonidinae, to which *M. fagi* HTG. belongs, in their third instar there are always seven inter-trunk anastomoses. This seemingly differentiates the larvae of *Itonidinae* from those of *Oligotrophinae*, the latter having eight anastomoses, thus one more than the former. This differentiating anastomosis appears only in *Oligotrophinae* and is found in the eighth abdominal segment.

It is interesting that this generalisation does not pertain to the larvae of *M. fagi* HTG. in the second as well as in the third instar. I observed that already in their second instar they have 8 and not 7 abdominal anastomoses. This is effected by the ending of their lateral respiratory trunk not in the seventh but in the eighth abdominal segment and there branching into two branches. The outward one is connected with the ninth spiracle in the eighth segment and the internal branch communicating with the internal one of the other side forms the eighth anastomosis (Pl. VII, fig. 13d). It must be said that sometimes there is no connection between these internal branches and there results a small interval between their ends in the second instar of the larva. In most cases, however, we have to do with a typical anastomosis. Intervals instead of the interior anastomoses also happen in other segments. We cannot therefore question the existence of the eighth anastomosis, because consequently we should be obliged to question the other ones also.

Lastly I must remark that in the larvae of *M. fagi* HTG. there appears one more anastomosis of which there is no mention in the paper by HENNIG (1948). Thus from the first pair of spiracles there run two branches since the lateral parts of prothorax to the middle of mesothorax, where they seem to direct towards both cerebral hemispheres. In the plane of symmetry of the body those branches bend towards the back part of the hemisphere and separate into smaller branches there. Between these twigs there is in mesothorax a connection, and because of this we may speak of an anastomosis connecting both respiratory trunks in mesothorax (Pl. VII, fig. 13b). I call it the cerebral anastomosis to discern it from the abdominal anastomoses.

In the central part of all the eight abdominal anastomoses there are always two bladder-like thickenings. They look as if two drum-sticks touched by the balls at their ends. Between the two bladderlets a short spiracular communication may be seen (Pl. VII, fig. 13d). The bladderlets in the larva's second instar do not show any visible internal structure.

The larva's second instar usually lasts a long time, often until half of August, sometimes to September (Table II). In abnormal conditions, however, it may last much shorter.

The body size, the glassy lustre of the skin, and its pinkish colouring, allow the larva of *M. fagi* Htg. in its second instar to be easily distinguished from that in its third instar.

### The third instar of the larva of *M. fagi* Htg.

Towards the end of the second instar the larva moults The moulted skin is very thin, colourless, and difficult to notice Again, the differences in the external appearance of the larva after moulting are very distinct.

The larva, first being transparent and pinkish, now becomes milky-white, dull, and untrasparent. It loses its lateral spiny tumours which it had its second instar on mesothorax, and it obtains a rather mysterious organ on prothorax ventrally. This is a brown sclerite plate, the so-called spatula sternalis, also breastbone or anchor process (in Polish called „łopatka brzuszna“ by Kapuściński 1946). The spatula is an organ characteristical for the third, usually the last instar of many larvae of *Itonididae*. In the body of the larva of *M. fagi* Htg. it has the form of a capital Y (Pl. VII, fig. 15). The „handle“ of the spatula sticks in the skin, again, the ends of its arms are free, they are directed head-wards and stick out. The expanse of both spines is rather constant and oscillates only between 0,07 and 0,09 millimetres.

The authors are of different opinions as to the meaning of the spatula. Hennig (1948, Vol. I, p. 75) supposes that this is a substitutional organ (Ersatzorgan) which was formed in connection with a reduction of the mouth-parth. However, the larvae use the mandibular capsule to eat in all their instars, i. e. also in their first two instars when they have no spatula sternalis. Sen (1939) in his paper on *Rhabdophaga saliciperda* Duf. ascribes to spatula sternalis the part of an organ used to bore a way through the plant's bark. However, there are many larvae of *Itonididae* possessing spatula sternalis and living in conditions other than *Rhabdophaga saliciperda* Duf. Amongst others *M. fagi* Htg. belongs to the latter as it bores no channels in its lifetime. Maybe, this organ plays different parts in various species of larvae of the *Itonididae*. I suppose that it enables the larvae of *M. fagi* Htg. to conserve a constant position in the chamber by resting the oustanding spines on the wall, or else a backward motion by pushing off the wall. Again, I did not observe an ability of executing bounds by the larva, while according to Keller (1956, p. 110) the larvae of *Itonididae* possessing spatula sternalis supposedly show such an ability.

On prothorax ventrally, on both sides of spatula sternalis, at a short distance one skin wart may be found on each side —

Table II

The development of larvae of *Mikiola fagi* Htg. in 1957
in the environs of Krzeszowice

| No. | Date of collecting | In 100 galls there were healthy larvae | Of these healthy larvae following numbers lived in instar | | | |
|---|---|---|---|---|---|---|
| | | | I | II | III | III with closing membrane |
| 1 | 10. 5. 58 | 100 | 100 | 0 | 0 | 0 |
| 2 | 13. 7. 57 | 80 | 0 | 80 | 0 | 0 |
| 3 | 19. 7. 57 | 57 | 0 | 57 | 0 | 0 |
| 4 | 30. 7. 57 | 58 | 0 | 56 | 2 | 0 |
| 5 | 3. 8. 57 | 66 | 0 | 56 | 10 | 0 |
| 6 | 10. 8. 57 | 58 | 0 | 38 | 20 | 0 |
| 7 | 20. 8. 57 | 53 | 0 | 20 | 32 | 1 |
| 8 | 27. 8. 57 | 62 | 0 | 2 | 55 | 5 |
| 9 | 7. 9. 57 | 58 | 0 | 0 | 50 | 8 |
| 10 | 14. 9. 57 | 48 | 0 | 0 | 38 | 10 |
| 11 | 16. 10. 57 | 20 | 0 | 0 | 3 | 17 |

I call these verruca ventralis dextra et sinistra (Pl. VII, fig. 15e). Similar verrucae also appear on mesothorax and metathorax. They lie in nearly the same distance from the body sides as on the first segment. On the surface of each verruca there are two minute papillae ventrales with setulae as well as two circular papillae without setulae. The first and second papillae are very small, and therefore verruca brings the impression of a vestigial organ. Their minute dimensions were probably the cause that they were not discerned by Kieffer (1895, p. 10) or mentioned by Hennig (1948). On the external side of each verruca ventralis there is on each side a papilla ventralis anterior.

Ventrally on the thoracal segments, on both sides of the plane of symmetry, there are circular papillae ventrales without setae. On prothorax one pair may be found between the spines of spatula sternalis, one pair on mesothorax and one on metathorax, while each papilla lies on a skin elevation devoid of cuticular spines, alias on a denuded mound (Pl. VII, fig. 15f). Sometimes on metathorax there are three papillae ventrales without setae instead of two. This case is represented on Pl. VII, fig. 15.

On the first seven abdominal segments (ventrally) there are large transverse fields without cuticular grains; on each of these fields there are four circular papillae ventrales anteriores. On the eighth segment, on a smaller grain-less field, there are only two papillae, while on the anal segment (possessing a different form than in the second instar) just beside the anal slit there are two papillae anales on each side (Pl. VII, fig. 15g).

On the first seven abdominal segments, except papillae ventrales anteriores, thre are — somewhat behind them — papillae ventrales posteriores. Contrarily to papillae anteriores, they possess setae. They appear on the segment, one on each side.

The chaetotaxy of the dorsal part of the body is identical as in the larva's second instar. Between the stigmae lying on this side six single setae (papillae dorsales) may be found. Again, on the sides of dorsum there always appear papillae pleurales.

Also the disposition of the respiratory trunks on the dorsal side is in all not different from that described for the second instar. Eight (not seven) anastomoses connecting the longitudinal trunks may be observed, and in every anastomosis a left and right side may be discerned, ending by a small bladder near the plane of symmetry of the larva's body.

The differences in external appearance between larvae of *M. fagi* Htg. of different age are so great that already the first glance after opening the gall chamber allows to say in which instar the larva is.

Inconsistent details may be found in the literature, as pertaining to the colouring of the larvae of *M. fagi* Htg. Büsgen (1895) writes correctly, that young larvae are coloured red but he does not say that only young ones are red. Ross & Hedicke (1927) describe a white colouring, and Escherich (1942) a pink one. Undoubtedly every one of the authors is right; but the red colour given by Büsgen pertains to the larva's first instar only, that quoted by Escherich — to the second, and that described by Ross & Hedicke — to the third.

## Prepupal and pupal instar of *M. fagi* Htg.

The third instar of the larvae of *M. fagi* Htg. usually lasts to the beginning of autumn. If the larva did not die to this time, it begins its last labour. Namely it weaves a membrane from web at the base of the chamber; I call it the closing membrane, membrana obturans. The membrane is circular, snow-white, and seems similar to paper (Pl. VII, fig. 16 h). A gall with membrana obturans separates in a short time from the leaf by itself and falls to the ground. Again, the galls without membrana, e. g. galls with younger larvae of *M. fagi* Htg., or hiding parasites, or else secondary lodgers, remain on the leaves until next spring.

Thus a gall which falls off has on its underside a circular opening closed by the membrane. In this place the imago will come out in future. The manufacturing of membrana obturans by the larva witnesses the end of the larval development. After this the larva moves towards the top of the gall, turns with its head towards the membrane, and stays motionless for a time, after which it pupates. A part of the larvae pupate already in autumn, some only in spring. Imago hatches in April. In 1947 in the environs of Krzeszowice, already at the beginning of October most of the galls with a healthy larva of *M. fagi* Htg. had the base of the gall covered by membrana obturans (Table II, No. 11).

### Galls with two larvae of *M. fagi* Htg.

According to the authors, the gall chamber is inhabited by only one larva of *M. fagi* Htg. I agree that this is so normally, but there are exceptions. During the examination of large numbers of galls from time to time such may be met with in which two larvae feed instead of one (Pl. VI, figs. 10 and 11). However, this is exceptional.

In 6425 galls collected in 1957 in the environs of Krzeszowice there were 15 with two larvae i. e. one in 427. Among the 10 379 galls collected in the same locality in 1958 there were 25 with two larvae i. e. 1 gall in 415 with one larva. Among the 300 galls brought by A. Madeja from Zakopane there were two such galls, but in the 550 which I collected in Las Wolski in 1957 there was none with two larvae. Among the 17 654 galls found in the years 1957—58 (the total of all named above) there were 42 with two larvae of *M. fagi* Htg.

The state of health of these larvae was varied. The data pertaining to this are listed in Table III. When analysing the listed data we remark that in 1958 as much as 22 galls in 42 contained larvae infested by parasites. It is also striking that in 7 cases only one larva was infested, and the other was healthy.

## B. Damages in the walls of the galls made by various animals.

Normally the juice of the cells in the gall chamber walls serves as nourishment for the larvae of *M. fagi* Htg. However, also other animals find their food in this, and owing to it the galls suffer various damages.

1. In spring, in May and June, when the gall chamber walls are still soft and juicy, there may be found — besides intact galls — some galls more or less destroyed by plant-eaters. In the gall wall there is then often an opening of large dimensions and the chamber is empty.

Such galls are by no means rare. However, a search for them must be begun rather early. On Mt. Niedźwiedzia Góra, on July 2nd, 1958, I found 21 such galls in an hour. They were mostly smallwhich speaks for an early use made of them — yellow, dry, with a larger or smaller opening in the wall, empty inside.

Table III

Health status of the larvae of *Mikiola fagi* Htg. when two of them abnormally appear in one gall chamber

| Locality | Number of examined galls | In one gall two larvae of *M. fagi* Htg. | | | | |
|---|---|---|---|---|---|---|
| | | Both healthy | One healthy, the other dead | Both dead | One healthy, the other infested by parasite | Both infested by parasite |
| Las Wolski 1957 | 550 | 0 | 0 | 0 | 0 | 0 |
| Zakopane 1957 | 300 | 2 | 0 | 0 | 0 | 0 |
| Krzeszowice 1957 | 6425 | 10 | 0 | 2 | 0 | 3 |
| Krzeszowice 1958 | 10379 | 4 | 1 | 1 | 7 | 12 |

Strongly damaged galls do not stay for long on the leaf and usually fall off leaving an indistinct scar of the leaf's surface. Therefore a later search for such galls may give a more or less negative result.

The described damages are made by carterpillars of moths. Among others the caterpillar of *Chimabache fagella* F. belongs here; I found it several times on the galls of *M. fagi* Htg. in Las Wolski near Kraków. It was occupied by eating the gall wall, and not the leaf. Once in the environs of Krzeszowice I found a naked green caterpillar of the family *Noctuidae* feeding on a gall chamber wall. However, a determination of its species did not succeed, as at home I bred a parasite of family *Ichneumonidae* instead of the moth.

2. I reckon such galls to the second category which have a caterpillar of a moth in the chamber instead of the larva of *M. fagi* Htg. On June 19th, 1957, and a second time on May 25th, 1959, in a gall not damaged exteriorly, a minute caterpillar of a moth was feeding in the chamber; it had a black head and a scutum prothoracale dorsale of the same colour. It had normally formed legs and prolegs. Inside the chamber there were threads across, among them there were numerous crumbs of faeces. The caterpillar was taken out of the chamber and fed at home with galls; when it moulted, it showed to be a caterpillar of *Chimabache fagella* F. named above. It could be determined because the caterpillar of this moth — beginning with its second instar — has on its hind legs abnormally enlarged tarsus characteristical for it.

Thus it could be shown that the caterpillar of *Chimabache fagella* F. may pass its first instar in the gall chamber of *M. fagi* Htg. Under its influence the gall wall becomes thinner and thinner, it usually collapses inside, always becoming feebler. Then the caterpillar eats out a large opening in the wall and comes out. It also happens that it occupies the chamber of some gall in the neighbourhood, or it begins to live on the leaves of the beech.

The question is unsolved how the caterpillar of *Chimabache fagella* F. gets into the gall chamber. It may be that the female of the moth which hatches in spring and lives until May in our conditions (Schille 1931) lays a part of its eggs at the bases of the galls of *M. fagi* Htg. There can be no question as to the laying of an egg directly into the gall chamber; the female's ovipositor does not allow it as it has no cutting apparatus (Pierce & Metcalfe 1935). We must suppose therefore that the caterpillar immediately after hatching eats into the gall chamber wall and occupies the chamber. The opening made by it in the wall quickly grows over and disappears. Neither is it known whether the caterpillar kills the larva of *M. fagi* Htg. or if the latter dies in the chamber after its being occupied by the new lodger, or else if the female of the moth searches for an empty gall for its offspring. This could be possible as there are enough of such galls with a dead *M. fagi* HTG., even in May.

The chambers left by the caterpillars of *Chimabache fagella* F. may be found in later months. They are easy to recognise after the numerous crumbs of faeces and the spun threads hanging among them. Again, galls with live caterpillars may be found only in spring, i. e. in May and June.

Only once, on September 9th, 1958, I found a small gall, without an opening in the wall, a minute caterpillar of a moth, greenish-yellow. The breadth of its head (0,226 mm) was smaller than that of the brain which was in prothorax and not in the head. Thus it had a fractional cerebral index (DZIURZYŃSKI 1958), which would undoubtedly ascertain that it was a representant of *Microlepidoptera* in its first instar. Unfortunately this caterpillar only lived until September 15th, 1958, and it was not possible to determine the species. I suspect, however, that it was a caterpillar of *Chimabache phryganella* HBN. in its first instar. This species of moth appears in Poland since September to November (SCHILLE 1931) and the caterpillar lives on various deciduous trees, among others also on the beech.

In 1957 in the material from Krzeszowice I found barely 19 specimens of galls left by caterpillars of *Chimabache fagella* F. As the caterpillars of this species of moth may be found more often on the leaves of the beech than in the gall chambers — at least on the branches which may be reached at from the ground — we must suppose therefore that not all caterpillars of *Chimabache fagella* F. pass their first instar in the gall chambers.

A chamber left by the moth's caterpillar is usually occupied by aphids with a white waxy excretion, probably *Phyllaphis fagi* L. I found 14 such galls in the environs of Krzeszowice in 1958, that is, of the 19 galls showing traces of being used by caterpillars of *Chimabache fagella* F. 74% were occupied by aphids.

3. In 1957, on the leaves of several beeches growing on Mt. Nowojowa Góra and Niedźwiedzia Góra near Krzeszowice, I found some galls of *M. fagi* HTG. the walls of which were ringed in a characteristic manner. The ring had thə from of a groove superficially made on the chamber wall, more or less

transversely to its long axis, not reaching the chamber (Pl. I, fig. 7). The larva of *M. fagi* Htg. lived in the gall and could develop further without obstacle. One of these galls had a wall damaged somewhat differently. (Pl. VI, fig. 8).

There were still less ringed galls than those reckoned to categories I and II. One was found on June 28th, 1957, on Mt. Nowojowa Góra, eight on Mt. Niedźwiedzia Góra in September and August. The latter were found much later than the first, but their damaging could doubtlessly have taken place much earlier, perhaps in May or June. In 1958, in spite of examining more than 10 000 galls found in the same area, I did not notice one damaged in this way. In 1959 all went similarly.

The author of this damage stays unknown. But I think that it could be the Hymenopterous species *Cimbex femorata* L. *(family Tenthredinidae)*. It is known, that the imagines of this species of *Hymenoptera* bite the surface of young twigs of deciduous trees, among them also of the beech. Their feeding leads to the formation of grooves in the form of rings or spirals. Their appearance reminds of the damages made on the galls. The imago of *Cimbex femorata* L. appears in Poland in May and June.

4. Among the 100 galls of *M. fagi* Htg. which I obtained from Zakopane on September 27th, 1957 (collected on an old beech 10 metres above ground in Dolina Białego, lower Tatra Mts.), there were eight damaged in a very characteristic way. Their top parts were bitten off, therefore damaged otherwise than the galls reckoned to category 1. The bitten surface was uneven, as if somebody had broken the top of the gall with teeth (Pl. VI, fig. 9). The break must have been made recently, probably in September, when the gall walls are lignified and therefore hard. The one who caused this did not do it to eat the woody wall but surely to get at the fat larva of *M. fagi* Htg. which reaches its maximal size in September. The chambers of the galls with tops broken off were empty.

We may suppose that the damages described were caused by some minute mammal climbing trees. It might be the acorneater (*Eliomys quercinus* L.) of which we know that it lives in the Tatra Mts. where it likes to frequent deciduous forests, that it is able to climb trees skillfully and feeds not only on the fruits of deciduous trees but also willingly on animal food (NIEZABITOWSKI 1933, and FEDOROWICZ 1928).

5. An opening in the gall wall may also form while some Chalcidid comes out of the chamber. However, such openings are much smaller than those made by the caterpillars of moths (Pl. I, figs. 5 and 6 to compare).

6. Lastly, the gall wall may be damaged by the ovipositor of the females of *Chalcididae* laying eggs in the chambers. These are narrow channels formed during the perforation of the gall wall by the ovipositor. On the gall wall surface in the place of perforation there forms a minute mound, and in the wall there is a trace of the perforation in the form of browned cells. On the interior chamber wall there forms a brown spot, usually well visible on the green underground. Sometimes instead of the spot there is in this place a tumour of strongly elongated cells. The number of tumours in the chamber may be considerable sometimes. This means that the female Chalcidid made several punctures in the wall before it laid the egg.

## C. *Secodes coactus* RTZB. an endophagous primary parasite of the larvae of *M. fagi* HTG.

Two *Chalcididae* are nearly exclusively named by the literature as parasites of *M. fagi* HTG., namely *Hyperteles elongatus* FÖRST. and *Torymus cultriventris* RTZB. — e. g. by RATZEBURG (1844), FÖRSTER (1856), BRISCHKE (1881), BÜSGEN (1895,) ESCHERICH (1942). The named *Chalcididae* really hatch from the galls of *M. fagi* HTG. but — in my opinion — they are not its parasites. I postpone the discussion of this problem to the second part of my paper on the inhabitants of the galls of *M. fagi* HTG.

In my opinion, in the family *Chalcididae*, the chief enemy (although not the only one) of the larvae of *M. fagi* HTG. is *Secodes coactus* RTZB. (*fagi* FÖRST.) belonging to sub-family *Eulophinae*, tribe *Entedonini*. The specific as well as the generic name

*Secodes fagi* were given by Förster (1856). He mentions in this paper that he obtained this Chalcidid from the galls of *M. fagi* Htg. (p. 81).

He also erected the genus *Secodes* from genus *Entedon* Dalm., as it differs from the latter — among other characters — by the presence in the fore-wing of an asetose cellula radii (Pl. VIII, fig. 26). There is just such a cell in the fore-wing of a Chalcidid bred by me from the galls of *M. fagi* Htg. In the paper by Förster (1856) — only this one was accessible to me — I found no nearer details on the appearance of his *Secodes fagi.* Therefore it is difficult to say whether the Chalcidid found near Krzeszowice is identical with the *Secodes fagi* determined by A. Förster. This induced me to describe the imago of the Chalcidid in question with more detail.

## 1. Imago of *S. coactus* Rtzb.

*S. coactus* Rtzb. from the environs of Krzeszowice is coloured nearly black with a green or green-blue hue on the front of the head and on the back part of the thorax and the adjacent part of abdomen. The lustre is metallic. The legs with four-jointed tarsi are black-brown, with yellow blots in the region of trochanteri, femori, and tibiae. The feet are ochreous yellow.

The females are somewhat larger than the males. The length of their bodies is nearly 2 millimetres, while that of the males about 1,5 millimetres. The widest part of the body (of the females as well as the males) is the head. The male's thorax is wider than the cylindrical abdomen, the female's thorax is as wide as abdomen, the latter egg-shaped. The abdomen is sessile (Pl. VIII, figs. 17 and 18).

The head of *S. coactus* Rtzb. seen from the front reminds of a trapezium in outline, its shorter side ventrally. According to Hedicke (1920, p. 8) all the elements of the head capsule in all *Chalcididae* are ankylosed without sutures. It is interesting that *S. coactus* Rtzb. seems to be an exception in this respect. There are sutures on its head. They limit a moderately convex clypeus with four setae and a more convex frons with 2 setae, separating them from the deep scrobi antennales which lie on the sides of frons. Above frons a transversal suture is visible. Its two arms beginning at the summit of the triangular frons extend obliquely left and right towards the upper limit of both the eye complexes. They separate the occipital field with three ocelli from the more ventrally placed facial parts (Pl. VIII, fig. 19s).

The eye complexes of the females and males are sparely haired, more so in females than in males. The antennae are placed on both sides of the triangular frons more or less in the half of its sides. The base of antenna is composed of a very small basal joint, called radicula, which is not counted as the antenna but forms an intermediary in the connection of the antenna and the head.

In the antenna of *S. coactus* RTZB. I discern scapus, pedicellus, anellus, and a five-jointed funiculus without clava. The vestigial, disc-like anellus lies between pedicellus and the first joint of funiculus.

According to FÖRSTER (1856) the antennae in genus *Secodes* have exactly the same number of joints as in genus *Harismenus* WALK. (called *Holcopelte* by FÖRSTER). Again, in antenna of *Holcopelte*, FÖRSTER discerns 8 joints with 1 anellus. This would agree with the number of joints found by me in *S. coactus* RTZB. from Krzeszowice.

The joints in funiculus gradually become shorter. There are small differences in the antennae of the male and the female. The female — although larger than the male — possesses somewhat shorter antennae. In its antenna there is a long and narrow scapus, while that of the male is shorter but wider (Pl. VIII, figs. 20s and 21s). On the joints of funiculus there are a few short setae; again, in the male there are more numerous and longer ones. The setae on all joints of funiculus in the male mostly grow from the basal parts of the joints, and this reminds of a ring-like arrangement. On the first and last joint of funiculus in the female such an arrangement cannot be seen.

On apex of the last joint of funiculus there is in both sexes a microscopical cylindric process, called apiculus. The female's apiculus is provided with two sensory setae. One of them grows on apex, the second one near to it but below apex, on a stair-like projection. Both show a comparatively considerable length;

it nearly equals the length of apiculus. The male's apiculus is simpler. On its end there is one very short seta, barely visible. It is shorter than the breadth of anellus. Its shortness was observed on fresh specimens, and also on antennae of males taken out of pupae before hatching. Therefore there is no possibility of its being broken, as it frequently happens in antennae taken from dry specimens of *Chalcididae*. At the base of apiculus of the male and female there is always in *S. coactus* Rtzb a rod-like sensory organ which I call „*sensilla trichoidea olfactoria*". There are also such sensillae on other joints of funiculus. The presence of two setae on the female's apiculus is a rather exceptional feature for *Chalcididae* (Pl. VIII, figs. 22 and 23).

In the mouth-parts mandibulae are coloured bronw and possess three teeth. The maxillo-labial complex deserves attention owing to an interesting form of palpi. Palpi maxillares and labiales are identically built. They are one-jointed (as also in other *Eulophinae*) but the basal part of both is nearly twice wider than the terminal part. The latter does not stand on the middle of the basal part but is translated to its interior lateral part. Therefore, more or less in half length of palpus, on its outer side there is a stair-like incision from which grows a cylindrical blunt-ended rodlet (Pl. VIII, fig. 28pr). Again, from the top of palpus there grows a sensory seta. In other species of *Eulophinae* I could find the sensory seta as well as the sensory rod side by side on the top of palpus. Glossa of *S. coactus* Rtzb. possesses few sensillae basiconicae; there are always four of them.

Thorax, as in the insects in general, divides into three segments, pro-, meso-, and meta-thorax. Metathorax continues with the first abdominal segment, the so-called propodeum with two spiracles. Pronotum is narrow and towards the head forms an outstanding collum. In mesonotum both notauli reach up to axillae with their ends, without touching scutellum. The sculpture of mesonotum is net-like, without hairs, as on Pl. VIII, fig. 24. On mesonotum there are four large setae disposed in pairs, on scapulae — one on each, dorsally. On scutellum which narrows caudally and somewhat covers the medial part of metanotum with its triangular outstanding margin, there are always two setae, and above them two pori (Pl. VIII, fig. 25). The fore wings are connected with mesonotum. In the wing — as in *Entedonini* in general — the subcosta is broken, and radius is further than in the first half of the wing. At that it is short and widens at once into a comparatively wide an large clava with narrow uncus directed towards the anterior margin of the wing. From uncus to that anterior margin there runs a row of hairs separating naked hairless wing areas which could be called cellula radii. This feature once allowed Förster to rise genus *Secodes* from genus *Entedon* Dalm. to which it was reckoned before (Pl. VIII, fig. 26).

The wing venal index presenting the ratio of subcosta (ramus submarginalis) to ramus marginalis, to radius, and ramus postmarginalis, is expressed by the figures 4:4:1:1 (the length of subcosta is not counted here to the point of breaking but to the place in which ramus marginalis begins on the wing's margin). In the legs the tibial calcares are somewhat shorter than metatarsus.

Special attention should be paid to the genitalia and the phallic organs of the male of *S. coactus* Rtzb. The genitals are symmetrical in pairs and composed of parts appearing also in other Chalcidids. The gonads have the form of elongated colourless sacs in which movements of the spermatozoa may be seen under strong enlargement. The gonad is connected by a short vas deferens with a bipartite vesicula seminalis. The wider part communicates with vas deferens, the narrower one — with ductus ejaculatorius. In transient light they have a reddish-brown colouring, in reflected light they are milky white and untransparent. A comparatively large, bag-like, transparent glandula accessoria is connected with ductus ejaculatorius. Its form depends much on the concentration of the liquid in which the genitals of *S. coactus* Rtzb. are conserved. All these parts are connected with organs of the same kind on the opposite body side, and also by a common duct with aedoeagus. (Pl. X, fig. 44).

In the copulative organs of the male two fundamental parts may be discerned: aedoeagus and phallotheca. Aedoeagus outlined as usually in other *Chalcididae*; there are two differences, however. It is unusually strongly curved towards the ventral side of the male's abdomen, which is easily observed when looking laterally at abdomen. In its back part it has the form of a boat turned with its bottom to the dorsum of imago. The capital end, always sticking in abdomen, is lengthened into two long processes reaching far into phalloteca. In this respect aedoeagus is similar to those of other *Chalcididae*. Again, it differs by having a short median process (Pl. X, fig. 46 s) in its median part, near the place where begin the long lateral processes mentioned above. With this process a muscle is probably connected, pulling aedoeagus into phallotheca after use.

Phalloteca has the form a small gutter with its bottom downwards. On its anal margin and on its ventral side left and right there are hypomers. In the literature pertaining to *Chalcididae* they are usually called titillatores (the name from titillo — I tickle). However, the name is not used correctly here. Titillatores according to Snodgrass (1935) and Keller (1956) are curved spines, slender processes, or small plates occurring on the terminal part of aedoeagus, and not on phallotheca; they really serve to tickle. Contrarily, the organs which I called hypomers do not serve to tickle but to hold the female during copulation. This explains the presence of thorns on their surface. Therefore it is better to call them hypomers.

These hypomers in the male copulation organs of *S. coactus* Rtzb. show a form which I did not yet see in *Chalcididae*. Usually the hypomer in these insects has the form of a quadrangular plate which is connected movably with phallotheca by one of its shorter sides. On the opposite side of the plate there are the thorns serving to hold the female during the copulation. Again, the hypomer of the male of *S. coactus* Rtzb. has a form similar to a fishing hook, not a rectangle. The bent point of this hook is directed headwards, the opposite end with two thorns-caudally. In transient light it is coloured brown, becoming black in the hook-bent parts. This ascertains that the hypomers in this species of Chalcidid are very strongly sclerotized (Pl. X, fig. 45 h).

The hypomers have a movable connection with phallotheca. By the contraction of the abducting muscle they direct their thorns to the sides. At the same time their hooked part becomes directed towards the end of the male's body (Pl. X, fig. 47).

## 2. The choice of galls by the female of *Secodes coactus* Rtzb.

As already mentioned, *S. coactus* Rtzb. is an endophagous parasite of *M. fagi* Htg. The larvae of *M. fagi* Htg. infested by the parasite are not always common and are not to be found everywhere. In the 4150 beech galls collected in Las Wolski near Kraków in the years 1947 and 1948 not one larva of *M. fagi* Htg. contained a parasitic larva of *S. coactus* Rtzb. Only as late as 1958 I managed to find some on the Panieńskie Skały rocks in Las Wolski. I found larger numbers for the first time in locality Czerna near Krzeszowice, and then in 1957 and 1958 in many specimens on Mt. Niedźwiedzia Góra near Krzeszowice.

The larvae of *M. fagi* Htg. in their first and second instars are transparent enough to render the parasite visible inside their body without sectioning the latter. However, the examined larvae mus be observed in physiological solution. To make a drawing, measure the size of the parasites, or ascertain their number in the host, a preparation must be made. This causes no great difficulties, as it is sufficient to tear apart the skin of the larva of *M. fagi* Htg. with a needle. The haemolymph flows out immediately and the parasites with it, if the larva was infested, of course.

The female of *S. coactus* Rtzb. has a considerable obstacle to surpass before laying the egg directly into the body of the larva of *M. fagi* Htg. The host larva is inside the gall chamber, invisible from outside and separated from the parasite by the gall wall. The parasite must pierce the wall with its ovipositor as well as the skin of its prey without seeing it. The egg-laying difficulties are enhanced by the shortness of the ovipositor. Other *Chalcididae* using the gall chamber to raise their young possess much longer ovipositors. The female of *Torymus cultriventris* Rtzb. belongs here in the first place. Even the female of *Hyperteles elongatus* Förist. has an ovipositor about three times longer than that of *S. coactus* Rtzb. This shortness of the ovipositor is the reason for only a part of the beech galls becoming possible to use by the females of *S. coactus* Rtzb.

In the period of laying eggs by the parasite (in the second half of May) the galls are already partially formed. Small galls (category sm) prevail strongly, but they differ in form, colour, and wall hardness.

In 100 galls collected on Mt. Niedźwiedzia Góra near Krzeszowice on May 24th, 1959, i. e. collected in the period in which the females of the parasite were still laying eggs, there were 68 small galls (category sm), 24 medium galls (category md), and 8 large ones (category lg). There were healthy larvae of *M. fagi* Htg. only in 22 galls, in 78 galls they were infested by *S. coactus* Rtzb. Among these 78 galls there were:

| | | |
|---|---|---|
| small galls | 58 | specimens |
| medium galls | 20 | " |
| large galls | 0 | " |

Thus *S. coactus* Rtzb. laid eggs into larvae of *M. fagi* Htg. living in small and medium galls with a preference for small ones. The majority of the infested galls were slim ones (category sl), too. The parasite did not use large galls (category lg) at all. A similar result was given by the material listed in table IV. The galls were collected on June 11th, 1958, thus somewhat later and after the period of egg-laying for *S. coactus* Rtzb. Among 250 galls there were 85 medium (category md), and 165 small ones (category sm), and there were no large ones at all. Among the small galls I could count 23 with walls from pink to red, and 142 with green walls. Among these green ones, 119 had hardened walls, the others had soft and juicy ones. This difference in hardness could be felt quite easily when cutting the wall with a razor-blade.

After an examination of the content of the gall chambers, as results from a study of table IV, it could be seen that *S. coactus* Rtzb. laid eggs nearly exclusively into the bodies of larvae of *M. fagi* Htg. living in galls of category sm, i. e. small ones and at the same time hard and green ones.

A choice of small and slim galls by the females of *S. coactus* Rtzb. in the considered material may be explained by the shortness of the female's ovipositor. Moreover I suppose that it has the capacity of discerning the gall wall thickness. Maybe it attempts tentative perforations, or orientates in the wall thickness already after its hardness. It is a fact the females chose small and hard galls. Again, I think it mysterious that in the galls in which feeds a larva of *M. fagi* Htg. infested by *S. co-*

*actus* Rtzb. the walls do not become pink. It results from table IV that in 21 pink-red galls there was such an infested larva only in one of them.

This last generalisation is valid only for the material in the environs of Krzeszowice, the chief place of my investigations. In galls collected in locality Międzyzdroje (situated on the shore of the Baltic sea) I also found larvae of *M. fagi* Htg. infested by *S. coactus* Rtzb.; these appeared in small and slim galls, but not only in green ones — in pink-red ones as well.

Table IV

Results of an examination of 250 galls of *M. fagi* Htg. collected on Mt. Niedźwiedzia Góra near Krzeszowice on June 11th, 1958

| Content of chamber | | Number of medium galls (md) | Small galls (sm) | | |
|---|---|---|---|---|---|
| | | | pink or red | green | |
| | | | | soft | hard |
| *M. fagi* Htg. alive | without endophagous parasite | 59 | 20 | 17 | 7 |
| | with endophagous parasite | 1 | 1 | 0 | 103 |
| *M. fagi* Htg. dead | chamber empty | 14 | 2 | 6 | 8 |
| | in the chamber a larva of Hyperteles Först. | 11 | 0 | 0 | 1 |

When only I controlled the results of my work in the years 1957—1959, I could always show that:

1. in large galls (category lg) there are no larvae of *M. fagi* Htg. infested by *S. coactus* Rtzb.,

2. such larvae do not appear, either, in small galls with soft and juicy walls,

3. such larvae appear, however, rather often in small and slim galls (categories I sm and II sl) having walls green at the beginning, yellowish towards the end of development of the parasite, walls at the same time hard, not juicy.

### 3. The development of *Secodes coactus* Rtzb.

The spring in 1958 in the environs of Kraków was rather late. The development of the leaves of *Fagus silvatica* L. from the winter buds began as late as May loth in the environs of Krzeszowice where I collected my material.

I observed eggs as well as young larvae of the parasite *S. coactus* Rtzb. in the bodies of larvae of *M. fagi* Htg. only since May 25th, 1958. The larvae of *M. fagi* Htg. then measured about 1 × 0,4 millimetres, and were in their second instar (details in table V). Again, larvae in their first instar were not infested.

Table V

A comparison of the size of larvae of *M. fagi* Htg. with the size of larvae of *S. coactus* Rtzb. found in the bodies of the former, in the period from May 24th to May 31st, 1958

| No. | Dimensions of larva of *M. fagi* Htg. in mm | | Dimensions of larva of *S. coactus* Rtzb, in mm | |
|---|---|---|---|---|
| | maximum length | maximum width | maximum length | maximum width |
| 1 | 0,76 | 0,4 | 0,26 | 0,08 |
| 2 | 0,85 | 0,37 | 0,24 | 0,08 |
| 3 | 0,85 | 0,36 | 0,28 | 0,09 |
| 4 | 0,87 | 0,4 | 0,27 | 0,10 |
| 5 | 1 | 0,36 | 0,17 | 0,07 |
| 6 | 1 | 0,37 | 0,23 | 0,07 |
| 7 | 1 | 0,4 | 0,25 | 0,06 |
| 8 | 1,1 | 0,4 | 0,25 | 0,09 |
| 9 | 1,2 | 0,44 | 0,3 | 0,08 |
| 10 | 1,2 | 0,45 | 0,21 | 0,07 |

The egg of *S. coactus* Rtzb. has a crescent-like shape. It is slightly wider in its anterior end than in the posterior one, convex-concave in the middle. Its chorion is smooth, its dimensions oscillate between 0,238—0,295 by 0,067—0,079 millimetres. The eggs as well as abandoned chorions may be found only in the haemolymph in the haemocoele of the larvae of *M. fagi* Htg. I never saw them outside a gall chamber or else on the skin of the host. Neither were they inserted in the skin of the larva of *M. fagi* Htg. as is done by some *Chalcididae*.

### a. The first instar of *S. coactus* Rtzb.

In the first instar, just after leaving the chorion, the larva has a crescent-like shape, similarly to the egg from which it originates. The larva is wider on the anterior end, tapering gradually towards the posterior end. The head equalling thorax with its width is connected with it without incision. There are no antennae, its mouth parts are similar to those in other larvae of *Chalcididae.* On the ventral side of prothorax there are two plug-like small tumours. A strong furrowing of the larva's skin and the presence of spine-like processes on the skin belongs to the characteristic features of a young larva. The spine-like processes appear on metathorax and on the abdominal segments dorsally. They are disposed in half-garlands on the caudal part of the segments. The anal segment is provided with larger triangular sharp-angled plates. They number about 10, they lie in several rows near one another (Pl. IX, fig. 30). In table V the dimensions of the larvae of *M. fagi* Htg. are compared with those of the larvae of *S. coactus* Rtzb. which fed inside the former.

As mentioned already, the larvae of *M. fagi* Htg. were in their second instar. I think that we cannot ascribe to the parasite a capacity to choose the age of the host to be infested. Quite simply the females of *S. coactus* Rtzb. hatch at a time when the larvae of *M. fagi* Htg. feeding in the galls are in their second instar.

The parasite's larvae after hatching out of the egg feed in the host's haemocoele, first in the anterior part of its organism, in the neighbourhood of the fat bodies, near the surface of the skin. Usually they appear singly. In the material collected in 1958 only 8 larvae had two parasites in their bodies, thus most had one parasite for one host.

However, this is no rule. In 1959 in 100 galls collected in the same place about May 25th the numbers of parasitic larvae in the bodies of larvae of *M. fagi* Htg. were considerably greater. The results of an examination of the galls were listed in table VI. It was shown that the number of larvae of *S. coactus* Rtzb. in one larva of *M. fagi* Htg. may be variable. Except larvae with one parasite, others were found with two, three, and even more parasites; in one there was a record number of ten. In the examined material collected on May 25th all the parasitic larvae were young, in their first instar. There were also eggs with a more or less developed embryo. Only a part of the larvae had left the chorion, most were only coming out of it. Not all larvae were alive. For instance, in the category of larvae with two parasites (except one) only one of the parasites lived. In the „higher" categories the number of dead parasites was usually rather high. For instance in the category with nine parasites there was a larva in which only four among the nine were alive, counting two eggs laid not long ago with the living. In a larva with ten parasites there were eight dead ones, one egg and one larva being alive. Thus the mortality among the parasites was considerable. Those were usually dead which had already left the chorion. The parasitic material was composed of eggs with a more or less developed embryo, of eggs with a split chorion with larvae coming out of it, of larvae which left the chorion and were alive, and of dead larvae the appearance of which allowed to conclude that they were dead since a long time. This allows to ascertain that the host was infested more than once and had been attacked by several females in different periods. The females usually lay one egg into the body of one larva of *M. fagi* Htg. (Table VI, categ. 1 and 2). In the „higher" categories it was possible to observe a simultaneous coming out of several larvae out of several chorions in one host. This demonstrates that a female of *S. coactus* Rtzb. may lay several eggs into one larva of *M. fagi* Htg. Whatever the number of eggs laid, from one larva of *M. fagi* Htg. there hatches always only one specimen of *S. coactus* Rtzb.

I did not search for the reason of the mortality of larvae of *S. coactus* Rtzb. However, I should like to remark here that the phagocytes did not cause their death. In his time Boese G. (1936) wrote on the phagocyte reaction; he observed, when examining larvae of *Pieris brassicae* L. infested by *Apanteles glomeratus* L., that the eggs laid by this Hymenopteran or the larvae hatching therefrom are attacked by phagocytes, surrounded, and destroyed. This kind of reaction of the phagocytes of larvae of *M. fagi* Htg. to the parasitic eggs or larvae of *S. coactus* Rtzb. was not observed. After tearing open the body of a larva of *M. fagi* Htg. when the haemolymph flows out together with the parasites, I found the eggs and larvae of *S. coactus* Rtzb. in the haemolymph naked, not surrounded by phagocytes.

Table VI

The degree of infestation of larvae of *M. fagi* Htg. by *S. coactus* Rtzb. (The galls were collected on Mt. Niedźwiedzia Góra near Krzeszowice on May 25th, 1959. In 100 larvae 78 were infested)

| Number of parasites in a larva of *M. fagi* Htg. | Categories | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Individuals found | 21 | 10 | 12 | 9 | 7 | 9 | 3 | 4 | 2 | 1 |

All this allows to ascertain that in 1959 the females o *S. coactus* Rtzb. attacked the larvae of *M. fagi* Htg. in a much stronger degree than in 1958. I explain this state of things so different from that in 1958 by an uncommon competition between individuals caused by differences in the population of both species. In table VII the results of an examination of the galls collected on October 10th, 1958, are presented, taken from the same locality as the galls collected on May 25th, 1959 (Table VI). It results from table VII that the number of non-infested larvae of *M. fagi* Htg. was strikingly small at the same time, amounting to 0,7—4%, or 2,3% in the average, according to the beech tree from which the material was taken. At the same time the number of galls with the parasite *S. coactus* Rtzb. amounted to 17—74%, or an average of 60%. The winter in 1958—59 was lenient, and we may suppose that in spring in 1959 there occurred a great difference in the density of population of both species of insects. In consequence this could cause a multiple infestation of the larvae of *M. fagi* Htg. by *S. coactus* Rtzb.

b. The second instar of the larva of *S. coactus* Rtzb.

In the period which I consider as the second instar of the larvae of *S. coactus* Rtzb. the dimensions of these larvae oscillate in wide limites: 0,340—0,570 by 0,135—0,214 millimetres. Plate IX, fig. 31, gives an idea on the changes in body form which may now be observed. The larva of *S. coactus* Rtzb. possesses a small head in its second instar, the head being somewhat elongated ventrally in the place where its mouth parts appear (Pl. IX, fig. 31a). Their structure is similar to the mouth parts of the larva of the Chalcidid *Doliphoceras pseudococci* Alam, family *Encyrtidae*, an endophagous parasite of *Pseudococcus newsteadi* Green. They were described by Alam (1959). Similarly as in the larva of *Doliphoceras*, also in the mouth organs of the larva of *S. coactus* Rtzb. there may be discerned: an arc-like epistoma directed towards the front of the head, two pleurostomae connected with the latter and forming processes with articulations for mandibulae, and two hypostomata directed backwards (visible on Pl. IX, figs. 30 and 31, omitted in fig. 31a). Except the mouth organs there are ventrally two button-like elevations, probably sense organs.

In the first instar the anterior part of the body of the larva of *S. coactus* Rtzb. is its widest part. Again, in the second instar the widest part is the part on the limit between metathorax and the first abdominal segment. Beginning with this place, the body gradually tapers headwards and backwards. The head is much narrower than prothorax from which it is distinctly separated. On abdomen, as in the first instar, there are thorny processes situated in half-garlands dorsally. They show better the segmental body structure of the larva than the indistinct intersegmental furrows. The last abdominal segment is armed similarly as in the first instar.

Inside the transparent body of the larva a narrow oesophagus may be seen as well as the midgut, widening egg-like, filled with food, closed by the end. Over oesophagus and under it there are the central nerve ganglia; the suboesophagal ganglion is connected with the nerve cord lying under the alimentary canal (Pl. IX, 31i, b, nc).

### c. The third and fourth instar of the larva of *S. coactus* Rtzb.

I did not observe moulting between the first and the second instar of the larva of *S. coactus* Rtzb. as discussed above. Again, it undoubtedly occurs between instars two and three.

The larvae of *S. coactus* Rtzb. in their second instar were observed by me on June 5th, 1958; again, those in the third one appeared since June 18th, 1958. The larvae in their first and second instars fed in the haemocoele of the larvae of *M. fagi* Htg. being in their second instar. The older larvae (those in the third instar) were parasites in larvae of *M. fagi* Htg. also being in their third instar. The dimensions of the larvae of *S. coactus* Rtzb. found on June 18th, 1958, varied between 0,450—0,830 by 0,160—0,380 millimetres.

The larva shows a maggot-like form. Its body is narrowed anteriorly and posteriorly, convex dorsally, flat ventrally. As there are no antennae, the anterior part of the body may be discerned from the posterior one by the mouth organs. The body of the larva is clothed by a thin skin, smooth, without warts, setae, or thorny processes (Pl. IX, fig. 32).

The larva feeds in the haemocoele of the larva of *M. fagi* Htg. As it grows, it pushes the host's alimentary canal to one side (Pl. X, fig. 40). With time it fills nearly completely the body cavity of the host and causes its death and the desorganisation of its tracheary system (Pl. X, fig. 41). Only the host's skin remains and the parasite does not leave it. This skin then hardens, becomes dry and brittle, and while it dries it indents in its anterior part (Pl. IX, fig. 38). Also its colour changes. It is no more white, it becomes reddish brown. The change is so striking that after opening the gall we may immediately recognise a skin of *M. fagi* Htg. hiding a parasitic larva of *S. coactus* Rtzb. inside.

After some time, in this reddish brown skin of the host we find the parasitic larva in its last instar which I regard as its fourth instar. At this period its body shape is somewhat different. Its body becomes egg-shaped, slightly sharpened at the posterior end. It contains very numerous fat bodies which are disposed rather regularly in longitudinal rows and give its body a white colour (Pl. IX, fig. 33).

It should be noted that even in the oldest larvae of *S. coactus* Rtzb. it was not possible to observe the tracheal system. Neither the spiracles nor the principal tracheal tubes could be seen. I suppose it is impossible to overlook the elements of this system.

The structure of the mouth parts is interesting. The larva has comparatively small mandibulae. At that, they are so much removed to the sides that between the ends of both pointing to one another there is a distance of 0,031—0,037 millimetres (Pl. IX, fig. 33b). In the second instar mandibulae cross each other's ends so that the larva may use them to cut its food. In the last instar this is impossible. Moreover, an independence of the movements of one mandibula from the other may be observed. In the younger stages they work simultaneously, closing or opening. In the last stage, when one is at rest, the other may execute movements.

Near the oral opening, on the surface of the skin neighbouring ventrally with the mouth, within the limits of epistoma, there are minute, circular, colourless organs, probably sense organs.

### d. The pupa of *S. coactus* Rtzb.

As already mentioned, the larva of this parasite does not leave the skin of its host, but stays inside it and pupates. Pupation takes place already in July or else in spring of the next year. It laso often happens that pupation does not follow in this second year, too, but the diapause continues into the third year. It is not yet known whether imagines hatch from these larvae retarded in their development.

In the period in which the larva of *S. coactus* Rtzb. pupates, the skin of *M. fagi* Htg. covering the latter becomes somewhat transparent and seems darker than it was when it hid the parasite's larva inside. A light-coloured blot appears on it in one place. It is made — after pupation of the parasite — from material which was not used for the formation of the pupa. At the beginning it is liquid, with the time it solidifies and forms a whitish untransparent substance under the skin of *M. fagi* Htg. This substance shines through the skin as a light-coloured yellowish blot (Pl. X, fig. 42). After this blot we recognise easily the presence of the pupa of *S. coactus* Rtzb. inside. But if — in spite of the presence of the said blot — we find inside not a pupa but a larva, which happens sometimes, we may be sure that it is the larva of some secondary parasite which destroyed the pupa of *S. coactus* Rtzb. At a closer examination it will surely be found to possess mouth organs shaped differently than those of the larva of *S. coactus* Rtzb. in its last instar.

The pupa of *S. coactus* Rtzb., colourless at the beginning, darkens quickly. At first its eyes bocome red; through the transparent skin of *M. fagi* Htg. they seem black. The pupa soon reaches its definitive colouring. The head and thorax become black and shine blue green. The abdomen is dark brown.

A male pupa is easily discernible from a female one. On the ventral side of abdomen of the male pupa there appear on the middle of the fourth and fifth segments two half-circular light-coloured fields directed caudally with the arched part; below there is the copulative apparatus, oval in outline (Pl. X, fig. 43). On the female pupa these blots are not visible, again through the skin the ovipositor may be seen. The latter does not reach to the base of abdomen (as many *Chalcididae* have it) and because of this the ovipositor is shorter than it could be with this length of the abdomen.

The scutellum of the pupae of both sexes has a structure of taxonomic value. Its caudal narrowed and lengthened end overlaps metanotum. This causes an elevation to form on the pupa's back, conspicuous when seen laterally (Pl. IX, fig. 45, arrow). There is no such tumour on the backs of pupae of other *Chalcidids* which also develop in the galls of *M. fagi* Htg. By the presence of the described tumour it is easy to distinguish the pupa of *S. coactus* Rtzb. from e. g. pupae of genera *Tetrastichus* Hal. and *Eupelmus* Dalm. which — rarely, it is true — may also be found hidden in the skin left by *M. fagi* Htg., similar in appearance to a skin hiding the pupa of *S. coactus* Rtzb.

## 4. The influence of the endophagous parasite *S. coactus* Rtzb. on the rate of growth and development of the larva of *M. fagi* Htg.

As was already mentioned, the larva of *S. coactus* Rtzb. spends its first and second instars in the larva of *M. fagi* Htg. being in its second instar. Again, the former's third instar is spent always only in the larva of *M. fagi* Htg. also being in its third instar. Considering a growth of the parasitic larva quicker than a larva of *M. fagi* Htg. in normal conditions' i. e. a healthy, non-infested larva, it was possible remark an interesting influence of the parasite on the growth and development of the host larva. To ascetain this influence, we must compare the dimensions and development stage of healthy larvae with those of infested ones collected at the same time and in the same locality. Such comparisons were made repeatedly on a large material of specimens. To illustrate this the results listed in table VII are given.

Table VII

A comparison of the dimensions and development stages of larvae of *M. fagi* Htg. without parasite and with the parasite *S. coactus* Rtzb. (Abbreviations: l — length, w — width (in millimetres), i — Instar. Niedźwiedzia Góra, May 30th to July 2nd, 1958.

| Date | *M. fagi* Htg. healthy | | | *M. fagi* Htg. with parasite *S. coactus* Rtzb. | | | Date | *M. fagi* Htg. healthy | | | *M. fagi* Htg. with parasite *S. coactus* Rtzb. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | l | w | i | l | w | i | | l | w | i | l | w | i |
| | 0,9 | 0,4 | | 0,7 | 0,3 | | | 0,7 | 0,3 | | 1,1 | 0,6 | |
| | 0,9 | 0,4 | | 0,8 | 0,3 | | | 0,9 | 0,3 | | 1,2 | 0,5 | |
| | 1,0 | 0,3 | | 0,8 | 0,3 | | | 0,9 | 0,4 | | 1,4 | 0,5 | |
| | 1,0 | 0,3 | | 1,0 | 0,4 | | | 0,9 | 0,4 | | 1,4 | 0,8 | |
| May 30th | 1,0 | 0,4 | II | 1,0 | 0,4 | II | June 20th | 1,0 | 0,4 | II | 1,5 | 0,7 | III |
| | 1,0 | 0,4 | | 1,1 | 0,3 | | | 1,0 | 0,4 | | 1,5 | 0,8 | |
| | 1 0 | 0,4 | | 1,1 | 0,4 | | | 1,0 | 0,5 | | 1,5 | 0,8 | |
| | 1,1 | 0,4 | | 1,1 | 0,4 | | | 1,1 | 0,4 | | 1,6 | 0,7 | |
| | 1,1 | 0,4 | | 1,1 | 0,4 | | | 1,1 | 0,4 | | 1,6 | 0,8 | |
| | 1,2 | 0,5 | | 1,2 | 0,4 | | | 1,1 | 0,5 | | 1,8 | 0,8 | |
| | 0,5 | 0,3 | | 1,1 | 0,5 | II | | 1,0 | 0,4 | | 2,0 | 0,8 | |
| | 0,8 | 0,2 | | 1,1 | 0,5 | III | | 1,0 | 0,4 | | 2,1 | 1,1 | |
| | 0,9 | 0,3 | | 1,2 | 0,4 | II | | 1,0 | 0,4 | | 2,4 | 1,1 | |
| | 0,9 | 0,4 | | 1,2 | 0,5 | II | | 1,0 | 0,4 | | 2,5 | 1,1 | |
| June 10th | 0,9 | 0,5 | II | 1,3 | 0,7 | II | July 2nd | 1,0 | 0,4 | II | 2,5 | 1,1 | III |
| | 0,9 | 0,6 | | 1,6 | 0,9 | III | | 1,1 | 0,4 | | 2,9 | 1,2 | |
| | 1,0 | 0,4 | | 1,8 | 0,8 | III | | 1,1 | 0,4 | | 3,0 | 0,9 | |
| | 1,1 | 0,3 | | 1,9 | 0,6 | II | | 1,1 | 0,8 | | 3,0 | 0,9 | |
| | 1,1 | 0,4 | | 1,9 | 0,9 | II | | 1,2 | 0,5 | | 3,0 | 1,1 | |
| | 1,2 | 0,4 | | 2,0 | 1,0 | III | | 1,2 | 0,5 | | 3,0 | 1,2 | |

The table contains data from four different dates. Every time ten healthy and ten infested larvae were measured, their development stage was ascertained. The measurements made on May 30th, 1958, do not yet show the effect of the infestation. In this day all the larvae of *S. coactus* Rtzb. were still in their second instar. Again the larvae of *M. fagi* Htg. the healthy ones as well as the infested ones, possessed similar dimensions and were in the same second instar. But, already on June 10th, 1958, the infested larvae were usually larger than the healthy ones, and some of them (four in ten) passed to their third instar. Still more distinct differences appear in the measurements on June 23rd and July 2nd, 1958. The healthy larvae at this time were not only smaller but also all still in their second instar. Again, all the infested ones became comparatively considerably larger and reached their third instar.

The influence of parasitic infestation on the quickening of the growth and development of the host larva is illustraded by Pl. VI, fig. 10, and Pl. X, fig. 39. On fig. 10 a gall with two larvae of *M. fagi* Htg. is represented. In the top part of the chamber there was a healthy larva no infested, small and in its second instar, below another one infested by the endophagous parasite *S. coactus* Rtzb. It had reached its third instar since a long time, and considerably surpassed the healthy larva by its size.

On fig. 39 two galls are drawn, found on June 23rd, 1958, on the same beech branch. The galls show an approximately similar size. In gall „a“ there was an infested larva of *M. fagi* Htg. in its third instar, in gall „b“ a healthy one in its second instar. The comparison of both their sides allows to conclude that the healthy larva was much smaller than the infested one.

Basing on measurements of this kind made repeatedly during the period of investigation, I arrive at the following generalisation: the presence of a parasitic larva of *S. coactus* Rtzb. in the body of the larva of *M. fagi* Htg. causes a quicker growth and a quicker development of the latter. I did not observe exceptions from this rule.

STRESZCZENIE

Pracę podzielono na trzy części. W części pierwszej uwzględniono powstawanie, wielkość i kształty galasów, a nadto przebieg rozwoju larw *Mikiola fagi* Htg. Wyróżniono 3 stadia rozwojowe i podano dla każdego cechy (barwa, położenie przetchlinek, skleryty), po których można je odróżnic. Następnie uwzględniono dla każdego stadium chaetotaksję (Pl. VII, fig. 14, 15) i budowę układu tchawkowego (Pl. VII, fig. 12, 13). W układzie tchawkowym, w II i III okresie życia larwy, zamiast wyróżnianych dotychczas 7 anastomoz abdominalnych, łączących wzdłużne pnie tchawek, wykryto ich 8 w abdomen a nadto dodatkowo anastomozę w thorax, którą ze względu na położenie nazwano anastomozą mózgową. (Pl. VII, fig. 13, z prawej strony u góry).

W części drugiej omówiono różne rodzaje uszkodzeń, jakich doznają galasy pod wpływem zwierząt szukających w nich pokarmu dla siebie lub swego potomstwa. Między innymi stwierdzono, że gąsienica motyla *Chimachache fagella* F. pierwszy okres swego życia spędza niekiedy w komorze galasa, zjadając jego ściany od wnętrza.

Część trzecia pracy omawia budowę (Pl. VIII, fig. 17—28) i rozwój (Pl. IX, fig. 29—38) bleskotki *Secodes coactus* Rtzb., pasożyta wewnętrznego larw *Mikiola fagi* Htg. Zwrócono tu uwagę na dymorfizm płciowy form dojrzałych i poczwarek, omówiono dokładniej budowę czułków, narządów gębowych, chaetotaksję głowy, tułowia, budowę skrzydeł, jako też narządów kopulacyjnych samca, w których hypomery (titillatores) odznaczają się oryginalną budową. Takiego kształtu hypomerów nie znaleziono u innych bleskotek, przechodzących swój rozwój w galasach *M. fagi* Htg. (Pl. X, fig. 39—41).

W rozwoju pasożyta wyróżniono cztery stadia rozwojowe, podano opis każdego, uwzględniono strukturę poczwarki i sposób odróżniania jej od poczwarek innych gatunków bleskotek, przechodzących swój rozwój w galasach *M. fagi* Htg. (Pl. IX, fig. 35—37).

Wreszcie zwrócono uwagę, że samice *Secodes coactus* Rtzb. składają jaja tylko w galasy drobne i średniej wielkości a nadto barwy zielonej, unikając czerwonych i dorodnych. Pasożyt,

żerujący w ciele larwy *M. fagi* Htg., powoduje jej szybszy wzrost i rozwój. Stąd infekowana *M. fagi* Htg. osiąga III stadium swego życia już w lipcu, podczas gdy okazy zdrowe dopiero w sierpniu lub we wrześniu.

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## РЕЗЮМЕ

Автор поделил настоящую статью на три части. В первой части описаны были: образование, величина и форма галлов, сверх того описан был процесс развития личинок *Mikiola fagi* Htg.

Автор выделил три стадии развития и привел для каждой из них характерные черты (цвет, положение дыхалец, склериты), по которым можно их отличить. Далее автор привел для каждой стадии хетотаксию (табл. VII, рис. 14 и 15) и строение системы дыхалец (табл. VII, рис. 12 и 13). В системе дыхалец во втором и третьем периоде жизни личинки, вместо известных до настоящего времени 7 брюшных анастомоз, соединяющих продольно стволы дыхалец *(tracheal trunks)* автор открыл 8 анастомозов в брюшке и сверх того, добавочный анастомоз в туловище, который, вследствие своего положения, назван был автором мозговым анастомозом (табл. VII, рис. 13, вверху с правой стороны).

Во второй части автор оговорил различные повреждения галлов, нанесенные им зверьми ищущими в галлах пищи для себя или для своего поколения. Между прочим автор окнстатировал, что гусеницы *Chimabache fagella* F. в первом периоде своей жизни поселяются иногда в камере галла, обглaдывая его стенки с внутренней стороны.

Третья часть статьи посвящена морфологии (табл. VIII. рис. 17—28) биологии (табл. IX, рис. 29—38) перепончатокрылого эндопаразита *Secodes coactus* Rtzb. живущего в личинках *Mikiola fagi* Htg. Автор обратил внимание на половой диморфизм зрелых форм и куколок. Он подробно описал строение щупалец, ротовых органов, хетотаксию, голову, туловище, строение крыльев и генитальный аппарат самца, в котором гипомеры *(titillatores)* отличаются своеобразным строением. Такая форма ги-

помер не встречается у других видов *Chalcididae*, проходящих свое развитие в галлах *M. fagi* Htg. (табл. X, рис 39—41).

В биологии этого паразита, автор выделил четыре стадии развития, подробно оговорил каждую из них, описал структуру куколки и ее отличительные черты по отношению к куколкам других *Chalcididae*, проходящих свое развитие в галлах *M. fagi* Htg. (табл. IX, рис. 35—37). Наконец автор обратил внимание на то, что самки *Secodes coactus* Rtzb. откладывают яйца только в галлы маленькие и средней величины зеленого цвета, избегая больших и красных. Паразит, живущий в личинке *M. fagi.* Htg. вызывает у нее ускоренный рост и развитие. Это является причиною того, что инфицированные личинки *M. fagi* Htg. находятся в третьей стадии своего развития уже в июле, тогда как здоровые, достигают ее лишь в августе или сентябре.

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## Plate VI

Fig. 1. A gall fo *Mikiola fagi* HTG. sectioned lengthwise, with chamber wide open from which the larva has been removed. Drawn on May 12th, 1958, the second day after opening of the winter buds of *Fagus silvatica* L. Length of the gall ca 0,5 mm.

Fig. 2. A. longitudinal section of a gall of *M. fagi* HTG. drawn on May 15th, 1958, the fifth day after opening of the winter buds. Inside the chamber a larva of *M. fagi* HTG. in its first instar. Height of the gall above the leaf 0,67 mm, under the leaf 0,67 mm.

Fig. 3. A longitudinal section of a gall of *M. fagi* HTG., drawn on May 20th, 1958, the tenth day after opening of the winter buds. The larva of *M. fagi* HTG., not drawn here, had then been in its second instar. Length of the gall with its under-leaf part 2,5 mm.

Fig. 4. A longitudinal section of a gall of *M. fagi* HTG., drawn on May 26th, sixteen days after opening of the winter buds. In the chamber a larva in its second instar. Length of the gall with its under-leaf part 2,8 mm.

Notice: all the galls drawn here were taken from one beech twig found on May 10th, 1958, on Mt. Niedźwiedzia Góra near Krzeszowice. The twig was reared in water at home.

Fig. 5. A gall of *M. fagi* HTG., 7,5 mm high, found in Las Wolski near Kraków on June 19th, 1957, left by a caterpillar of the moth Chimabache fagella F., which had spent its first instar there. Dimensions of the opening 1,5 by 2,3 mm.

Fig. 6. A gall of *M. fagi* HTG., 2,4 mm high, with exit opening on the top, its dimensions 0,16 by 0,23 mm. Opening made by a Chalcidid which had developed in the gall.

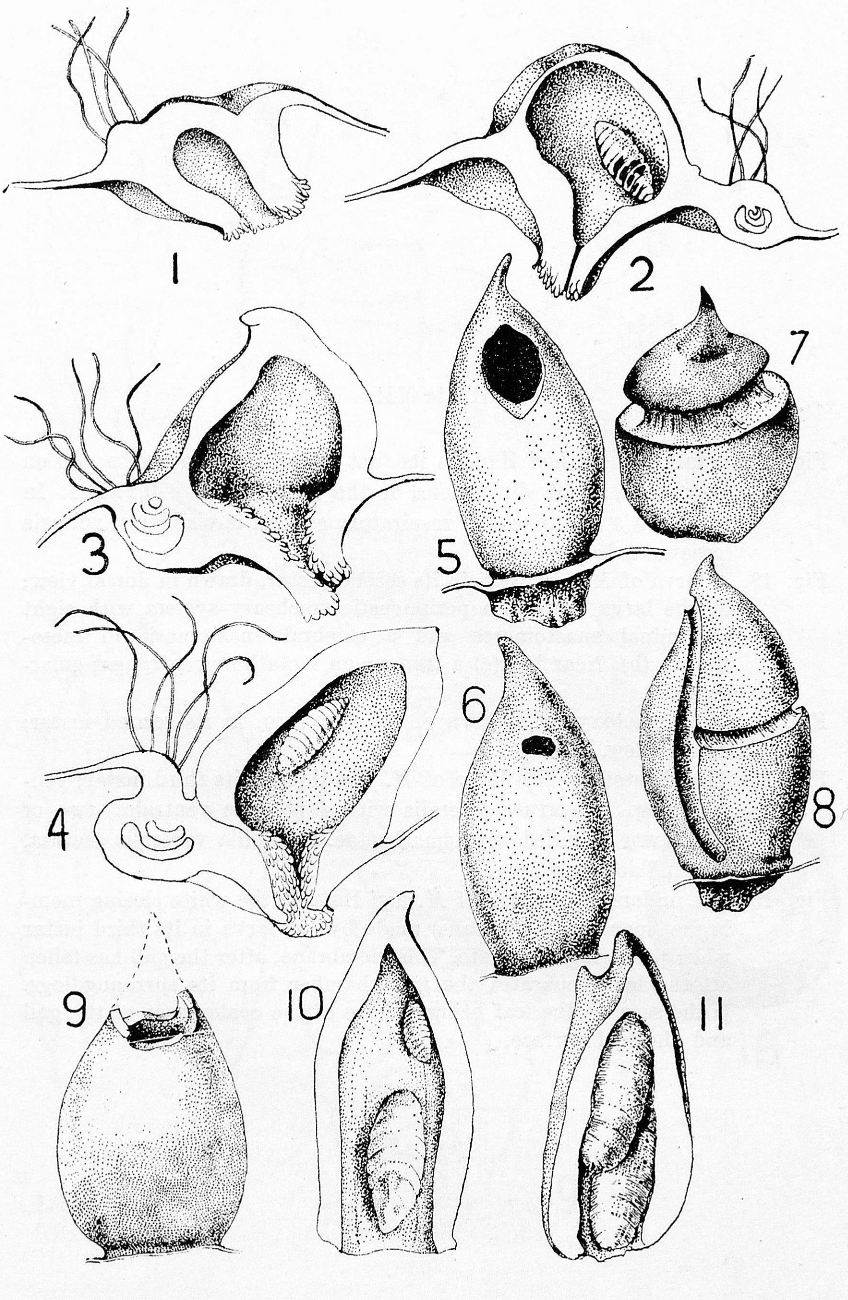
Fig. 7. Ringed gall of *M. fagi* HTG., 8 mm high, found on Mt. Nawojowa Góra near Krzeszowice, on June 27th, 1957.

Fig. 8. A gall damaged outside by the same sort of agent as the gall on fig. 7. Found on Mt. Niedźwiedzia Góra on September 14th, 1957.

Fig. 9. A gall of *M. fagi* HTG. with lignified walls, with top broken off and empty chamber, found on September 30th, 1957, in Zakopane at the foot of the Tatra Mts.

Fig. 10. A gall of *M. fagi* HTG., dimensions 5 by 2,5 mm, found on Mt. Nowojowa Góra on August 2nd, 1958. The chamber contained two larvae of *M. fagi* HTG. In the upper part there was a healthy larva in its second instar, below another one infested by the endophagus parasite *Secodes coactus* RTZB. The infested larva was much larger than the non-infested one and in its third instar.

Fig. 11. A gall of *M. fagi* HTG., dimensions 5,1 by 2,2 mm, found on July 26th, 1958, on Mt. Niedźwiedzia Góra. In the chamber there were two larvae of *M. fagi* HTG., both infested by *Secodes coactus* RTZB., both in their third instar.




Auctor del.
*A. Dziurzyński*

Plate VII

Fig. 12. A larva of *M. fagi* HTG. in its first instar, taken out of a gall on May 14th, 1958; dimensions of the larva 0,52 by 0,17 mm. In the larva a metapneustic respiratory system is visible; a: spiracle (greater enlargement).

Fig. 13. A larva of *M. fagi* HTG. in its second instar, drawn in dorsal view; in the larva there is a peripneustic tracheary system with eight abdominal anastomoses and a cerebral anastomosis in mesothorax (b). Near by, (c) a tumour on metathorax (stronger enlargement).

Fig. 14. The chaetoxy of a larva of *M. fagi* HTG. in its second instar; dorsal view.

Fig. 15. The chaetotaxy of a larva of *M. fagi* HTG. in its third instar; ventral view. e: verruca lateralis with 4 papillae ventrales, two of which are provided with small setae. f: papilla ventralis asetosa, g: papillae anales.

Fig. 16. The underside of a gall of *M. fagi* HTG. h: the white closing membrane (membrana obturans) made by the larva in its third instar when preparing to pupate. This membrane, after the gall has fallen off the leaf, separates the gall chamber from its surroungdings. j: the scar on the leaf being a trace of the coalescence of the gall and the leaf surface.

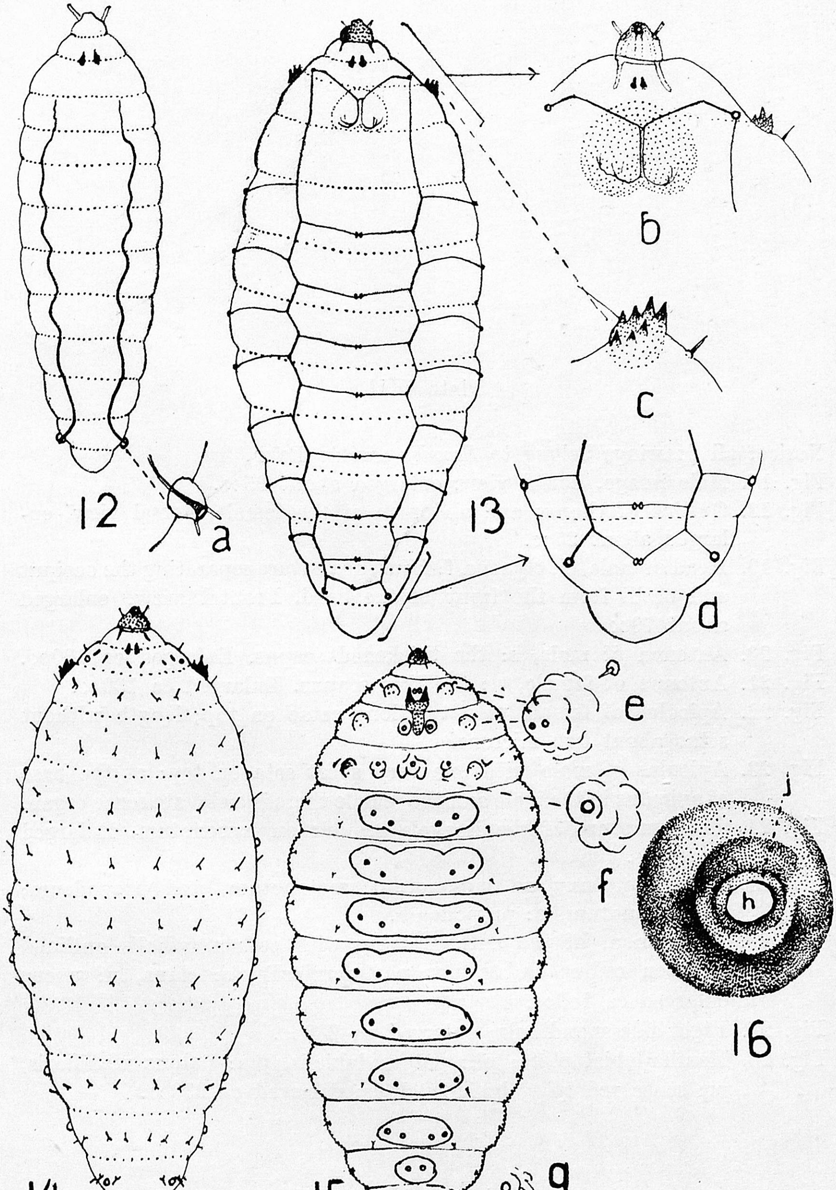



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Plate VIII

Notice: all drawings belong to *Secodes coactus* Rtzb.

Fig. 17. Male imago, dorsal view, enlarged about 25 ×.

Fig. 18. Outline of thorax and abdomen of the female, dorsal view, enlarged about 25 ×.

Fig. 19. Head of male, cl: clypeus, f: frons, s: a suture separating the occiput and ocelli from the front of the head. Frontal view, enlarged about 70 ×

Fig. 20. Antenna of male, s: the thickened scapus. Enlarged ca 130 ×.

Fig. 21. Antenna of female, s.: the thin scapus. Enlarged ca 130 ×.

Fig. 22. Apiculus of female with two long setae on top; length without setae about two microns.

Fig. 23. Apiculus of male with one very short seta on top: at the base of apiculus in the male and the female there is a clavate sense organ.

Fig. 24. The sculpture of the imago's armour on mesonotum. Enlarged ca 340 ×.

Fig. 25. The chaetotaxy on mesonotum, metanotum, and propodeum; m: metanotum, p: propodeum.

Fig. 26. A fragment of the anterior wing with cellula radialis outlined between radius and ramus postmarginalis; c: clava, u: uncus enlarged ca 140 ×.

Fig. 27. Right-side mandibula; enlarged ca 230 ×.

Fig. 28. Maxillo-labial plate; pl.: palpus labialis, pm: palpus maxillaris, pr: sense rod lying beside palpus; enlarged ca 230 ×.

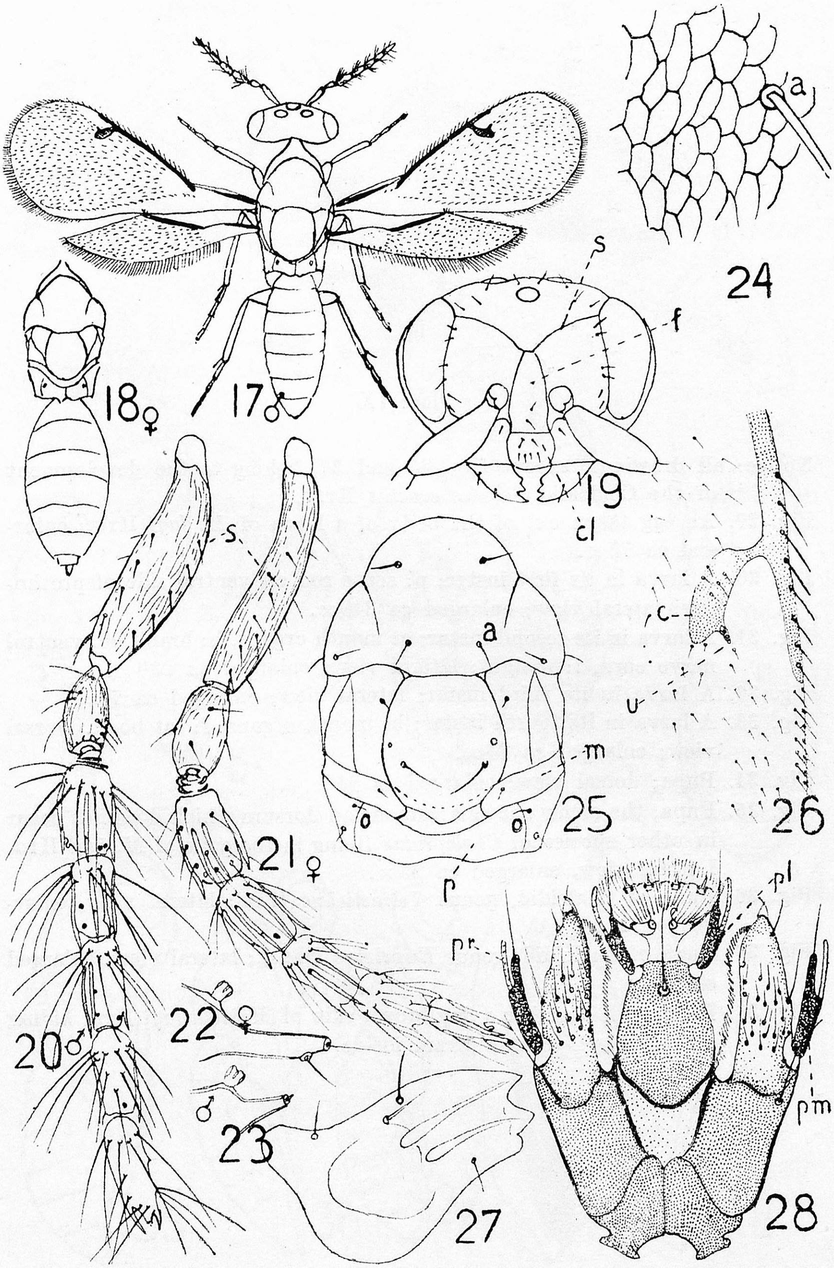


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Plate IX

Notice: all drawings, except figs. 36 and 37, belong to the development of the Chalcidid *Secodes coactus* RTZB.

Fig. 29. An egg taken out of the body of a larva of *M. fagi* HTG.; enlarged ca 75 ×.

Fig. 30. A larva in its first instar; p: sense rod on ventral side of prothorax; lateral view; enlarged ca 340 ×.

Fig. 31. A larva in its second instar; a: mouth organs, b: brain, nc: ventral nerve cord, i: midgut; lateral view; enlarged ca 230 ×.

Fig. 32. A larva in its third instar; lateral view; enlarged ca 75 ×.

Fig. 33. A larva in its fourth instar; b: mouth organs, f: fat body. Dorsal view; enlarged ca 25 ×.

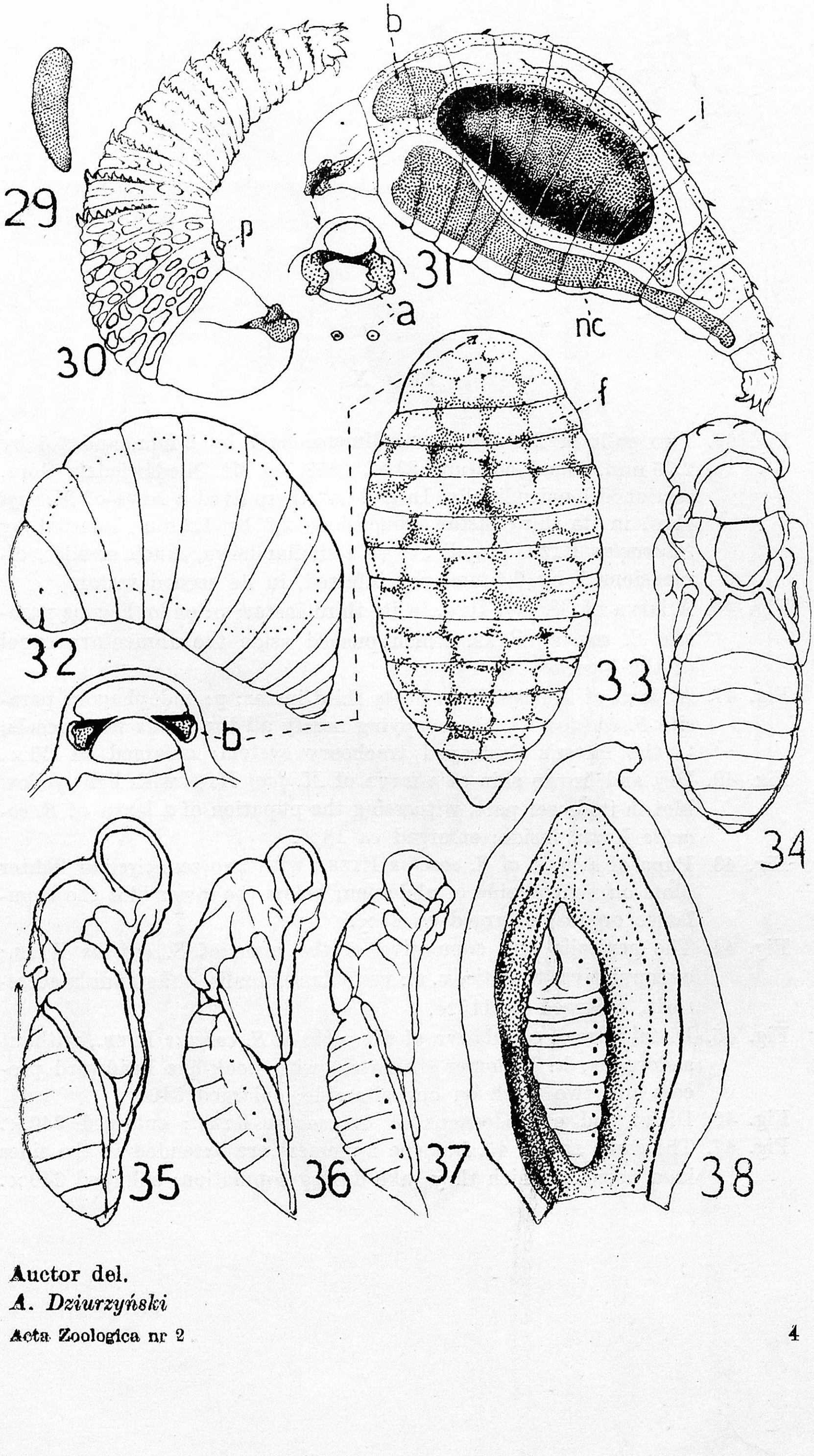
Fig. 34. Pupa; dorsal view; enlarged ca 25 ×.

Fig. 35. Pupa; the arrow shows a tumour on dorsum which does not occur in other species of *Chalcididae* living in the galls of *M. fagi* HTG. Lateral view, enlarged ca 25 ×.

Fig. 36. Pupa of Chalcidid, genus *Tetrastichus* HAL.; lateral view, enlarged ca 25 ×.

Fig. 37. Pupa of Chalcidid, genus *Eupelmus* DALM.; lateral view, enlarged ca 25 ×.

Fig. 38. In the gall chamber a dry brown skin of *Mikiola fagi* HTG. hiding a larva of *S. coactus* RTZB. inside.

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## Plate X

Fig. 39. Two galls of *M. fagi* Htg., dimensions 7 by 2 mm, and 6,5 by 2,25 mm, found on June 23rd, 1958, on Mt. Niedźwiedzia Góra, sectioned longitudinally. In gall „a" there lived a larva of *M. fagi* Htg. in its third instar, dimensions 2,3 by 1,2 mm, infested by *S. coactus* Rtzb. in gall „b" — a similar larva, much smaller, dimensions 1 by 0,4 mm, not infested, in its second instar.

Fig. 40. A larva of *M. fagi* Htg. in its third instar; p: endophagous parasite *S. coactus* Rtzb. which pushed aside the alimentary canal of the host.

Fig. 41. A larva of *M. fagi* Htg. in its third instar; p: endophagous parasite *S. coactus* Rtzb., occupying nearly all the host's haemocoele; t: the latter's destroyed tracheary system; enlarged ca 25×.

Fig. 42. Dry and brown skin of a larva of *M. fagi* Htg. with light-yellow blot in its lower part, witnessing the pupation of a larva of *S. coactus* Rtzb. inside; enlarged ca 18×.

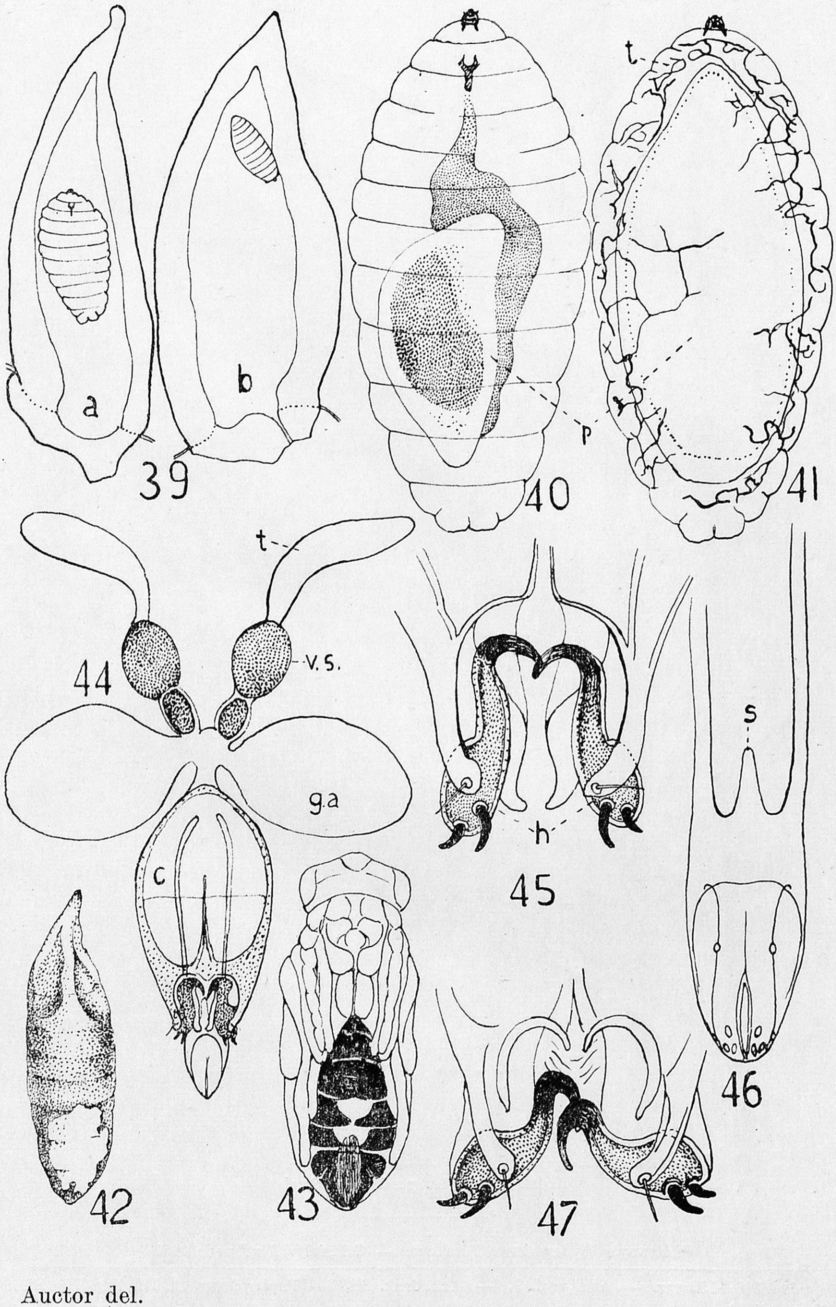
Fig. 43. Pupa of a male of *S. coactus* Rtzb., with two semicircular lighter blots on ventral side of abdomen; below the lower blot the copulative organs; enlarged ca 25×.

Fig. 44. The genitalia and copulativa of the male of *S. coactus* Rtzb.; c: copulativa, t: testis, v. s.: vesicula seminalis, ga: glandula accessoria, enlarged ca 115×.

Fig. 45. Distal part of copulativa of the male of *S. coactus* Rtzb., without aedoeagus; h: hypomer (titillator) with hook-like headward process and two teeth on opposite side; enlarged 340×.

Fig. 46. Distal end of aedoeagus of *S. coactus* Rtzb.; enlarged 340×.

Fig. 47. The same as fig. 45, but the hypomers are extended to the sides in a position which they take during copulation; enlarged 340×.

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