

# NORSK ENTOMOLOGISK TIDSSKRIFT

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# Studies on the Relation between *Apanteles glomeratus* L. (Hym., Braconidae) and *Pieris brassicae* L. (Lepid., Pieridae).

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## Introduction.

The general appearance and the world-wide distribution of the parasitical wasp *Apanteles glomeratus* L. has made it the subject of many studies. This is also accomplished by the fact that its principal hosts are the larvae of the Large White (*Pieris brassicae* L.) and the Small White (*Pieris rapae* L.). According to Howard (1930, p. 498—499) Aldrovandi in 1602 was the first to observe the emergence of the parasite larvae from the host, and Vallisnieri probably was the first to understand the phenomena.

Later the emergence of the parasites has been observed and described in several papers. The larvae of *A. glomeratus* leave the host caterpillar when this is full-grown and due to pupate.

According to Seurat (1899) Westwood was the first to describe the oviposition of the *Microgasteridae*. Several workers later all agree that the oviposition in nature normally takes place in the newly emerged caterpillar. Experiments in the laboratory mostly gave the same result, although Fabre (1908) in his famous papers gives a detailed description of how the female oviposited in the eggs of the Large White while the female did not take any interest in the small caterpillars. Jegen (1918) contrary to the others, says that the eggs are laid outside the host larva. Some workers as Matheson (1907), Gautier (1918, b), Faure (1926) and Hamilton (1935—36) observed that oviposition in the laboratory was possible in different stages of the host, as eggs and caterpillars in the first, second and third stage. Others as Adler (1918 and 1920) do not agree with this.

The present paper tries to study in which of the stages of *P. brassicae* oviposition may take place, and to follow the development of *A. glomeratus* in relation to the development of the host. Most of the experimental work was done during 1946, but parts of it also in 1947 and 1950. I would like to

use this opportunity to thank Dr. W. Hellen, Helsingfors, for controlling my identification of *A. glomeratus*, Professor Colletts legat for financial support, Miss Ingeborg Gjøen for making the drawing (fig. 1) and Mr. Olaf Bache for taking some of the pictures (fig. 3, 4, 5, 7, 8).

### Material and methods.

The Large White, *Pieris brassicae* L., is very common around Oslo. The pupa hibernates, and the first generation is on the wings from the middle of May. The adults of the second generation fly in July with a maximum in the last half of July and the first half of August.

*P. brassicae* was collected on cabbage at Blindern, Oslo. Specimens of the second generation were always used, except in a few special cases. It was in this way always easy to get sufficient material, except in 1947 when the Large White was scarce around Oslo. *P. brassicae* was collected as eggs and placed in the laboratory before hatching to prevent infection from *A. glomeratus*. No parasites were observed in the egg stage.

*A. glomeratus* is the most common primary parasite of the cabbage worms around Oslo.

The great majority of *A. glomeratus* used in these experiments originated from parasitized caterpillars of the first generation, collected in the cabbage fields at Blindern.

Unfortunately no laboratories designed for experimental work were available, and the conditions, therefore, have not been as good as wanted. In 1946 the room temperature was kept at 22° C,  $\pm \frac{1}{2}$  C, except for a few nights when it dropped down to 20—21° C. The relative humidity in the room was 50—60 %. The room was illuminated about 12 hours daily by electric lightning and soft daylight. The candle power was in the level of the cultures 325—375 lux.

The larvae of *P. brassicae* were during the two first stages and the first days of the third stage kept in open petri dishes. Later they were kept in bottomless bottles. These were placed upside down and covered with cheese cloth (fig. 1). The bottles were 10 cm in diameter and 15 cm deep, inside measurements. The physical conditions in dishes and bottles were somewhat different from those measured in the room.

After emerging the larvae were divided in groups of 8—10. They were fed once a day. The feeding and management of the larvae were done as properly and carefully as possible. Nevertheless some of the larvae died, probably because of diseases. The healthy larvae used 19—20 days from emergence to pupation. The cocoons of *A. glomeratus* were removed from the dying host larva and placed in 15 cc test tubes. The hatching took place 6—7 days later. The wasps were fed once a day by filter paper soaked in sugar solution. The wasps mated at once after the emergence, and most of them were then placed in a dark place at 15—16° C.

The conditions under which the female parasites oviposit, will of course be very different in laboratories as compared with nature. The use of parasitical insects in laboratory work is so common in the field of biological control, that the experience gained during these experiments perhaps could be of some interest. The common procedure is to let the parasites go free in cages together with the host. In the

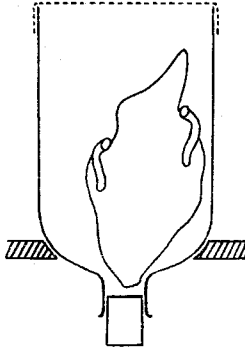


Fig. 1. Schematic drawing of a bottle used for the rearing of the larvae of *P. brassicae*.

present work the size of the cages varied from great glass-jars to small tubes. Oviposition took less time in 15 cc test tubes or even smaller tubes. Closed by wadding these were also handy and practical in use.

Oviposition was mostly carried out at a temperature of 18–22° C. If the temperature was higher or lower, it was more difficult to get the wasp to oviposit. The importance of humidity was not examined. The light ought to be as evenly distributed as possible. Daylight was not necessary, and oviposition could also take place when it was so dark that it was difficult to read. The condition of the female parasite proved to be of great importance. Females recently collected in the field were of little use. After being kept in the laboratory for some days, oviposition was more easily obtained. If the females were hungry or thirsty, oviposition was impossible, or at least very difficult to obtain. The easiest way to obtain oviposition was to introduce the possible host into a tube containing three to four females. More females would easily disturb each other, especially if the host object tested was small. Males would also disturb the females, often by trying to mate. It seemed often easiest to obtain oviposition with females two-three days old, which had been prevented from oviposition. But this was no necessity. Newly-emerged females would oviposit, and on the other hand experiments with females even 20 days old could give positive results. A strange thing was that oviposition seemed to be more easily obtained in the tube where the parasites lived. The most successful method was then to let the host into the tube where the females were. Eggs and the smaller larval stages ought to be placed on a little piece of cabbage, when introduced to the tube containing the females. The females were mostly mated, but this was not necessary.

As indicated above, oviposition depends upon many factors. Under the conditions where it was easiest to obtain oviposition, the optimal conditions, the females would not attack every object offered them. And a few females would not even oviposit in the first stage larva under optimal conditions. That a female oviposits in an object will not necessarily prove that that object is the stimulus to the oviposition or

stinging. It sometimes happened that the female stung an object which normally does not give any stinging impulse because this happened to be present close to an object which acted as the impulse. The following happened a few times: Eggs of *P. brassicae* placed on a little piece of cabbage were offered the females. They would start searching and soon try to sting the eggs. During the excitement which could arise, it happened that the females stung the cabbage leaf or other females.

### **The oviposition of *A. glomeratus* in different stages of *P. brassicae*.**

When the *Apanteles* female contacts a suitable host subject, it behaves in a very characteristic way. There are no differences in the behaviour of the females during oviposition in nature and in the laboratory. When a piece of cabbage with some first stage larvae is introduced to the tube containing the female, she will soon start searching. She moves slowly, the antenna curved. Contacting the host, the movements become even slower and she seems to feel the larva carefully with the antennae. Sometimes the ovipositor can be seen moving out and in from the end of the abdomen. Starting to sting she will bend the abdomen forward. The ovipositor is now visible. The fore part of the body is raised, the wings are bent upwards, their upper sides facing each other, and kept firmly in this position. During this forward movement of the abdomen she will insert the ovipositor into the host. If the host is not reached, she will take a few quick steps towards it and then insert the ovipositor. She will now stay quiet in this position while the sting lasts and oviposition usually takes place (fig. 2). The body is often kept in a nearly vertical position with the wings at a right angle to the thorax. The antennae are often bent upwards parallel to the wings. The femurs of the legs are more at a right angle to the body than in the usual walking position. The legs are locked in this position, the femur — tibia often forming an angle, while the joint tibia-tarsus is nearly always straightened out. The legs of the metathorax are mostly kept close to the body, while the two other pairs stand out more from the body. Often she is only supported by the last pair of legs, but it may be accidental which of the six legs will contact the piece of cabbage leaf. The ovipositor is usually inserted into the ventrolateral parts of the host. When the sting is finished, the ovipositor is withdrawn, the body is straightened and wings and legs are replaced in their normal position. After the sting the female may be seen pressing



Fig. 2. *A. glomeratus* stinging a first stage larva of *P. brassicae*. 3 ×.

the end of the abdomen against the piece of cabbage as if to clean the ovipositor.

All stages of *P. brassicae* were tested as possible hosts, and a description of the results is given below.

#### *Egg.*

The eggs of *P. brassicae* are cylindrical with a conical upper end, approximately  $1\frac{1}{4}$  mm high and  $\frac{1}{2}$  mm in diameter. The cuticle forms 16 longitudinal ribs, connected by weaker ribs. They are yellow coloured, but before hatching, they turn greyish, the upper end becoming more black because of the colour of the head capsule of the larvae. The eggs are placed side by side in irregular clusters.

When a cluster of eggs on a piece of cabbage is introduced to the females, the latter will soon start searching over the piece. Contacting the eggs, their interest is concentrated on them although some will leave them and start searching again. They will move about on the eggs and feel them thoroughly. They force the head and parts of the thorax down between the eggs. Often the searching ends in stinging efforts. The ovipositor is moved in and out, the wings lifted, and the abdomen bent forward, but the wasp will seldom remain in the typical stinging position.

In some experiments a single egg was carefully removed from the cabbage and introduced into the tube. The females also tried to oviposit in such loosened eggs, but the egg usually rolled away. If the conditions were optimal, it was as easy to get the females to sting newly-laid eggs as eggs immediately before hatching. If the conditions were not

optimal, stinging was more readily obtained in eggs immediately before hatching. As an example of the experiments with the eggs the following is given.

Nine eggs, laid the same morning, were introduced to females, eight to nine days old. The females had been used for other experiments earlier. The eggs remained on as small a piece of cabbage as possible. Some of the females reacted at once, and four females tried continuously to sting the eggs. In removing the eggs, they accidentally fell from the table on to the floor. Two of the females, sitting on the eggs, did not loosen contact with the eggs, but continued to search and tried to sting while the eggs were lying on the floor. The eggs were then removed to the tube without the females loosening their interest. The experiment lasted for 25 minutes and the whole time the females tried to sting.

It also happened that the females did not take any interest at all in the eggs. In some of these experiments the females stung other stages of *Pieris* before and after the tests with the eggs.

The egg can only prevent the sting by passive resistance. The possible movements of the emerging larva within the shell are probably of no importance as an active resistance. In several of the experiments which were watched under the stereoscopic microscope, it seemed as if it was difficult for the female to force the ovipositor through the shell. This is also indicated by the fact that the females would try to sting one egg after another for more than half an hour. The cuticle is not too thick, and it was observed that the ovipositor penetrated the shell in some cases, in both fresh and old eggs. That eggs really were deposited, was proved by microscopical examination. Fig. 3 shows a cross-section of the upper end of an egg where eggs of *A. glomeratus* are seen inside the shell but outside the developing embryo. After stings in eggs which were immediately before hatching, the rearing of the emerging caterpillars showed that these were parasitized. In these cases the eggs are deposited in the larva inside the egg-shell, as shown in fig. 4. But in some cases it was found that the female had deposited the eggs between the shell and the larva.



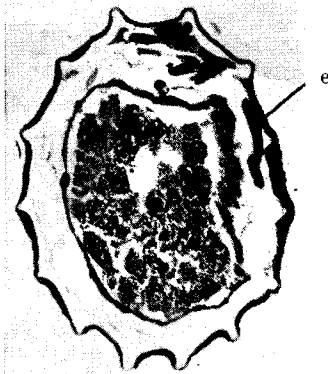


Fig. 3. Cross-section of an egg of *P. brassicae* showing eggs of *A. glomeratus* (e) inside the shell but outside the embryo. 93  $\times$

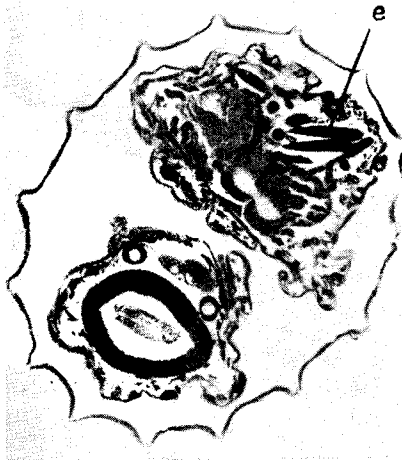


Fig. 4. Cross-section of an egg of *P. brassicae* shortly before hatching. Eggs of *A. glomeratus* (e) are found inside the larva. 93  $\times$ .

### *The larval stages.*

During the five stages the larva grew from about 1,8 mm to a length of 40 mm while the diameter increased from 0,3 mm to 5 mm. The colour changes from yellow in the first stage to a mainly green in later stages. The first stage larva has primary white setae while the other stages are also equipped with secondary black setae. During the last part of the fifth stage the larva, as a prepupa, is attached to the support by a girdle around the back and by the anal feet. For experimental purpose the prepupa was removed from the support.

If first stage caterpillars are introduced to the wasps, oviposition will mostly take place at once (fig. 2). The same female will oviposit one larva after the other, or she will oviposit several times in the same larva. Often two females would oviposit or sting the same larva simultaneously. It was always easy to obtain results with first stage caterpillars, also if a single larva without cabbage was put into a tube with one single female. But as mentioned earlier, it was impossible a few times, without any intelligible reason, to get the female to sting. The cuticle and the setae are no obstacle to the wasp, but during the oviposition the larva can creep, dragging the female after itself. The oviposition may take place without any other active resistance from the larva, but mostly it reacts by bending the forepart of the body backwards in order to remove the searching female. After the ovipositor is inserted, the larva generally does not show any such reactions. The results of the beating depend very much upon the age of the larva. In the last part of the first stage the female may be frightened away. These larvae can also discharge a small drop of green saliva from the mouth, but this is of little importance.

The sting is mostly placed in the ventrolateral parts of the 6—9th segment, but it may be placed anywhere. Sometimes the female tried to oviposit through the head capsule, but without any success. Generally, but not always, the sting resulted in oviposition, the eggs being found in the body cavity (fig. 5).

If larvae in the second stage are introduced to the females, the female wasps generally react by stinging which mostly results in oviposition. This also happens if one single larva is offered to one single female. The setae are of little importance in preventing the sting, and the cuticle is easily pierced by the ovipositor. The reaction of the larva is very similar to the first stage, but of greater effectiveness. The beat and the saliva may prevent the female from stinging, but after some trials the female will mostly succeed. If several females are present, some may be frightened, while others will sting.

Under optimal conditions the females mostly reacted by trying to sting the third stage larva. But it was here very difficult to get the female to oviposit if the experiment took place in a glass jar. Just after the moult the setae are so close together that it was difficult for the female to reach the integument with the ovipositor. Except for the spots, the female did not seem to have any difficulty in piercing

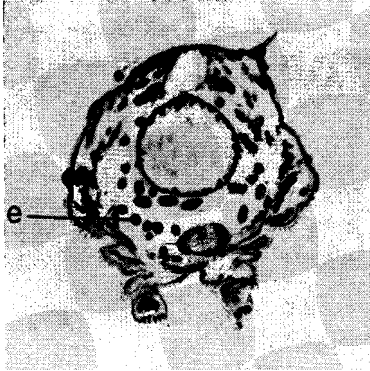


Fig. 5. Cross-section of a first stage larva of *P. brassicae*. Eggs of *A. glomeratus* (e) are found in the body cavity. 93  $\times$ .

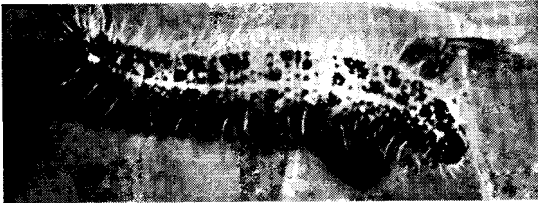


Fig. 6. *A. glomeratus* stinging a fifth stage larva of *P. brassicae*. 3  $\times$ .

the body wall. The larva may easily crawl away from a wasp preparing to oviposit, and the females are often frightened away before stinging has started. Often she is also knocked away after the sting has started, giving a short sting of a few seconds. The drop of saliva from the mouth of the larva will often "drown" the female.

Just after the moult to the fourth stage oviposition is very difficult. In the later part of the stage it is much easier for the female to oviposit. This is not difficult to obtain if the conditions are optimal. The reactions of the larva are the same as for a third stage caterpillar, but they are of greater effect. The females are often hit by the drop of saliva and die in a few minutes. When several females are present, what looks like a violent struggle between the females and the larva, will be the result. Some females will be frightened away, some will soon be hit by the saliva, and some will succeed in stinging.

By performing the experiment in a test tube it is not difficult to get even a single female less than one day old, to sting and oviposit in a fifth stage caterpillar (fig. 6). The female may sting several times in the same larva, and as many as four females have been observed stinging one larva at the same time. The reaction of the larva is the same as in the fourth stage, but stronger. It is even on older larvae difficult for the female to reach the integument because of the long setae. The result is that it often takes some time for the female to find a place where oviposition is possible, and she is therefore often knocked off before oviposition can start. Sometimes it also took quite a long time (up to  $\frac{1}{2}$  hour) before the first trial started.

Microscopical examination showed that the eggs were often deposited in the integument of the caterpillar, as shown in fig. 7, where nearly all the eggs are found in the epidermis. Only a few are free in the body cavity. According to Adler (1918) the length of the ovipositor is 0,43 mm, but only the outer part, 0,13 mm long, is inserted into the host. Ovipositors from females used for the present paper had a total length of about 0,32 mm, the outer part being about 0,08 mm long. The integument of the fifth stage caterpillar is about 0,04 mm thick. In the cases where the eggs were found in the epidermis the whole outer part of the ovipositor had not been inserted into the host, or it had reached the integument at an angle.

When contacting a prepupa the *Apanteles* female will react as described for the fifth stage, but the reaction of the prepupa is somewhat different. It bends the body sideways and may in this way drive the female off or frighten her away. But no saliva is secreted. Oviposition may also here be the result of the sting, but so far it cannot be said whether this is usual. As an example one interesting experiment may be cited:

A prepupa was introduced to some females in a test tube. The females had been used before. Several stings were observed. During the test pupation took place. It was accompanied by waves of contraction in the underlying pupa. By the movements of the female it was possible to make sure that the ovipositor was inserted into the pupa itself. When the exuvia was shed off, all stinging in the pupa stopped. Only two stings were observed in the pupa, one in the head and one in the thorax, and this happened immediately after the old skin was removed from that part of the pupa. While the old cuticle was shed off, stinging continued in the hind part of the pupa which was still covered with the larval cuticle and one sting was observed in the old cuticle after it was thrown off. Although the experiment was continued, no more stings were observed in the pupa. Breeding showed that oviposition had occurred.



Fig. 7. Cross-section of the body wall of a fifth stage larva of *P. brassicae*. Eggs of *A. glomeratus* (e) are found in the the epidermis and in the body cavity. 185  $\times$

### *The pupa.*

The pupae used for these experiments were approximately 24 mm long. They have a ridge on the dorsal side of the thorax and the hind part of the abdomen, and a jagged ridge on the dorsolateral parts of the first abdominal segments. The colour can differ from greyish to nearly pure green with black spots. The cuticle is, except just after the pupation, hard and smooth without setae and spines. The pupae were either loosened from the support, or they were put into the tube on their supporting piece of cabbage.

The females would either show no interest at all, or they would continuously search around on the pupa, sometimes for quite a long time. Of the more than 100 experiments made, only two resulted in stinging. Controls proved that females used for negative pupa experiments, would sting and oviposit other stages of *Pieris*. The experiment with the prepupa cited above is typical. In the experiments where stinging was observed, the wings on one or both sides of the pupa had been bent out, exposing parts of the pupa where the cuticle was thinner than on the ordinary surface. This was done on approximately one third of the pupae used in order to secure places for oviposition where the cuticle should not be too hard. If done immediately after pupation the cuticle is still so soft that it was not difficult to bend out wings or antennae.

It seemed as if the normal cuticle was too hard for successful oviposition. The bending of the pupa often frightened the females while they searched around on the pupa.

The two positive results shall be briefly referred:

One pupa, two days old, where antenna and wings on one side had been bent aside, was introduced to two females in a test tube. The females were 17—18 days old and had been used before. They tried at once to sting, but it seemed as if they only succeeded in forcing the ovipositor through the naked parts of the pupa. The normal cuticle seemed to be too hard. Later dissection proved that eggs had been laid.

In the other experiment the females were five days old, and used before. After searching for five minutes, one female tried to sting twice in the naked parts. It was impossible to tell if any eggs were laid.

### *Imago.*

The body of the imagines used was a little more than 20 mm long. It is heavily covered with scales and hairs. The dorsal side is black, the lateral parts grey and white.

If these experiments were done in large glass jars, no contact was obtained between the butterfly and the wasp. The tests therefore had to be done in testtubes and the wings were removed from the butterfly. In all, only 25 such experiments were done, and only in three of these did the wasp try to sting, while she was searching in some others. In these cases the females used were between 5—7 days old, and in one of the cases had not been used before. Many attempts to sting were observed and microscopical examination showed that some were successful (fig. 8). Eggs were observed in the body cavity of the butterfly. The thorax and head of the female is so heavily sclerized that it seems impossible for the female to sting here. Most of the adult is covered with scales and hairs making it very difficult for the female to reach down to the body. The reaction of the female is also very strong because she crawls with the legs. To treat the butterflies with ether before the experiment made the wasps try to avoid the butterflies.

No systematical tests in order to find out which objects stimulate the *Apanteles* females to sting have been done. Only a few more experiments with *P. brassicae* need be mentioned. Experiments with larvae in the moult gave results similar to those mentioned, but the reaction of the larva during moulting is not so strong as before or after. Fifth stage caterpillars from which the parasites had already emerged, were also attacked by the females. They tried to sting, and this could sometimes be difficult. In one case the *Apanteles* larvae had left the host seven days ago, and the caterpillar was now almost dead, only the mouth parts moving faintly. The females tried to sting, but this was very



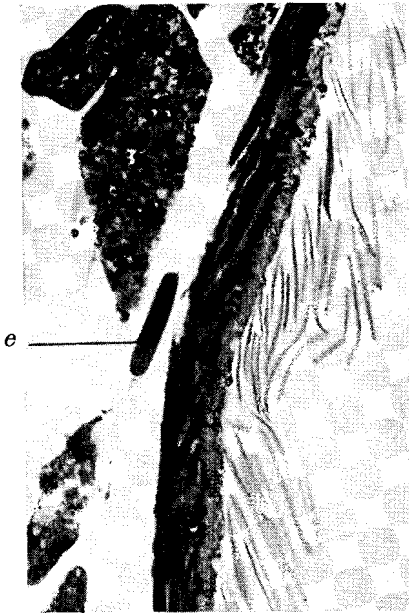


Fig. 8. Cross-section of the body wall of an adult *P. brassicae*. One egg of *A. glomeratus* (e) is found in the body cavity. 185  $\times$ .

difficult because the larva had shrunken so strongly. Examination was not made to see if any eggs had been laid. It is not necessary for the object to be alive in order to be attacked. In one case a little piece of kohlrabi with empty egg shells and newly-emerged larvae were used. The larvae had been killed immediately after emergence and had been dead for six days, when the test was made. The females which were two days old, had been used for tests with pupae but with no results. They now tried to sting both the empty egg shells and the dead shrunken larvae.

#### Discussion of the oviposition experiments.

Based on the preceding experiments, it may be said that the following stages of *P. brassicae* under optimal laboratory conditions make the *A. glomeratus* female sting: egg and larvae in all stages. This also refers to the prepupa. The *Apanteles* female can also sting the adult butterfly, but it will only exceptionally sting in the pupa.

Oviposition took place in all these stages of the host. Already Fabre (1908), Gautier (1918 b), and Faure (1926) found that oviposition could take place in the eggs of *P. brassicae*. Faure (1926) was also able to get the females to sting the third stage larva of *P. brassicae*, while Matheson (1907) and Hamilton (1935—36) observed that the *A. glomeratus* female would attack third stage larvae of *P. rapae*. But most of the former workers say — based on their laboratory experiments — that oviposition will only take place in the first stage caterpillar.

To give general statements based on negative results is a very dangerous thing. The fact that oviposition does not always occur when the parasite finds the host, even if it is a generally accepted host, can explain many of the negative results of former workers. The strangest results are those obtained by Fabre who did not succeed in getting the wasps to oviposit in the larvae, but in the eggs. Schmitz (1910) thought that he perhaps used a species other than *A. glomeratus*. There may be another explanation to his observations. Fabre (1920, p. 262—263) writes that the experiments with the larvae took place in a one liter glass jar (“un bocal de la capacite d'un litre environ”) while those with the eggs took place in a tube one inch wide (“un tube de l'ampleur d'un pouce”). The negative results with the larvae contrary the positive results with the eggs, may be explained by this difference in size of the experimental rooms.

In the preceding experiments the female has not been given any choice of hosts. Little can therefore be said about the host preference. It is also difficult on the preceding experiments to say anything about the stimuli determining the sting and which sense organs are the most important. The size of the object seems to be of less importance (cp. fig. 2, and 6) and cannot explain why the female did not sting the pupa readily. The same may be said of the shape of the objects. The structure of the surface of the objects tested shows a great variation, from the ridged surface of the egg to the hairy larvae and the scaly abdomen of the adult. One cannot quite exclude the structure of the surfaces being perhaps of some importance. The surface of the pupa is much smoother than of the other stages. The variation of the colour of the objects tested is probably of no importance, but chemical factors may be of importance. It is also possible that we must take into consideration the combination of several of these factors.

The resistance of the object to oviposition is a factor which must be considered when we talk about the host suitability of these objects. The cuticle is so hard that it makes oviposition in pupa and parts of the adult difficult. It seems also to be of some importance for the oviposition in the eggs. The female sometimes does not reach the embryo or the larva in the egg. The integument of the larva is easily penetrated, but the epidermis of the fifth stage caterpillar is sometimes too thick. The setae make oviposition difficult in the newly moulted larvae in the third and fourth stage and in fifth stage caterpillars.

As indicated in the description of the experiments, the active resistance of the larvae could prevent oviposition already in the last part of the first stage. The effect of the active resistance increased with the size of the larva.

As a conclusion it may be said that the stage which is best suited for attack, is the first stage, and especially the larva just after it has emerged from the egg. It is no surprise to find that just the first stage larva is the stage attacked in nature.

While little has been written in earlier papers about passive resistance many have mentioned and described the active resistance of the caterpillars. Martelli (1907) describes the reaction of the larva as violent and the females as frightened and cautious. Picard (1922) and Faure (1926) do not agree on this. The reaction of the larvae is faint and does not frighten the female. These are larvae in the first stage, and it is confirmed by the present experiments. Hamilton (1935—36) found the resistance of the larvae in the second and third stage so strong that the female did not succeed in oviposition. My experience is that this may happen, but it is far from usual under optimal conditions. The discharge of saliva from the mouth parts have been discussed by different authors. Adler (1918) maintains that even first stage larvae after having fed on the cabbage secrete green saliva which together with the beat from the forepart of the body totally prevents oviposition. Klein (1932) and Hamilton (1935—36), in spite of their experiments, could not find that first stage larvae secreted green saliva for defence. Adler has, without any doubt, been too categorical in his statements, although it may happen that even first stage larvae secrete saliva for defence. The secretion of saliva and the beat with the forepart of the body are defensive reflexes also released by other stimuli than the ovipositional trials of

the female. If males of *A. glomeratus* were put into the tube to the larvae, the larvae would react in the same way if they got irritated by the males. When the larvae were irritated by a piece of thread, they reacted in the same way, and it was in this way possible to get newly-emerged larvae, still feeding on the egg shell, to secrete a small drop of saliva. The reactions of the larvae differed in strength according to the strength of the irritation. This may explain some of the disagreement in the older observations.

#### The duration of the sting and number of eggs in one oviposition.

In some cases the duration of the sting was measured by a stop-watch. The duration of the sting was here taken as the time the ovipositor was inserted in the host. Usually this will be the same period of time the wasp is in the typical stinging position. It was not always possible to get the length of time required for complete oviposition because the female was so often knocked off the host probably before the sting was finished. These short stings are mostly not included in the observations. The times up to 36 seconds are given in table 1. They are here grouped according to the stage of the host. Because so few observations were made, the material has not been grouped according to the age of the female and if she had stung before or not. These observations show that the usual length of time was 9—12 seconds for an oviposition in a first, second, or third stage larva. The results will easily differ according to the conditions, which is shown by the recordings from literature. Olenov (1925) says that stings last for 10 seconds in first stage larvae. Martelli (1907) found that it lasted between 15 and 20 seconds. Adler (1918) also found 20 seconds. Grandori (1911) mentions 20—30 seconds and Hamilton (1935—36) that it differs between 20 and 40 seconds.

In table 1, only measurements up to 36 seconds are listed. 17 of the observations were of more than 36 seconds, occurring in all stages. During such long stings it sometimes happened that the female let the wings back to the normal position for a shorter period but without withdrawing the ovipositor from the host. The longest record was 2 minutes and 25 seconds. This will be briefly reviewed as it gives an illustrating picture of the variations:

Table 1.  
Duration of the sting in different stages of  
*P. brassicae* larvae.

Stage	Seconds									Total
	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36	
I	19	44	89	28	13	5	2	2	1	203
II	8	17	27	21	5	8	4	3	0	93
III	1	6	20	9	7	5	3	1	0	52
IV	0	5	7	7	13	5	8	5	0	50
V	1	1	2	5	5	6	2	1	2	25
Total	29	73	145	70	43	29	19	12	3	423

Table 2.  
Number of *A. glomeratus* larvae found after one sting in the  
first and second stage larvae of *P. brassicae*.

Stage	Number of <i>A. glomeratus</i>										Total
	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	
I	0	1	2	2	5	12	9	0	1	0	32
II	0	0	0	3	4	8	7	2	1	1	26
Total	0	1	2	5	9	20	16	2	2	1	58

Some first stage larvae, one day old, were introduced to females, 6-7 days old. The females had been used before. One larva got stung by one of the females, at first 2 minutes and 19 seconds, then 22 seconds and at last for 2 minutes and 10 seconds. The intervals between the stings were very short, the ovipositor being inserted again in a new place as soon as it was withdrawn from the old. The female then left this larva and stung another for 2 minutes and 25 seconds and shortly after, for 32 seconds.

It is natural to treat the number of eggs laid in one oviposition in this connection. Table 2 contains the number of eggs by one oviposition in first and second stage larvae. No attention has been paid to the conditions of the female. The number was obtained in the way that all larvae, both those which emerged and those which stayed in the host, have been counted. Based on our knowledge of the development of *A. glomeratus* in *P. brassicae*, this should be justifi-

Table 3.

Number of *A. glomeratus* larvae found after ovipositions in different stages of *P. brassicae* larvae.

Stage	Number of <i>A. glomeratus</i>										Total
	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	
I	7	14	34	22	6	4	0	3	1	0	91
II	2	6	8	13	6	4	4	5	2	1	51
III	2	3	12	9	2	0	4	2	1	2	37
IV	1	4	2	3	6	2	1	2	0	1	22
V	0	0	1	1	1	2	0	0	0	0	5
Total	12	27	57	48	21	12	9	12	4	4	208

fiable. It happens that eggs or larvae of the parasite may die during the development; these will not be counted in this way. This seems to happen so seldom that we will obtain a more correct number in this way than by trying to count the number of eggs just after the oviposition. The usual number of parasites was 26—35, or more exactly 26—30. This is the same for the first and the second stage. We get the same picture if we include all larvae without regard to the number of stings. This is done in table 3. The usual number of parasites after oviposition in the third stage larva was also between 25 and 36. If we take all larvae into account we get an accumulation around 30 parasites and this must be the result from those which got one sting. It happened after a sting of ordinary length that no *A. glomeratus* larvae emerged from the host. The maximal number of eggs laid by one sting was, on the other hand, 41 in a first stage larva and 51 in a second stage larva.

The number of eggs laid will easily differ because of different conditions. In 1950 some more experiments were done, and the number of larvae found after one sting was then mostly 20—25 (cp. p. 174). The same variation is found if we include laboratory observations from the literature. Grandori (1911) says that 4—12 eggs are deposited by one sting, 12 being the maximal number he observed. Olenev (1925) got 6—20 eggs per sting, and the results of Adler (1918) were between 6 and 32. Hamilton (1935—36) reports 30,5 eggs as an average for stings in 15 larvae, 2 and 54 being the minimum and maximum. Hamilton got his numbers by the same manner of calculation as used in the pre-



sent paper. Martelli (1907) got a variation from 16—48 with 26—38 as usual. He based his numbers on counting the cocoons of the wasp, and they may therefore be a little too low. Except for Hamilton, the others do not tell how they got their numbers.

The observations from 1946 are in agreement with those made by Hamilton. One could perhaps expect some correlation between the duration of the sting and the number of eggs laid. This is difficult to find. Grandory says that the sting lasts for 20—30 seconds while 4—12 eggs are laid, and Martelli says 15—20 seconds and 16—48 cocoons. While the observations concerning the time required for the oviposition agree with those made by Olenev (10 seconds versus my 9—12), this is not the case with the eggs laid (6—20 versus mine 26—35). On the other hand, the duration of the stings is not of the same size as those reported by Hamilton (20—40 seconds versus my 9—12) while the number of eggs laid are about the same (30,5 versus my 26—35).

Short stings of 1—2 seconds usually did not result in any eggs laid. This could indicate that some time must pass before any eggs are deposited. In order to obtain few parasites in a larva, the female was taken by the wings and snatched away after a few seconds, before the sting was finished. This resulted in a less number of larva than after normal stings. The very long stings, on the other hand, did not result in any extreme number of parasites in the host.

### The development of *A. glomeratus*.

The next problem will be to follow the development of the parasites after the eggs are laid, and study the suitability of the different stages. It seems natural to divide it in two and first follow the development to the point where the *A. glomeratus* larvae leave their host, and then the emergence and relevant problems.

After the hosts were infected they were kept under the conditions described on p. 146 until the parasites emerged or the host died. Based on these breedings it was shown that *A. glomeratus* could complete its development and emerge after oviposition in the following stages of *P. brassicae*: eggs immediately before hatching, larvae in the first, second, third and fourth stages and in larvae in the first day of the fifth stage. Complete development never occurred after oviposition in the fresh eggs, prepupa, pupa and imago.

The stings in the young eggs always resulted in not-parasitized larvae or the eggs did not hatch at all. This agrees

with the findings of Gautier (1918 b) who is the only one who has treated this problem. When and how the limits between possible and not possible oviposition in the eggs go, are not determined. When the eggs had been laid in the first day of the fifth stage caterpillar, the parasites emerged while the host was still in the larval stage. In these cases the host contained between 26 and 128 parasites. In a few cases the host contained some hundred parasites, and then it died as a larva, 11 to 19 days after oviposition. Although some of the parasites had reached the last stage, none of them emerged before the host died. If the host contained but a few parasites, it would pupate before the parasites emerged, as shown in the following example:

September 1st 1946, 8 pm: one larva, on the first day of the fifth stage, was stung and it pupated seven days later. It was kept in the laboratory to November 14th when it was placed outside. By control the 7th of March 1947 the pupa was found dead. Dissection showed that it contained one third stage larva in the abdomen.

If the eggs were laid in fifth stage caterpillars which had stopped feeding or were in the prepupa, the host would pupate, to die later as pupa, while none of the parasites emerged. The parasites could develop to the last (the third) stage, at least when oviposition took place before the caterpillars had reached the prepupal period. A few examples may be of interest:

August 28th 1946, 11.30 am: Sting observed in a larva in the crawling period of the fifth stage. Pupation two days later. The pupa was stored indoors, cool. October 31st: The thorax had dried, while the abdomen still looked normal. Dissection showed that the pupa contained two third stage larvae in the thorax and eight third stage and two second stage larvae in the abdomen, some of the last mentioned were still alive. July 22nd 1947, 10.30 pm: (This is the same experiment as that mentioned on p. 154) a prepupa received several stings almost at the time pupation took place. The pupa was stored indoors. The 30th of July it looked as if immediately before hatching (1 ♂). The 2nd of August it was dead, no emergence had occurred. Dissection showed that it contained 125—150 living larvae of *A. glomeratus*. They were in the first and second stage and were mostly found in the abdomen of the host.

The fate of the eggs which were laid in the epidermis has not been followed. In the only pupa where oviposition was stated (see p. 156), death occurred approximately one month after oviposition. Dissection showed that the pupa contained 36 larvae (1st and 2nd stage).

At the moment nothing can be said about the factors preventing complete development in the last cases mentioned. Very little is known about the factors influencing the normal development of *A. glomeratus*. George (1927) studied the influence of the food plants of the caterpillars. The five different food plant species he tested did not have any influence on the development of *A. glomeratus*. Of the biological factors the phagocytosis is the most interesting. Boese (1936) has shown that phagocytosis may occur in the larvae of *P. brassicae* after oviposition by *A. glomeratus*, but he found it of very little importance after oviposition in the first stage larvae.

The number of parasites is a factor influencing the possible development of the parasites. The 26—35 which represent a normal oviposition, can all develop completely if the eggs are laid in a stage of the host where complete development is possible at all. More than one oviposition may take place in the same larvae and we may get a host with a very large number of parasites. We will here find a limit for the number of parasites which can develop in one host. No special attention has been paid to this problem, but in some cases a high degree of superparasitism occurred. The maximal number of *A. glomeratus* larvae in one host, where at least some of the parasites developed completely, was: in larvae stung in the first stage: 86 parasites; in larvae stung in the second stage: 234 parasites; in larvae stung in the third stage: 249 parasites; in larvae stung in the fourth stage: 324 parasites; and in larvae stung in the fifth stage: 128 parasites. In some cabbage worms which died during the development, death was probably caused by superparasitism. That the host may die because too many parasites are present, has been observed several times. Martelli (1907) observed that cabbage worms which contained 79—112 parasites died. This was observed in nature, Faure (1926) think that this will hardly happen in nature, but it may happen in the laboratory. The maximal number found in one larva in nature is reported by different workers. Some have only counted the number of cocoons, while others have added the number of parasites which remained in the host. Most authors mention a number between 45 and 90 as maximum. Some of the highest numbers recorded are: Moss (1933) found up to 100 parasites in one larva, Olenev (1925) found 103 as the maximum number, Grandori (1911) 130—132 and Adler (1918) 180. All these numbers are from cater-

pillars parasitized in the first stage. As shown above, more parasites can develop in one host if the eggs are deposited in bigger caterpillars. This is not surprising, since more space and food are available to the parasites in the older caterpillars.

### **The emergence of the larvae of *A. glomeratus* from the host.**

Very early in the literature the emergence of parasitical larvae from the host was observed and described, and very often this description refers to the emergence of *A. glomeratus*. This phenomenon was first explained by supposing that the parasites were the offspring of the cabbage worm. After the real nature of the phenomenon was understood, more details have been added to the description of the emergence. The present paper can add few details to the older picture, and only a short description necessary for the understanding of the remaining parts will be given.

At the end of the fifth stage the parasitized larvae will stop feeding and start crawling around. Most of them would finally end on the cheese cloth in the top of the bottle or at the upper part of the side of the bottle. Here they started spinning the usual mat and remaining quietly upon it until the parasites emerged. The larvae of *A. glomeratus* leave the host by each eating its way through the body wall of the caterpillar. The first indication is the irregular shape of the caterpillar as the parasites start on their way out. When approximately one third of the larva is free, it starts spinning, the outward movement slowing down a little. The yellow cocoon is finished a few hours after the larva has left the host. When the parasite is almost free, it bows down towards the support and in towards the host, so that when it is totally free, it ends under the host. This movement may take place even if the caterpillar sits in the roof. This can explain why it is we often find the cabbage worm on the top of a row or more irregular cluster of cocoons, as already mentioned by Faure (1926). It may also happen that the larvae will continue their way out to the sides of the host, without bowing under the host, and then we find the caterpillar with two rows of cocoons, one on each side. Bleeding was very seldom observed from the wound through which the parasite emerged. This is because the parasites throw off the old skin of the second stage under the emergence, the old skin remaining in the host like a cork in a hole. Most of

the parasites leave the host along the sides of the 6—9th segment, although it may take place from all parts of the host, except the head capsule. Dissections of larvae a few days before the parasites were due to emerge, showed the same concentration of parasites in the 6—9th segment. When this uneven distribution takes place is still an open question.

Descriptions of the emergence all agree in most features, except for that given by Fabre (f. i. 1920). He insists that all larvae leave the host through the same hole. It is very difficult to understand how he could get this picture of the emergence. Secondly, Fabre maintains that the mat spun by the host, is necessary for the parasites as giving them support for their own threads for their cocoons. This has also been shown to be wrong.

At 22° C the time required was usually 25 minutes for one *A. glomeratus* larva on the visual part of the outward movement. The parasites emerge almost simultaneously and the 30 parasites contained in one host would have emerged in about 45 minutes. The duration depends upon the number of larvae present and could be about two hours when hundreds of parasites were present. Sweetman (1936) mentions that it takes about  $\frac{3}{4}$  of an hour for the parasites to leave the *P. rapae* larva, and Gatenby (1918) says about one hour.

When observing the emergence one is struck by two things. First, that the emergence of the parasites takes place at the moment when the caterpillar seems ready to pupate; secondly, that apparently all parasites emerge simultaneously. We will treat the second phenomenon first. It is mentioned by almost every one who has described the emergence. Gatenby (1919) has tried to give an explanation. He "concludes that the outward movement of the more advanced individuals is due to a physiological stimulus and that their movements influence the remainder to do likewise." (Clausen, 1940, p. 32). Moss (1933, p. 216) finds it possible that the larva, having reached a certain size, becomes "unable to subsist on the dissolved oxygen in the host's body fluids and must have direct access to the outside air".

In order to see if all *A. glomeratus* larvae really emerged simultaneously, some parasitized caterpillars were kept under observation before and after the emergence. It was in this way only once found that one *A. glomeratus* larva emerged distinctly before the others: It was from one caterpillar which had been parasitized on the first day of the second stage. Fourteen days after the oviposition the emergence took place. One parasite left the caterpillar between

two and six hours before the general emergence of the 34 parasites. Dissection after this general emergence showed that eight larvae remained in the host.

It is easier to see whether any larvae leave the host after the collective emergence. Immediately after the last of these larvae had left the host, the host was removed and kept under observation. From three of the 59 caterpillars which were examined in this way, larvae of *A. glomeratus* left the caterpillar distinctly after the others. In one case a parasite emerged 12 hours after the others, in the second case two parasites emerged after the others. In the last case the host had been parasitized on the first day of the first stage. 22 parasites worked their way out of the host 24½ days later. 12 hours after this, the first delayed parasite emerged and two days after this another emerged. Dissection showed that seven more parasites got stuck in the host. In 26 of the 56 caterpillars examined, dissection showed that not all the parasites had emerged.

It is of course very easy to overlook such delayed parasites, and in fact the only note about it I have been able to find is one by Gatenby (1919). He observed that some of the parasites left the host ten minutes after the others.

#### **A. *glomeratus* larvae remaining in the host.**

As will be seen from the example cited in the preceding chapter, not all the parasites leave the host. Some will get stuck more or less out of the host. Others may be seen under the cuticle where they have tried to bite their way out, and quite a few are first seen after the host is opened. The parasites remaining in the host may be classified in two groups: first those which have reached the stage where they emerge, and, secondly, those which have not got that far in their development. Larvae from the first group could be found in all segments of the host, but especially in the 6—9th. In some cases it seemed possible to give an explanation why the larva had not been successful in its attempt to emerge. Some, partly free, had got caught in the tracheae from the host or in its own old exuvia. Some had not been able to bite a hole because the cuticle had been too hard. Such unsuccessful attempts were mostly observed when the larva had tried to bite its way through one of the large dorsal spots, through the head capsule or through one of the abdominal or anal legs. In some cases the larva had followed the cuticle, and the track from the biting could be seen from outside, often



leading from one side of the host to the other. In a few cases these tracks started under one of the large dorsal spots, which then perhaps had forced the larva to change direction in its outward movement. It was also observed that the larva had bit its way through the intestine of the host or through another parasite, even then without being able to emerge. In a few cases the larva had entered the intestine and continued in the inside of it in the same direction as the intestine. In other cases the parasite got caught when it had tried to cross through the intestine, and the old skin had been thrown off when it entered the intestine. Many of the larvae which had made an incomplete hole in the integument of the host, were found when the host was dissected to be covered by a black coat around the forepart. This is caused by the darkening of the blood of the host, which when exposed to the air, will react in this way.

The larvae which were not fully developed, could be found in all parts of the host, but usually were found in the region of the abdominal legs ventral to the intestine. Even in the head capsule such larvae could be found, and often in the last segment. They were then mostly found across the rectum, over or especially under it in a fold between the anal legs. Other larvae could be detected completely hidden in the legs and only a careful examination could give the exact number of larvae in the host. When the host was examined shortly after the emergence, the remaining parasites were found to be alive. They seemed to die in three to four days.

The smallest *A. glomeratus* larvae, which sometimes could be in the first stage, were usually found in the legs, under the rectum and in the head capsule. Especially if the host contained many parasites, some were found in these places. They were probably so small because of their unsatisfactory position in the host. It is a question whether the remaining larvae would continue their development after the others had emerged. That to some extent it seemed to happen, is shown by the delayed emergence of a few parasites.

Table 4 contains the number of *A. glomeratus* larvae remaining in the host after oviposition in the first stage caterpillar. The material has been grouped according to the total number of parasites present in the host. The last group (61—86) is wider than the others. Of the 82 caterpillars examined, larvae remaining were found in 40. The two first columns show that when the host contained many parasites, it was more seldom to find caterpillars where all the para-

Table 4.

The number of not-emerged *A. glomeratus* larvae after oviposition in first stage larvae of *P. brassicae*.

A. glomeratus pr. host	P. brassicae larvae where		Total number of A. glomeratus	A. glomeratus not emerged	
	all emerged	not all emerged		Total	%
1—15	10	1	111	9	8
16—30	23	16	924	65	7
31—45	8	15	786	55	7
46—60	1	5	309	28	9
61—86	0	3	223	67	30
	42	40	2353	224	9,5

sites had emerged. The 82 caterpillars contained 2353 larvae of *A. glomeratus*, 224 of which did not emerge. That is 9,5%. In the group containing 1—60 larvae 7—9% did not emerge. If the host contained more than 60 parasites, the percentage of not-emerging parasites increased to 30. It is interesting to note that we here are closer to the maximal number of parasites observed in one host, if any would be able to emerge at all. The percentage of remaining larvae was lowest for the groups containing 16—45 parasites, that is, about the number of parasites which was usually found after one oviposition.

What has been said about the remaining larvae after oviposition in the first stage caterpillar, is also true after oviposition in the second, third and fourth stage caterpillar. These results are listed in tables 5, 6 and 7. If we try to compare the different stages, we must include hosts containing the same number of parasites. This is done in table 8 where caterpillars containing 60 or less *A. glomeratus* larvae are listed. After oviposition in the second stage caterpillars there were relatively more hosts from which all the parasites emerged, than after oviposition in the other stages. In percentage, less parasites remained in the host after oviposition in the second and third stage, than after parasitism in the first and fourth stage.

Sometimes the number of remaining larvae could vary much, as, for example, among the caterpillars parasitized in the second stage. One of these contained 132 specimens, two of which did not emerge, while, on the other hand, one

Table 5.

Not-emerged *A. glomeratus* larvae after oviposition  
in second stage larvae of *P. brassicae*.

A. glomeratus pr. host	P. brassicae larvae where		Total number of A. glomeratus	A. glomeratus not emerged	
	all emerged	not all emerged		Total	%
1-15	2	3	48	9	19
16-30	6	5	280	7	3
31-45	10	5	550	18	3
46-60	5	2	361	2	1
61-75	1	5	405	7	2
76-90	2	3	408	6	2
91-234	0	8	1270	311	25
	26	31	3322	360	10,8

Table 6.

Not-emerged *A. glomeratus* larvae after oviposition  
in third stage of larvae of *P. brassicae*.

A. glomeratus pr. host	P. brassicae larvae where		Total number of A. glomeratus	A. glomeratus not emerged	
	all emerged	not all emerged		Total	%
1-30	2	3	88	5	6
31-60	3	2	204	2	1
61-90	0	7	508	92	18
91-120	0	4	414	28	7
121-150	0	8	1045	99	9
151-249	0	4	903	244	27
	5	28	3162	470	14,9

remained in a caterpillar which contained two parasites, and six out of seven remained in another.

Very little information is available in the literature about the remaining larvae. Gatenby (1919) mentions only that in some of the caterpillars he found one or more parasites had not emerged. Hamilton (1935-36) says that in 50 % of the caterpillars parasitized in the first stage, not all the parasites emerged. This percentage is about the same as found in the present paper. He mentions further that the number of parasites varied from 1-5, all in the last stage.

Table 7.

Not-emerged *A. glomeratus* larvae after oviposition  
in fourth stage larvae of *P. brassicae*.

A. glomeratus pr. host	P. brassicae larvae where		Total number of A. glomeratus	A. glomeratus not emerged	
	all emerged	not all emerged		Total	%
1—30	1	6	113	15	13
31—60	1	11	522	35	7
61—90	0	3	213	16	8
91—120	0	3	325	29	9
121—150	0	2	283	32	11
151—324	0	12	2772	896	32
	2	37	4228	1023	24,2

Table 8.

Not-emerged *A. glomeratus* larvae from *P. brassicae* larvae  
which contained less than 61 *A. glomeratus*.

Oviposition in <i>P. brassicae</i> in stage	P. brassicae larvae where		Total number of A. glomeratus	A. glomeratus not emerged	
	all emerged	not all emerged		Total	%
I	42	37	2130	157	7
II	23	15	1239	36	3
III	5	5	292	7	2
IV	2	17	635	50	8

The number of remaining parasites was 2,8 % of the total number. Richards (1940) found that 4,9 % of the larvae failed to leave *P. brassicae*. In the material used for the present paper the number varied from 1—54 and the percentage was 9,5. Some of the larvae were in the first and second stage. These disagreements are of less importance as the laboratory conditions probably have been different in the two cases. Hamilton found also that the number of remaining larvae did not have any relation to the total number of parasites present. I can only agree with him to a certain extent. When the number of parasites was below 60, it was true. But when the number was above 60, that is, when it was near the maximal number of parasites present, then the number of remaining larvae also increased.

It would, in connection with the development of the parasite, have been very interesting to compare the suitability of the different stages of the host. In order to do this, it would have been necessary to include an investigation of the mortality of the parasite during the development, and the influence of the host on the reproductive rate and mortality of the parasite after it has left the host.

#### **Double parasitism of *P. brassicae*.**

In the cases described, the parasites in a host all originated from eggs laid within a short interval of time. The parasites therefore were almost of the same age when they emerged. If the host contained parasites of different age, would they then emerge at intervals corresponding to the difference in age? In order to study this problem some caterpillars were parasitized twice, but with a definite interval between the two ovipositions. The first oviposition took place when the cabbage worms were less than one day old, and with a few exceptions only one sting was given to each larva. The second oviposition in the host took place  $\frac{1}{2}$ —12 days after the first. In the younger larvae usually one sting was given the second time. In the older larvae sometimes two or three stings could be given simultaneously. With caterpillars 12—13 days old, being in the moult between the 4th and 5th stage, more than one sting was always given to each caterpillar the second time. In all, 67 caterpillars were used for these experiments, most of which were made in 1950. The caterpillars were bred in the usual way and observed for any emerging parasites. The parasites emerged simultaneously similar to an emergence from an ordinary parasitized caterpillar, and only one such collective emergence was observed from each host. But from ten caterpillars one parasite, and from one caterpillar two parasites, emerged definitely after the others. Most of these parasites emerged only a few hours after the collective emergence. But in four cases the delay was one to four days. Dissection of the caterpillars showed that not all the parasites had left the host. In all but one the 19 caterpillars which contained broods of  $\frac{1}{2}$  or 1 days difference in age, parasites were found remaining. Most of the larvae remaining were in the last part of the second, or in the third, stage. The parasites which remained in the caterpillars parasitized at 8 and 12 days' intervals, were either full-grown, or they were small, approximately 1—3 mm long, and in the first and second

Table 9.

The development of *A. glomeratus* in larvae of *P. brassicae* stung at different intervals.

Average number of <i>A. glomeratus</i> larvae which	Interval in days between the stings							
	1/2	1	2	3	4	6	8	12
emerged.....	37	39	25	26	23	28	22	17
remained.....	7	8	8	0	2	7	8	26
total.....	44	46	33	26	25	35	30	44

stage. The larvae remaining in these caterpillars clearly showed the two different broods. By means of this and the total number of parasites present in the caterpillars, it is possible to get an idea of the fate of the two broods in the different hosts. Table 9 shows that the average numbers of parasites in the caterpillars which received two stings at  $\frac{1}{2}$  and 1 day intervals, were 44 and 46. Nearly all the parasites emerged and it was impossible to separate the two broods by the size of the *A. glomeratus* larvae. From the caterpillars parasitized at 8 and 12 days' intervals, an average of 22 and 17 parasites emerged. This must be parasites from the first oviposition. From the "8 and 12 days" caterpillars a few full-grown *A. glomeratus* larvae did not emerge. We therefore get a more correct picture of the broods if we include these full-grown parasites, giving a first brood average of 23 and 19 parasites. Supposing that the first brood in all these cases to be of the same size, this would show that the caterpillars parasitized at  $\frac{1}{2}$  and 1 day intervals, must contain two complete broods, which, except for a few specimens, emerged simultaneously. From the caterpillars parasitized at 8 and 12 intervals, only the first brood emerged. The second brood should be represented by the 1—3 mm long *A. glomeratus* larvae remaining in the host. For the "8 days" caterpillars which received one sting the second time, this gives an average of 7 parasites in the second brood. Besides this, one caterpillar which received several stings contained only 36 parasites. The second broods therefore are not so numerous as normal ones. The same picture is shown by the caterpillars parasitized at 12 days intervals. These all received several stings the second time. And the number of parasites from the second broods, approximately 1—2 mm long at dissection, were only 36—0—49—28—8.

Caterpillars parasitized at 3 and 4 days' intervals, show quite another picture. From those at three days' intervals all emerged, the average being 26 larvae. In the "four days" caterpillars, only fullgrown parasites were left in the host, and most of them had tried to emerge. The average number of parasites was here 25. These numbers indicate only one successful oviposition. That, then must be the first one, the larvae of which have emerged in the ordinary way. Of the second brood very few, if any at all, were left. This is the more astonishing, as no less than 8 of the 14 caterpillars parasitized at 4 days' interval, received two or three stings the second time.

To give an explanation of the conditions in the caterpillars parasitized at two or six days' intervals, is difficult. In both cases there was only one collective emergence, and it was not possible to divide the remaining *A. glomeratus* larvae into two groups. The average of the total number of parasites present in one host (33 and 35) is larger than what was found after just one oviposition in these experiments, but it is too small to represent two complete ovipositions. The second brood must be partly present, represented by a few specimens in most of the caterpillars. In these cases where little or nothing was found of the second brood, this may happen in different ways. The female perhaps did not lay any or only few eggs, or a part of the brood died during development. In the first case, the female must be able to distinguish between these parasitized caterpillars and not-parasitized, probably by means of a sense organ in the ovipositor (cp. Salt, 1937).

The double parasitions show that even when there is  $\frac{1}{2}$ , 1 or perhaps in some cases 2—6 days' difference between the ovipositions in the same host, the parasites leave the host within the same hour, except for a few scattered, delayed emergences. Caterpillars found in open air sometimes contain so many larvae of *A. glomeratus* that several ovipositions must have taken place. Even if the ovipositions take place only in the first stage caterpillar, there can be a definite time interval between the ovipositions. (In Lyon, France, the first stage lasts for 3—7 days depending upon the season (Faure, 1926), and in the Oslo region it is observed to last up to 20 days.) But the *A. glomeratus* larvae from a caterpillar found in nature, always show the typical simultaneous emergence as in these experiments.

The simultaneous emergence of the *A. glomeratus* larvae differing in age, can only be possible by some kind of regula-

tion of the development of the parasites. The parasitical period of the larvae originating from the second oviposition, is shorter than for those from the first. The duration of the parasitical period and its possible variation is, therefore, of interest.

#### **The duration of the parasitical period of *A. glomeratus*.**

The time used for the development of the parasites inside the host differs according to the temperature of the surroundings. In order to study the duration of this period and see if it varies with factors other than the temperature, the material from 1946 has been used. Fig. 9 shows the duration of the parasitical period of *A. glomeratus* after oviposition in different stages of the host. Only hosts containing 25—50 *A. glomeratus* larvae have been used. The time used for the development is indicated by the ordinate. Along the abscissa the normal development of the host is indicated so that the figure also shows when the oviposition took place in the host. The time used for the development of the parasite is much shorter when the eggs are laid in older caterpillars. When the eggs were laid on the first day in the first stage caterpillar, the parasites would emerge about 18 days later. But after oviposition on the first day of the fifth stage, the parasites emerged only 11—12 days later.

It could also happen that the duration of the development would depend upon the number of parasites present in the host. This is shown in fig. 10 and 11 which are based upon material from caterpillars where oviposition took place on the first day of the first and the second stage. The figures show that the duration of the development increases with the number of parasites present in the host. If this is true, emergence would first take place from those caterpillars which contain the smallest number of parasites. Table 10 shows the average number of parasites in the two first and the two last emergences in the different broods used for these experiments. The emergence first took place from those caterpillars which contained the smallest number of parasites and lastly from those with the largest number. This shows that the time of development of the parasite increases with the number of parasites present also when the eggs have been laid in the third and fourth stage caterpillars. These findings are not in agreement with those made by Hamilton (1935—36). He found that there did not appear to



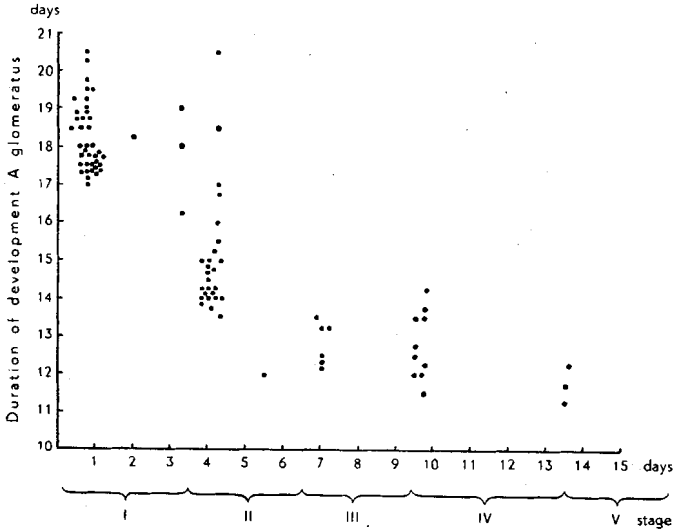


Fig. 9. The duration of the parasitical period of *A. glomeratus* after oviposition in different stages of *P. brassicae*.

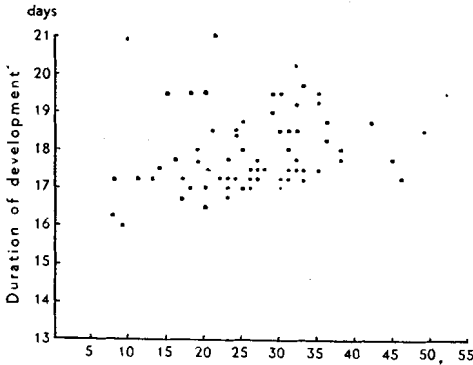


Fig. 10. The duration of the parasitical period of *A. glomeratus* in relation to the number of larvae present in the host. Oviposition on the first day of the first stage of *P. brassicae*.

be any difference in the length of endoparasitic life depending on the number of larvae present in the host. Although these experiments were carried out under somewhat different conditions from the double-parasitisms, fig. 9 can, to some extent, explain the results obtained in the double-

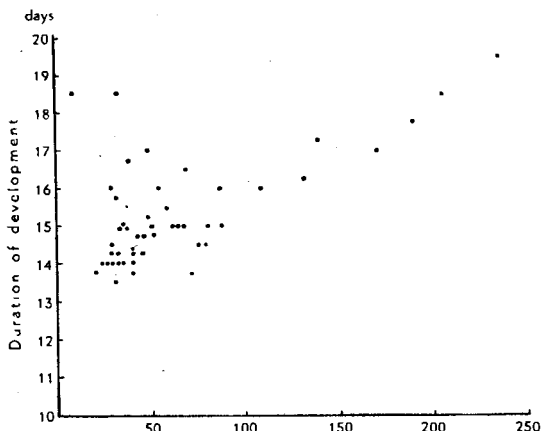


Fig. 11. The duration of the parasitical period of *A. glomeratus* in relation to the number of larvae present in the host. Oviposition on the first day of the second stage of *P. brassicae*.

parasitisms. The quicker development of parasites after oviposition in older stages of the host, may explain that broods differing perhaps as much as six days in age can be full-grown about the same time, while this, in the same way, is not possible for those differing 8—12 days. It is insufficient to explain that the emergence is as simultaneous as it proved to be. This could point towards factors external to the parasites as being the possible stimulus for the outward movements.

Table 10.

The average number of *A. glomeratus* in larvae of *P. brassicae* where emergence took place first, second, next to last and last.

Oviposition in <i>P. brassicae</i> in stage	Average number of <i>A. glomeratus</i> in emergence No.				Number of broods of <i>P. brassicae</i>
	1	2	n-1	n	
I	24	24	33	32	17
II	43	49	68	84	9
III	53	58	62	162	6
IV	45	87	130	199	6

### The problem of the synchronic development of the host-parasite.

In the period previous to the emergence of the parasites, the behaviour of the parasitized caterpillar is very similar to a not-parasitized one. After spinning the silken mat it rests quietly on the mat awaiting the emergence. A normal caterpillar would now have spun the girdle around the back tying it to the mat. This has not been observed on normally parasitized caterpillars. They always seem to stop before spinning this girdle as already pointed out by Gautier (1918 a). The possible synchronization in the development of the host and the parasites expressed by the emergence of the parasites taking place during the prepupal behaviour of the host, is so striking that it has been pointed out in several papers. It would be tempting to put forward the hypothesis that the physiological changes in the host in connection with the pupation, is the stimulus to the parasites to leave the host. This could explain both the simultaneous emergence of the parasites and that the emergence seems to be fixed to a certain period in the development of the host. Moss (1933) dealing with the problem of the emergence of the larvae of *A. glomeratus*, finds that "the moment of emergence seems to be determined by the behaviour of the host and not by the physiological condition of the parasite" (p. 215). He writes further that "nothing is known at present as to the stimulus that determines emergence" (p. 216) but as mentioned on p. 167 he believes that it may possibly depend upon the need for oxygen.

When the eggs of *A. glomeratus* had been laid in older cabbage worms, the emergence also seemed to be fixed to the same period in the behaviour of the host. The host would leave the cabbage, crawl and spin the mat in the same way. After spinning the mat it would sometimes sit quietly and wait for some time but it always stopped at this point and never spun the dorsal thread if any parasites were to emerge later. The duration of the development of the host and the parasites is in these cases regulated so that this is possible. Fig. 12 shows when the pupation of not-parasitized caterpillars took place and how the emergence of the *A. glomeratus* larvae were in relation to this. The larvae from the caterpillars parasitized on the first day of the first stage emerged approximately one day before pupation should have taken place. This is in accordance with the behaviour of the parasitized caterpillar. The caterpillars parasitized in the

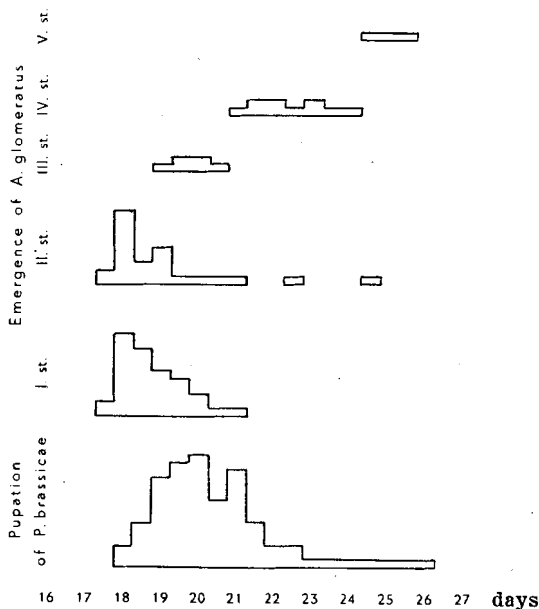


Fig. 12. The emergence of *A. glomeratus* in relation to the pupation of *P. brassicae* after oviposition in different stages of the host. Only caterpillars containing 25—50 *A. glomeratus* are included.

first stage do not seem to have been much delayed in their development. Hamilton (1935—36) on the contrary found that parasitized caterpillars were 3,1 days delayed in the development at the last moult. I will return to this problem in a later paper in connection with a more complete treatment of the influence of the parasites on the growth and development of the host. If we in the same way compare the emergence from the caterpillars parasitized on the first day of the fourth stage, this took place approximately 2—4 days after the pupation should have occurred. The behaviour of the caterpillars indicates that they must be 3—5 days delayed in their development. But besides this, the development of the parasites is much faster than after oviposition in the first stage caterpillar (cp. p. 176). The eggs are laid nine days later (cp. fig. 9), but the development of the parasites is 4—6 days quicker. The quicker development of the parasites, and the delay in the development of the host explains why the emergence apparently takes place during the same period of development of the host as after oviposition in the first stage caterpillars.

On p. 176 it was shown that the development of the parasites *i. a.* depends upon the number of parasites present. An explanation of this could be that it depends upon the quantity of the food available to each parasite. If only a few eggs were laid in a first stage caterpillar, would then the quantitative conditions be as good as when several eggs are laid in a fourth or fifth stage caterpillar? And would we then get the quick development of the parasites so that they would emerge earlier than the usual prepupal period, for example, while the host was still feeding? In order to get few eggs in first stage caterpillars the females were removed shortly after the sting was started (cp. p. 163). But even when the host in this way contained less than 10 parasites, they would not emerge in the feeding period, e. g., on the first or second day after the last moult. The host behaved in the usual way, and emergence seemed to take place while the host was preparing for pupation. In two cases the parasites emerged while the host still was in the fourth stage.

This shows that the parasites are able to emerge in periods other than the usual prepupation period. In fact Gautier (1918 a) mentions that he observed emergences from fifth stage caterpillars which were only  $3\frac{1}{2}$  cm long and were "bien loin de la period de chrysalidation" (p. 198), and George (1928) observed one case where three *A. glomeratus* larvae emerged three days before the host pupated.

Another way to exclude the hormone which regulates pupation, from being a possible stimulus for the outward movement of the parasites, is to remove the sources for this secretion before the secretion is started. As demonstrated by Kopeck (1922) and later confirmed by several workers, the hormone initiating pupation is in the *Lepidoptera* secreted by the brain (or perhaps in some circumstances by the prothoracic gland) while the juvenile hormone is secreted by the corpora allata. In order to eliminate hormones as a stimulus for the outward movements of the parasites, 66 caterpillars, about  $\frac{1}{2}$  of which were parasitized, were used for ligature experiments. The ligature was put round the thorax, mostly between the pro- and mesothorax, and the head and the parts of the thorax anterior to the ligature were removed. After this the caterpillars would stay quiet, even if they had been in the feeding or crawling period of the fifth stage. They could survive for nearly 50 days, although young caterpillars especially mostly shrunk rapidly and died in about one week. The parasites emerged simultaneously in the usual way. Some parasites remained in the host, but not in any larger numbers than ordinary. The caterpillars

Table 11.

The emergence of *A. glomeratus* from larvae of *P. brassicae* ligatured in the fifth stage.

The moment of ligaturing in days after last moult	Number of emergences from <i>P. brassicae</i> grouped in days after last moult					Number of <i>P. brassicae</i> from which none emerged
	5	6	7	8	9	
5 1/2			1			0
4 1/2			4	1		0
3 1/2			6	1		1
2 1/2		2	1	1		0
1 1/2			1	1		7
Not ligatured			3	4		0

were ligatured 1½ days to 5½ days after the last moult, while they were still feeding on the cabbage. From the control caterpillars the parasites emerged 7 to 8 days after the last moult (tab. 11). From the ligatured caterpillars the parasites emerged at the same time. Seven of the caterpillars which were ligatured 1½ days after the moult, died without the parasites having emerged. In most of the cases the host although shrunk and small, lived long enough for the parasites to emerge. From the caterpillars ligatured after this period, emergence took place from all except one, and this died within three days after the experiment, that is, probably before the parasites could get time to emerge.

The development of the parasites must have continued after the ligaturing at the same rate as in normal caterpillars. The caterpillars were ligatured before the critical period when the hormone regulating pupation is secreted (cp. Kaiser, 1949). The hormone or changes caused by it, can therefore be excluded as possible stimulus for the outward movement of the parasites. At present this stimulus is not known. The second moult is in *A. glomeratus*, as in most other *Microgasteridae*, coincident with the emergence from the host. It may be that this must be considered a part of the problem of emergence. Although the initiation of moulting is probably regulated by internal secretion in *A. glomeratus* as in other insects, the fact that broods of parasites differing several days in age emerge simultaneously, strongly indicates that factors external to the parasites play an important role in determining the time of

emergence. As a conclusion it may be said that several aspects of the present paper show the strong reciprocal influence between the host and the parasites in the regulation of development but the details of this interaction are at present unknown.

### Summary.

The easiest way to get the *A. glomeratus* female to oviposit in the laboratory, was to introduce the object to 3—4 females in a test-tube where the females had lived for some time. Several factors could prevent the females stinging.

The females of *A. glomeratus* stung and oviposited readily in eggs and larvae in all stages and in the prepupa of *P. brassicae* (fig. 2—7). Stings in the pupa were only observed in 2 % of the experiments, and in 3 of 25 experiments stings were observed in the imago. Eggs were deposited in both pupa and imago (fig. 8). The females would also sting dead caterpillars in the first stage and full-grown dying caterpillars from which the larvae of *A. glomeratus* had emerged one week earlier. Because of the passive and active resistance of the host the caterpillars in the first days of the first stage were best suited for oviposition.

The duration of the sting was usually 9—12 seconds at ovipositions in caterpillars in the first, second or third stage (table 1). The longest time measured was 2 minutes and 25 seconds for one sting. The usual number of larvae found after one sting was around 30 after oviposition in caterpillars in the first, second or third stage (table 2, 3).

Full development of *A. glomeratus* was possible after oviposition in eggs immediately before hatching, larvae in the first, second, third, and fourth stage, and the first day of the fifth stage. After oviposition in younger eggs, the eggs died, or the emerging caterpillars were not parasitized. After oviposition in caterpillars in the first day of the fifth stage, the result depended on the number of *A. glomeratus* present in the host. If only few parasites were present, the caterpillar would pupate and die as pupa. If the caterpillar contained 26—128 *A. glomeratus* larvae, the larvae would emerge in the usual way while the caterpillar was still in the fifth stage. If the caterpillar contained several hundred larvae, it would die without pupating and without the emergence of the parasites. After oviposition in later periods of the fifth stage and the prepupa, the host pupated and died

in the pupal stage without the emergence of the parasites. The same happened after oviposition in the pupa.

The greatest numbers of *A. glomeratus* larvae found in one host from which some parasites emerged, were, after oviposition in the first stage caterpillar, 86 specimens, second stage 234, third stage 249, fourth stage 324 and fifth stage 128.

Some *A. glomeratus* larvae left the host up to two days after the general simultaneous emergence. Not all larvae left the host. Some did not succeed in the emergence while others were not full-grown. After oviposition in first stage caterpillars, 9,5 % of the parasites did not emerge, and in  $\frac{1}{2}$  of the caterpillars remaining *A. glomeratus* larvae were found. When the host contained many parasites it was more difficult to find caterpillars from which all had emerged and the percentage of remaining larvae also increased (table 4). The results were similar after oviposition in the second, third, or fourth stage caterpillars (table 5, 6, 7). If caterpillars containing up to 60 *A. glomeratus* larvae were compared, the percentage of remaining larvae was lower after oviposition in the second and third stage than after oviposition in the first and fourth stage (table 8).

If the same caterpillars were parasitized twice at intervals from  $\frac{1}{2}$ —12 days, only one normal, simultaneous emergence took place. If the interval was  $\frac{1}{2}$  or 1 day (or perhaps in some cases up to 6 days) both broods emerged at the same time. If the interval was 8 or 12 days, the second brood was not full-grown and remained in the host. The second broods in the last cases were not so numerous as normal ones. In caterpillars parasitized at 3 or 4 days' interval all *A. glomeratus* larvae were full-grown and nearly all emerged. Very few, if any, belonging to the second broods were found (table 9).

The time required for the parasitical period was shorter after oviposition in older larvae of *P. brassicae*, than when the eggs were laid in the first stage caterpillars (fig. 9). This can to some extent explain why broods differing in age could emerge at the same time. The duration of the parasitical period increased with the number of parasites present in the host (fig. 10, 11 and table 10).

The emergence of the *A. glomeratus* larvae was also after oviposition in the older stages fixed to a period where the host seemed to prepare for pupation. This was possible because the development of the *A. glomeratus* larvae was quicker than usual (fig. 9), and the development of the



caterpillar was delayed (fig. 12). Also from the caterpillars containing few parasites, emergence took place while the caterpillar seemed to prepare for pupation, except in two cases where the *A. glomeratus* larvae left the host while this was in the fourth stage.

Ligaturing the caterpillars in the fifth stage before the hormone regulating pupation was secreted, had no influence on the development of the parasites. Emergence took place in due time in the usual way (table 11). It is pointed out that there is a strong reciprocal influence between the host and the parasites in the regulation of the development, but the details of this interaction are at present unknown.

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# The Food Plant Preference of the Larvae of *Pieris brassicae* L. (Lepid., Pieridae).

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Verschaffelt (1910) was the first to study the correlation between the food plant choice of insects, plant odour and plant chemistry. The larvae of *Pieris brassicae* L. and *Pieris rapae* L. were among the insects he used for his study. He had noticed that certain plants were heavily attacked by these larvae, mostly various *Cruciferae*, especially cultivated ones, and species of *Tropaeolum* and *Reseda*. Various mustard oils are characteristic of these plants. Verschaffelt supposed that the larvae were attracted by the odour of the mustard oils. The *Pieris* larvae would feed on unattractive plants and materials as e. g., wheat, starch and filter paper if they were treated with juices or pastes of an ordinary host plant, *Bunias orientalis*. The mustard oils derived from different species of host plants differ in chemical composition. When the *Pieris* larvae are attracted to their food plants, do they identify the different plant species by their characteristic odours, or do they react to the whole group of different plant odours as attractive without distinguishing between odours from different plant species? Already Verschaffelt found that some plants were preferred and others were slightly attacked. This paper tries to furnish some more evidence on this problem.

## Materials and methods.

For these experiments only larvae of the Large White, *Pieris brassicae* L., have been used. They all belonged to the second generation, and the collections were made in September and October 1950. The larvae were collected from *Brassica oleracea* L., *Armoracia rusticana* G. M. Sch., *Bunias orientalis* L., and *Tropaeolum majus* L. which are the most common host plants in the region. The oviposition of the female had in all probability taken place on the same plant species on which the larvae lived when they were collected. Most of the larvae were collected in the last stages, but some were collected as

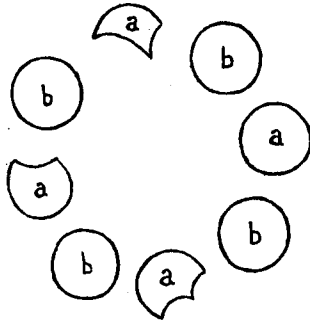


Fig. 1. The results of two hours feeding of a larva of *P. brassicae* from *Brassica oleracea*. a: pieces of *B. oleracea*, b: pieces of *Tropaeolum majus*.  $\frac{2}{3} \times$ .

eggs. In captivity they all were fed on their natural food plant species. The larvae belonged to several colonies and no care was taken to obtain larvae from single broods. All collections were made in Oslo, except for those larvae which lived on *A Armoracia rusticana*. They were collected in Drøbak, a few miles south of Oslo. I would like to take this opportunity to thank cand. mag. Marit Hammerstad and cand. mag. Per Oftedal for their assistance in making the collections.

The food test were performed in petri-dishes, approximately 7 cm in diameter. Pieces of the food plants were cut out with a cork bore, giving an area of 163 mm<sup>2</sup> tissue in each piece. In each experiment two species of plants were used. Eight pieces, four from each of the two species, were arranged alternately in a circle in the dish. The larva was placed in the centre and left for two hours in the dish. All the larvae used were in the feeding period of the fifth stage, and each larva was used only once. After the test the outline of the pieces were copied on graph-paper, and the areas eaten calculated. Figure 1 shows the result of one typical test. The larvae had lived on *B. oleracea* and the plants tested were *B. oleracea* (a in the figure) and *Tropaeolum majus* (b). The feeding period of the fifth stage lasts for some days, and the larvae used were therefore not exactly at the same age. The areas eaten by the different larvae are therefore not directly comparable, and the area of the two plant species eaten by each larva ought to be expressed as a percentage of the total area eaten by the larva. This has not been done because the differences in area eaten were so great that the percentage would be of little interest. The experiments were performed in a room with ordinary daylight, the temperature being about 20° C.

### Results.

With larvae fed on cabbage (*Brassica oleracea* var. *capitata* L.) 46 experiments were carried out. The results are given in table 1. In all six combinations of the plants there is a definite preference for one of the species offered. This

Table 1.

Total areas in mm<sup>2</sup> eaten by larvae of *Pieris brassicae* from *Brassica oleracea*.

Number of larvae	<i>Brassica oleracea</i>	<i>Armoracia rusticana</i>	<i>Bunias orientalis</i>	<i>Tropaeolum majus</i>
10	845	0		
5	213		0	
10	601			18
6		267	5	
5		461		0
5			0	0
5			106	0

is even more evident than the table shows, as the area eaten usually is a result of the larva feeding on two or three pieces (cp. fig. 1.). For larvae which had lived on cabbage the preference list should then be 1) *Brassica oleracea*, 2) *Armoracia rusticana*, 3) *Bunias orientalis* and 4) *Tropaeolum majus*.

Usually the cabbage leaves are much thicker than those of the other species. In order to eliminate this factor cabbage leaves were substituted by thin cauliflower leaves in five of the experiments where *Brassica oleracea* was tested against *Armoracia rusticana*. This made no change in the preference of the larvae. In the five experiments with cabbage — *Armoracia rusticana* the areas eaten were 240 mm<sup>2</sup>—0 mm<sup>2</sup> and in those five with cauliflower — *Armoracia rusticana*: 603—0 mm<sup>2</sup>.

In the tests with *Bunias orientalis* against *Tropaeolum majus* the five first experiments did not give any feeding at all. Five new experiments were then performed with new larvae. After the usual two hours only one larva had eaten, namely 38 mm<sup>2</sup> of *Bunias orientalis* and nothing of *Tropaeolum majus*. The experiments were then prolonged for two hours more, and the total results are given in table 1. This could indicate that both *Bunias orientalis* and *Tropaeolum majus* are little attractive to *Pieris brassicae* larvae which have lived on cabbage. This is further strengthened by the fact that larvae of the same brood were at the same time used in the tests with *Brassica oleracea* — *Tropaeolum majus* (601—18 mm<sup>2</sup>) and in four of the tests with *Armoracia rusticana* — *Tropaeolum majus* (343—0 mm<sup>2</sup>). But nothing definitely can be said as no control on cabbage was taken with the non-feeding larvae.

Table 2.

Total areas in mm<sup>2</sup> eaten by larvae of *Pieris brassicae* from *Armoracia rusticana*.

Number of larvae	<i>Brassica oleracea</i>	<i>Armoracia rusticana</i>	<i>Bunias orientalis</i>	<i>Tropaeolum majus</i>
15	697	702		
5	332		25	
5	300			0
5		909	33	
5		677		3
5			434	0

There could be some individual variation in the preference. This is shown in the tests with *Brassica oleracea* — *Tropaeolum majus* where one of the larvae also fed on the Indian cresses 18 mm<sup>2</sup>, against 114 mm<sup>2</sup> on cabbage. And in the test with *Armoracia rusticana* — *Bunias orientalis* where one larva fed 5 mm<sup>2</sup> on one of the *Bunias orientalis* pieces while it did not feed at all on the horse-radish.

The results of the 40 experiments with larvae which had fed on *Armoracia rusticana* are given in table 2. There is no significant difference between the areas eaten of *Brassica oleracea* and *Armoracia rusticana*. These two species are preferred to *Bunias orientalis* which again is preferred to *Tropaeolum majus*.

Five of the caterpillars used in the tests with *B. oleracea* and *A. rusticana* only fed on one of the species, while the ten others fed on both. The material used originated from different broods, and it is too small for any further statements. It would be very interesting to follow this problem as to those larvae which seemed to prefer one of the species and those which fed readily on both. In seven of these tests cauliflower was used instead of cabbage but without any change in the results.

In the other food plant combinations the preference for one of the species is evident. In five of these tests the larva also tasted the not-preferred food, and one larva fed more on *Bunias orientalis* than on the generally preferred *Brassica oleracea* (10—6 mm<sup>2</sup>).

35 experiments were performed with larvae fed on *Bunias orientalis*. The results are given in table 3. The list of preference for this larvae is: 1) *Bunias orientalis*, 2) *Armoracia rusticana*, 3) *Brassica oleracea* and 4) *Tropaeolum majus*.

Table 3.

Total areas in mm<sup>2</sup> eaten by larvae of *Pieris brassicae* from *Bunias orientalis*.

Number of larvae	<i>Brassica oleracea</i>	<i>Armoracia rusticana</i>	<i>Bunias orientalis</i>	<i>Tropaeolum majus</i>
5	17	330		
10	12		887	
5	74			0
5		61	930	
5		69		12
5			372	2

Table 4.

Total areas in mm<sup>2</sup> eaten by larvae of *Pieris brassicae* from *Tropaeolum majus*.

Number of larvae	<i>Brassica oleracea</i>	<i>Armoracia rusticana</i>	<i>Bunias orientalis</i>	<i>Tropaeolum majus</i>
5	163	69		
5	210		0	
10	23			1493
5		642	90	
5		137		289
5			402	849

The preference is evident in all the six groups, but in some of them a small but definite area of the not-preferred food plant has been eaten. This is accomplished in different ways. In the experiments with *Brassica oleracea* — *Bunias orientalis* two of the larvae which consumed the largest areas, also fed on the cabbage pieces. In the tests with *Armoracia rusticana* — *Bunias orientalis* one larva was responsible for the whole area of horse-radish eaten. But all caterpillars ate the largest area from the plant species which generally was preferred in the test.

With larvae fed on *Tropaeolum majus* also 35 experiments were carried out. The results are given in table 4. The list of preference for these larvae should then be: 1) *Tropaeolum majus*, 2) *Brassica oleracea*, 3) *Armoracia rusticana* and 4) *Bunias orientalis*. Here also a considerable area of the generally not-preferred species was sometimes eaten. The most striking results in that respect are those with *Bunias*

*orientalis* and *Tropaeolum majus*. Although *Tropaeolum majus* seems to be at the top of the preference list and *Bunias orientalis* at the bottom of the list, no less than 402 mm<sup>2</sup> of *Bunias orientalis* were eaten. The individual results are: (*Bunias orientalis* — *Tropaeolum majus*) 36—105; 299—79; 11—319; 22—96; 34—250. All larvae had eaten both species, but the large area of *Bunias orientalis* is especially due to one of the larvae. This indicates that there must be considerable individual variation.

### Discussion.

These experiments show that the larvae of *Pieris brassicae* have a preference for some of the food plant species depending upon the original food plant of the larvae. The larvae which had fed on *Brassica oleracea*, *Bunias orientalis* and *Tropaeolum majus* preferred the plant species on which they had lived. This could be due to the presence of biological races, but it is most probably an acquired preference. It will help to keep the larvae to stick to their original host plant. This is of little importance in nature, as the larvae will very seldom have to choose between two or more of these species. The food plant of the larvae is determined by the oviposition of the female. It would have been very interesting therefore to have been able to study any possible influence of the food plant of the larva on the oviposition of the female and the so-called "Hopkins host-selection principle".

The larvae which had lived on *Armoracia rusticana* are — contrary to the three other groups — not all attracted to their original host plant. As indicated on p. 190 further investigations would here be very interesting.

Already Verschaffelt (1910) noted that the plants were not eaten equally readily, but he did not make any closer examination of this problem except that he mentions that some species, especially the shepherd's purse (*Capsella bursa-pastoris*) were very slightly attacked, possibly because of the presence of distasteful, subsidiary constituents. None of his not-attractive plants however was used in my experiments. That a larva will not necessarily prefer the plant species on which it has fed, was shown by Dethier (1941) in his experiments with larvae of *Papilio ajax*. Given the choice between the leaves of carrot and filter paper treated with methyl chavicol the larvae would prefer the filter paper although they had lived upon carrot.



The ability of the *Pieris brassicae* larvae to show a special preference for some of the species while others are not so eagerly eaten, shows that the larvae must be able to distinguish between the four species. The experiments where some pieces of one of the species were eaten while the others were not tasted at all, indicate that taste is not the most important factor in these cases. One could perhaps expect that touch in connection with physical properties such as leaf thickness and pubescence should be of importance. The experiments where thick cabbage pieces were replaced by thin cauliflower without any change in the results indicate that leaf thickness is of less importance. And pubescence can only be responsible for the difference in a few of the combinations. In some of the experiments the larvae had fed on several pieces of both species tested. Whether in these cases the taste has been the determining factor is impossible to tell. But other of the experiments show that also these plants can be distinguished by the *Pieris brassicae* larvae without feeding on the leaves. And Eger (1937) found that the sense of taste was of no great importance for the lepidopterous larvae in recognizing their food plants. In fact the only factor which can give any reasonable explanation would be the plant odour. Already Brues (1920) suggested that the odour of a plant may be one factor influencing the food plant choice by lepidopterous larvae, and Dethier (1947, p. 249) says that "phytophagous insects are guided by plant odors". The sense of smell is also an important factor in the orientation of the larvae of *Pieris brassicae*. It helps the larvae in one brood to keep together during the three first larval stages (Wojtusiak, 1930). And the experiments by Verschaffelt (1910) also show that it is the plant odour which orientates the larvae about the food plant. Although the odour of a plant is due to a mixture of different chemical compounds, it is as stated by Dethier (1947) often possible to find one chemical compound which is responsible for the characteristic odour of the plant. In the *Cruciferae* and the species of *Tropaeolum* the characteristic odour is due to so-called mustard oils. The mustard oils are various esters of the isothiocyanic acid, HCNS. They occur in the plants mostly as glucosides, but probably also in small quantities as free oils.

According to the experiments *Tropaeolum majus* ought to be put in a group by itself. Of the three others, *Brassica oleracea* and *Armoracia rusticana* must have something in common, the last one being in between the *Brassica oleracea* and *Bunias orientalis*. This will not necessarily have some-

thing to do with the systematic relationship between the species, but with the mustard oils present. According to Wehmer (1932) allyl mustard oil or allyl isothiocyanate,  $C_3H_5NCS$ , is the main component of the oil from *Armoracia rusticana*, but besides this also phenylethyl isothiocyanate,  $C_6H_5C_2H_4NCS$ , and some phenylpropyl isothiocyanate,  $C_6H_5C_3H_6NCS$ , are present. The allyl isothiocyanate has also been isolated from the seeds of cauliflower. In *Tropaeolum majus* the benzyl isothiocyanate,  $C_6H_5CH_2NCS$ , has been found in seeds and leaves. The different oils present in these plants show that the larvae are probably able to distinguish between these closely related compounds, and that the oligophagous *Pieris brassicae* must be conditioned to more than one odour. This is similar to what Dethier (1941) obtained with *Papilio ajax*. This oligophagous larva is able to discriminate between six odours. Dethier was able to test his larvae on pure oils. It would be very interesting to do the same with the larvae of *Pieris brassicae*.

### Summary.

Fifth stage larvae of *Pieris brassicae* have been given the choice between pieces of *Brassica oleracea*, *Armoracia rusticana*, *Bunias orientalis* and *Tropaeolum majus*. Those larvae which had been taken from *Brassica oleracea* preferred: 1) *Brassica oleracea*, 2) *Armoracia rusticana*, 3) *Bunias orientalis* and 4) *Tropaeolum majus*.

For those from *Armoracia rusticana* the results were: 1) *Brassica oleracea* and *Armoracia rusticana*, 3) *Bunias orientalis* and 4) *Tropaeolum majus*. For those from *Bunias orientalis* the results were: 1) *Bunias orientalis*, 2) *Armoracia rusticana*, 3) *Brassica oleracea* and 4) *Tropaeolum majus*. For those from *Tropaeolum majus* the results were: 1) *Tropaeolum majus*, 2) *Brassica oleracea*, 3) *Armoracia rusticana* and 4) *Bunias orientalis*. Except for those which had lived on *Armoracia rusticana*, they preferred the plant on which they had lived, probably an acquired preference.

The larvae must be able to distinguish between the four species, probably because of the plant odour caused by the different mustard oils present in the different species. *Pieris brassicae* must therefore be conditioned to more than one odour.

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## Insektfynd på fjället Härjehåгна.

Av Karl-Herman Forsslund, Stockholm,

Vid ett sammanträffande med ing. Magne Opheim, Oslo, under den nordiska entomologkongressen i Köpenhamn 1950 kom jag att nämna en del fjärlfynd, som jag i juli 1927 gjorde på fjället Härjehåгна på norsk-svenska gränsen. Ing. Opheim påpekade då att norska entomologer aldrig samlat i dessa trakter och uppmanade mig att publicera fynden. Jag har därför gjort en sammanställning av vad jag återfunnit i mina anteckningar och samlingar. Huvudsakligen ägnade jag mig åt Trichoptera men tog även vara på en del insekter av andra ordningar, ehuru allt material ännu inte blivit bestämt. De på norska sidan påträffade trichoptererna har jag redan tidigare offentliggjort i denna tidskrift (1935, Bind IV p. 82). För fullständighetens skull upprepar jag dessa uppgifter i nedanstående förteckning, kompletterade med de på svenska sidan om gränsen gjorda fynden. Riksgränsen går nämligen över högsta toppen, varigenom fjället delas i ett större parti på den norska sidan och ett mindre på den svenska. Jag anser det vara lämpligt att i detta fall bortse från riksgränsen och även nämna fynd som gjordes strax öster därom. Det norska partiet ligger inom Engerdalens sogn i Hedemarkens fylke (faunistisk provins HEn), det svenska inom Idre socken i Dalarna.

Härjehåгна är med sina 1185 m ö. h. ett av de högsta fjällen i dessa trakter. Högsta toppen, som bär riksröse nr. 136, är täckt av skorplavklädda stenar. Dessa avlösas nedåt av vinderoderade fält med grupper av klynnetåg (*Junctus trifidus* L.) och styvstarr (*Carex Bigelowii* Torr. = *rigida* Good.). Ännu längre ned utbreda sig vidsträckta, kala hedar, ovanligt jämna och fina utan nämnvärda blockmarker men med en del smärre mossar. Här ligga ett par små sjöar, av vilka jag besökte en, Hågnsjöen. Den har stenbotten och strand av rished med några buskar av *Salix glauca* L., *lappinum* L., och *phyllicifolia* L. Vid dess södra ände finnes en rismosse.

Från sjön rinner mot NW Hågnbäcken, omgiven av täta *Salix*-snår och ängar, kärr och mossar. När den passerat trädgränsen har den svällt ut till en liten å och kallas nu Härjeån för att vid sitt lopp inom Sverige benämns Stora Härjeån. I detta sitt nedre lopp rinner den huvudsakligen i barrskog. En verklig björkregion är här liksom i Dalafjällen knappast utbildad. Det är mest längs bäckar och dalgångar som flikar av björkskog kan skjuta upp i fjällheden, dock ofta med en och annan insprängd gran. I dalen mellan Härjehåгна och det SW därom belägna Vithåгна rinner ån Röa, till vilken jag också gjorde en tur. Den omgives av skogar med starkt björkslag. — Mitt kvartér hade jag i en säter, Nysäteren, belägen väster om riksgränsen ett kort stycke nedom trädgränsen.

Vid bearbetningen av det insamlade materialet har jag fått hjälp av flera specialister, vilka nämnas vid resp. grupper. Jag säger dem här mitt tack för hjälpen. Även tackar jag folkskollärare Gottfrid Sthen, Idre, som gjorde mig sällskap på färden och var mig till stor hjälp vid insamlingsarbetet. Jag medtar även några fynd, som herr Sthen gjorde vid ett senare besök vid fjället (år 1928).

N i förteckningen avser Norge och S Sverige. Området ovan trädgränsen eller *regio arctica* utmärks med *r. a.*

#### *Odonata.* (K. Ander det.)

*Aeschna coerulea* Ström. N. Nysäteren 24/7, Hågnsjöen *r. a.* 26/7.

*Somatochlora metallica* v. d. Lind. N. Hågnbäcken *r. a.* 26/7.

— *alpestris* Selys. N. *r. a.* 26/7.

— *arctica* Zett. N. *r. a.* 26/7.

#### *Hemiptera.* (F. Ossiannilsson det.)

*Sigara producta* Reut. S. Moss-tjärn i barrskog 24/7.

#### *Neuroptera.* (B. Tjeder det.)

*Sialis fuliginosa* Pict. N. Härjåen 24/7.

*Hemerobius pini* Leach. N. På gran nära trädgränsen 26/7.

S. På gran 21/7; St. Härjeån 24/7; 24/8 1928.

#### *Trichoptera.*

*Rhyacophila nubila* Zett. N. Hågnbäcken *r. a.* 26/7. S. St. Härjeån 24/7, Röa 27/7.

*Agraylea cognatella* McLachl. N. Hågnsjöen *r. a.* 26/7.

*Philopotamus montanus* Don. N. Härjåen 24/7.

- Plectrocnemia conspersa* Curt. S. Röa 27/7.  
*Polycentropus flavomaculatus* Pict. S. St. Härjeån 24/7, Röa 27/7.  
*Holocentropus picicornis* Steph. S. Tjärn med gles *Carex rostrata* 24/7.  
*Cyrnus flavidus* McLachl. S. St. Härjeån 24/7, Röa 27/7.  
*Neuronia lapponica* Hag. S. St. Härjeån, *Salix-Carex*-kärr 24/7.  
*Agrypnia obsoleta* Hag. (= *Phryganea* o.). N. Hågnsjöen och mossgöl i r. a. 26/7. S. St. Härjeån och två tjärnar 22, 24/7, Röa 27/7.  
 — *picta* Kol. S. Kärr och blöta mossar vid. St. Härjeån 24/7.  
*Molanna albicans* Zett. N. Hågnsjöen r. a. 26/7.  
*Molannodes tincta* Zett. S. Liten lugn bäck vid St. Härjeån 24/7; tillsammans med den typiska formen, som har mörkbruna framvingar med gula fläckar, förekom här en form med enfärgat silvergrå framvingar; jag har sett denna senare från flera lokaler i norra och mellersta Sverige, och då melanformer tyckas helt saknas ger jag den härmed namnet *argentea* n. var.  
*Beraeodes minuta* L. S. St. Härjeån 27/7.  
*Silo pallipes* Fabr. N. Hågnbäcken r. a. 26/7. S. St. Härjeån 22, 24/7.  
*Micrasema gelidum* McLachl. N. Härjeån 24/7, Hågnbäcken och liten bäck i r. a. 26/7. S. St. Härjeån 22, 24/7, liten bäck nära trädgränsen 27/7.  
*Sericostoma personatum* Spence. S. Biflod till St. Härjeån 24/7, Röa 27/7.  
*Athripsodes nigronervosus* Retz. (= *Leptocerus* n.). N. Hågnsjöen r. a. 26/7.  
*Limnophilus rhombicus* L. S. St. Härjeån 24/8 1928.  
 — *borealis* Zett. S. St. Härjeån 23, 24/8 1928.  
 — *pantodapus* McLachl. S. St. Härjeån 22, 24/7, *Carex*-tjärn nära trädgränsen 27/7.  
 — *nebulosus* Kirby. S. *Carex-Salix*-kärr vid tjärn nära trädgränsen 27/7.  
 — *centralis* Curt. N. Hågnbäcken r. a. 26/7. S. Härjeån 22, 24/7.  
 — *extricatus* McLachl. S. St. Härjeån 24/7.  
 — *trimaculatus* Zett. S. Rännil vid tjärn nära arädgränsen 27/7.  
*Stenophylax caenosus* Curt. N. Härjeån 24/7. S. St. Härjeån 22, 24/7.  
 — *alpestris* Kol. S. St. Härjeån 24/7.

- Stenophylax algosus* McLachl. S. St. Härjeån 22/7.  
 — *infumatus* McLachl. N. Härjeån 24/7. S. St. Härjeån 22, 24/7.  
 — *stellatus* Curt. N. Härjeån 24/7. S. St. Härjeån 24/7, Röa och bäck nära trädgränsen 27/7.  
*Ecclisopteryx guttulata* Pict. N. Hågnbäcken r. a. 26/7.  
*Apatania wallengreni* McLachl. N. Hågnsjöen r. a. 26/7.  
*Gynapatania muliebris* McLachl. N. Liten bäck i r. a. 26/7.  
*Apatidea zonella* Zett. N. Nysättern 21/7.  
 — *subsp. dalecarlica* Forssl. N. Liten bäck i r. a. 26/7.

*Lepidoptera.* (*Macrolep.* F. Nordström det. *partim*,  
*Microlep.* P. Benander det.)

- Argynnis euphrosyne* L. N. Både i skoglandet och i r. a. 23, 26/7.  
 — *frigga* Thunb. N. Rismosse r. a. 26/7.  
*Erebia pandrose* Bkh. *subsp. lappona* Esp. N. r. a. 26/7. S. Nardurs-äng i björkskog 27/7.  
*Trichiura crataegi* L. S. St. Härjeån, larv på *Salix phylicifolia* 24/7.  
*Anarta richardsoni* Curt. *subsp. dovrensis* Staud. N. Vinderoderad rished nära toppen 26/7, 3 ex., varav 2 *in copula*.  
 — *melanopa* Thunb. N. r. a. 26/7.  
*Sympistis melaleuca* Thunb. N. r. a. 26/7.  
*Scopula ternata* Schrank. N. Blandskog 24/7.  
*Lygris testata* L. S. St. Härjeån 24/8 1928.  
*Cidaria munitata* Hübn. *subsp. arcticaria* Germ. N. Blandskog 24/7, Hågnsjöen r. a. 26/7.  
 — *ferrugata* Clerck. N. Blandskog 24/7.  
 — *albulata* Schiff. S. Hedbjörkskog 27/7.  
*Pygmaena fusca* Thunb. N. Blockrik björkhed 26/7; r. a. 24/8 1928.  
*Gnophos sordaria* Thunb. S. Hedbjörkskog 27/7, talrik.  
*Psodos coracina* Esp. *subsp. lappona* Werhli. N. Rismosse och *Cetraria nivalis*-hed i r. a. 26/7, flög bl. a. på *Loiseleuria*.  
*Parasemia plantaginis* L. S. Hedbjörkskog 27/7.  
*Anthrocera exulans* Hochenw. N. r. a. 26/7. S. Rismosse nära Röa 27/7, flera ex. Samtliga ex. tillhöra *f. vanadis* Dalm., vars systematiska valör ännu tycks vara oklar.  
*Crambus maculalis* Zett. S. 22/7.  
 — *alienellus* Zck. S. St. Härjeån 24/7.  
*Pyrausta decrepitalis* H. S. S. 22/7, St. Härjeån 24/7.

- Argyroploce schulziana* Fabr. N. 22/7.  
*Ancylis myrtillana* Tr. S. 22/7.  
*Borkhausenia similella* Hübn. S. 22/7.  
*Gelechia viduella* Fabr. N. Blandskog 24/7.  
*Tinea picarella* Cl. N. Blandskog 24/7.  
*Incurvaria vetulella* Zett. S. Blandskog 21/7.  
 — *rupella* Schiff. S. St. Härjeån 24/7.

*Coleoptera.* (A. Jansson det. *partim.*.)

- Carabus glabratus* Payk. S. Barrskog nedom Nysäteren 28/7.  
*Notiophilus hypocrita* Curt. N. Nysäteren 25/7.  
*Patrobis septentrionis* Dej. S. Röa, under strandsten 27/7.  
*Deronectes multilineatus* Falk. S. Hedtjärn i trädgränsen 27/7 (P. Brinck det.).  
*Hydroporus tartaricus* Lec. S. Hedtjärn i trädgränsen 27/7.  
*Agabus nigroaeneus* Er. S. Hedtjärn i trädgränsen 27/7.  
 — *congener* Thunb. S. Hedtjärn i trädgränsen 27/7.  
 — *bipustulatus* L. S. Hedtjärn i trädgränsen 27/7.  
*Gyrinus opacus* Sahlb. S. Hedtjärn i trädgränsen 27/7.  
*Mycetoporus brunneus* Marsh. S. St. Härjeån 24/7.  
*Catops watsoni* Spence. N. Nysäteren, i säterstuga 23/7.  
*Tanatophilus lapponicus* Herbst. S. Något nedom trädgränsen 27/7.  
*Podabrus alpinus* Payk. N. Härjeån 26/7.  
*Podistra pilosa* Payk. N. Salix-snår r. a. 26/7. S. St. Härjeån, busksnår 24/7.  
*Rhagonycha testacea* L. N. *Aconitum-Salix*-snår vid bäck i r. a. 26/7.  
*Malthodes flavoguttatus* Kiesw. S. St. Härjeån 24/7.  
*Triplax scutellaris* Charp. N. På *Polyporus* på björk 24/7 talr. ex.  
 — *aenea* Schall. N. Tillsammans med föregående, talr. ex.  
*Byrrhus pilula* L. N. Rismosse i r. a. 26/7.  
*Corymbites affinis* Payk. N. På *Salix lapponum*, Hågsjöen r. a. 26/7.  
*Callidum violaceum* L. N. Nysäteren 25/7.  
*Rhagium mordax* De G. N. På savande björk 24/7.  
*Evodinus interrogationis* L. N. 22/7.  
*Leptura sexmaculata* L. N. Nysäteren 24/7.  
*Saperda scalaris* L. var. *hieroglyphica* Pall. N. Nysäteren 22/7.  
 S. Hedbjörkskog 27/7.  
*Donacia obscura* Gyll. S. St. Härjeån 24/7.  
*Plateumaris sericea* L. S. St. Härjeån 24/7.  
*Phytodecta quinquepunctata* Fabr. S. St. Härjeån 24/7.



- Phytodecta pallida* L. N. På *Salix lapponicum* i r. a. 26/7.  
*Phyllosecta vitellinae* L. S. St. Härjeån på *Salix* 24/7.  
*Deporaus betulæ* L. N. 26/7.  
*Trichius fasciatus* L. S. 27/7.

### Diptera.

- Limnobia quadrimaculata* L. N. Blandske, 24/7. (Bo Tjeder det.).  
*Pedicia rivosa* L. N. Härjeån 24/7. S. Rännil nära trädgränsen 27/7  
*Rhagio scolopacea* L. N. *Aconitum-Salix*-snår i r. a. 26/7.  
*Empis lucida* Zett. N. 22/7. (O. Ringdahl det.).  
*Dolichopus nigricornis* Meig. N. Härjeån 24/7. (D:o).  
*Platychirus peltatus* Meig. N. 22/7. (Stackelberg det.).  
 — *clypeatus* Meig. 24/8 1928. (D:o).  
*Leucozona lucorum* L. N. 22/7.  
*Syrphus tricolor* Fall. S. St. Härjeån 24/7. (Stackelberg det.).  
 — *nitens* Zett. S. St. Härjeån 24/7. (D:o).  
*Cinxia borealis* Fall. N. och S. På högsta toppen 26/7 (D:o).  
*Ferdinandea cuprea* Scop. N. Nysäteren på savande björk 24/7. (D:o).  
*Scatophaga suilla* Fabr. N. r. a. 26/7. (R. Frey det.).  
*Lonchaea laticornis* Meig. N. 22/7. (D:o).  
*Ernestia truncata* Zett. N. Nysäteren på savande björk 24/7. (O. Ringdahl det.).  
*Protocalliphora sordida* Zett. N. r. a. 26/7. (D:o).  
*Hypodermodes mystacea* L. N. Nysäteren på savande björk 24/7. (D:o).  
*Phaonia vagans* Meig. N. Nysäteren på savande björk 24/7. (D:o).  
*Lasiops nigritellus* Zett. S. På *Angelica* nära trädgränsen 27/7. (D:o).  
 — *innocuus* Zett. N. r. a. 26/7. (D:o).  
 — *hirsutulus* Zett. N. r. a. 26/7. (D:o).

### Hymenoptera.

- Bombus lapponicus* Fabr. N. Något nedom trädgränsen 23, 26/7.  
 — *hypnorum* L. N. Härjeån 24/7.  
 — *jonellus* Kirby. N. Härjeån 24/7, rismosse i r. a. 26/7.  
*Vespa norvegica* Fabr. S. Nära trädgränsen 27/7.  
 A. Roman det.:  
*Cratichneumon nigritarius* Gr. N. 22/7.

- Cryptus titubator* Thunb. N. Nysäteren 25/7. S. St. Härjeån 24/7. *Angelica* något nedom trädgränsen och vind-eroderad rished ir. a. 27/7.
- Helcostizus albator* Thunb. N. 22/7, Nysäteren 25/7.
- Cubocephalus nigriventris* Thunb. N. r. a. 26/7. S. *Angelica* något nedom trädgränsen 27/7.
- Cratocryptus anatorius* Gr. S. *Angelica* något nedom trädgränsen 27/7.
- Microcryptus femoralis* Thn. S. St. Härjeån 24/7.
- Gelis acarorum* L. N. Hågnsjöen, hedstrand r. a. 26/7.
- Lampronota borealis* Rn. S. St. Härjeån 24/7.
- Cteniscus flavomaculatus praeustus* Hgn. N. r.a. 26/7.
- Euryproctus arbustorum* Hgn. S. *Angelica* något nedom trädgränsen 27/7.
- Mesochorus longicauda* Thn. N. På gran i björkskog 26/7.

### Summary.

#### *Insects collected in the mountain Härjehåгна.*

A list is given of insects captured in the mountain Härjehåгна in 1927. This mountain is situated on the boundary between Norway and Sweden somewhat south of 62° N. lat. Its highest top is 1185 m, the tree line runs between 800 and 900 m above sea level. In the arctic region dwarf shrubs dominate, except in some small mosses. In higher levels the ground is winderoded and carries groups of *Juncus trifidus* L. and *Carex Bigelowii* Torr. The lower parts of the mountain are covered with coniferous forests which near the tree line become more and more mixed with birch. There is no continuous region of pure birch.

A new variety of the caddis fly *Molannodes tincta* Zett. is described: *argentea* n. var. It differs from the typical form by the silver-grey colour of the forewings (not dark brown with yellow spots as in the typical form). The writer has found this var. also in other parts of Sweden but has never seen any intermediate forms. It is seen flying together with the typical form.

Abbreviations: N.=Norway, S.=Sweden, r. a.=*regio arctica* (the area above the tree line).

## Notes on the Norwegian Lepidoptera (Noctuidae, Geometridae).

By Nils Knaben.

### 1. *Agrotis fatidica* Hb. (fig. 2 a).

W. M. Schøyen (1879) recorded the capture of *Agrotis fatidica* Hb. at Drivstuen, Dovre, on August 6th, 1878. The single specimen found was a male in very worn and faded condition. The usual markings are more or less visible, but differ considerably from those of typical specimens. In the Dovre specimen, for instance, the distance between the orbicular and the reniform stigma is rather large. The orbicular stigma is circular; the claviform stigma extraordinarily short, approximately  $\frac{1}{2}$  ordinary size.

To be quite sure about the identification I found it necessary to examine the genitalia. Through the kindness of Dr. L. R. Natvig, Zoologisk Museum, Oslo, and Dr. G. Warn-ecke, Hamburg, it has been possible to examine the Dovre specimen and specimens of *fatidica* from the Alps.

In the Dovre specimen the valves are rather robust, expanding considerably in the middle. Harpe strong, apically broad, truncate. Saccus very short, almost circular when viewed from the side. Aedeagus comparatively straight, somewhat shorter than the valves.

In the investigated specimens from the Alps (Pitztal in Tirol) the valves are somewhat narrower; the upper and lower edges practically parallel. Harpe more slender than in the Dovre specimen. Saccus when viewed from the side twice as long as wide. Aedeagus curved, somewhat longer than the valves.

Kozhantshikov's (1937) figures of the valves in *fatidica* (5 specimens) agrees on the whole with those of the valves in *fatidica* from the Alps.

According to the above statements the Dovre specimen probably belongs to a distinct northern form of *fatidica* Hb. Until, however, more material is forthcoming I hesitate to place it as a *subsp. nov.*

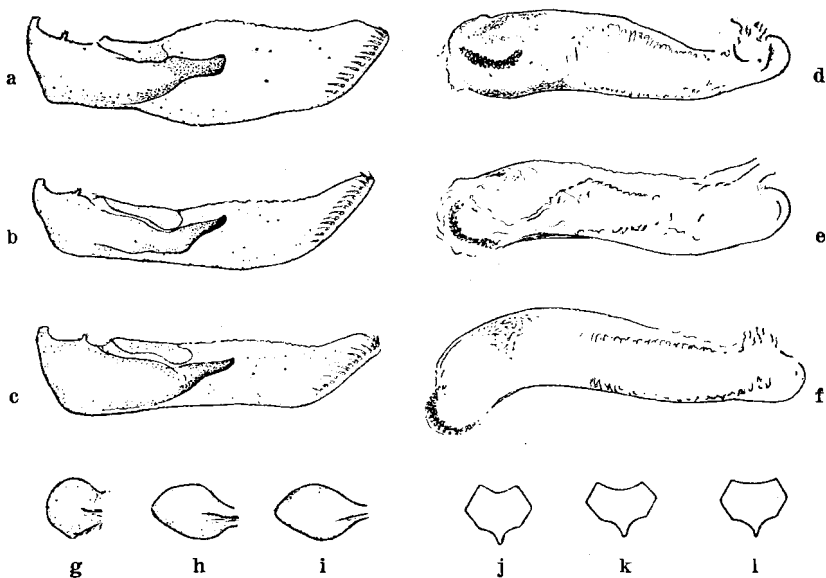


Fig. 1. Valve (right), aedeagus, saccus and juxta of *Agrotis fatidica* Hb. from: Dovre in Norway (a. d. g. j.); Pitztal in Tirol (b. e. h. k) and (c. f. i. l.). ( $\times 13$ .)

## 2. *Polia furca colletti* Sparre Schneider (fig. 2 c).

In the summer of 1871, on June 11th, Professor R. Collett found, under a stone, near Dombås (Dovre) a beautiful noctuid which was described by Sparre Schneider (1876) under the name of *Dianthoecia colletti*. Later on he found that *colletti* belonged to the genus *Mamestra* Tr. (Sparre Schneider 1881).

During a visit to Dr. Staudinger's in the autumn of 1890 Sparre Schneider had the opportunity of seeing a series of *Polia* (*Mamestra*) *furca* Ev. and immediately recognized *colletti*. However, he draws attention to some diverging characters in the Norwegian specimen, i. e. a prominent violet shade which characterizes the forewings in *colletti*, but is only slightly pronounced in *furca* and in the closely related *schneideri* Stgr. He therefore maintains the designation *colletti* for the Norwegian form (Sparre Schneider 1913).

The next specimen of *colletti* was taken by me on July 15th, 1938, at Skjolden in Sogn. My excursion to Sogn that year was practically finished, when the night before my return home, about 11.30 pm, in a meadow I noticed a noctuid

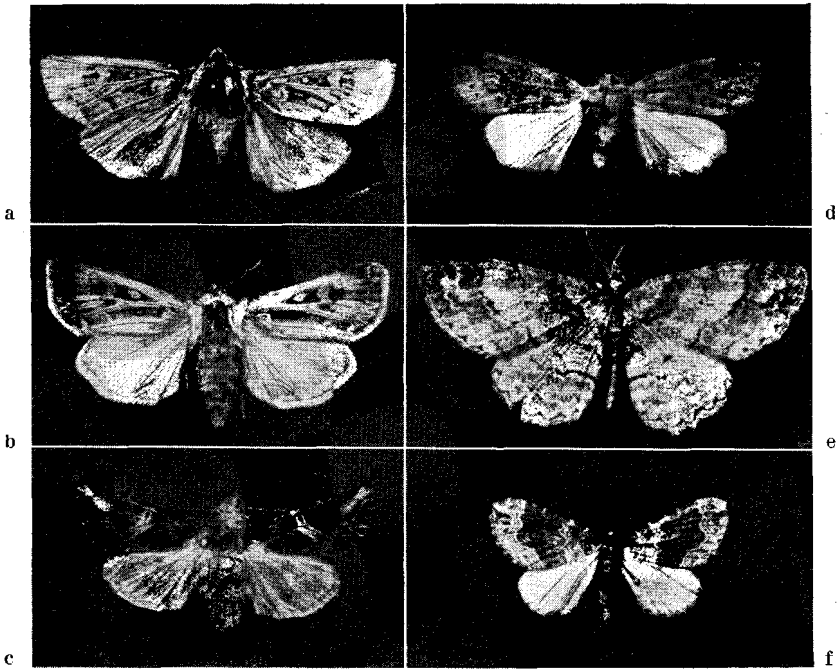


Fig. 2. (a) *Agrotis fatidica* Hb. from Dovre in Norway. (b) *A. fatidica* from Pitztal in Tirol. (c) *Polia furca colletti* Sparre Schneider from Dovre. (d) *Cosmia gilvago* Esp. from Tøyen, Oslo. (e) *Boarmia consonaria* Hb. from Vallø. (f) *Cidaria otregiata* Metc. from Nordmarken ( $\times 1,3$ ).

on a flower of *Knautia arvensis*. It appeared to be a fine *colletti* ♀ with the same prominent violet colour which distinguishes the ♂ specimen from Dovre.

*Polia furca colletti* has been considered a mountain form, but here it was found at sea level.

### 3. Some species new to Norway.

*Cosmia gilvago* Esp. (fig. 2 d). On September 20th, 1949, in the evening, a female of this species was attracted to the lights in my office at Tøyen, Oslo. This species has previously been erroneously recorded from Norway by Sparre Schneider (1876). As stated by W. M. Schøyen (1880) the specimens in question are in reality *Cosmia fulvago* Cl. ab. *flavescens* Esp.

*Boarmia consonaria* Hb. (fig. 2 e). Of this species there are 2 male specimens at the Zoological Museum in Oslo,

labelled Vällø, Tønsberg (ex coll. E. Strand). This must be the *Boarmia* which Strand (1902) wrongly records as *crepuscularia* Hb., taken on May 14th—17th, 1901, at the same locality.

*Cidaria otregiata* Metc. (fig. 2 f). In all 3 specimens from Aker exist in the collection of the Zoological Museum, Oslo (ex coll. Rygge). One of these was caught in Nordmarken on June 20th, 1915, another at Bogstad on June 27th, 1916.

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### Appendix.

Not long ago I received from Mr. P. Holaker a specimen (♂) of *A. fatidica*, taken at Kongsvoll in the beginning of August this year (1951).

## Eldre funn av Macro-Lepidoptera i Norge.

Av Magne Opheim, Oslo.

I denne oversikt vil bli nevnt alle de *Macro-Lepidoptera* som er funnet før 1900, men ikke påvist her i landet etter dette år. Materiale fra Zoologisk Museum, Oslo og fra Tromsø Museum er blitt undersøkt og bestemmelsen av dyrene kontrollert. Listen omfatter 34 arter. Angående utbredelsen i Sverige har jeg benyttet Svenska Fjärilar og F. Nordström: Förteckning över Sveriges Storfjärilar, og for Danmarks vedkommende Hoffmeyer-Knudsen: De danske Storsommerfugle og S. Hoffmeyer: De danske Ugler.

### *Pontia (Leucochloë Rüb.) daplidice L.*

En ♀ ble funnet i første halvdel av september 1886 på Helgelandsmoen (Ringerike) av løytnant Holm og skjenket til Zoologisk Museum, Oslo av cand. jur. E. B. Schie. Antagelig innvandret fra Sverige. Sommerfuglen er kjent som »vandredyr«. I Sverige er den utbredt i 9 landskaper fra Skåne til Uppland.

### *Colias croceus Fourcr. (educa F.)*

Denne vidtflyvende immigrant ble først iakttatt i Skandinavia i året 1877, da arten hadde en veldig ekspansjon. 1877 er et av de mest kjente »*edusa*» år. Amanuensis G. Holm fra Uppsala tok det første norske eksemplar (♀) på Helgøya i Mjøsa <sup>10/8</sup>, senere fanget W. M. Schøyen 3 ♂♂ ved gården Forr i Sør-Fron den 20. i samme måned etter å ha observert den allerede den 16. (Schøyen 1877). Arten er aldri senere funnet her i landet. Bare få stykker er tatt i Sverige, sist iakttatt i 1935. I Danmark er den funnet oftere og kan være ganske alminnelig enkelte år.

### *Thymelicus (Adopoea Billb.) lineola Ochs.*

Sparre Schneider fant *lineola* forholdsvis alminnelig ved Næs Verk <sup>29/7</sup> 1872, mens han året etter bare fant et eneste eksemplar vel en km. fra den første flyveplass (Schneider

1876, 1882). Senere tok W. M. Schøyen en ♂ i Asker omkring 1. august 1875. Kjell Ander (1944) har gitt en oversikt over artens utbredelse i Skandinavia med kart. Den er ikke funnet nordenfor 60° og er lokal og sjelden i Mellemsverige men alminnelig i Skåne. Det er ikke umulig at *lineola* kan være forsvunnet fra ovennevnte lokaliteter i Norge. Larven lever på hestehavre (*Arrhenatherum elatius*), kveke (*Agropyrum repens*) o. a. grasarter.

#### *Deilephia nerii* L.

Denne praktfulle tusmørkesvermer er bare funnet en gang her i landet, nemlig i Homansbyen i Oslo <sup>15/9</sup> 1865 (Esmark 1870). I Sverige er det 6 sikre funn fra 1883—1943 og i Danmark 4 funn mellom 1905 og 1933. Artens hjemland er den tropiske del av Afrika, men den finnes årlig i Sør-Europa.

#### *Gluphisia crenata* Esp.

Funnet av denne sjeldne spinner skyldes prof. Esmark som tok en ♂ og en ♀ ved Bækkelaget ved Oslo. (Se fig. s. 211).

I Sverige er den påvist bare fire ganger. Larven lever på *Populus*. Sommerfuglen flyr fra mai til juli.

#### *Pygaera anachoreta* F.

Det eneste norske funn er en ♀ fra Filipstad i Oslo, fra Esmarks samling.

Ytterst sjelden i Sverige. Flyvetiden er mai—juni. Larven lever på *Populus* og *Salix*-arter.

#### *Cosmotriche potatoria* L.

I Zool. Mus. Oslo er 3 eksemplarer avd enne art, en ♀ fra Gulslogen (VE), klekket fra larve <sup>7/7</sup> 1876 (Sparre Schneider leg.), en ♂ fra Kristiania (Oslo) (Esmark coll.) og en ♂ angivelig fra Næs Verk (Aall coll.). I Enum. Ins. Norv. nevnes at Siebke skal ha tatt den ved Christiania (Oslo).

I Danmark regnes den for å være forholdsvis alminnelig mens den i Sverige bare er funnet som en stor sjeldenhet. Larven lever på forskjellige grasarter.

#### *Acronycta aceris* L.

Ifølge Enum. Ins. Norv. er arten tatt av Schøyen ved Christiania og av Sølsberg i Gjemsø ved Skien. Oslo-museet har bare et eksemplar (♀) fra Christiania (Esmark coll.).



I Sverige forekommer den til Dalarna og regnes som ikke sjelden. I Danmark er den mest utbredt på øyene, sjeldnere på Jylland. Flyvetiden er juni—juli. Den meget karakteristiske larve lever på lønn, hestekastanje, eik, sjeldnere på andre lauvtrær.

#### *Acronycta cuspis* Hb.

De tre nærstående arter *cuspis* Hb., *tridens* Schiff. og *psi* L. er alle tatt med i Enum. Ins. Norv., mens Schøyen sløyfer *tridens* i sin fortegnelse av 1893. Haanshus fører igjen alle opp i 1933. Sparre Schneider fant larven av *cuspis* på or (*Alnus*) ved Næs Verk august 1873. I Oslomuseet finnes bare et eksemplar med etikett *cuspis* men uten lokalitet fra Esmarks samling. Dessverre er det uten bakkropp, men vingetegningen minner om sistnevnte art. Larvene av de tre arter kan lett bestemmes, derimot er de voksne dyr nokså lik hverandre, så man bør undersøke genitalorganene for å få dem bestemt med sikkerhet. Haanshus' funn av *tridens* på Ormøya ved Oslo i 1884 (Norsk Ent. Tids. 1920, p. 59) bør vel betraktes som usikkert da eksemplaret ikke finnes i samlingene i Oslo og kan vel ansees for å ha gått til grunne. Larven av *cuspis* er monofag og finnes på or, mens *tridens* og *psi* lever på forskjellige trær, også frukttrær. I Danmark og Sverige regnes *cuspis* som den sjeldneste av de tre artene.

#### *Actebia fennica* Tausch.

Det er et spørsmål om *fennica* tilhører den norske fauna, alt vi har er nemlig en ♂ fra Esmarks samling uten lokalitet. Schøyen setter et ? ved den i sin fortegnelse og kanskje med rette for vi vet jo ikke om Esmark bare hadde norske dyr i sin samling. Arten har en østlig utbredelse i Europa bortsett fra forekomsten i Schweiz. Den er ikke funnet i Danmark, er meget sjelden i Sverige, men blir mer alminnelig lenger øst. I Aunus (Karelia) er den mer hyppig enn i selve Finland (Kaisila 1947). Flyvetiden er juni—juli.

#### *Anomogyna gelida* Sp. Schn.

Noen nye funn i Norge siden arten ble oppdaget av Sparre Schneider i april 1882 i Sør-Varanger, har vi ikke, men den er riktignok funnet flere steder i Sverige og Finland

særlig i de siste tiår på grunn av intens samlervirksomhet. B. Lingonblad (1945) har inngående studert artens biologi i Muonio Lappmark. Sommerfuglen som er sterkt lokal forekommer i barskog med undervegetasjon av blåbærlyng. Utviklingen er toårig idet larven overvintrer to ganger. Flyvetiden er som regel i midten av juli. Larven lever på blåbær og *Taraxacum*. I Sverige er *gelida* (syn. *mevesi* Aur.) kjent fra Jemtland og nylig funnet i Torne Lappmark (I. Svensson 1950). (Se figuren side 211.)

#### *Polia bohemanni* Stgr.

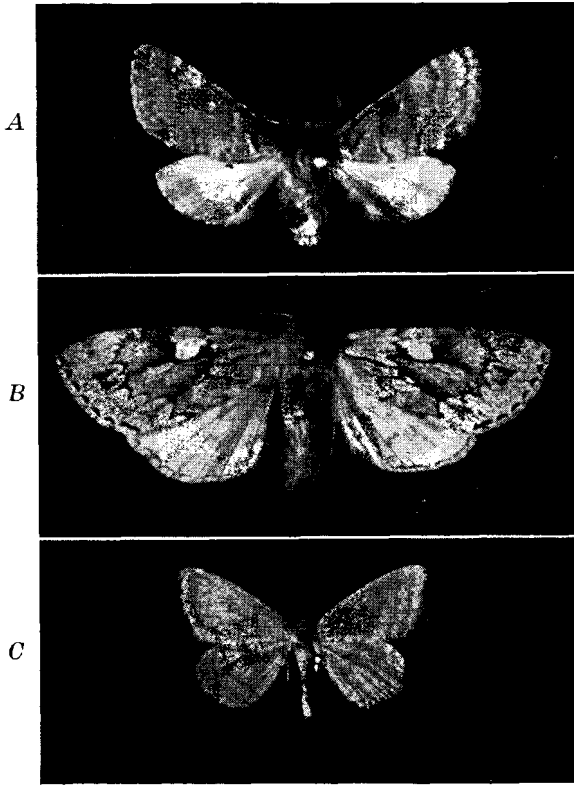
Siste norske funn av denne arktiske art er fra Målselven 1899. Tidligere tatt i Alta og Sør-Varanger. I Sverige er den funnet så langt sør som Jemtland. Flyver om dagen på furuskogsmyrer.

#### *Harmodia albimacula* Bkh.

På Zoologisk Museum i Oslo finnes 6 stykker (4 ♂♂ og 2 ♀♀). 5 av disse er tatt på Tøyen av Siebke og Moe, <sup>20/7</sup> 1846, <sup>22/6</sup> 1847, <sup>12/7</sup> 1885, Esmark har et fra Roseberg (Oslo) <sup>5/7</sup> 1846. I henhold til Enum. Ins. Norv. er arten også funnet av Schøyen. Ifølge fortegnelsen av 1893 skal *albimacula* også være tatt i Smaalenene (Østfold) omkring 59° (Hvaler?). Omkring århundreskiftet ble den påvist ved Moss av A. Schneider (Schneider 1902). Larven lever på nikkesmelle (*Silene nutans*). Utbredt nordover til Dalarna i Sverige, i Danmark bare funnet på Bornholm og Møen.

#### *Sideridis obsoleta* Hb.

Osломuseet har bare 2 eksemplarer, hvorav det ene er tatt av Esmark angivelig i omegnen av Oslo. Enum. Ins. Norv. anfører feilaktig lokaliteten Odalen (Schøyen 1881). Det annet eksemplar (♀) er forsynt med to stedsetiketter, Dronningbjerget, Bygdø og Ryenberg (Kristiania) 1869, imago 1870 (Moe leg.) Flyvetiden er juni—juli. Larvens næringsplante er takrør (*Phragmites*). Arten regnes som en sjeldenhet i våre naboland, i Sverige er den nordligst funnet i søre Ångermanland.



- A. *Gluphisia crenata* Esp., ♂, Bækkelaget, Ø. Aker (Oslo Mus. coll., Esmark leg.)  
 B. *Anomogyna gelida* Sp. Schn., holotype, ♂, Furumoen, Sør-Varanger april 1882 (Tromsø Mus. coll., Sparre Schneider leg.)  
 C. *Scopula frigidaria* Möschl. ssp. *schøyeni* Sp. Schn., ♂, Bosjavre, Sør-Varanger <sup>18</sup>/<sub>7</sub> 1882 (Oslo Mus. coll., Sparre Schneider leg.)  
 Forstørret ca. 1.6 ganger.

*Cucullia gnaphalii* Hb. og *C. asteris* Schiff.

Sparre Schneider har æren for å ha påvist disse to arter i Norge. Begge (♀♀) ble funnet som unica i Oslo, *asteris* på St. Hanshaugen <sup>19</sup>/<sub>7</sub> 1875 og *gnaphalii* i året 1880. Larven av den siste lever på gullris (*Solidago virgaurea*), mens *asteris* også har andre kurvblomstrede som *Aster* og *Gnaphalium* som næringsplanter. I Danmark er *gnaphalii* bare funnet i få

eksemplarer i Jylland, den er også sjelden i Sverige hvor den er tatt i 6 landskaper. Den andre arten, *asteris*, er alminneligere, i Sverige finnes den dog bare i 4 av de sørligste landskapene.

*Parastichtis unanimitis* Hb.

Ifølge Enum. Ins. Norv. fant Sparre Schneider en larve av denne art i april 1874 på Frogner (Oslo) og fikk klekket en ♀ i juni. I Zool. Mus. Oslo finnes bare ett eksemplar av *unanimitis*. Det er uten bakkropp, men med tydelig tegning på vingene. Det har tilhørt Siebkes samling og var av ham bestemt til *Dryobota protea* Hb., men ble senere av W. M. Schøyen rettet til *unanimitis*. Næringsplanten er strandrør (*Phalaris arundinacea*). I Sverige hvor arten regnes som sjelden, opptrer den som typisk kystart, mens den i Danmark er funnet over hele landet, riktignok ikke i noe større antall.

*Panemeria tenebrata* Scop.

Dr. Wocke tok to eksemplarer av *tenebrata* 31. mai 1862 ved Hamar, siden er den ikke observert her i landet. I Sverige er den notert 1792 av Thunberg, og Billberg skal ha hatt et svensk eksemplar. Senere er den funnet igjen av Wallengren ved Sölvesborg i Blekinge (Ander 1945). Men etter den tid foreligger ingen nye funn. Fra Danmark nevnes mange lokaliteter. Arten er sterkt lokal og er lett å overse; den finnes helst på våte marker. Larven finnes på blomstene og frøene av arve (*Cerastium*).

*Schrankia turfosalis* Wocke.

Det norske materiale av *turfosalis* består av 3 eksemplarer fra Odalen, tatt juli 1883 av W. M. Schøyen. Arten er sikkert lite iakttatt på grunn av sin ringe størrelse (vingebredde 13—14 mm). Larven er ukjent, lever antagelig på frytle (*Luzula*). Sommerfuglen flyr på myr og våt mark. I Sverige og Danmark er den funnet på atskillige lokaliteter.

*Euchloris smaragdaria* F.

På Zoologisk Museum i Oslo finnes 2 ♂♂ fra Roseberg (Oslo) tatt henholdsvis 23. og 25. juni 1846 av Esmark og en ♂ fra Vestre Aker, tatt 1. juli 1876 av Sparre Schneider. Larven lever i England utelukkende på strandmalurt (*Artemisia maritima*) som her i landet bare forekommer på Hvaler. Ellers i Europa kan den finnes på diverse andre planter. Arten er hverken funnet i Sverige eller Danmark, mens den i Finnland er observert på mange lokaliteter.

*Scopula frigidaria* Möschl. ssp. *schøyeni* Sp. Schn.

I Norge er arten bare påvist i den indre del av Sør-Varanger fra Bosjavre til Vaggattemjavre av Sandberg (1885) og Sparre Schneider (1883). På norsk side er den såvidt jeg har undersøkt, ikke funnet etter 1892 (Sparre Schneider 1895). Wessel kan muligens ha tatt den senere. I Finland er den observert så langt sør som i Kuusamo-distriktet, mens den ennå ikke er funnet i Sverige. Flyvetiden er midten av juli. (Se figuren side 211.)

*Cidaria pupillata* Thnbg.

Arten er bare tatt en eneste gang i Norge, nemlig på Stabekk ved Oslo av Esmark (årstallet ukjent). Utbredelsen av *pupillata* i Nord-Europa er nokså merkelig. Den er kjent fra Estland, Ålandsøyene, sørvestligste Finnland, 4 østlige landskaper (omkring den 60. breddegrad) i Sverige og Vest-Jylland. Larven finnes på maure (*Galium*).

*Eupithecia immundata* Z.

I Esmarks samling fant Schøyen en ♀ av *immundata*, oppstilt blant *satyrata* med lokalitet Rosenhof, Kristiania <sup>6</sup>/<sub>7</sub> 1849 (Schøyen 1885). Næringsplanten for larven er trollbær (*Actaea*). I likhet med de andre arter av slekten *Eupithecia* spiser den blomsten og bæret (frukten). I Sverige ble *immundata* først påvist i 1932 og er nå funnet i 4 landskaper. I Danmark ble den oppdaget 1914 og er senere tatt på flere lokaliteter.

*Ennomos autumnaria* Werneb.

I Oslomuseet er der 2 ♂♂ og 3 ♀♀ av *autumnaria*, tatt på Tøyen av Esmark og Siebke (bare 1 angitt med dato, <sup>26</sup>/<sub>8</sub> 1852). Larven lever på forskjellige lauvtrær. I våre naboland betraktes arten som en sjeldenhet.

*Celama karelica* Tengstr. (*arctica* Schøyen).

Her i landet er der hittil av *karelica* bare funnet 2 stykker (♂ og ♀) som begge er innlemmet i Zool. Mus. Oslo. Lokalitetene er Elvenes, <sup>17</sup>/<sub>7</sub> 1878 (Schøyen leg.) og toppen av fjellet ved Kirkenes, <sup>16</sup>/<sub>7</sub> 1879 (Sandberg leg.) (Schøyen 1880). Larven lever bl. a. på blåbær og molter. *C. karelica* er en høyboreal art som er utbredt over største delen av Finland (Kaisila l. c., med kart), i Sverige er den funnet på noen få lokaliteter, særligst i Värmland og Uppland. Forekomsten i Sør-Varanger er artens nordligste.

*Atolmis rubricollis* L.

Ifølge Enum. Ins. Norv. er *rubricollis* tatt på Tøyen av Siebke og larver ble funnet på Frogner i august 1871 av Sparre Schneider. Dessuten er den nevnt i Grimsgaards index fra Sarpsborg. På Zoologisk Museum i Oslo er der foruten Siebkes eksemplarer (2) også to med etikett Kristiania (Esmark leg.) Arten regnes for vanlig i våre naboland til ca. 62°. Larven finnes på trær hvor den lever av lavarter. Flyvetiden er juni—juli.

*Hyphoraia lapponica* Thnbg.

I alt er der tatt 8 stykker av denne sub-arktiske art i Norge, de fleste i Sør-Varanger. Siste funn fra  $2\frac{2}{6}$  1898 (Wessel leg.). Sparre Schneider fant en ♂  $\frac{3}{7}$  1884 på Mauken i Målselven. Enum. Ins. Nov. nevner et gammelt funn fra Kvaløy (ved Hammerfest) (?). Arten er et myrinsekt og larven finner man på molter, dvergbjørk o. a. I Sverige er *lapponica* tatt så langt sør som Lycksele Lappmark.

*Spilarctia lutea* Hufn. (*lubricipeda* Esp.)

På Zoologisk Museum i Oslo finnes 3 eksemplarer: Kristiania (Collett leg.), Mandal (Horn leg., Esmark coll.), uten lokalitet (Esmark coll.). Flyvetiden er mai—juli, larven er polyfag, finnes på flere slags busker og urter. Arten er alminnelig i Sverige (sørlig utbredelse, overskrider ikke 60°) og Danmark.

*Callimorpha dominula* L.

Eneste funn er fra Lærdal i Sogn hvor 4 eksemplarer ble tatt  $\frac{10}{7}$  1897 om dagen (Lie-Pettersen 1897). Arten kan vel betraktes som relik i Norge. I Sverige er den som regel sjelden (nordligst Uppland), men kan enkelte år vise seg mer vanlig. Larven er polyfag.

*Aegeria melanocephala* Dalm.

Esmark har tatt det eneste norske eksemplar (♀) på Tøyen, det finnes i hovedsamlingen i Zoologisk Museum i Oslo. Larven lever i osp. Flyvetiden er mai—juni. I Sverige bare notert fra 3 landskaper, ikke kjent fra Danmark.

*Paranthrene tabaniformis* Rott.

Osломuseet har hele 10 stykker av *tabaniformis*, samtlige funnet i Oslo av Esmark, Moe og Siebke som har et datert  $\frac{3}{7}$  1851. Dessuten er en ♀ tatt ved Skien august 1898

(W. Christie). Flyvetiden er juli, larven i osp og *Salix*-arter. I Sverige regnes denne og følgende arter for sjeldne, nordligst i Norrbotten.

*Synanthedon myopaeformis* Bkh.

Schøyen (1881) nevner et eksemplar ( $\sigma$ ) av *myopaeformis* i Oslomuseet fra Esmarks samling med lokalitet Kristiania. Foruten dette er det også en  $\sigma$  fra det lille materiale som var igjen av Grimsgaards store samling. Det meste av samlingen var blitt ødelagt av skadedyr, resten ble skjenket til museet for noen år siden. Eksemplaret som var tatt <sup>13/7</sup> 1879 i Sarpsborg, var bestemt til *formicaeformis* Esp. av Grimsgaard men viste seg ved nærmere undersøkelse å være en *myopaeformis*. Larven lever i forskjellige frukttrær, hagtorn, rogn osv. I Sverige bare observert i Skåne og Uppland, i Danmark et stykke funnet på Sjælland. Haanshus (1933) anfører arten fra Rogaland. Det er tvilsomt om den forekommer der.

*Synanthedon formicaeformis* Esp.

I Enum. Ins. Norv. nevnes at Boheman har funnet *formicaeformis* på Dovre. I Zoologisk Museum Oslo finnes en ♀ fra Kristiania (Esmark coll.) samt en  $\sigma$  fra Jarlsberg (ved Tønsberg) tatt av Bidenkap i 1891. Larven i *Salix*-arter, flyvetiden er juni—juli. I Sverige nordligst i Lycksele Lappmark.

*Dipsosphecia ichneumoniformis* F.

De to eneste norske eksemplarer ( $\sigma\sigma$ ) er fra Kristiania (Esmark coll.) og Kongsberg (Münster leg.). Larven finnes i røttene av erteblomstrede planter. Flyvetiden juli—august. Nordgrensen for utbredelsen i Skandinavia går ved 60°.

Av de 34 ovennevnte arter er 3 sjeldne immigranter, hvorav to er bare funnet som unica. Av de øvrige 31 arter er 12 observert på et større område (2 eller flere lokal.), 5 på et mindre areal og resten bare på én lokalitet. Av de siste er hele 8 unica. Det er påfallende at så mange som 18 arter er utelukkende eller delvis fra prof. Esmarks samling. De fleste arter er fra Oslo området, i alt 21 sikre og 2 usikre funn.

Det er mulig at enkelte av artene er forsvunnet fra Norge, men kan vel anta at de aller fleste kan gjenfinnes hvis man søker etter larvene og klekker disse.

I listen har jeg ikke tatt med *Proutia* (*Fumea* Hb.) *norvegica* (Schøyen) Heyl., da nemlig *Fumea*-artene nå etter Lewin's (1949) undersøkelser må regnes til *Micro-Lepidoptera* under gruppen *Tineina*.

Schøyen meddeler 1887 at Siebke tok et eksemplar (♀) av *Hadena* (*Blepharita* Hmps.) *amica* Tr. antagelig ved Kongsvoll eller i Drivdalen  $\frac{5}{8}$  1861. Eksemplaret som var noe avfløyet ble også av dr. Wocke antatt for å være denne art. Det har imidlertid vist seg ved ny undersøkelse at det i virkeligheten er en *Crymodes maillardi* Hb.-G. I Nord-Europa er *amica* bare kjent fra Finland og Karelia.

Omkring århundreskiftet var det funnet mellom 640 og 650 arter av Macro-Lepidoptera i Norge, mens det nå antas å være kjent vel 750, det vil si at der skulle være funnet ca. 70 arter mer i de siste 50 år enn i forrige århundre. Det skyldes vel mer rasjonelle innsamlingsmetoder og delvis klimaforbedring, jeg tror ikke antall samlere er større nå eller at samlevirksomheten er øket siden forrige århundre.

Jeg skylder dr. L. R. Natvig, Oslo og direktør T. Soot-Ryen, Tromsø, stor takk for utlån av materiale.

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## Tre noctuider nye for Norges fauna, funnet på Jæren (Ry).

Av Arne Nielsen, Sandnes.

*Aporophyla lutulenta* Bkh. En ♀ ble tatt 28. august 1949 i sandklittene (sandkulene) på Reve i Klepp, Rogaland av Tore Nielsen. Som den satt i solskinnet på sanden, så den ut som en liten kullbit. Gjenfangst 3 ♀♀ på Køder 6.—14. september 1950 på Orre i Klepp, også nær stranden, ca. 3 km fra første finnested.

*Peridroma margaritosa* Hw. (= *Agrotis saucia* Hb.). En ♀ ble tatt på Vig i Orre på køder ca. 200 m fra stranden høsten 1949. Gjenfangst på samme lokalitet på »honningdogg« på hyllehekk 24. og 29. juni 1950. Videre fanget Torgeir Arneson, Sandnes, et sterkt avvikende eksemplar i Time 13. september 1950.

*Trichoclea albicolon* Hb. Ialt 6 ekspl. ble tatt på Vig i Orre på »honningdogg« på hyllehekk 11.—24. juni 1950. Et eksemplar ble også tatt 17. juni på marehalmrøttene i sandkulene på Orre ca. 1 km fra forannevnte lokalitet.<sup>1</sup>

<sup>1</sup> Et hittil ubestemt eksemplar, tatt 26. juni 1935 i Sande (Ry) av Fritz Jensen, har vist seg å tilhøre denne art (det. M. Opheim).

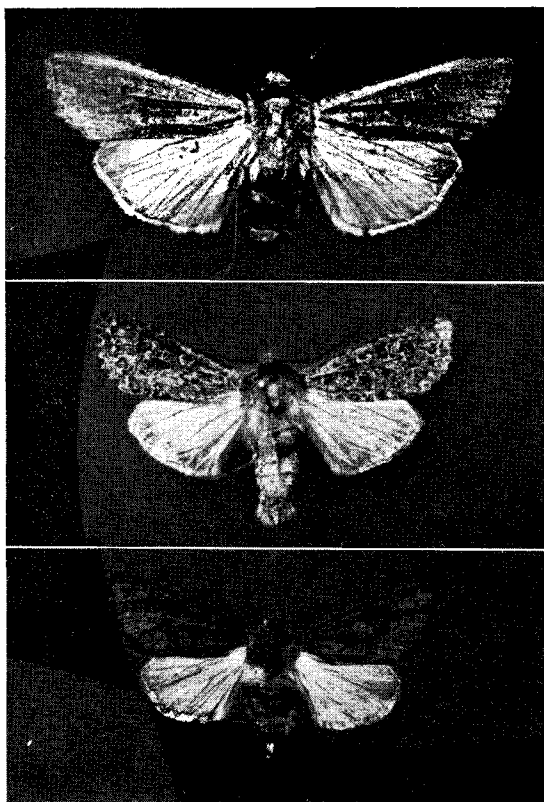


Fig. 1.

Knaben fot.

Øverst: *Peridroma margaritosa* Hw. (= *Agrotis saucia* Hb.) ♀.

I midten: *Trichochlea albicolon* Hb. ♂.

Nederst: *Aporophyla lutulenta* Ekh. ♀.

(Forstørret ca. 1,3 ganger.)

Ingen av ovennevnte arter er tidligere kjent fra Norge. De er blitt bestemt ved elskverdig hjelp av konservator Nils Knaben, Zoologisk Museum, Oslo og ingeniør Magne Opheim, Oslo.

Alle mine funn ble gjort på eller meget nær den åpne havstrand innen et strandområde på ca. 3 km.

## The Norwegian Species of *Amischa* Thoms. (Col. Staph.)

By Andreas Strand, Oslo.

From Norway the following three species of the genus *Amischa* Thoms. are known:  *analis* Grav., *cavifrons* Sharp and *Sarsi* Munst.

The males of *cavifrons* and *Sarsi* are easily distinguished by their secondary sexual characters (see the drawing). The number of the black hairs in the middle of the margin of the sixth sternit is normally 4 (I have seen a specimen with 5) in *Sarsi*, whereas *cavifrons* has 6 or more. The upper surface of the head of *cavifrons* is broadly impressed, whereas in *Sarsi* it is more or less channelled.

As regards the male of  *analis* the opinions differ very much as will be seen from the following quotations:

Kraatz (1858, p. 257):

“Beim Männchen ist die obere Platte des vorletzten Hinterleibssegmentes stark, beim Weibchen schwach dreieckig ausgerandet.”

Sharp (1869, p. 176):

“It is extremely difficult to separate the sexes of *H. analis*. Kraatz says that a larger triangular notch of the seventh segment of the abdomen is indicative of the male; this notch certainly varies in size in different individuals, but I am unable to satisfy myself that the difference is sexual.”

Fowler (1888, p. 98):

“Sexual differences indistinct.”

Ganglbauer (1895, p. 215):

“Beim ♂ ist das achte Dorsalsegment an der Spitze winkelig ausgerandet, beim ♀ abgestutzt oder leicht ausgebuchtet. Das sechste Ventralsegment ist beim ♂ etwas mehr vorgezogen als beim ♀, überragt aber nur sehr wenig das achte Dorsalsegment.”

Munster (1927, p. 277):

“As to the differences between the sexes, they are very slight; the last sternit is narrower in the ♀ and more evenly rounded than in the male, where it is more truncate and with

a trace of an emargination in the middle; the smaller bristles are a little darker and closer in the ♀; the notch of the last tergite seems to be a little deeper and narrower in the ♀, but I am not sure whether it is always so."

Horion (1935, p. 100):

"Im rheinischen Nachtrag XII steht eine Notiz, dass Herr Wüsthoff-Aachen bei seinen Studien über die Sexualorgane der Atheten bei analis nie ein ♂ und bei cavifrons nie ein ♀ gefunden habe. Wüsthoff hat weiter Hunderte von Tieren dieser gemeinen Arten, auch viel ausserrheinisches Material, untersucht, und das Resultat ist dasselbe. Da auch in der Hsch.-Form und in der Art der Ausrandung des 6. Tergites alle Übergänge nachweisbar sind, vertritt Wüsthoff den Standpunkt, dass beide nur eine Art sind: *Amischa analis* Grav."

Peyerimhoff (1938, p. 70):

"♂, front plan, antennes sans soies spéciales, dernier tergite incisé au milieu, le sternite peu prolongé et sans soies groupées."

And further (p. 65 and 66):

"En Angleterre, Sharp (Ent. m. Mag., LIV, 1918, p. 154) la déclare "profusely abundant" et note que tous les exemplaires qu'il a étudiés, — "I have dissected some hundreds of specimens" — étaient des femelles. Il ajoute "I have no doubt as to the gynarchy of this section of the genus *Amischa*". Il est possible en effet qu'il s'agisse là d'un cas de "parthénogénèse géographique". Tel ne serait pas le cas sur le continent, notamment en France où, toutes réserves faites sur les surprises des vérifications anatomiques, le mâle *d'analis* se rencontre facilement avec la femelle."

And lastly, in the Catalogus Coleopterorum Daniae et Fennoscandiae of 1939 *Sarsi* is considered as a synonym of *analis*.

Sharp, in his later years, and also Wüsthoff, have made examinations of the genitalia, but all the other authors mentioned above have, as far as I understand, made no such examinations. I do not think I am wrong in supposing that what they have considered as the male of *analis* in reality is the female, and that confusion with other species, poor preparation or individual variations have induced them to believe that they were faced with sexual differences. In two cases I have been able to prove this by dissection of the specimens in question. What Munster considered as the male of *analis* is the female, and five specimens which Peyerimhoff kindly sent me as "*analis* ♂" were all ♀♀.

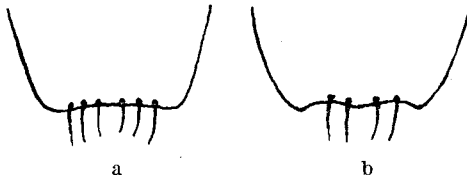


Fig. 1.

- a. Sixth sternite of *Amischa cavifrons* Sharp.  
 b. » » » *Amischa Sarsi* Munster.

On my invitation Scheerpeltz has been kind enough to examine his extensive material of *analisis* without being able to find a single ♂.

As mentioned above Wüsthoff is of the opinion that *analisis* and *cavifrons* are ♀ and ♂ of the same species.

In his description of *cavifrons* Sharp (1869, p. 177) makes the following comparison with *analisis*:

“In the female of *H. cavifrons*, the notch of the seventh segment is broader and deeper than in specimens of *H. analisis* of the same size; and in both sexes the elytra are shorter, being only of the length of the thorax.”

However, these characters seem to be subject to considerable variation, and it must be admitted that the ♀♀ of the two species are very difficult to distinguish. In any case, my attempts to draw a definite line of distinction between them have failed, also as regards the genitalia.

If *analisis* and *cavifrons* were really ♀ and ♂ of the same species, and parthenogenesis were out of the question, the distribution of them would have to be the same.

Sharp (1869, p. 177) says that *cavifrons* is only found “in the hilly districts of Scotland, in the neighbourhood of Edinburgh and near Thornhill”, while *analisis* is “extremely abundant in all sorts of situations all over the country”.

Fowler (1913, p. 223) adds localities in Lancashire, Cumberland and St. Kilda for *cavifrons* and Joy (1932, p. 50) has “Eng. N., Scot.”

W. Steel (i. l.) informs me that “*Amischa cavifrons* is quite common in places in the mountains of N. England and Scotland, but does not appear to occur in the South of England”.

The only statement from S. England of which I know, and which A. A. Allen has been kind enough to draw my attention to, is the following from Windsor Forest (Donisthorpe, 1939, Prelim. List Col. Windsor Forest): “In moss in willow-swamp, and in frass of old ash tree; scarce. (V, VI, IX)”.

It is unknown to me whether the male was among these specimens. If not, I am afraid it might well be question of a form of *analis*.

Peyerimhoff refers to the following information from Sainte-Claire Deville (1935, p.129) as regards the distribution of *cavifrons* in France: "Çà et là sur les sommets dénudés de la plupart des mass.mont.: Ballon d'Alsace!, Mt.-Dore!, L'Aigoual, Gde Chartreuse, B.-Alp., Alp. Mar., etc." while *analis* is said to be found everywhere in France and Corsica.

It seems to be certain that *cavifrons* has a much more restricted distribution than *analis*, and even if it must be taken into account that the ♂♂ are more scarce than the ♀♀, this can hardly explain the difference.

For the same reason *Sarsi* can not be the male of *analis*. In Norway *Sarsi* has been found in the following localities, all in the southern part of the country:

Ø 1: Kirkeøy (Munster) 12: Halden (Hanssen).

AK 10: Solberg (Munster) 11: Asker (Hanssen, Munster) Skaugumås (Munster) Nesøya (Munster) 12: Snarøya (Munster) Lysaker (Munster) 13: Østensjøvatn (A. Strand) Røa (A. Strand) V. Aker (Hanssen, Munster) Bygdøy (Munster) Hovedøya (Munster) Ullern (A. Strand) 14: Oslo (E. Strand) 18: Hemnes (Munster) 19: Eidsverk (Munster) 24: Lillestrøm (Munster) HEs 3: Kongsvinger (Hanssen) Os 15: Biri (Munster) Bø12: Mjøndalen (Munster) Nedre Eiker (Munster) 13: Hokksund (Munster) Fiskum (Munster) 15: Kongsberg (Munster) 16: Sandsvær (Munster) VE1: Skoger (Munster) AAy15: Grimstad (Munster).

Palm (i. l.) does not know *Sarsi* from localities in Sweden and it is also unknown to Victor Hansen (i. l.) from Denmark.

In a collection which Hellén kindly sent me for examination from Finland *Sarsi* is represented from the following localities, all in the most southern part of the country:

Ab: Runsala (Hellén) N: Kyrkslätt (R. Frey) Esbo (Hellén) Helsinge (Hellén) Segelskär Tvärminne (R. Frey) Thusby (O. Engstr.).

Munster (l. c.) mentions that he has seen a specimen of *Sarsi* from Tirol, but I have not been able to examine it.

Although further examinations certainly will show that *Sarsi* has a wider distribution than known at present, there seems to be no doubt that it is far more restricted in its distribution than *analis*.

In addition to the sexual differences of the male mentioned above, *Sarsi* seems to be characterized by dark colour, somewhat flattened thorax, comparatively long elytra and rather

close puncturation of the abdomen. Munster mentions that the head is less triangular and distinctly narrower than the thorax and this again narrower than the elytra, while *analisis* and *cavifrons* have the head almost as broad as the elytra. He also mentions that perhaps the small bristles on the sixth sternit are a little thinner.

However what has been said above of the difficulties of keeping apart the ♀♀ of *analisis* and *cavifrons* also applies to *Sarsi*.

As regards *analisis* the only solution seems to be as pointed out by Sharp, that we have to count on parthenogenesis.

Of particular interest in this connection is Iceland. According to Lindroth (1931, p. 186, 187) *analisis* is the only species of *Amischa* found in Iceland, where it is common and widely distributed. Through the kindness of Mr. Lohmander of the Gothenbourg museum I have been able to examine the material of *analisis* which Lindroth collected in Iceland, in all 272 specimens, and, although I have only dissected a few specimens, there can be no doubt that all of them are ♀♀. They all have the series of short, rather thick-set bristles at the hind margin of the sixth sternit, a character which is typical of the female.

There is moreover every probability that *analisis* is not the only parthenogenetic species of *Amischa*.

In his description of *decipiens* Sharp (1869, p. 179) says:

"The male of this species is only to be distinguished from the female by the under plate of the seventh segment of the abdomen being slightly narrower and more elongate than in the female. In neither sex has the posterior margin of the upper plate of this segment any triangular notch; the posterior margin is not, however, completely rounded, but is slightly and indistinctly emarginate."

Peyerimhoff (1938, p. 66) points out that he has seen a male of *decipiens* from Tunis, but neither Sharp's description nor Peyerimhoff's drawing of the male seems to be convincing, and neither of them has, to my knowledge, made sure by dissection that it really was the male.

My suspicion seems to be justified by the fact that Steel informs me that he has a large amount of material of *analisis* and *decipiens*, which he usually finds together, but he has seen no males of them.

In any case, further investigations would be of the greatest interest.

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## On the Species of *Grynobius* Thoms. (Col. Anobiidae).

By Andreas Strand, Oslo.

According to the catalogue of Winkler (1924—1932, p. 799) the genus *Grynobius* Thoms. comprises the following 4 species:

- excavatus* Kug. (syn. *castaneus* Reitt. and ? *castaneus* F.)  
from West and Central Europe with v. *Eichhoffi* Sdl.  
from Germany, Sweden and the British Isles.
- tricolor* Ol. from North and Central Europe and Caucasus.
- Kiesenwetteri* Edw. from the British Isles.
- planus* F. from North and Central Europe, Italy and Caucasus.

As Buck (1950, p. 127) has recently shown *Kiesenwetteri* is but a large female of *excavatus*.

Hubenthal (Küster—Kraatz, 1912) has published a revision of the genus with the following table:

- "1. Halsschild breiter als der Kopf, seine Seiten stark gerundet, vorn mehr oder weniger niedergedrückt; Schildchen so lang als breit; 3. Fühlerglied länger,



bis doppelt so lang als das 4.; Fühler im ganzen etwas gestreckter. Körper groß, plump.  $4\frac{1}{2}$ —6 mm.

*excavatum* Kug.

Kleiner, Zwischenräume der Flügeldecken schmaler, gewölbt:

*excavatum* Kug.

Größer, Zwischenräume breiter als die Punktreihen, flacher:

v. *Eichhoffi* Seidl.

1". Halsschild kaum breiter als der Kopf, seitlich wenig gerundet, vorn etwas niedergedrückt; 3. Fühlerglied etwas länger, bis um die Hälfte länger als das 4.; Fühler im ganzen etwas gedrungener. Körper kleiner, schlanker.

2". Heller gefärbt. Schildchen so lang als breit. Streifen der Flügeldecken grob punktiert; Zwischenräume schmal, gewölbt. Behaarung goldgelb.  $3\frac{1}{2}$ — $4\frac{3}{4}$  mm.

*tricolor* Oliv.

2". Viel dunkler gefärbt. Schildchen breiter als lang. Streifen der Flügeldecken feiner punktiert; Zwischenräume viel breiter als die Streifen. Behaarung weißlichgelb.  $3\frac{1}{2}$ — $4\frac{3}{4}$  mm.

*planum* F. Mls."

My attempts to determine the material of *Grynobius* which I have examined, by using the table of Hubenthal, have been unsuccessful, and the reason is that the characters on which he and other entomologists have relied, have proved to be very variable and can not be considered as species characters.

Horion (1935, p. 269) points out that Edwards has not recognized more than one species (apart from his *Kiesewetteri* which, as mentioned above, is a synonym) and Horion himself is of the opinion that the genus ought to be thoroughly revised. Victor Hansen (1951, p. 181) has recently given very good reasons for the opinion that *excavatus* and *tricolor* belong to one and the same species.

It is rather astonishing to see that, to my knowledge, Buck (l. c.) is the only entomologist who has examined the aedeagus. His drawing of the organ of *excavatus* corresponds to what I have found in the Norwegian specimens I have examined and also in specimens from Denmark, Sweden and France, sent me partly as *excavatus* and partly as *tricolor*.

Of particular interest is the material from the Naturhistorisches Museum in Vienna, which Scheerpeltz kindly has sent me for examination. It comprises 16 specimens determined as *excavatus*, 9 as *tricolor*, 6 as *planus* and 10 as *castaneus*. The 3 first mentioned species have, at least partly, been determined by Hubenthal as a label on the first specimen in the series of each species shows. I have examined the aedeagus of a specimen of each of the 4 "species" with the result that no difference at all can be detected. The specimen of *planus* has a label with the text "Fenestrelle Ganglb. 1908" and this specimen is mentioned by Hubenthal as examined by him, so there can be no doubt that he has accepted it as *planus*.

3. From what I have had the opportunity of examining up to now it seems probable that the genus *Grynobius* comprises only one species, viz. *planus* F.

Under the various names this species has been recorded from Algeria, Spain, France, Italy, Switzerland, Germany, Austria, Hungary, the Netherlands, the British Isles, Denmark, Sweden, Norway and Caucasus. Jakobson (1905—16, p. 818) has also Kiev and as doubtful Leningrad and Moscow. Hubenthal (l. c.) is no doubt wrong in mentioning Finland, cf. Hellén (1939).

In Scandinavia the species has a markedly Western distribution and seems to be confined to coastal districts. Thus, in Sweden it is known from Skåne, Halland and Bohuslän and in Norway it has been found in the following localities: *TEy* 15: Skåtøy (Lysholm), *VAy* 4: Kristiansand (Ullmann), *Ri* 50: Årdal and Nes in Årdal (Helliesen), *HOy* 22: Bergen (Sølsberg and Sparre Schneider), *HOi* 41: Skånevik (Warloe), *MRe* 5: Dalsfjord Sunnmøre (Lyngnes), *NTi* 19: Vannvikan (Lysholm).

*Grynobius planus* lives in dried stumps, trunks and branches of various foliiferous trees (f. inst. oak, beech, chestnut, roan, hazel, poplar, willow and cherry) and in Sunnmøre, on the west coast of Norway, Dr. Lyngnes has found the species to be very noxious in wood of birch, alder and willow in houses, and particularly in boat houses.

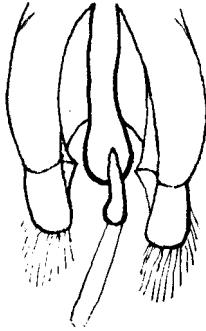


Fig. 1.

Aedeagus of *Grynobius planus* F.

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## In memoriam.

### Leland Ossian Howard.

Da sjefen for U. S. Bureau of Entomology i Washington D. C., dr. L. O. Howard døde 93 år gammel, den 1. mars 1950, gikk ett av entomologiens største navn over i historien.

Allerede i 1894 ble Howard sjef for Division of Entomology, som dengang omfattet 9 funksjonærer, men under hans ledelse steg institusjonen raskt i betydning, og da han fratrådte i 1927, etter oppnådd aldersgrense, var staben steget til 750 og Bureau of Entomology som det nå het, disponerte et budsjett på over 3 millioner dollars. Dr. Howard var av de få mennesker som overkommer alt, og ved siden av sine administrative plikter skaffet han seg også en internasjonal posisjon som forsker. Ett av hans spesialområder var parasitiske Hymenoptera, men han publiserte også grunnleggende arbeider over fluer som smittebærere og over stikkemygg. Av størst betydning er kanskje hans arbeid med biologisk bekjempelse av skadeinsekter, et område hvor han ble verdensautoritet. Under hans ledelse ble parasitter på en rekke av Amerikas farligste skadeinsekter importert fra de forskjellige verdensdeler, og Bureau of Entomology ble et sentrum for studiet og kultur av parasittiske insekter.

Antallet av dr. Howards entomologiske publikasjoner overstiger 1000. Han har beskrevet hundrer av nye insektarter og også mange nye slekter. I embets medfør foretok dr. Howard utallige reiser og han besøkte de fleste europeiske land hvor han knyttet personlig forbindelse med fremtredende entomologer, forbindelser som han senere holdt ved like. I Washington D. C. var dr. Howard en av de ledende personligheter i den akademiske verden, og i Cosmos Club, som spilte en stor rolle i hans liv, innehadde han etter hvert de fleste klubbembeter; i 1909 ble han valgt til president. Med sin medfødte evne til å omgås mennesker, med sitt lune humor og sin store viden var han det selvskrevne sentrum i kretsen av amerikanske og utenlandske, besøkende, entomologer. Hans sjarmerende personlighet vil bli savnet av alle dem som hadde den lykke å treffe ham.

L. R. N.

### Filippo Silvestri

som døde 2. juni 1949, var et av entomologiens store navn og en sentral skikkelse på de internasjonale kongresser. Silvestri, som innehadde professoratet i landbrukszoologi var også direktør for Landbrukshøgskolen i Portici. Han var en framstående systematiker og har skrevet en lang rekke arbeider over *Myriapoda*, *Thysanura*, *Symphyla*, *Protura*. I 1913 oppdaget han noen bitte små, primitive insekter som han ga gruppenavnet *Zoraptera*. Silvestri har også publisert fremragende arbeider over termitter og myrmekofile og termitofile insekter foruten studier over embryologien hos de små snyltevepser tilhørende gruppen *Chalcidoidea*. Disse studier ledet ham etter hvert inn på biologisk bekjempelse av skadeinsekter, et område hvor han ble en av de ledende autoriteter.

L. R. N.

### A. D. Imms

døde 3. april 1949.

Som yngre innehadde han forskjellige stillinger i India, og da han i 1913 vendte hjem til England ble han Chief Entomologist ved Rothamsted Experimental Station. I 1931 overtok han også lærerstillingen i entomologi ved universitetet i Cambridge.

Imms har bl. a. utgitt flere avhandlinger om termitter og de kjente, ypperlige lære- og håndbøker »Recent Advances in Entomology« (1931) og »General Text-book of Entomology« (1939).

L. R. N.

### Nils Alarik Kemner.

Den 8. mai 1948 avgikk dr. N. A. Kemner ved døden og i ham har nordisk entomologi mistet en av sine mest fram-tredende og egenartede personligheter.

Kemner var født i Malmö i 1887, ble fil. mag. i Lund i 1914 og fil. dr. i 1918. I 1940 ble han tildelt professors tittel for sine fortjenster av entomologien ved Zoologiska Institutionen i Lund.

I 1920 mottok han et tilbud om en stilling i hollandsk tjeneste på Java, hvor han arbeidet et års tid. Hans interesse rettet seg her særlig mot studiet av termittenes og termitt-gjestenes biologi, et område hvor han etterhvert leverte flere verdifulle bidrag. Blant hans mange entomologiske publikasjoner bør også framheves hans studier over hypermetamorfosen hos visse billearter.

Insektsamlingene ved Zoologiska Institutionen i Lund er internasjonalt kjent på grunn av de mange typer fra en rekke av Sveriges mest framtreddende eldre entomologer. Etter at dr. Kemner ble knyttet til denne institusjon nedla han et energisk og omfattende arbeid på nyordning og utvidelse av de entomologiske samlinger, både de innen- og utenlandske. Hans store arbeidskraft kom også Entomologiska Sällskapet i Lund tilgode, og han startet tidsskriftet *Opuscula Entomologica*, en publikasjon som etter hvert arbeidet seg fram i første rekke blant nordens entomologiske tidsskrifter.

Dr. Kemner foretok studiereiser til en rekke land, og han var en både aktiv og interessert deltager i nordiske og internasjonale kongresser.

L. R. N.

### Ivar Trägårdh

døde 22. mai 1951, i sitt 73. år.

Som leder av den entomologiske avdeling ved Statens skogsförsöksanstalt helt fra 1915 til oppnådd aldersgrense i 1943 har professor dr. Trägårdh hovedæren for den imponerende utvikling som den svenske skogentomologi har gjennomgått i den siste menneskealder. I en lang årrekke var Trägårdh viseordfører i Entomologiska Föreningen og redaktør av *Entomologisk Tidskrift* og av serien »Svensk Insektfauna«.

Den som har kommet i kontakt med svenske entomologer, skogsmenn eller pedagoger har fått et sterkt inntrykk av, at Trägårdh har virket overordentlig inspirerende som lærer, ekskursjonsleder og forfatter gjennom sine forelesninger, lærebøker og »Biologiska skisser«. Han satte sine pedagogiske og journalistiske evner inn på å øke folkets kunnskap om fosterlandets natur og dyreliv. Og med det kunnskapsstoff han skaffet til veie for å høyne skogens rasjonelle helsepleie ydet han et betydelig bidrag til veksten av sitt lands nasjonalformue.

Også Norge står i stor takknemlighetsgjeld til Trägårdh, fordi det som naboland ble direkte delaktig i hans forsknings resultater. En hel generasjon av norske firstmenn har fått sin innvielse i skogentomologiens problemer gjennom hans lærebøker. Dertil kommer at Trägårdh var knyttet til Norge med mange vennskapsbånd.

I alle land var Trägårdh anerkjent som en av de foregangsmenn som i begynnelsen av det 20. hundreåret banet veien for den moderne epoke i skogentomologien og ga den

eksperimentelle biologi en bred plass ved siden av den deskriptive og systematiserende forskning. Det program han gikk inn for og ga uttrykk i »Mål och medel inom skogsentomologien« (1923) viste seg ypperlig skikket som grunnlag for et intimt og fruktbringende samarbeid med de svenske skogsmenn.

Det er en rikdom av biologiske undersøkelser, nyoppdagelser, diskusjonsproblemer og praktiske erfaringer strødd rundt i Trägårdhs årsmeldinger. Resultatene av hans spesialforskninger er publisert i en rekke avhandlinger bl. a. om middenes komparative morfologi og systematikk, om »Barkborrarnas gångsystem«, om »Tallens och granens fiender bland småfjärilarna« (1915), »Nunnans uppträdande i Gualöv« (1920), »Den större märgborren« (1921), »Barkborrekampanjen efter stormhärjningarna 1931—1932« (sammen med V. Butowitsch), »De virkesförstörande insekterna« (1939) og (sammen med K. U. Forsslund) »Markens djurliv« (1932). Ekstrakten av sin forskning og sine praktiske erfaringer har Trägårdh gitt oss i sitt hovedverk »Sveriges skogsinsekter« (2. utgave 1939).

Det ville gi et ufullstendig bilde av Trägårdhs rikt fasetterte personlighet å unnlate å nevne hans fengslende bidrag til den sosiale biologi med essaysamlingen »Civilisationens dilemma« (1934). Den slutter med disse ord: »Forskarglädjen är ett mäktigt både kulturellt och ekonomiskt tillgodohavande för ett land.«

Trägårdhs eget livsverk er det beste bevis på ordenes sannhet.

T. H. S.

# Årsmelding

## 11. oktober 1946—23. mai 1950.

### *Medlemstall.*

I meldingsårene har foreningen fått følgende nye medlemmer: cand. mag. Per Bergan, Oslo; stud. real. Johanna Margrete Sømme, Oslo; forsøksassistent J. Fjeldalen, Oslo; kommunelærer Knuud Juul, Aarhus, Danmark; tandl kare Arne Sundholm, Karskrona; forfatteren Axel Sandemose, K rkelvik pr. Ris r; dosent dr. philos. Kjell Ander, Lund; amanuensis Paul Ard , Lund; amanuensis Wolter Hell n, Helsingfors; dr. ing. Otto Falkenberg, Oslo; f ltassistent Nils Holger H glund, Bergvik, Sverige; fr ken Helen Rost, Hamar; agronom Svante Ekholm, Helsingfors; prof. dr. Th. Schjelderup Ebbe, Oslo; stud. real. Alf Bakke, Oslo; lege Arne Nielsen, Sandnes; kamrer Sven Berd n, Lomma, Sverige; l roverksl rare fil. mag. Gunnar Viktor Dahlgren, Hallstavik, Sverige; herr Arne G. M ller, Stockholm; ingeni r Josef Hlisnikowski, Praha; stud. real. Audfinn Tj nneland, Bergen; cand. mag. Ragnhild Sundby, Oslo. Ett medlem er utmeldt.

Foreningen har p. t. 88 medlemmer, derav norske: 49 personlige og 7 institusjoner, og utenlandske: 27 personlige og 5 institusjoner.

### *Biblioteket.*

I bytte for Norsk Entomologisk Tidsskrift har man f tt følgende nye bytteforbindelser: Stockholms H gskola: »Avhandlingar i Zoologi«; Deutsches Entomologisches Institut, Mecklenburg: »Arbeiten  ber phys. u. angew. Entomologie aus Berlin-Dahlem«; Soc. f. Brit. Entomology, Bournemouth, England; »Journal (Transact.) of the Soc. f. Brit. Entomology«; Dep. of Entomology, Univ. Museum, Oxford: »Hope Reports« og s rtrykk; The Library, Dep. of Zoology, Cambridge: s rtrykk; Nederlandsche Ent. Ver., Amsterdam: »Tijdschrift voor Entomologie«; Lab. de Biochemie de l'Univ. de Liege: s rtrykk; Soc. Ent. de France: »Bull. Soc. Ent. de France« og »Annales Soc. Ent. de France«; Dr. E. Schedl, Linz, Austria: »Zentralblatt f. d. Gesamtgeb. d. Entomologie« og s rtrykk; Ent. Lab., Kyushu Univ., Japan: »Mushi«; Biol. Lab., Harvard Univ., Cambridge, U. S. A.: »Psyche«; Comp. Diamantes de Angola, Lisboa: s rtrykk. Som vanlig er publikasjonene innlemmet i Zoologisk-Museums bibliotek.

### *Representasjon.*

P  det VII. Nordiske Entomologm te i Helsingfors, 5.—7. august 1947 var foreningen representert ved konservator Leif R. Natvig, likeledes p  den VIII. Internasjonale Kongress for Entomologi i Stockholm, 9.—14. august 1948.



På årsmøte i N. E. F., 21. mars 1947 ble konservator Natvig oppnevnt som foreningens representant i Den nasjonale komité for de biologiske vitenskaper.

### Møter.

#### Møte på Zoologisk museum fredag 11. oktober 1946.

Natvig kåserte over: »Hvad der er hendt ute i den entomologiske verden i krigsårene.« En oversikt i »Nature« for mai 1946 publisert av F. J. Griffin, registrar ved Royal Entomological Society i London, ga opplysninger om tyske museer etter krigen. Det Senckenbergische Museum i Frankfurt a/M. er alvorlig skadet av høyeksplosive bomber, men største delen av samlingene, som var evakuert, ble reddet; likeså biblioteket. Museet i Stuttgart er helt utbrent. Hele utstillingssamlingen og magasinene av invertebrater er ødelagt. De mest verdifulle deler av den entomologiske samling var imidlertid evakuert. Kernen-Verlag har fått lageret av publikasjoner ødelagt, unntatt visse deler av »Groß-Schmetterlinge der Erde«. Schweitzerbartsche Verlag har ikke lidt større tap. Her utgis bl. a. »Die Fliegen der palaearktischen Region«. Det zoologiske museum i Bonn er helt ødelagt. Bl. a. er Winnertz berømte Diptersamling, med typer, og Nees von Essenbeck's Hymenoptersamling (med typer) tilintetgjort. Forlaget H. Goecke, Krefeld har lidt atskillig skade, bl. a. store deler av opplaget til »Entomologische Blätter«. I Berlin er Zoologisches Museum der Universität sterkt skadd. Følgende entomologer er fremdeles knyttet til museet: prof. Bischoff, prof. Hering, prof. Ramme, prof. Hedicke, dr. N. I. Kardakoff, dr. Eisentraut. Prof. Herings berømte samling av bladminner er ødelagt, men en del av de klekte insekter er reddet, likeså Staudinger-samlingen inklusive Micros. Såvidt Griffin kunne bringe på det rene er følgende entomologer døde: Alfken, Max Müller, Engel, Draut, Urban. Dr. Hedicke's hjem ble bombeskadet, hans samling og alle insekter han hadde lånt fra utlandet er ødelagt. Deutsches Entomologisches Museum i Berlin-Dahlem er praktisk talt uskadt. Samlingene var evakuert til Post Blücherhof i Mecklenburg, men er senere brakt tilbake av direktøren, prof. H. Sachtleben. Blant Berlinerforlagene er Friedländer & Sohn ødelagt og bare en del av lageret, som var evakuert, ble reddet. Lokalene til Nicholaische Buchhandlung er bare en skrauphaug. Likeså lokalene til Gebrüder Bornträger. På grunnlag av utenlandsk litteratur, fortrinsvis »Entomological News« og »Entomologist's Monthly Magazine« ga Natvig en rekke personalopplysninger. Den bekjente engelske entomolog Kenneth J. Morton døde 29. januar 1940. Han har skrevet en rekke arbeider over *Ephemeroptera*, *Neuroptera*, *Plecoptera* og *Trichoptera*, men hans favorittgruppe var *Odonata* hvor han var en av de ledende spesialister. Hans samling og bibliotek er testamentert til The Royal Scottish Museum, Edinburgh. Harry Eltringham, M. A., F. R. S., døde 26. november 1941. Blant hans mest kjente verker er »African mimetic Butterflies« og »Histological and illustrative methods for entomologists«. Dr. Charles W. Stiles døde 24. januar 1941. Han har skrevet betydelige arbeider over *Ixodidae*, men er kanskje mest kjent som sekretær i den internasjonale nomenklaturkommissjon. Dr. Charles W. Leng, direktør for Statens Inland Museum, New York, døde 25. januar 1941. M. P. Riedel, den kjente Tipulide-spesialist døde i Frankfurt a/O. i mars 1941. Dr. W. Junk, den kjente tyske forlegger døde i Hague i desember 1942. Sir Guy Marshall har trukket seg tilbake som direktør for Imperial Institute of Entomology i London. Som hans etterfølger er utnevnt dr. Sheffield

Neave. Ifølge Ent. News meddeler direktøren for Division of Publication of the Philippines, Dr. Eduardo R. Alvarado, at Bureau of Science med de internasjonalt kjente samlinger og en stor del av lageret med vitenskapelige publikasjoner, ble totalt ødelagt under den japanske okkupasjon. Blant de tilintetgjorte publikasjoner er »Philippine Journal of Sciences«. Natvig omtalte også de viktigste arbeider som i krigstiden var publisert i ovennevnte tidsskrifter og påpekte de oppsiktsvekkende priser som på engelske auksjoner ble betalt for sjeldne endemiske Lepidoptera.

Til slutt demonstrerte Strand sin nettopp utkomne bok om Nord-Norges coleoptera.

#### *Møte på Zoologisk museum fredag 20. desember 1946.*

Da en ny møteprotokoll skulle tas i bruk, ga formannen, Natvig, noen korte opplysninger om den første protokoll som nå skulle gå inn i arkivet. Den omfattet tidsrommet fra foreningens stiftelse i 1904 og til 11. oktober 1946. Protokollen inneholder stiftelsesdokumentet og samtlige refererte møter i denne periode. I alt er det 77 alminnelige møter, 11 styremøter, referat fra IV. Nordiske Entomologmøte i Oslo 1933 samt referat fra 2 ekskursjoner (Roverud i 1912 og Hvaler i 1914). I protokollen er dessuten innklebet skrivelser og telegrammer fra krigsårene og i anledning foreningens 40-års jubileum.

Natvig meddelte noen personalia vedrørende følgende østerrikske entomologer som er avgått ved døden: Dr. Max Bernhauer, spesialist i Staphylinider, døde 14. mars i Horn i Niederösterreich. Emil Moczarski, Pselaphide-spesialist, døde 5. april 1945 i Wien. Dr. Fritz Netolitzky, Bembidie-spesialist, døde i Wien 5. januar 1945. Dr. Franz Späth, Cassidie-spesialist, døde i Wien 25. juni 1946. Han har bl. a. bearbeidet de eksotiske Cassididae i Zoologisk museum og publisert en avhandling i N. E. T. Albert Winkler, den kjente insekthandler i Wien, døde 7. april 1945. Han var forlegger for »Koleopterologische Rundschau« og »Catalogus Coleopterorum regionalis Palaearctica«.

Aftenens foredragsholder, forsøksleder Husås, fortalte om: »Inntrykk fra den I. Internasjonale Plantevernkonferens« i Heverlé-Louvain, Belgia 15.—29. sept. 1946, hvor han møtte som offisiell norsk delegert. Han ga først en oversikt over kongressens organisasjon og formål. Kongressen var delt i en vitenskapelig del (15.—19. sept.) og en populærvitenskapelig del (19.—29. sept.). Det var samtidig møter i de 4 seksjoner: 1. Plantevernmidlenes toksiske virkning på mennesker og dyr. 2. Bruken av plantevernmidlene mot parasitter på dyr og planter. 3. Analysemetoder, kontroll, standardisering, karantene og forordninger. 4. Plantevern i koloniene. Dessuten hver dag et felles foredrag over emner av mer almen interesse. Deretter kom Husås inn på de nyere insektisider som hadde vært drøftet på kongressen:

DDT.Resultater av forsøk mot en rekke skadedyr fra ulike land viste at DDT var et epokegjørende nytt middel i kampen mot skadedyr. Toksiditetsforsøk var også utført i flere land, og etter dette er det grunn til å være litt mer varsom enn de første sveitsiske meldinger ga uttrykk for, men på den andre siden er det trolig ikke nødvendig å ta så strenge forsiktighetsregler som de amerikanske myndigheter krever.

666 eller heksaklorcykloheksan, var nærmere undersøkt bl. a. i England, Frankrike og Sveits. De ulike isomerene var isolert og en var på jakt etter en fabrikkasjonsmetode som kunne gi mer av høyvirksomme gammakomponenten enn 10—15 %, som forekommer i vanlig handelsvare. Det var forsøk som tydet på at dette ville lykkes.

Like ens var det en stor oppgave å lage »luftfri« preparater som ikke setter smak på produktene. I sveitsiske forsøk hadde det vist seg at 666 hadde bedre virkning enn DDT mot biller som *Ceutorrhynchus pleurostigmata* March., *C. quadridens* Panz., *C. napi* Gyll. og *Psylliodes chrysocephala* L.

1068. Et nytt insektisid oppdaget av Julius Hyman ved Velsicol Corporation i Chicago. Stort sett tilsvarende virkning som DDT, men 3—10 ganger så virksomt mot enkelte skadedyr som maur og kakerlakker. »Navnet« kommer av den empiriske formel  $C_{10}H_6C_{18}$ .

Azobenzol var alt tatt i bruk i kampen mot midd i veksthus i U. S. A. og engelske forsøk som ble referert, viste god virkning av sprøytevæsken. I U. S. A. ble mest nyttig utgassing.

Natriumselenat var nyttig med godt resultat som systemisk insektisid, særlig overfor midd og bladlus. Dessverre kan det skade plantene, og dessuten er det meget giftig for folk og fe slik at det bare kan komme på tale til blomsterkulturer.

O. Ryberg, Sverige, kom med et kraftig innlegg inn på importkontrollen med planter. Ved hjelp av flere eksempler mente han å kunne bevise at sertifikatene fra plantesjukdomsinspeksjonen i Holland og Belgia ofte har liten eller ingen verdi.

På et møte av de delegerte fra ca. 20 land ble vedtatt å utnevne en komité som skulle arbeide med forberedelse av II. Internasjonale Plantevernkongress. Det ble antydnet at England ville arrangere denne i London i 1948. (Autoreferat.)

Natvig kåserte over »Overføring av gulfeber«. Gulfeberen er en akutt febersykdom hvis 1. stadium karakteriseres ved feber på 39—41° C. Etter 2—3 dager inntreier en tilsynelatende bedring. I 2. stadium skjer en degenerasjon av de indre organer med blødning, gulfarging av huden, oppkast av svarte blodmasser — »vomito negro«. Dødelighet: 60—70 %. Finlay publiserte i 1886 et arbeide hvor han hevder at en mygg — *Stegomyia fasciata* — eller som den nå kalles *Aedes aegypti*, overfører smitten. Hideyo Noguchi arbeidet på andre linjer. Han mente at en spirochaet, *Leptospira icteroides*, var sykdommens opphav. Det ble framstillet en vaksine mot denne og man mente å ha fått has på sykdommen. I 1927 kom det plutselig store epidemier i Brasil og The International Health Division of the Rockefeller Foundation overtok arbeidet. Det ble påvist at smittestoffet er et virus. Sykdommen opptrer i 2 former: den gamle urbane gulfeber, som først og fremst bekjempes ved utrydding av myggenes klekkesteder, dernest jungelfeberen som er vanskeligere å få has på da ville aper danner et naturlig reservoar for smittestoffene. Sykdommen er utbredt i de fleste tropiske strøk, den har enkelte ganger også opptrådt i Europa, bl. a. i Gibraltar, Sydfrankrike og i 1865 ennog i Swansea i England. Også i Nordamerika har det vært epidemier. Da imidlertid *Aedes aegypti* krever temmelig høy temperatur til sin utvikling, dør bestanden alltid ut på nordligere breddegrader og sykdommen forsvinner, inntil ny myggeimport finner sted. Myggen lar seg lett transportere med skuter og kan klekkes i vannrester ombord. Den kan også transporteres med fly. I nyere tid er det påvist at en rekke myggearter eksperimentelt kan overføre virus. Dette er tilfelle med 5 amerikanske, 1 orientalsk, 9 afrikanske og 1 europeisk art, og man frykter for at flere orientalske arter vil kunne overføre virus. Av denne årsak er det nå organisert streng kontroll med fly, framfor alt i Afrika, for å søke å hindre at sykdommen kan bli overført til India og omliggende områder. Man antar at sykdommen opprinnelig er afrikansk, men at den ble overført til Vestindia med negerlaver som spanierne brakte over til Espanolia (Haiti). (Autoreferat.)

*Årsmøte på Zoologisk museum fredag 21. mars 1947.*

Formannen, Natvig åpnet møtet og ønsket den danske gjest, ingeniør Suenson, hjertelig velkommen. Han oppleste deretter årsberetningen som ble godkjent. Regnskapet, som ble referert av revisor, Opheim, ble også godkjent.

Valget fikk følgende utfall: formann: Natvig, sekretær: Knaben, 2. varamann til styret: Opheim, medlem av redaksjonskomiteen: Økland, revisor: Semb-Johansson. Som foreningens representant i Den nasjonale komiteen for de biologiske vitenskaper ble valgt: Natvig.

Man drøftet deretter muligheten for å sende norske representanter til det VII. Nordiske Entomologmøte i Helsingfors i august 1947, da valutaforhold og trafikkmessige hensyn i vesentlig grad ville vanskeliggjøre større norsk deltagelse. Spørsmålet om neste nordiske entomologmøte i Norge ble også behandlet og man ble enig om å underrette de øvrige nordiske entomologforeninger om at Norge skal prøve å ta møtet i 1953.

Aftenens foredragsholder, Andr. Strand, kåserte om en reise til Sovjetsamveldet.

Til slutt framviste N. Knaben en serie vakre fargediapositiver fra Bergen og Vestlandet. Særlig stor interesse vakte noen nydelige bilder av blomster og insekter.

*Møte på Zoologisk museum tirsdag 9. desember 1947.*

Natvig kåserte over inntrykk fra det VII. Nordiske Entomologmøte i Helsingfors, 5.—7. august 1947, hvor han deltok som Universitetets representant og samtidig representerte N. E. F. Møtet, hvori deltok ca. 200 medlemmer, var ypperlig arrangert, og alt var gjort for at de utenlandske gjester skulle få best mulig utbytte av sitt opphold i Finland. Atskillige svenske entomologer, til dels med fruer, var møtt fram, likeså en del danske. Fra Norge deltok direktør R. Brekke, Trondheim, lektor H. Holgersen, Stavanger og konservator Natvig, Oslo. Et foredrag av professor Saalas om finsk entomologi ga et imponerende inntrykk, både av entomologiens betydelige rolle i finsk zoologisk forskning og av det målbevisste samarbeid mellom teoretisk og praktisk entomologi.

Antall foredrag var nokså omfattende, men den store stoffmengde ble greitt fordelt og avvirket på fellesmøter og 3 forskjellige seksjoner. Det var også ordnet med besøk på zoologisk museum og på den landbruks- og forstzoologiske samling. Universitetets entomologiske samling er imponerende både i omfang og på grunn av den oversiktlige oppstilling. Det finske vertskap hadde arrangert en rekke selskapelige sammenkomster og det ble vist en utstrakt gjestfrihet like overfor de utenlandske gjester. Etter kongressen var det ekskursjoner til: 1. Heinola-Punkaharju, 2. Tavastehus-Lepaa og 3. Tvärminne zoologiska station. Natvig reiste tilbake over Åbo og gjennomgikk også de betydelige entomologiske samlinger ved Universitetet der. I Stockholm benyttet han 3 dager til studier ved Riksmuseets entomologiske avdeling.

Natvig refererte derpå en publikasjon han nettopp hadde mottatt fra den amerikanske major John Bailey om dennes inntrykk fra besøk ved en rekke europeiske museer og entomologiske samlinger. Til slutt framviste han en samling insekter fra Columbia innsamlet av herr Hans Lunde i Drammen og skjenket museet.

**Møte på Zoologisk museum tirsdag 13. april 1948.**

Aftenens foredragsholder, cand. real. Astrid Løken fortalte om sine inntrykk fra et studieopphold i U. S. A.

»Department of Entomology ved universiteter og college i U. S. A. er helt imponerende, ja virker overveldende når en tenker på de kummerlige forhold som entomologien eksisterer under her hjemme. Ved Michigan State College f. eks. er det foruten den professor som samtidig er bestyrer av avdelingen 7 fast ansatte entomologer. Det ble i løpet av året holdt mer enn 20 ulike »klasser« innen faget, bl. a. i »general entomology«, systematikk, insektkontroll, skogsinsekter, fruktinsekter, vanninsekter, veksthus-insekter, plantevern, medisinsk entomologi, teknologi osv. En del klasser ble gjentatt hvert semester, andre var bestemt av årstiden.

Med hensyn til praktisk vitenskapelig arbeid er forsøksstasjonene kanskje vel så viktige som universitet og college. Forsøksstasjonene er enten »State Experiment Station«s eller »U. S. Experiment Stations«. Det ligger i navnet at de første sorterer direkte under den respektive stat, er gjerne knyttet til State College. De siste administreres fra United States Department of Agriculture (USDA).

Jeg var så heldig å treffe sjefen for Bee Culture Division, USDA Mr. Jas. Hambleton, som fortalte meg at de nettopp var iferd med å starte to nye bestøvningslaboratorier som ville bli de første i sitt slags. Ved hans elskverdige hjelp fikk jeg høve til å arbeide ved et av disse laboratorier, nemlig det som ble opprettet i Logan, Utah. Det praktiske bestøvningsproblem en her søkte å løse gjaldt Alfalfa eller lusern (*Medicago sativa*). Frøingen ble dårligere år for år og en var blitt klar over at en viktig årsak var den sterke tilbakegang av ville bestøvende insekter. Dette er et alminnelig fenomen mange steder i U.S.A. — jo mer jord som blir lagt under kultur, dess vanskeligere er det for biene å finne velegnede bo. For å bøte på mangelen på villbær, ble bikuber leiet for blomstringssesongen. Det viste seg at honningbia sjelden gikk normalt inn i lusern-blomsten på grunn av dennes spesielle bygning. Følgelig er honningbia her en dårlig bestøver.

Jeg var i Utah fra begynnelsen av juli til midten av september 1947. En stor del av tia gikk med til å kartlegge villbiene. Vi identifiserte de insektene som samlet på plantene og fortrinnsvis dem som samlet på alfalfa. Vi var også stadig på jakt etter deres bo, som vi ofte gravet ut for å få kjennskap til deres biologi og diskuterte stadig mulighetene for kunstig oppdrett. Vi lokaliserte kolonier av arter av *Anthopora*, *Halictus*, *Megachile* og *Nomia*. *Andrena* ble observert i feltet, men boene ikke lokalisert mens jeg var der. Seint på sommeren ble det funnet to humlebo. Disse ble en morgen før soloppgang flyttet til en høystakk like ved et lusern forsøksfelt. CO<sub>2</sub> ble nyttet til å bedøve dyrene. Dessverre foregikk dette eksperiment for seint i sesongen, individtallet i boene var lavt. Men de arbeidere som dro ut for å samle, fløy til vår store skuffelse over eller utenom lusern-feltet og samlet på ville planter oppe i fjellskråningen. Ikke et eneste individ av disse artene (*B. morrisoni* og *B. huntii*) ble lokalisert i forsøksfeltene.

*Nomia melandri* var en god alfalfa bestøver og var alminnelig i enkelte felter lenger sør i Utah og i Idaho, staten nord for Utah. Den bygger fortrinnsvis i svakt fuktig jord. En del kolonier ble flyttet fra Idaho til felter nær laboratoriet. Det foregikk på den måten at en passe stor blokk av jorda, som inneholdt gode *Nomia* kolonier, ble skåret ut med spade, plasert i høvelig pappkartong og fraktet til forsøksstedet, hvor blokken ble gravet ned. Flytningen foregikk meget

seint på sommeren i håp om at en ville få gunstige resultater neste sommer.

Jeg var også med og undersøkte hvordan de bestøvende insektene reagerte på ymse sprøytemidler. F. eks. ble det gjort et forsøk med 3 % DDT i et helt isolert felt syd i Utah, hvor det var relativt mange ville insekter foruten 8 bikuber. Bi-aktiviteten ble vurdert to dager før og tre dager etter sprøytingen, som ble foretatt i lusernfeltet tidlig om morgenen, før insektene var kommet til feltet. (Det ble også gjort forsøk med sprøyting midt på dagen, disse var tydelig mer skadelige.) En prøvde ulike metoder til å kontrollere virkningen. F. eks. ble så mange insekter som råd var merket idet de kom til feltet like etter sprøytingen. Videre hadde en sett at maur trakk døde *Nomia* individer inn i maurtuen. En undersøkte derfor halvparten av en tue før sprøytinga og den andre halvparten etterpå. Antallet av funne døde *Nomia* individer var henholdsvis 4 og 16. Et stort område med *Nomia*-kolonier ble funnet like ved forsøksfeltet. De graver sine innganger nærmest loddrett ned i jorda. Under forsøket ble alle inngangene innafør bestemte områder tildekket med jord hver kveld og antallet av åpne innganger ble så regelmessig tallet neste dag. På denne måten mente en å kunne få peiling på om mange individer ble drept av sprøytemidlet. Det viste seg at *Nomia* og *Melissodes* hanner overnattet på noen høye stargress-vekster. Disse ble merket før soloppgang (de kvikner nemlig til og flyr sin vei straks sola når feltet). En oppdaget at de samme individene kom tilbake til samme overnatningsplass kveld etter kveld. Det ble også tallet antallet av døde honningbier like utafør kubene. Dessverre kunne ikke det trekkes noen sterk konklusjon av dette forsøket idet en var uheldig med været, men meget tydet på at DDT, iallfall en 3 % blanding, ikke har så skadelig virkning på de bestøvende insekter som en før har trodd.

En hadde også store forsøksfelter hvor agronomer, plantevernspesialister og bispesialister (apiculturists) samarbeidet om forsøkene. Det skulle være sjølsagt at det nettopp er slikt samarbeid mellom fagfolk som må til hvis en skal ha sjanser til å få løst de problemer som er eller etter hvert melder seg, innen landbruket så vel som på andre felter. (Autoreferat.)

Etter foredraget drøftet man et fra dr. Lindroth, Stockholm, oversendt diskusjonsgrunnlag angende insekt-nomenklaturen. Et resumé over sakens behandling ble utarbeidet av N. E. F.s nomenklaturrepresentant, konservator Natvig, og oversendt til dr. Lindroth.

Schøyen brakte på bane ønskeligheten av at man søkte arrangert ekskursjoner for foreningens medlemmer. En ekskursjon til Skrim 12. og 13. juni fikk imidlertid, av forskjellige årsaker, bare liten tilslutning.

#### *Møte på Zoologisk museum fredag 12. november 1948.*

Konservator Soot-Ryen, Tromsø, beretter om en ferd over Svartisen sommeren 1948 og ledsaget foredraget med en rekke instruktive lysbilder. Avsmeltingen har i seinere tid vært enorm, hvilket tydelig framgikk ved sammenligning av fotografier fra samme lokaliteter opptatt i gammel og ny tid. Det som særlig hadde gjort inntrykk på foredragsholderen var de store mengder insekter som fantes spredt over breen. Øyensynlig var de ført med oppstigende luftstrømmer fra andre områder og ført inn over breen. Insektene på breen var mer eller mindre kuldestive og lette å samle inn. Forutsatt at tettheten av insekter var noenlunde ens over hele breen, ville foredragsholderen anslå totalmengden for hele Svartisen til ca. 1 milliard. Bemerkelsesverdig var de ganske store former som fantes blant de innsamlede

insekter, bl. a. store *Coleoptera* og en stor snylteveps (*Ephialtes*). Denne mente Soot-Ryen ikke tidligere er funnet i Skandinavia, og han formodet at de nærmeste kjente lokaliteter var Ungarn og Sibiria. Snyltevepsene utgjorde nesten 90 % av samtlige innsamlede insekter. Ellers gjorde Lepidopterne seg mest bemerket. En liten Geometride, *Eupithecia intricata* Zett. var dominerende, foruten *Anarta*-arter (*Noc-tuidae*), hvorav materialet, ifølge Opheim, omfattet 6 arter, bl. a. *A. myrtilli* L., ny for Nord-Norge. Det var også funnet noen Odonater (*Somatochlora*). Soot-Ryen mente at et nærmere studium av insekter på breene ville være en takknemlig oppgave for entomologer. I tilslutning til foredraget ble det en del diskusjon om insekt-transport med luftstrømmer, bl. a. deltok Kvalheim, Natvig og Økland.

#### Møte på Zoologisk museum mandag 7. mars 1949.

Docent dr. philos. Kjell Ander kåserte over: »Entomologien i Lund, historia och persongalleri«.

»Lunds universitet grundades redan 1668 men det dröjde länge innan naturvetenskaperna blevo reprenseterade. Den förste som fick i uppdrag att bredvid medicinsk undervisning även meddela dylik i naturvetenskaperna var Kilian Stobaeus (1690—1742). Denne var Linnés lärare under den korta tid han uppehöll sig i Lund. Stobaeus har en viss betydelse för entomologien i Lund, 1735 donerade han nämligen sina samlingar, däribland insekter till universitetet och lade därmed grunden även till de entomologiska samlingarna. Under 1700-talet ökades dessa bl. a. av prof. Erik Lidbeck, som var föreståndare för den s. k. mullbärsplantagen i Lund, en silkesmaskodling, som snart nedlades. På entomologiska museet finnes ännu en stor härva silke från denna plantage. Mot slutet av 1700-talet var A. J. Retzius (1742—1821) professor i naturhistoria; han utgav ett par smärre skrifter i entomologi. Hans efterträdare var C. F. Fallén (1760—1830) vilken var den första av de stora 1800-tals entomologerna i Lund. Fallén ägnade sig särskilt åt *Hemiptera* och *Diptera* men uppträdde även som förf. om *Coleoptera* och *Hymenoptera*. Det var en originell personlighet, som endast under terminerna uppehöll sig i Lund och eljest bodde på sitt lantställe Esperöd i Ö. Skåne. Hans betydande samlingar övergick till J. W. Zetterstedt (1785—1874) vilken är det andra stora entomolognamnet. Av honom överlämnades huvudmängden till universitetet. Zetterstedt lyckades ej bli Falléns efterträdare men blev professor i botanik. Han är berömd för sina Lapplandsresor, och de arbeten han utgav om dem. Genom dem blev det nordliga Skandinavien fauna tidigt känd för vetenskapen. Under den första resan (1821) besökte han även Nordnorge och under en senare resa till Jämtland även Levanger. I dessa arbeten behandlar han alla vingade insektordningar och beskriver en mängd nya arter. Sin största berömmelse har han emellertid förvärvat såsom dipterolog genom det ännu oombärliga verket *Diptera Scandinaviae* i 14 delar. Zetterstedt gynnade Lundaentomologien på alla sätt och donerade alla sina samlingar till universitetet. I den andra Lapplandsresan deltog även A. G. Dahlbom (1806—1859), det tredje namnet bland de lundensiska entomologerna. Denne blev redan 1841 e. o. adjunkt i entomologi vid Lunds universitet, och sedan dess har undervisning i detta ämne givits i Lund. Senare fick han fastare anställning och såsom intendent för de entomologiska samlingarna direkt överseende över dem. 1857 blev han e. o. professor i ämnet. Han avled redan 1859. Dessförinnan hade han medhunnit att organisera samlingarna till ett entomologisk museum och att publicera en lång rad arbeten huvudsakligen över *Hymenoptera*.

Genom talrika resor på kontinenten knöt han forbindelser med dåtidens lärde och genom hans och Zetterstedts verksamhet oppblomstrade en livlig entomologisk forskning i Lund. Efter Dahlboms död indrogs professuren, men snart nog blev hans lärjunge C. G. Thomson (1824—1899) adjunkt i ämnet. Denne geniale taxonomiske forskare har vunnet stor ryktbarhet genom sina grundläggande arbeten på *Hymenoptera parasitica* men även som coleopterolog vann han anseende; över huvudtaget var han mycket mångsidig. Thomson var temperamentsfull och som lärare fascinerande. Alla hans samlingar tillföll entomologiska museet. Efter hans död indrogs befattningen och hans lärjunge Simon Bengtson (1860—1939) uppehöll undervisningen och vårdade samlingarna till dess 1918 en helt ny befattning skapades. Såsom nyutnämnd föreståndare för entomologiska avdelningen fick han inflytta samlingarna i den nybygda institutionen. Bengtson sysslade ej endast med taxonomisk forskning, speciellt på *Ephemera*, utan även med insekternas anatomi. Så introducerades denna gren av entomologien åt vilken flera av hans lärjungar ägnade sig. Bengtson vann sig mycket om undervisningen men förmådde ej skaffa medel för en modernisering av museet, vilket företrädaren ej så mycket ägnat sig åt. Bengtsons efterträdare blev hans lärjunge N. A. Kemner (1899—1948) som med stor energi och framgång utvidgade och moderniserade museet. Genom sin stora entusiasm, sina stora kunskaper och sina goda ledaregenskaper lyckades han snart att väsentligt förbättra entomologiens ställning och att få en rad lärjungar, vilka, både arbetade på museet och bedrev vetenskapliga undersökningar. Entomologien blomstrade åter i Lund. Beklagligtvis avbröts hans verksamhet genom en svår sjukdom, som visade sig obotlig, men hans gärning skall för alltid vittna om hans mycket stora betydelse för entomologien i Lund. (Autoreferat.)

Foredraget ble illustrert med bilder.

#### *Møte på zoologisk museum onsdag 16. november 1949.*

Aftenens foredragsholder var amanuensis Arne Semb Johansson som fortalte fra sitt studieopphold i U. S. A. 1948—49.

»Først oppholdt jeg meg ved den entomologiske avdeling ved Cornell University, Ithaca, N. Y. Det er en av de beste entomologiske avdelinger i U. S. A. Arbeidet der var i første rekke konsentrert om økonomiske spørsmål, vesentlig undersøkelser over de nye insektisider og deres anvendelsesmuligheter. Den utstrakte anvendelse av kjemiske midler i insektbekjempelsen hadde også skapt mange nye problemer. Ved siden av forskningen inntok undervisningen en bred plass, og det ble gitt mange kurs innenfor de forskjellige områder av entomologien.

Personlig arbeidet jeg med en histologisk undersøkelse av sentralnervesystemet hos teger *Oncopeltus fasciatus* Dallas, idet jeg forsøkte å anvende sølvimpregnering etter protargol-metoden. Arbeidet ble dog ikke avsluttet før jeg måtte reise.

Fra Cornell gikk turen med buss over til The Citrus Experiment Station, Riverside, California, hvor jeg studerte biologisk kontroll av insekter, både dens teoretiske og praktiske sider. Alle viktigere landbruksvekster er innført til California, og i tidens løp har det derfor ikke vært til å unngå at det også er kommet inn skadeinsekter. Da disse har vært uten naturlige fiender i sitt nye hjemland, har de opptrådt i store mengder og gjort meget stor skade. En viktig side av den biologiske kontroll har derfor vært å oppdage de naturlige fiender i de respektive skadeinsekters hjemland og så forsøke å få dem importert



og etablert i California. Det viktigste spørsmål var for tiden bekjempelsen av »Red Scale« (*Aonidiella aurantii* Mask.) på Citrus-trær. Den er et gammelt og kjent skadeinsekt i California, men etter at det opptrådte blåsyre resistente raser, er problemet kommet inn i en ny fase. Og det var ikke løst. I California hadde de også oppnådd praktiske resultater i de foreløpige forsøk som var gjort med bekjempelse av »the alfalfa caterpillar« (*Cotias philodice eurythme* Bdl.) med virus. Dette arbeid ble ledet fra avdelingen for insektpatologi ved Berkeley.

Fra California gikk turen videre med buss via Salt Lake City til The Forest Insect Laboratory i Sault Ste Marie i Canada, det nyeste og best utstyrte laboratorium for dette formål i Amerika. Den siste tid før hjemreisen ble igjen tilbrakt ved Cornell University. (Autoreferat.) I forbindelse med foredraget, som var ledsaget av fargefotografier, ble forskjellig medbragt litteratur framvist av Semb Johansson.

Etter foredraget viste ing. Opheim fram to for Norges fauna nye Noctuider: *Rhyacia saucia* Hb. og *Aporophyla lutulenta* Bkh., begge tatt av dr. Arne Nielsen i Klepp på Jæren. Han demonstrerte også funn av den sjeldne noctuide *Syngrapha microgamma* Hb. fra Nordmarka og *Chloroclystis coronata* Hb., en geometride som tidligere er kjent bare fra et enkelt funn fra Moss, hvor Barca fant den 1916. Sistnevnte art er ikke kjent fra Sverige eller Danmark. Knaben demonstrerte en for norsk fauna ny noctuide: *Cosmia gilvago* Esp. som var fløyet til lampen på hans kontor på Tøyen museum 20. september i år. Videre synte han fram en serie på 15 stk. av en noctuide: *Phytometra confusa* Steph. samtlige fløyet til lampen på kontoret i tiden 14. aug.—19. sept. i år. Denne art har bredt seg nordover i seinere tid, i Norge tidligere bare tatt i 2 ekspl. 1945 og 1948, begge på Tøyen.

Hafslund framkom med en del nyere iakttagelser over granbarkbillenes herjinger i Vestmarka i de siste år. Strand trakk fram spørsmålet hvilken billeart det kunne være som dr. Lyngnes hadde påvist kunne opptre skadelig på forskjellig trevirke. Det dreiet seg om en *Grynobius* men uvisst om det var *G. tricolor* eller *G. excavatus*. (Ref. Knaben.)

#### Møte på Zoologisk museum onsdag 19. april 1950.

Første post var forslag til valg av formann og øvrige tjenestemenn. Natvig meddelte at han av helbredshensyn ønsket å fratse som formann. Likeledes uttalte varaformannen, Strand, og sekretæren, Knaben, ønske om å fratse. Man ble enige om å foreslå følgende kandidater: formann: amanuensis A. Semb Johansson; nestformann: direktør R. Brekke, Trondheim; sekretær: cand. real. P. Bergan; kasserer: forsøksassistent J. Fjeldalen; redaktør: statsentomolog T. H. Schøyen; medlem av redaksjonskomiteen: dr. F. Økland; suppleanter til styret: konservator Knaben og ingeniør Opheim; revisor: kontorsjef A. Strand.

Man gikk deretter over til å drøfte forskjellige spørsmål i forbindelse med neste nordiske entomologmøte i Oslo 1953, og mulighetene for økonomisk støtte fra offentlige institusjoner.

Til slutt framviste Natvig en del interessante insektformer han hadde medbragt fra sin stipendiereise til Storbritannia i 1949. Bl. a. den praktfulle Agriionide: *Megalop. coeruleatus* Drury, og en del eiendommelige Diptera med øyne på stilk (*Diopsis* o. a.).

Årsmøte på Zoologisk museum tirsdag 23. mai 1950.

Natvig ønsket velkommen til årsmøtet og ga straks ordet til Fjeldalen som fremla regnskapet, revidert av Semb Johansson. Regnskapet ble enstemmig godkjent. En oversikt (årsmelding) over tidsrommet 11. okt. 1946—23. mai 1950 ble opplest av Natvig og likeledes godkjent.

Ved valget ble samtlige av styret foreslåtte tjenestemenn valgt, hvorefter den nye formann, Semb Johansson overtok. På vegne av det nye styre takket han for den tillit som var vist ham og hans medarbeidere; likeså rettet han en takk til det avgåtte styre for de arbeid som var nedlagt i foreningen.

A. Strand fortalte om to *Chrysolider*, *Chrysolida crassicornis* Hell. *Phytodecta intermedius* Hell. fra Vestlandet, beskrevet av konservator Helliess. Formannen ble bemyndiget til å overbringe en invitasjon til nordisk entomologmøte i Oslo, på møtet i København og samtidig ble styret anmodet om å gjøre de nødvendige forundersøkelser.

L. R. N.

## Bokanmeldelser.

Enzio Reuter: **Index Generorum et Specierum seriei Notulæ Entomologicae.** Vol. (1921)—25 (1945). 190 s. Helsingforsiae 1949.

Hovedparten av de i denne index oppførte dyreformer tilhører insektene, dessuten er anført gallmidd og andre skadelige middearter samt en del edderkopper som er angitt som vertsdyr for visse Hymenoptera. Av høyere dyr er oppført de pattedyr og fugler som er verter for parasitiske insekter eller nidicoler, og til slutt fins også en fortegnelse over planter som står i relasjon til insekter eller midder.

Index er ordnet systematisk etter ordener og en innholdsfortegnelse forrest henviser til de enkelte ordener. Artene er ordnet alfabetisk under hovedslekten. Hvor denne er oppdelt i underslekter, fins disse angitt til slutt etter hovedslektens artsfortegnelse og dessuten på sin alfabetiske plass under ordenen. Arter nye for vitenskapen er trykt med kursiv og arter nye for den finske fauna er trykt sperret.

Med den enorme utvikling som den entomologiske litteratur etterhvert har fått, blir det stadig mer vanskelig for en vitenskapelig arbeidende entomolog å holde seg ajour med det som publiseres. Enhver litteraturoversikt eller index som utkommer betyr derfor en stor lettelse for forskerne, og denne omhyggelig utarbeidede index over 25 bind av et av Skandinavias mest framtrepende fagtidsskrifter vil derfor hilses med glede av enhver entomolog.

L. R. N.

Anker Nielsen: **Contributions to the metamorphosis and biology of the genus *Atrichopogon* Kieffer.** Det Kgl. Danske Videnskabers Selskab. Biol. Skr. Bd. VI. Nr. 6. 92 s., 33 fig., 2 pl. København 1951.

Forstudiene til dette mønstergyldige arbeid er utført på en liten hydropetrisk lokalitet i Rold Skov i Himmerland, Nord-Jylland, hvor forfatteren fant 7 typer av *Atrichopogon*-larver i små stenede vannsig som fra en sumpig eng renner ned i Lindenberg Aa. Klekningsforsøk lyktes for 5 larvetyper, men fra en av disse ble det klekket to forskjellige typer av pupper. Også imagines fra de to puppe-typer kunne

differensieres. Ingen av de klekte imagines kunne med sikkerhet identifiseres med kjente arter, hvorfor forfatteren har beskrevet dem som nye arter.

Da metamorfosen er lite kjent hos disse små diptera, har Anker Nielsen gitt en inngående beskrivelse av deres morfologi og anatomi, ledsaget av meget vakre tegninger. Særlig imponerende er hans undersøkelse av larvehodets anatomi, med beskrivelse av det eiendommelige pharynx-skjelett og de enkelte delers funksjon under næringsopptagelsen, delvis studert på levende materiale. På grunnlag av en rekke observasjoner mener han at artene overvintrer i larvestadiet. Ved sammenliknende studier av larver, pupper og imagines oppstiller han et stamtre for gruppen, og han mener at den mest primitive type er en terrestrisk form som lever under bark på gamle trær. Taxonomien hos disse insekter er meget vanskelig, og de fleste karakterer, som hittil har vært benyttet til differensiering av imagines, er kvantitative og til dels meget variable. Forfatteren framhever at systematikken må baseres på utviklingsstadiene, hvis det ikke lykkes å finne mer sikre kriterier for imagines, hva han betviler. Det er tvilsomt hvorvidt de to former som er klekket fra samme larvetype, virkelig er gode arter eller muligens representerer to former av en dimorf art.

Denne studie slutter seg på en verdig måte til rekken av klassiske undersøkelser som har skaffet Danmark en så framtrepende plass innen den internasjonale entomologi.

L. R. N.

Erik Wikén: **Latin för botanister och zoologer.** 497 s. Gleerups Förlag. Malmö 1951.

Forfatteren, som i 1944—45 og 1945—46 holdt kurser i naturvitenskapelig latin på realgymnasiet ved Uppsala Enskilda Läroverk, er av den oppfatning at visse kunnskaper i latin burde bli obligatoriske i utdannelsen av biologer. Han henviser til visse forslag i denne retning som er framkommet i senere år i Sverige.

Visstnok inntar latinen nå en langt mer beskjeden plass i den biologiske litteratur enn tidligere, men fremdeles opprettholdes kravet om at diagnoser av nye arter skal skrives på latin, og latin og latinisert gresk danner fremdeles grunnlaget for terminologien i den systematiske botanikk og zoologi. Da dessuten en rekke av de eldre, grunnleggende descriptive verker er avfattet på latin, vil en systematikk ikke komme utenom kravet til, iallfall noen kjennskap til biologisk latin.

Den foreliggende bok gir en oversikt over de deler av den latinske grammatikk og ordlære som har betydning for biologer. Selv om de fleste neppe har anledning til å fordype seg slik i dette språkstudium at de selv kan skrive en korrekt diagnose på latin, vil denne bok, med sine mange eksempler og ordlister, utvilsomt bli et uunnværlig hjelpemiddel for systematikere, og den bør finnes i ethvert større naturvitenskapelig bibliotek.

L. R. N.

Thure Palm: **Die Holz- und Rinden-Käfer der nordschwedischen Laubbäume.** (Meddelanden från Statens Skogsforskningsinstitut, bd. 40, nr. 2, 1951), 242 s. med 63 fig. og 3 plansjer, sv. kr. 5.00.

Denne grundige og omfattende arbeid over de nordsvenske løvtrebiller er basert på innsamlinger, iakttagelser og klekninger over et langt tidsrom, men særlig på undersøkelser som Palm, til dels i sam-

arbeid med andre svenske entomologer, har utført fra 1944 av. I alt omfatter det 414 arter, og av disse har Palm for 122 arter sett larven og for 97 puppen.

Som eksempel på den allsidige behandling stoffet har fått nevner jeg at arbeidets alminnelige del bl. a. omfatter opplysninger om faunaens sammensetning, artenes frekvens, deres fordeling på undersøkelsesområdene og utbredelse i Sverige forøvrig, deres forhold til treslaget og avhengighet av miljøfaktorer og treets beskaffenhet, deres ernæringsbiologi, bilder av gnag og andre kjennings tegn i veden, artenes utviklingsbiologi, deres forstlige betydning, forstlige forholdsregler mot billeangrep samt eksempler på biocoenoser og suksessjoner.

I den spesielle del, som omfatter ca. 100 sider, er det for hver art gitt til dels meget utførlige opplysninger om levevis, i stor utstrekning understøttet av fotografier.

Vi ligger her i landet langt etter når det gjelder undersøkelser som disse. Den som med veiledning i Palms arbeid vil ta fatt på tilsvarende undersøkelser hos oss, kan sikkert regne med rikt resultat, bl. a. en rekke arter som hittil ikke er funnet hos oss fordi deres levevis har vært utilstrekkelig kjent eller helt ukjent.

A. S.

**Ad. Horion: Verzeichnis der Käfer Mitteleuropas (Deutschland, Österreich, Tschechoslovakei) mit kurzen faunistischen Angaben.** 1. Abt.: Caraboidea, Palpicornia, Staphylinoidea, Malacodermata, Sternoxia, Fossipedes, Macroductylia, Brachymera. Alfred Kernen, Verlag. Stuttgart 1951.

Det er nå gått så lang tid siden Ganglbauers og Reitters arbeider kom ut, at de er blitt foreldet, ikke minst når det gjelder faunistiske oppgaver. Mens vi for de nordiske land, de Britiske øyer og Frankrike har forholdsvis nye kataloger over disse områders billearter, har vi savnet en ajourført oversikt for det sentrale Mellom-Europa.

I 1941 kom 1. bind av et stort anlagt arbeid av Horion («Faunistik der deutschen Käfer»). Arbeidet var forutsatt å skulle omfatte 8 bind, I 1949 kom 2. bind, med tittel «Faunistik der mitteleuropäischen Käfer», men Horion opplyser at det dessverre er solgt så lite av dette bind at utgivelsen av de andre bind har måttet innstilles.

Til gjengjeld har han utarbeidet en oversiktsliste over samtlige kjente arter fra Tyskland, Østerrike og Tsjekkoslovakia, med korte opplysninger om hovedutbredelse og utbredelse i det området som er behandlet.

Den første halvparten av listen foreligger nå, og det blir forhåpentlig ikke lenge før også den andre halvparten kommer. Foruten å føre listen ajour etter litteraturen har Horion fått med omfattende, upubliserte funnoppgaver fra en rekke koleopterologer.

Med sitt inngående kjennskap til det stoff han behandler er Horion en sikker veileder, og hans liste anbefales på det beste til alle som er interessert i faunistiske spørsmål.

A. S.

# NORSK ENTOMOLOGISK TIDSSKRIFT

UTGITT AV  
NORSK ENTOMOLOGISK FORENING  
MED STATS BIDRAG OG BIDRAG AV  
NORGES ALMENVITENSKAPELIGE  
FORSKNINGSRÅD

BIND VIII

OSLO 1951

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A. W. BRØGGERS BOKTRYKKERI A/S

Hefte 1—3 kom ut i september 1950.  
» 4—5 » » » november 1951.

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## Fortegnelse over medlemmer av Norsk Entomologisk Forening (1951).

### *Norske medlemmer:*

- Bakke, Alf, stud. real., Neberggt. 16, Oslo. (Skogentomologi.)  
Bendixen, Ludwig, mask.tekn., H. T. Møllersgt. 12, Molde. (Vanninsekter.)  
Bergan, Per, cand. real., Univ. Zool. Lab., Blindern, Oslo. (Treborende insekter.)  
Brekke, Reidar, direktør, Trondheims Forsikr.selskap A/S. (Ephemeroidea, Trichoptera, Plecoptera.)  
Christiansen, B. O., stud. real., Prestevn. 76, Blommenholm. (Vanninsekter.)  
Dahl, Johs., lærer, Onarheim, Hardanger. (Lepidoptera.)  
Dahl, Johanna M. Sømme, stud. real., Holmenkollvn. 133, Oslo. (Bestøvningsbiologi.)  
Dahlby, Rolf Chr., Elveveien 3, Strinda, pr. Trondheim. (Ephemeridae, Trichoptera, Plecoptera.)  
Fjeldalen, Jac., amanuensis, Statens plantevern, Oslo. (Skadeinsekter.)  
Fredriksfryd, Erling, stortingsmann, Kr. Schwensensgt. 12, Halden. (Lepidoptera.)  
Granholm, Arne, lærer, Kamperhauggt. 6, Skien. (Lepidoptera.)  
Hafslund, Per, lektor, Bergstien 19, Drammen. (Skogentomologi.)  
Heiland, Jens, lab.assistent, A/S Plantevern-Kjemi, Sandvika. (Thysanoptera.)  
Henrichsen, Odd, Asker.  
Holgersen, Holger, konservator, Stavanger Museum, Stavanger. (Formicidae, Cicadinae.)  
Holmboe, F., distr.veterinær, Olavskleven 37, Stavanger. (Coleoptera.)  
Hveding, Hårik, tekniker, Kongensgt. 89, Trondheim. (Lepidoptera.)  
Husås, Øystein, konsulent, A/S Plantevern-Kjemi, Skøyen. (Diptera, Skadeinsekter.)  
Jensen, Fritz, buntmaker, Postboks 139, Stavanger. (Coleoptera, Neuroptera, Trichoptera, Lepidoptera.)  
Johansson, Arne Semb, amanuensis, Univ. Zool. Lab., Blindern, Oslo. (Hymenoptera parasitica.)  
Jå, John. Eug., lærer, Alnabru st.  
Kielland, Jan, Oslo, p. t. Tanguanika, Afrika. (Lepidoptera.)

Knaben, Nils, konservator, Zoologisk Museum, Oslo. (Lepidoptera.)  
 Kvalheim, Olav, overlærer, Cappelensgate 3 a, Oslo. (Lepidoptera.)  
 Kvitte, Gotfred, amanuensis, Kirkeveien 114 A, 9, Oslo. (Orthoptera,  
 Neuroptera.)

Lervik, Alf, baneinspektør, Trondheim st. (Coleoptera.)  
 Lundetræ, Ole B., lærer, Utne, Hardanger. (Lepidoptera.)  
 Lyngnes, R., dr. philos., Løvik, Sunnmøre. (Treborende insekter i hus.)  
 Lysdahl, Eugen, lektor, Askim. (Lepidoptera.)  
 Løken, Astrid, konservator, Univ. i Bergen, Zool. Museum, Bergen.  
 (Hymenoptera, Apidae.)  
 Natvig, Leif R., dr. philos., førstekonservator, Zoologisk Museum, Oslo.  
 (Blodsugende og helseskadelige insekter.)

Nielsen, Arne, lege, Sandnes. (Lepidoptera.)  
 Olstad, O., dr. philos., Statens viltundersøkelser, Oslo.  
 Opheim, Magne, ingeniør, Frognerveien 58, Oslo. (Lepidoptera.)

Rost, Helen, Tromsø Museum, Tromsø. (Syrphidae.)

Sandemose, Aksel, forfatter, Kjørkelvik, pr. Risør. (Lepidoptera.)  
 Schjelderup-Ebbe, Th., prof., dr. philos., Eil. Sundtsgt. 11, Oslo.  
 Schøyen, T. H., statsentomolog, Statens plantevern, Oslo. (Skade-  
 insekter.)  
 Soot-Ryen, T., direktør, Tromsø Museum, Tromsø. (Diptera.)  
 Steen Christensen, N., Drammensveien 35, Oslo.  
 Strand, Andreas, kontorsjef, Telegrafstyret, Oslo. (Coleoptera.)  
 Sundby, Ragnhild, cand. mag., Univ. Zool. Lab., Blindern, Oslo.  
 (Lepidoptera.)  
 Sundt, Eivind, Myrvold, Kolbotn st. (Coleoptera.)

Tambis-Lyche, Hans, fiskerikonsulent, Welhavensgt. 2, Bergen.  
 (Aranea.)

Tjønneand, A., cand. mag., Zool. Mus., Universitetet i Bergen.  
 (Insektøkologi.)

Torgersen, Olav, dr. med., Bjørnevn. 24 b, Slemdal.

Wigant, Gudmund, lærer, Steinborgvei 25, Bryn. (Lepidoptera.)

Økland, Fr., dosent, dr. philos., Dueveien 6, Blindern, Oslo. (Økologi  
 og dyregeografi.)

Aasum, Einar, tannlege, Grong. (Vanninsekter.)

#### *Norske institusjoner:*

Bergens Museum, Universitetet i Bergen, Bergen.  
 Kongelig Norsk Vitenskapselskap, Erling Skakkesgt. 47, Trondheim.  
 Norges Landbrukshøgskole, Vollebekk.  
 Stavanger Museum, Stavanger.  
 Statens Forsøksvirksomhet for Ferskvannsfiske, Zoologisk Museum,  
 Oslo.  
 Tromsø Museum, Tromsø.  
 Univ. Zool. Laboratorium, Blindern, Oslo.

*Utenlandske medlemmer:*

- Ander, Kjell, fil. dr., docent, Univ. Zool. Inst., Lund, Sverige.  
Ardö, Paul, amanuensis, Univ. Zool. Inst., Lund, Sverige.
- Berdén, Sven, tjänsteman, Kvarngatan 5, Lomma, Sverige.  
Bergvall, Jean Robert, tjänsteman, Revsund, Sverige.  
Bruce, Nils, tullkontr., Gårdby, Öland, Sverige.
- Dahlgren, Gunnar, lärovekslärare, Parkvägen 3, Hallstavik, Sverige.
- Ekholm, Svante, växtskyddsinsp., Storsvengen 15 b, Drumsö, Finland.
- Forsslund, K. H., docent, Experimentalfältet, Sverige.
- Gigja, Geir, lærer, Postboks 866, Reykjavik, Island.
- Hansen, Victor, dr. philos., h.r.dommer, J. E. Ohlensgd. 4, København Ø, Danmark.  
Hellén, Walter, amanuensis, Univ. Zool. Museum, Norra Järnvägsgr. 13, Helsingfors, Finland.  
Hlisnikowsky, Ing. J., Na Valech 34, Praha IV, Tschecoslovaquie.  
Höglund, Nils H., fältassistent, Bergvik I, Sverige.
- Jansson, Anton, fil. dr., redaktör, Sturegr. 52, Örebro, Sverige.  
Juul, Knud, komm.lærer, Hasle, Aarhus, Danmark.
- Klefbeck, Einar, läroverksadjunkt, Stjernhielmsvg. 10, Falun, Sverige.
- Lamprecht, H., fil. dr., N. Långgatan 23, Landskrona, Sverige.  
Lindroth, C. H., fil. dr., docent, Djursholm, Sverige.
- Møller, Arne G., försäljningschef, Skallbergsgatan 29, Västerås, Sverige.
- Nordström, Fr., fil. dr., tandläkare, Kungsholmstorg 1, Stockholm, Sverige.
- Palm, Ture, jägmästare, Vimmerby, Sverige.  
Palmén, Ernst, docent, Laboratorium Zoologicum Universitatis, P. Rautatiekatu 13, Helsingfors, Finland.
- Ringdahl, Oscar, fil. dr., Gülüchsgt. 9, Hälsingborg, Sverige.
- Sjöberg, Oskar, prov.läkare, Boks 2254, Falun 3, Sverige.  
Stockmann, Sten, direktör, Skepparegt. 6, Helsingfors, Finland.  
Sundholm, Arne, tandläkare, Karlskrona, Sverige.
- Wirén, Einar, fil. dr., lektor, Lundsberg, Sverige.
- Utenlandske institusjoner:*
- Institutio Zoologica Universitas Turkuensis, Åbo (Turku), Finland.  
Royal Entomological Society of London, 41 Queens Gt., South Kensington, S. W. 7.  
Statens Skogsforskningsinstitut, Experimentalfältet, Sverige.  
Statens Växtskyddsanstalt, Stockholm 19, Sverige.  
Uppsala Universitet, Zoologiska Institutionen, Uppsala, Sverige.

*Zoologisk museum gjør oppmerksom på følgende:*

## REGLEMENT

### FOR BRUKEN AV SAMLINGENE OG BIBLIOTEKET I ZOOLOGISK MUSEUM

(Godkjent av Det akademiske kollegium 2. februar 1940; med endring  
godkjent av Kollegiet 24. september 1949.)

1. Fagfolk som arbeider vitenskapelig vil kunne få høve til å nytte museets samlinger og bibliotek til studiebruk ved å vende seg til museets styrer gjennom vedkommende avdelings konservator, som eventuelt også anviser arbeidsplass.
2. For den som får tillatelsen, vil samlingene og biblioteket være tilgjengelig i museets arbeidstid (hverdager kl. 9—15, dager før helligdag kl. 9—14). Utenom denne tid vil det bare unntagelsesvis være adgang (f. eks. for tilreisende) etter særlig avtale med konservator.
3. Materialet utleveres ved konservator og skal leveres tilbake til ham før arbeidstiden er slutt. Utlånt materiale må behandles ytterst varsomt. Det må ikke fjernes etiketter, påsettes nye eller endres noe i museets samling uten konservators tillatelse.
4. Er det særlig ønskelig for en forsker å låne materiale til studier utenfor museets bygning, og dette blir tillatt, må skriftlig spesifisert kvittering leveres for hvert lån. Tillatelsen gis av museets styrer i samråd med konservator.
5. Til utlandet vil museets materiale i regelen bare bli utlånt til museer og institutter, eller på det vilkår at en slik institusjon står som garantist for lånet.
6. Litteratur vil kunne utlånes (for 4 uker) når det kan skje uten hindring for museets eget arbeid. Ved lån av litteratur skal det leveres kvittering på museets lånekort. Bøker (og særtrykk) leveres tilbake til den avdeling de er utlånt fra. Utlånt litteratur må behandles forsiktig og den som låner er ansvarlig for enhver skade eller tap av utlånt litteratur.

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Undertegnede ønsker å nytte Zoologisk Museums samling og bibliotek på de vilkår som er nevnt ovenfor.

Oslo .....

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Ovennevnte reglement skal undertegnes av event. låntagere og innleveres til museet. — Hvis museets materiale nyttes til vitenskapelige arbeider, forutsettes det anført i event. publikasjoner at materiale er utlånt fra Universitetets Zoologiske Museum.

*Kst. museumsstyrer, førstekonservator dr. L. R. Natvig.*



*Eldre bind av*

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