LARVAE OF OWLET MOTHS (Noctuidae)

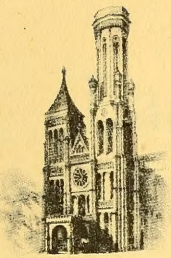
Biology, Morphology, and Classification

O I Merzheevskaya

This book provides information on the biology and morphology of owlet moth larvae and keys to their subfamilies, genera, and species. Morphological characters, body coloration, and dermal patterns are detailed for each species. The larvae of 144 species of owlet moths are described and data on developmental changes in instars given for 91 of them.

This book should be helpful to entomologists, agricultural entomologists, plant-protection specialists, and teachers and students of biology, agriculture, and forestry.

LARVAE OF OWLET MOTHS



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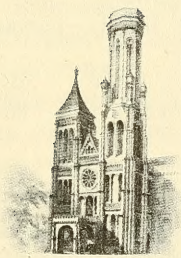
Biology, Morphology, and Classification

by

O.I. Merzheevskaya

GEORGE L. GODFREY
Scientific Editor



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Foreword to the English-language Edition

The Smithsonian Institution Libraries, in cooperation with the National Science Foundation, has sponsored the translation into English of this and hundreds of other scientific and scholarly studies since 1960. The program, funded with Special Foreign Currency under the provisions of P.L. 480, represents an investment in the dissemination of knowledge to which the Smithsonian Institution is dedicated.

O.I. Merzheevskaya's publication on the immature stages of Belorussian noctuids is a definite complement and supplement to H. Beck's (1960) *Die Larvalsystematik der Eulen* which covered Central Europe. While Merzheevskaya certainly was influenced by Beck as evidenced by her acknowledged use of certain figures and indices from Beck's work, her species accounts provide a wealth of additional information on all the larval instars for the majority of the species that she discussed whereas Beck's larval descriptions targeted the ultimate larval instar. Her detailed observations on the changes in integumental structures, especially setal bases and granulation, of the body and the color patterns of the head and body during larval development, constitute the core of and may be the most significant, systematic aspect of her study. In addition to the larval descriptions, nearly every species account is accompanied by basic phenological information in Belorussia, the known host plants, and detailed information on egg morphology and egg color. Her notes on larval and egg color include changes attributable to development, and for the former, intra- as well as inter-instar shifts in basic coloration and patterns.

The identification keys are designed only to determine the mature larva, and they are written quite well and are amply illustrated with line drawings. However, I question the practicality of many of the keys to species because the dominant characters used by the author are coloration and maculation. Generally these disappear or become obscured in preserved material. The author discussed a preservation technique involving ethyl alcohol, salicylic acid, common salt, and distilled water which she published in 1965 that supposedly fixes the colors of green, pink, white, and yellow up to six months and the integumental melanic pattern for over five years. I never have tried this technique which apparently has

some advantages over others and am not criticising it, but the fact remains that the colors and related patterns on preserved larvae change over time. Thus, the keys may be useful only for larval specimens that are no more than six months old.

Discussion of feeding behavior and survival for certain polyphagous species, e.g., *Mamestra oleracea* (L.) and *M. suasa* (Schiff.), in relation to dietetic diversity in the section entitled "Biology of Larvae", should interest any person interested in rearing noctuids. The author's main point is that if a polyphagous species is fed only a single host species, even an acceptable one, it will experience greater mortality and decreased fertility over two to three generations than if it is allowed to feed on a variety of hosts. She cited previous studies that support her contention.

Readers please note that many of the listings in the Bibliography contain some inaccurate or incomplete titles, names of the publishers, and paginations. These are carry-overs from the original text.

Considering that Merzheevskaya's publication originally was released in 1967, congratulations are too late, but certainly the information that has been provided is much appreciated and very useful.

Drs. Yuri P. Nekrutenko (Institute of Zoology, Kiev, Ukraine, USSR) and Eleonora Khot'ko (Minsk) communicated the following biographical information about the author: Olga Ivanovna Merzheevskaya was born into a farmer's family in Rechitsa Region, Gomel District, Byelorussia on 12 November 1904 and died in Minsk, 13 May 1981. She received her schooling at Teachers College (Byelorussia) and advanced training through the Natural History Division, Pedagogical Faculty, Byelorussian State University in Minsk. From 1944–1960's she conducted research at the Division of Zoology and Parasitology, Academy of Sciences of Byelorussian SSR, first on nematode pests of principal field crops, later on the Noctuidae and Geometridae. She published over 50 papers, including three major monographs: "Nematoda of the Principal Field Crops in Byelorussian SSR" (1953), "Larvae of the Owlet Moths (Noctuidae) . . ." (1967), and "Owlet Moths of Byelorussia" (1971). Among her colleagues she had a good reputation for being well organized in her research, a good teacher, and a clear-minded researcher. She was chief of the Entomology Laboratory, Division of Zoology and Parasitology, Academy of Sciences of Byelorussian SSR; head of the Byelorussian Branch, All-Union Entomological Society; and was reputed to be the leading entomologist in Byelorussia.

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Illinois Natural History Survey
Champaign, Illinois

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Editor
Prof. A.S. Danilevskii
Doctor of Biological Sciences

Preface

Noctuidae, the extensive family of owlet moths, includes many species that damage agriculture. In Belorussia owlet moths severely damage crops, pastures, forest and park nurseries, berries, beneficial wild flora, and ornamental flowers. Agriculture and forestry are threatened most by the turnip moth, other cutworms, silver y-moth, cabbage moth, and pine beauty moth. Plant protection organizations have done extensive work in identifying harmful species, predicting population levels, and devising control measures.

It is essential to correctly identify species in the harmful phase—the larval stage. Such identification is very difficult since the larvae of various species of owlet moths are morphologically similar and often look alike. Handbooks for the identification of larvae are few. T.N. Ryazantseva (1937) and M.A. Ryabov (1960) have contributed keys in *Opredelitel' Nasekomykh po Povrezhdeniyam Kul'turnykh Rastenii* (Keys to Insects Based on Damage Caused to Cultivated Plants), but these cover only a small number of owlet moths. In 1964 a limited edition of *Opredelitel' Obitayushchikh v Pochve Lichinok Nasekomyk* (Keys to Larvae of Soil-Dwelling Insects) was published, which contains a rather sizable key to larvae of owlet moths compiled by E.V. Chadaeva from data available in literature up through 1963. Two monumental works on larvae of owlet moths have been published abroad, one by the American scientist, S.E. Crumb (1956), and the other by the German scientist, H. Beck (1960).

Appreciating the need of Belorussian entomologists for an identification key for the harmful phases [larvae] of owlet moths, I undertook a study of the larvae of species found in Belorussia. This book presents the results of these studies.

Keys to subfamilies, genera, and species are based on their most reliable structural features: characters of the general body structure, head, mandibles, spinneret, chaetotaxy, and color pattern on the body and head. The book is richly illustrated[1]; illustrations borrowed from literature are duly acknowledged.

Before consulting keys to larvae one should know the external morphology of the larva. Keys to subfamilies and genera and detailed descriptions of the species are based on the last instars. Changes in larval

[1]Figures 1 through 7 have been placed in the text and Figures 8 through 97 arranged at the end of the book.

instars also have been indicated for many species. The cycle of development of larvae, hibernation, and food plants also are indicated.

In my opinion, information on the structure of the eggs and the nature of oviposition is also quite useful. In the section "Biology of Larvae" I have presented information available in the literature and from my own observations on the effect of temperature and humidity on embryonal and postembryonal development in nature, as well as some information on food preferences.

I am greatly indebted to Prof. A.S. Danilevskii and the late M.A. Ryabov for invaluable advice. My colleagues R.V. Molchanova, S.V. Kundakova, and E.I. Khot'ko in the Department of Zoology, Belorussian Academy of Sciences, cooperated in the laborious process of specimen collection and participated in laboratory investigations. R.V. Molchanova and S.V. Kundakova contributed many illustrations. I extend my sincere gratitude to all who assisted in the preparation of the manuscript.

Table of Contents

List of Species

Subfamily Hadeninae

1. Genus *Orthosia* Ochs.

2. Genus *Cerapteryx* Curtis

3. Genus *Tholera* Hbn.

4. Genus *Panolis* Hbn.

5. Genus *Hadena* Schrk.

6. Genus *Mythimna* Ochs.

Subgenus *Mythimna* Ochs.

Subgenus *Leucania* Ochs.

7. Genus *Discestra* Hmps.

PART I

General Information

METHODOLOGY

To study any problem a definite methodology must be developed. Since my studies were limited to the morphology of larvae and their biology, methodology proved simple. What was problematical was the collection of larval material. Collections were made from both cultivated and wild vegetation in different regions, and the larvae and eggs counted. In addition, moths were collected live to get eggs since Gerasimov (1952) recommended that the study of larvae is better accomplished by raising them from eggs of identified species. However, the collection of live females was no easy task! Sakharov's insect trap (1927), employed for a number of years, yielded only dead insects. Milyanovskii's suggestion (1957) to substitute crumpled paper for the fumigant in the cone of the insect trap was a negligible improvement. Hence, using Sakharov's insect trap as a basic design, Gerastevich and I (1962) constructed a device for the collection of live insects. Initially we used the metallic cone used in Sakharov's trap and attached a cloth sack to a metallic ring that was 2.0 cm less in diameter than the upper end of the metallic cone (Figure 1, a). A cone of white capron, 14 cm in diameter (Figure 1, b) with an opening in the middle, was attached to the ring holding the cloth. A metallic ring 6.0 cm in diameter was fitted into the opening of the cone, and the lower end of the sack was gathered together and tied with a cord. Moths were extracted from the sack through the lower end by untying the knotted cord. Such a soft trap was very effective in capturing moths, but their recovery was difficult. It proved more convenient to stretch the sack on a wire frame, using a wire 3.0 mm in thickness. This simplified the device which had to be detached and brought to the laboratory every day. The frame of the trap consisted of two truncated cones: a lower cone (Figure 2, b) 60 cm-high with a diameter of 56 cm at the wider, open end and 12 cm at the narrower, lower end. The frame was covered on top with a black cloth outside, white inside. The upper cone (Figure 2, c) was 14 cm-high with a diameter of 54 cm at the upper end and 6.0 cm at the lower. This cone was covered with white capron stretched tightly in the form of a lid and pressed downward (Figure 2, a). At twilight we fixed the device to a ring attached to a pole in such a way that a 500 watt bulb was situated over the upper edge of the cone at a distance of 4.5 to 5.0 cm. Moths flying around the bulb (along with other insects) dropped into the chamber. The captives crawled out only rarely since the chamber was covered inside with white material intensely illuminated from above, making it difficult for the insects to find the small outlet. In the morning the trap was carried carefully to the laboratory, the upper "cone-lid" removed, and

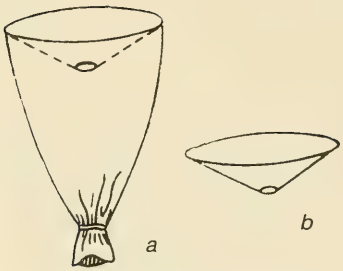


Figure 1. Soft trap for collecting live insects:
a—general view; b—upper cone.

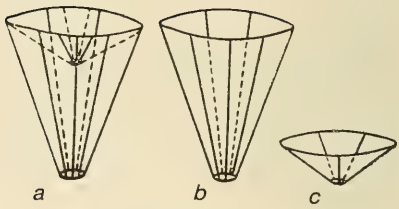


Figure 2. Frame of trap for collecting live insects:
a—general view; b—lower cone; c—upper cone.

the required female owlet moths selected from the resting insects. With good weather conditions over 500 insects were captured in one night, discounting dipterans. They collected in such large numbers that sometimes they disturbed each other. Hence, we enlarged the surface required for rest by attaching cloth tatters to the inside of the lower cone.

Throughout the summer two insect traps were usually set up—one in a field and the other in the forest. Thus, material was collected with the help of artificial light at one or two points. A bait of overfermented molasses was used in other places. We had used such a bait in earlier collections (Merzheevskaya, 1956). The bait consisted of molasses, water, and yeast, and sometimes extra sugar (molasses 250 to 300 g, warm water 700 to 800 g, and yeast 3 g mixed and stored in a warm place). At a temperature of 26 to 28°C the bait fermented in one day, and at 22 to 23°C in two or three days. Taking into consideration the characteristics of insects, especially Lepidoptera, to feed on the sap of so-called "intoxicating trees", the bark of trees in a forest was coated with the bait.

To collect and count the material, a definite number of trees (10) in a chessboard pattern (trees were 10 m apart) were coated (roughly 500 cm^2 on each tree coated from both sides constituted the test area). In fields the bait was coated on opposite sides of boards approximating a similar area. Large moths were plucked from the bait by hand and small ones scooped into a test tube.

The collected females were placed in glass jars or tanks (0.5 liter capacity) to oviposit and fed a 20% sugar solution in water; stalks of various plants were thrust into the wet soil inside the tanks and sometimes also inside jars. The eggs laid were counted every day, measured, the structure of the chorion studied, and subsequent changes in them during the course of embryonal development were observed. Newly hatched larvae

were measured and their color, pattern, body form, setae, etc. described. Similar descriptions were done for each instar. Slides were prepared for detailed microscopic studies of the various larval structures—spinneret, claws, setae, etc. Body chaetotaxy and integumental structure were studied on slides and from whole specimens.

Larvae of all instars were preserved. The method of storage in 75% alcohol with preliminary fixation in boiling water or fixation in 10% formaldehyde did not satisfy our requirements, since it notably bleached the color and pattern of the larvae. Preservation of the pattern is very important since material gathered in summer must often be processed in autumn-winter. Hence, we used a special fixer (Merzheevskaya, 1965) which preserved the color (green, pink, white, yellow, and others) for five to six months and the pattern of dark shades for over five years. The fixer consisted of 96% ethyl alcohol, salicylic acid, chemically pure common salt, and distilled water. Two grams of salicylic acid was dissolved in alcohol and the volume of the solution brought up to 100 cc. Simultaneously, 100 cc of 1.0% aqueous solution of common salt was prepared. The two solutions were mixed and stored in a dark bottle. The fixer was ready for use in one day, and live larvae or those anesthetized with ether were dropped into it.

Feeding larvae were held in glass jars (0.5 to 1.0 liter capacity), flat vessels, or tanks and fed not only on plants recommended in the literature, but on many others as well. Food specificity was studied in detail in the case of some species, i.e., larval groups were fed throughout their development on definite plant species. For comparison, one group was raised on a mixture of several plant species. The plant intake was evaluated on a 5-point scale: plants not touched by the larvae—1 point, consumed from 5 to 10%—2 points, 15 to 30%—3 points, 40 to 60%—4 points, and 70 to 100%—5 points. The plant consumption by larvae of younger instars was measured on a millimeter graph paper. In some cases the food was weighed. For this purpose a part of the plant leaf was removed without the midrib, the curved edges trimmed, and the size determined by placing on millimeter graph paper. After this the leaf was weighed, weight per mm determined, and placed in a jar as food for the larva. After one day, again using millimeter graph paper, the amount of leaf consumed was determined in terms of size and weight.

During the period of investigations, atmospheric temperature and humidity were measured four times a day (at 1:00 a.m., 7:00 a.m., 1:00 p.m., and 7:00 p.m.) using Assmann's psychrometer in the laboratory and in the open at a height of 1.0 m. The effect of temperature on larval growth was studied in regulated growth chambers.

Before winter larvae which usually hibernate in soil were placed together with soil in tin cans up to 30-cm high with an opening at the bot-

tom, and buried in such a way that the upper rim of the can was at ground level. The cans were later covered with a metal sieve and lightly dusted with sand. Larvae which hibernate above ground level under a bedding or in some protected site were placed in warmed tanks kept under an awning or on a balcony.

BIOLOGY OF LARVAE

Food and Damage

Feeding on leaves, stalks, and roots, owlet moth larvae suppress plant growth and sometimes even destroy them. The extent of damage depends on the population and feeding characteristics of the species. Population levels remaining identical, stalk pests (stalk moth—*Mesapamea secalis* L., vernal moth—*Amphipoea fucosa* Frr., and others) and cutworm moths (*Agrotis* and *Euxoa*) inflict far greater damage than leaf or seed-boring larvae. The stalk moth larva damages rye from the commencement of vegetation to tillering and later. Larvae of younger instars bore long tunnels in the upper part of stalks concealed by rolled leaves, while more advanced instars nibble them almost hollow. Younger instars of the vernal moth also damage the upper part of stalks of spring grasses during the period of formation of second and third leaves, causing plant mortality. Outwardly, these damages are similar to those inflicted by the fruit fly since the main sheath leaf remains green for sometime even though plant growth has ceased. Larvae of older instars hide during the day under lumps of soil and feed on plant stalks and leaves. According to Znamenskii (1926), they often nibble the stalks above the tillering nodes. Cutworms of older instars nibble stalks of various plants at the level of the soil or slightly above and also consume the root and tuber. They feed on leaves in younger instars. A single larva of a stalk moth or cutworm can destroy a significant number of plants. With 5 to 10 larvae present in a grass plot 1.0 m^2, large bald spots appear. Puzyrnyi (1929) established experimentally that 5 or 6 larvae of the turnip moth destroy 80 to 90% of the winter shoots in an arshine (or 0.505 m^2).

Leaf-boring species initially scrape the leaf parenchyma without reaching the ribs, later bore holes, and then consume the leaf as a whole. Partial leaf loss is not too harmful, but total leaf loss results in plant mortality. Some species (silver Y-moth—*Autographa gamma* L. and lucerne moth—*Chloridea viriplaca* Hufn.) are also adapted to feeding on seeds. The grain moth larva (*Apamea sordens* Hufn.) almost totally feeds on seeds, the female moth generally oviposits on grass plumes. Larvae of younger instars feed on the leaves of wheat, rye, and wheatgrass vines. Instances are known from the literature (Pospelov, 1958) of, and I have

observed, rustic shoulder-knot moth larvae feeding on maize leaves. According to Beck (1960), this species feeds on grass seeds, preferring those of wheat-grass and large-panicled forest and park grasses. An identical number of seed- and leaf-boring larvae in an equal area inflict less damage than the same number of larvae of stalk moths or cutworms because the former damage only part of the plant. In the case of mass invasion by either, however, yield loss can be very significant.

Mass proliferation of such harmful species as *Autographa gamma* L., *Agrotis segetum* Schiff., *Panolis flammea* Schiff., and *Barathra brassicae* L. was observed over large territories in Belorussia time and again in the last century and early in the present century. The last such outbreak of the turnip moth occurred in 1914 (Kulagin, 1915) and of the silver Y-moth in 1922 (Plyushchevskii-Plyushchik, 1922). In recent years population outbreaks of these species has been more localized in character. In 1932 the silver Y-moth was observed in large numbers in some regions of Vitebsk and Mogilev (Markovets, 1951; Bezdenko, 1952). According to data published by the Department of Protection, Ministry of Agriculture, Belorussian Soviet Socialist Republic, in 1937, the turnip moth damaged rye in some collective farms of Grodnensk region. Mass proliferation of these two species was also noted in 1952—the turnip moth in Grodnensk region and the silver Y-moth in Vitebsk.

During the 1952 outbreak in Grodnensk region the density of turnip moth larvae on winter rye in some collective farms was 50 specimens per m^2, and of silver Y-moth on flax plantations in the collective farms of Vitebsk region, 138 spec/m^2 (Merzheevskaya, 1956 and 1963). In 1962 and 1963 similar population explosions were recorded for many other species of owlet moths: *Mesapamea secalis* L., *Agrotis exclamationis* L., *Tholera decimalis* Poda, *Mythimna pallens* L., *Apamea monoglypha* Hufn., *A. lateritia* Hufn., and *Trachea atriplicis* L. The cabbage moth (*Barathra brassicae* L.) was found en masse in 1950 in some collective farms of Braginsk area of Gomel' region; the larval density in cabbage patches reached 20 to 30 spec/m^2.

Damage to cereals by larvae of the stalk moth (*Mesapamea secalis* L.) and the spring rye moth (*Amphipoea fucosa* Frr.) has been reported repeatedly. The stalk moth in some collective farms of Gomel' and Brest regions in 1952 damaged 4 to 10% of the rye. In 1964 this species damaged 40% of the rye in a six-hectare field in Vitebsk. In 1954 spring rye crops were significantly damaged by the vernal moth in some sections in Grodnensk region and in 1955 in Vitebsk. Long-term larval counts have led to the conclusion that harmful species, when small in numbers, feed mainly on weeds and wild plants and rarely on cultivated crops.

Cultivated plants and useful wild flora are damaged by polyphagous species adapted to feeding on various plant types and by oligophagous

species that feed only on closely related plants of a single family or genus. Most species of owlet moths are polyphagous and several are oligophagous, but the monophagous species rare. Some *Cucullia,* which feed on wormwood, should be tentatively classed as monophagous because the range of their food plants has not been thoroughly studied. Among the oligophagous species one also could include the pine beauty moth (*Panolis flammea* Schiff.), which feeds mainly on common pine needles and to a lesser extent on the needles of spruce and other coniferous species; the spotted moth (*Diphthera coenobita* Esp.), which feeds mainly on spruce needles but also on pine and larch needles; the buckwheat moth (*Trachea atriplicis* L.) which feeds on buckwheat; and the rustic shoulder-knot moth (*Apamea sordens* Hufn.), which consumes seeds of some grasses. Other species living on grasses and sedges could also be considered oligophagous.

Polyphagous species include almost all Agrotinae, many Hadeninae, Zenobiinae, Melicleptriinae, and Plusiinae, which in most cases live on a wide range of food plants. Kozhanchikov (1937), who studied the extraordinary polyphagy of Agrotinae, listed the families and genera of plants providing food to these moths. These plants comprise 34 families and over 100 genera. The food of the turnip moth has been studied best. The plant families and genera which serve as food for the turnip moth are listed below; the list was compiled from literature data and personal observations by myself and my colleagues (Merzheevskaya, Khot'ko, Kundakova, and Molchanova, 1964).

Pinaceae—*Picea, Pinus*
Gramineae—*Zea, Echinochloa, Panicum, Avena, Poa, Agropyron, Secale, Triticum, Hordeum*
Liliaceae—*Allium, Asparagus*
Betulaceae—*Betula*
Fagaceae—*Fagus*
Moraceae—*Humulus, Cannabis*
Urticaceae—*Urtica*
Polygonaceae—*Rumex, Polygonum, Fagopyrum, Calligonum*
Chenopodiaceae—*Beta, Chenopodium, Atriplex, Salsola*
Amaranthaceae— *Amaranthus*
Portulacaceae—*Portulaca*
Caryophyllaceae—*Stellaria, Cerastium, Coronaria, Gypsophila*
Papaveraceae—*Chelidonium, Papaver*
Cruciferae—*Sisymbrium, Barbarea, Roripa, Berteroa, Brassica, Sinapis, Raphanus, Thlaspi, Capsella*
Rosaceae—*Spiraea, Malus, Rubus, Potentilla, Alchemilla, Rosa*
Leguminosae—*Lupinus, Medicago, Melilotus, Ononis, Trifolium, Ornithopus, Onobrychis, Vicia, Pisum, Phaseolus, Glycine, Arachis*

Geraniaceae—*Geranium*
Linaceae—*Linum*
Euphorbiaceae—*Euphorbia*
Vitaceae—*Vitis*
Malvaceae—*Malva*
Guttiferae—*Hypericum*
Umbelliferae—*Conium, Petroselinum, Pimpinella, Aegopodium, Anethum, Daucus*
Ericaceae—*Calluna*
Vacciniaceae—*Vaccinium*
Primulaceae—*Primula, Androsace*
Plumbaginaceae—*Limonium*
Convolvulaceae—*Convolvulus*
Boraginaceae—*Cynoglossum, Myosotis*
Labiatae—*Dracocephalum, Galeopsis, Lamium, Leonurus, Stachys, Salvia*
Solanaceae—*Hyoscyamus, Solanum, Lycopersicum, Nicotiana*
Scrophulariaceae—*Linaria*
Pedaliaceae—*Sesamum*
Plantaginaceae—*Plantago*
Cucurbitaceae—*Cucumis, Cucurbita, Citrullus*
Compositae—*Helianthus, Achillea, Matricaria, Tanacetum, Artemisia, Tussilago, Senecio, Arctium, Carduus, Cirsium, Onopordon, Centaurea, Cichorium, Leontodon, Tragopogon, Taraxacum, Sonchus, Lactuca, Hieracium*

This list comprises 147 species of 114 genera of 36 families. Obviously, the number of plant species consumed is far more because many authors have mentioned only the generic names of plants. For example, for the heart-and-dart moth only 19 species of food plants of 9 families and 9 genera have been recorded in the literature. We supplemented this list with 56 species, bringing the total to 75 species of plants of 52 genera of 32 families. The range of food plants of the heart-and-dart moth covers almost all the families listed above for the turnip moth except for Moraceae, Amaranthaceae, Portulacaceae, Ericaceae, Plumbaginaceae, Boraginaceae, and Pedaliaceae. Three families were added: Salicaceae, Ranunculaceae, and Saxifragaceae. Filip'ev (1932) underscored the high polyphagy of the black moth (*Mamestra persicariae* L.) which was confirmed in our investigations also. We recorded its feeding on 68 plant species of 34 families. Many Agrotinae, Hadeninae, and some species of other subfamilies could be placed among broad polyphagous species. According to our observations, *Graphiphora augur* F. could feed on 56 species of plants of 24 families, *G. ditrapezium* Schiff. on 49 species of 19 families, and *Mamestra suasa* Schiff. on 60 species of 26 families. These species feed on many herbaceous plants as well as leaf-bearing trees.

In spite of their wide polyphagy, owlet moths have a definite range of preferred or more favored plants during their period of growth and development, i.e., they exhibit food specificity. Food specificity or the fact that some insects select food of a definite quality has long been known. It was recorded even in the last century by Walsch (1864). Early in the twentieth century Verschaffelt (1910), Vasil'ev (1912), Brues (1923), Kuznetsov (1930), and others conducted special studies on the food specificity of insects. Danilevskii (1935, 1938, and 1941) and Kozhanchikov (1941, 1946, 1950, 1951, 1952, and 1956) studied this problem in depth.

The foregoing authors found that among the plants consumed by polyphagous insects certain groups could be identified as optimal for their growth, or less suitable, or altogether unsuitable for completion of development. We studied the food relations of many species of owlet moths and discovered that higher dicotyledons represent the most optimal plants for almost all polyphagous species. Normal development on monocotyledons (grasses) from the first instar occurs only in some species. Feeding of the turnip moth (Merzheevskaya, Khot'ko, Kudakova, and Molchanova, 1964) on shoots of rye, barley, and meadow grass resulted in high mortality. Feeding on rye during the period of larval growth led to 62.5% mortality, and during hibernation 80%; feeding on barley to 70% and 100% respectively; and feeding on meadow grass 55% and 100% respectively. According to Kozhanchikov (1937), feeding the turnip moth on wheatgrass caused a mortality of 97.8% among the larvae. Kosobutskii (1928) recorded somewhat different data: the loss of turnip moth larvae fed on rye shoots was 30%, wheat 40%, barley 20%, and oats 20%. We concede that the adaptation of owlet moths to feeding on various plants at different places need not be identical. The heart-and-dart moth is more adapted to feeding on grasses. In our tests feeding on rye in the growth period led to 52.5% mortality and during hibernation 73.6%; feeding on barley 50 and 75% respectively; and feeding on meadow grass 25 and 76% respectively.

Fagaceae, Tiliaceae, some Liliaceae, Vacciniaceae, and Papaveraceae are totally unsuitable as food for turnip and heart-and-dart moths. These moths, though representing extremely proximate species, differ in food habits. The heart-and-dart moth is more polyphagous and able to feed from the first instar on grasses, forest-herbaceous plants, and even on woody species. Free to select food items, they feed on leaves of mountain ash, hazelnut, willow, and strawberry—plants eschewed by the turnip moth. This could explain why the heart-and-dart moth is encountered far more often in forests than the turnip moth.

In our experiments one larval group was always raised on mixed food. It should be noted that the loss of growing larvae in these groups was invariably less than in groups raised on a single food plant, and their development proceeded normally and hibernation favorably. The overwintering

mortality loss of turnip moths was 41.1% and of heart-and-dart moths 33.3%. For comparison examine the feeding data of two congeneric species of the subfamily Hadeninae: the tomato moth (*Mamestra oleracea* L.) and the dog's tooth moth (*M. suasa* Schiff.) (Merzheevskaya and Khot'ko, 1961). The optimal food plants for the tomato moth are higher dicotyledons and Chenopodiaceae; Rosaceae, Betulaceae, and Gramineae are unsuitable. The optimal plants for the dog's tooth moth are the same as for the tomato moth plus Ranunculaceae and Saxifragaceae. The latter species is better adapted to feeding on grasses, meadow grass, and forest vegetation and is encountered more often in meadows and forests. In experiments the tomato moth was raised on 42 species of plants, of which 14 were from the optimal group, 16 the less favorable, and 12 the unsuitable. The dog's tooth moth was raised on 46 species of plants: 16 proved wholly advantageous, 20 less so, and 10 unsuitable. In continual feeding on each plant of the optimal group, both species of moths grew well and suffered few mortalities; in feeding on less favorable plants, growth was delayed and mortality significant. Plants of the third group led to total larval mortality. Good indexes were obtained with feeding on mixed food: larval growth proceeded normally with negligible mortality.

The cabbage moth (*Barathra brassicae* L.) was established as the most polyphagous species. Its food plants comprise over 70 species of 22 families. The most optimal for this species are Cruciferae, Chenopodiaceae, Polygonaceae, several Rosaceae, and Compositae. For the polyphagous silver Y-moth (*Autographa gamma* L.) the most optimal are Cruciferae, Leguminosae, and Chenopodiaceae. Optimal plants promote the growth of larvae, pupae, and fertility of the imago. The larvae invariably select these plants for food and consume larger quantities of them than other plants. However, in our experiments on free selection, the larvae of almost all the polyphagous species often took to less favorable plants but consumed far smaller quantities of them than of optimal plants. The intake of plants totally unsuitable for complete larval growth was also observed but consumption negligible and, too, seen only in larvae of older instars. This peculiarity was noted earlier for the tomato and dog's tooth moths (Merzheevskaya, 1961) and the turnip moth (Daricheva, 1964).

A characteristic feature of polyphagous species is a regular change of diet. Such a change in food was recorded by Zorin and Zorina (1929) for the larvae of the tomato moth. In experiments on raising larvae on mixed food we noted their changeover to diverse plants. It was difficult, however, to establish this through observations of a group in a container, and hence, we studied the behaviour of single larvae of the tomato moth, dog's tooth moth, turnip moth, and heart-and-dart moth. The first two species were held in tanks. It was established (Merzheevskaya, 1961) that the daily ration of the tomato moth under conditions of free food selection consisted of 3 to 5 plant species, and of the dog's tooth moth of 3

to 6 species. The intake of the tomato moth covered 22 plant species and of the dog's tooth moth 18 species within one week. Plants in the containers were replaced every second day. Observations were recorded for the V-instar.

Experiments on the turnip and heart-and-dart moths were conducted in wide-mouthed jars in which leaves, roots, and tubers of potato were provided for 13 days. Leaves of identical size were selected or a portion cut from a large leaf. One larva of each moth species was raised in each jar at the end of the V-instar. Since the intake was evaluated on a five-point scale, a highly variable picture was obtained. A given plant was assessed differently on different days. Often a plant remained untouched for two to three consecutive days and then was consumed within the next two to three consecutive days. Experiments were conducted in July. Table 1 presents the dates of observations; three dates (days of molt) on which the larvae did not feed or fed minimally were discounted. It is evident from the Table that the larvae consistently changed their food selection. The larva of the turnip moth in the V-instar fed on three or four species of plants a day, and in the VI-instar on five to eight species. Larvae of both species of moth consumed rye but the intake generally scored only three points. The highest scores were recorded for weeds, beet, carrot, and lettuce. The behavior of larvae of the turnip, heart-and-dart, and tomato moth raised singly was similar. A larva often crept from one plant to another, sometimes rested for 2 to 3 hrs on a plant without feeding, then moved to a second, third, fourth, or fifth plant before beginning to eat. This showed plant selectivity by the larva.

A definite relation may be assumed between selective capacity, continuous changeover of food, larval well-being in the developmental period, and high survivorship during the period of hibernation when raised on mixed food. By changing or selecting dietary items the larvae satisfy particular requirements. Raising larvae on a single plant species deprived them of the possibility of satisfying certain requirements. If a polyphagous species is fed on a single plant species, even though it may be optimal, the adverse effect is faintly manifested in the first generation itself, and suppressed growth seen in the second to third generation. For example, the dog's tooth moth raised over the course of two to three generations on one plant species, led to increased larval mortality (Figure 3) and decreased fertility (Figure 4) (Merzheevskaya, 1961). Moreover, feeding on a single plant species altered the sex ratio: females decreased in number (Figure 5) and males increased (Figure 6). It may be stated that raising on a single plant species is inadequate for the growth of females and disadvantageous for their overall growth. The results of our experiments on the feeding of larvae indicate that a change of food is a physiological necessity for polyphagous moths.

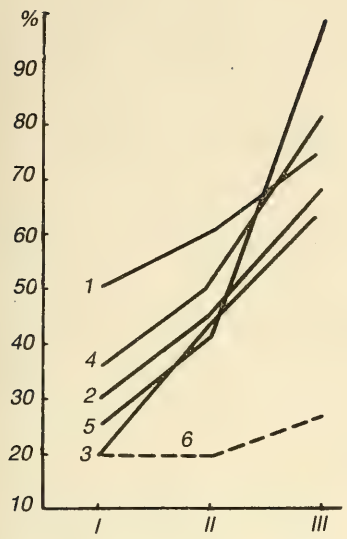


Figure 3. Dynamics of larval mortality in the dog's tooth moth (*Mamestra suasa* Schiff.) when fed on *Allium cepa* (1), *Rumex confertus* (2), *Beta vulgaris* (3), *Grossularia reclinata* (4), *Plantago major* (5), and mixed plants (6) over three generations (I, II, and III).

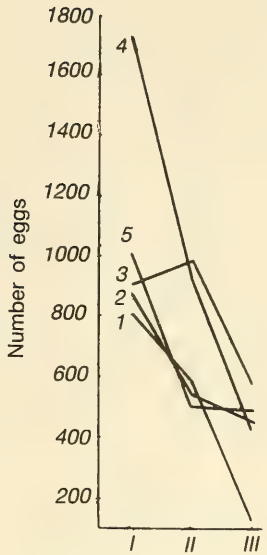


Figure 4. Average fertility of female dog's tooth moth (*Mamestra suasa* Schiff.) when fed for three generations on a single plant species: *Allium cepa* (1), *Beta vulgaris* (2), *Ranunculus repens* (3), *Daucus sativus* (4), and *Taraxacum officinale* (5) (I, II, and III generations).

It has long been known that the younger instars of polyphagous insects are less polyphagous than older instars. Let us mention a few examples from the family Noctuidae: older instars of the silver Y-moth are broadly polyphagous and this moth is a serious pest of many agricultural crops, mainly flax and peas, while for younger instars, these plants are unsuitable. Raising on flax alone in the initial instars resulted in larval mortality (100%). The most favorable plants for younger instars are Cruciferae and some Compositae. When raised on flax, peas, and other plants, the larvae develop into older instars. We had occasion to notice in 1952 the mass movement of the larvae of the silver Y-moth on flax plantation. Their growth to IV- and V-instars proceeded on weeds of the family Cruciferae which had sprung up in cereal crops. The buckwheat moth (*Trachea atriplicis* L.) feeds as older instars on almost all buckwheat plants, including common buckwheat and is a pest of this crop. We tried several times to raise this species on buckwheat, but the larvae died as I- and II-instars. Hence, common buckwheat is totally unsuitable as food for younger instar larvae. The most favorable plants for younger instars are rough knotweed and black bindweed. The turnip moth (*Agrotis segetum*

Table 1. Food selection by larvae of turnip and heart-and-dart moths raised singly (figures depict intake on a five-point scale)

	Turnip moth										
	June										
Plant	17	18	19	20	24	25	26	27	28	29	30
Rye shoots	—	2	—	—	—	—	—	3	—	—	3
Beet leaves	—	—	5	3	4	2	—	3	4	—	3
Beet roots	2	—	—	—	—	5	2	2	5	4	—
Orache	—	—	5	5	—	4	—	—	4	—	3
Cabbage	—	4	—	—	—	—	—	—	—	3	—
Lady's mantle	—	3	—	—	—	—	—	—	—	5	—
Clover	—	—	—	—	3	—	—	4	—	—	—
Carrot leaves	—	—	—	—	—	—	—	—	2	—	—
Carrot roots	4	—	—	—	5	—	5	—	—	5	2
Bindweed	—	—	—	2	—	—	3	—	—	4	—
Potato leaves	4	—	5	—	—	—	—	4	—	—	3
Potato tubers	—	—	—	—	—	2	—	—	—	—	4
Plantain	—	—	—	—	2	—	4	—	—	—	—
Cucumber leaves	2	—	—	—	—	—	—	—	—	2	—
Sunflower	—	—	—	—	2	—	—	3	—	—	—
Burdock	—	—	3	—	—	—	2	—	4	—	5
Dandelion	—	—	—	4	4	—	—	2	2	—	—
Lettuce	—	4	—	—	4	—	—	—	—	3	—

Plant	Heart-and-dart moth										
	June										July
	18	19	20	24	25	26	27	28	29	30	1
Rye shoots	2	3	—	—	—	—	2	—	3	4	—
Beet leaves	—	2	—	2	2	2	—	2	—	—	4
Beet roots	—	—	—	—	—	—	—	—	2	—	3
Orache	4	—	—	4	5	3	5	—	—	4	—
Cabbage	—	—	—	—	3	—	—	—	2	—	—
Lady's mantle	—	—	2	3	2	—	—	4	—	—	5
Clover	—	2	—	—	—	—	3	—	—	2	—
Carrot leaves	—	—	—	2	—	2	—	—	—	—	—
Carrot roots	—	—	—	—	2	4	—	—	—	3	—
Bindweed	—	2	2	—	—	—	4	4	—	—	2
Potato leaves	2	—	—	—	2	—	—	—	—	—	—
Potato tubers	—	—	—	—	—	—	—	—	—	2	—
Plantain	—	5	—	—	—	4	—	5	—	3	—
Cucumber leaves	—	—	—	—	—	—	—	—	—	—	—
Sunflower	—	—	—	2	—	2	—	—	—	—	—
Burdock	2	—	3	—	—	—	5	5	4	—	5
Dandelion	4	—	—	—	2	5	5	4	3	—	—
Lettuce	—	—	—	2	—	2	—	—	—	3	—

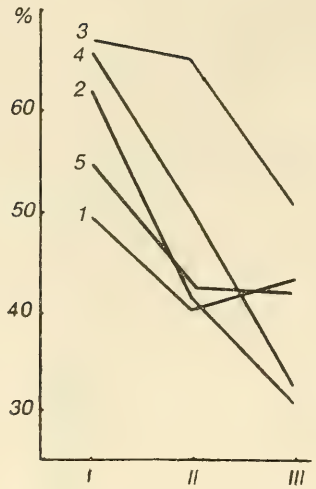


Figure 5. Variation in number of females of *Mamestra suasa* Schiff. (in %) raised on a single plant species over three generations: *Allium cepa* (1), *Beta vulgaris* (2), *Ranunculus repens* (3), *Daucus sativus* (4), and *Taraxacum officinale* (5) (I, II, and III generations).

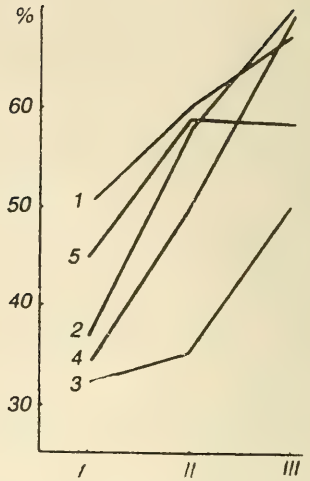


Figure 6. Variation in number of males of *Mamestra suasa* Schiff. (in %) raised on a single plant species over three generations: *Allium cepa* (1), *Beta vulgaris* (2), *Ranunculus repens* (3), *Daucus sativus* (4), and *Taraxacum officinale* (5) (I, II, and III generations).

Schiff.) in older instars takes to rye and often damages the shoots of this crop, but according to Kozhanchikov (1937) and our observations, feeding on rye in the initial instars is disadvantageous for its growth. The cabbage moth (*Barathra brassicae* L.) is known as a serious pest of cabbage. I- to III- instar larvae feed on the outer green leaves while the IV- to VI- instars bore into the head. When first instar larvae were raised on the inner leaves of cabbage, mortality was high. Given free selectivity of food, I- and II-instar larvae very rarely touch cabbage. Many more such examples could be cited.

The much wider polyphagy of polyphagous larvae of older instars is explained by the fact that they are more often exposed to changed feeding conditions. An example is the adaptability of the turnip moth to feed on rye in older instars. This species in younger instars usually feeds on weeds in fallow lands. By the time winter crops are sown in these lands, the larvae have already reached V- and VI- instars. It should be remembered that adaptation to feeding on rye shoots occurred gradually over a prolonged period. The range of food plants of other species could likewise be enlarged in older instars. We had occasion to notice many times that larvae were often forced to feed on less favorable food after a crop had been sown, for example, the larvae of *Euxoa tritici* L. bored tomato stalks,

the larvae of *Luperina testacea* Schiff. tobacco stalks, the larvae of *Discestra trifolii* Hufn. barley shoots, and the larvae of *Tholera decimalis* Poda potato roots.

The evolution of trophic relations of animals has attracted the attention of zoologists for quite sometime. In 1926 the prevailing view was Zweigelt's. According to him the initial form of feeding of larvae was polyphagous and specialization proceeded toward reduction in polyphagy right up to monophagy. However, the very extensive polyphagy of insect larvae in older instars, the presence of a large number of polyphagous species in a changing environment, and so on, and the results of innumerable experimental investigations altered the view of some scientists regarding the evolution of trophic relations of animals. Even in 1935 Danilevskii had written: "The usual concept of polyphagy as the initial form of feeding, expressed by Zweigelt in the formula 'from polyphagy through oligophagy to monophagy', is only schematic and hardly reflects the actual course of evolution of the food specificity of insects. The enlargement of the range of food plants with age, reported in the case of many insects, also does not favor primary polyphagy." Based on long-term observations, Kozhanchikov (1952) expressed his view quite emphatically: "The polyphagy of animals can be considered a manifestation of biological specialization but not quite a primitive feature of organization. Polyphagy, like monophagy, requires the presence of several special physiological and biological features. Thus, oligophagy should be regarded as a primitive form of food relations among animals when the range of edible objects is limited by the natural similarity of their chemistry."

We subscribe to the views expressed by Danilevskii and Kozanchikov and assume that the development of polyphagy was promoted by a change of environment surrounding the insect and by individual variation in the organism. For the same reasons, a reverse phenomenon could also be assumed, i.e., return from polyphagy to oligophagy right up to monophagy.

Only Kozhanchikov (1952) has expressed the idea that polyphagous species have a physiological need for change of food. According to him, the importance of food change as a metabolic stimulus among animals has hardly been studied by researchers. The influence of diversified feeding appears probable, but it must be noted concomitantly that monophagous animals, which are not so few, reveal no metabolic oppressions. Thus, oligo- and monophagy, widely encountered among animals, support so to speak the absence of a physiological need for polyphagy. However, in our opinion, the existence of oligo- and monophagy does not totally exclude the physiological need for a change in diet by polyphagous species

because the method of feeding by oligo- and monophages evolved and was genetically fixed under different conditions.

Development of Larvae

Some species of the family Noctuidae undergo larval development in the spring. These include members of Catocalinae, Acronictinae, Hadeninae, and others. Several species of Zenobiinae, Plusiinae, and Hadeninae develop in summer. Some species develop in summer and enter hibernation in autumn in the larval phase. These include many Agrotinae, species of *Polia* and others from Hadeninae, species of *Apamea, Meristis,* and others from Zenobiinae. Species of *Triphaena, Graphiphora, Lycophotia, Diarsia, Agrotis, Aplecta,* and *Mythimna* enter hibernation or diapause as V- and VI-instars, while some undergo a greater number of molts and hence, continue development longer. Species of Catocalinae, *Tholera, Amphipoea, Euxoa, Hydraecia, Episema,* and others hibernate in the egg phase. Since in almost all such species, embryonic growth is completed in autumn, according to the data of Sorauer (1925), Popov (1929), Fideler (1937), Kozhanchikov (1956), Beck (1960) and our own observations, the larvae could be considered as "diapausing" in the eggshell. According to Fiedler, in Germany the larvae of some *Euxoa* emerge from the eggs in December and begin to feed early in spring even with snow on the ground. The turnip and heart-and-dart moths enter hibernation in different instars, but according to the data available in literature (Ostapets, 1926; Kozhanchikov, 1956), only the larvae which have completed feeding withstand winter temperatures satisfactorily.

In view of the fact that the development of different species of owlet moths commences at different times and hibernation proceeds in different phases, harmful effects are also observed at different times of the year. The damage caused by species hibernating in the larval phase of younger instars is very noticeable in spring, while species which enter hibernation in older instars make their presence felt in summer or summer and autumn. The damage caused by species hibernating in the pupal phase (many Hadeninae, Plusiinae, Cuculliinae, Zenobiinae, and others) is more noticeable in summer or summer and autumn depending on the number of generations.

Some species in Belorussia and other places of the Palaearctic produce a single generation: Catocalinae, Beninae, *Panolis, Xylena, Aplecta, Orthosia, Apamea,* and others. Some multivoltine species produce two or three generations under the conditions of Belorussia. For example, the silver Y-moth in the southern part of the Republic produce three generations nearly every year and in the northern and central parts, two generations. Some Agrotinae (*Graphiphora c-nigrum* L., *Ochropleura plecta* L.,

and *Axylia putris* L.), Hadeninae (*Discestra trifolii* Hufn., *Mamestra suasa* Schiff., and *Mythimna pallens* L.) and Plusiinae (*Autographa confusa* Steph., *Plusia chrysitis* L., *Abrostola triplasia* L., *A. trigemina* Wern., and others) produce two generations per year. Such species as *Agrotis segetum* Schiff., *A. exclamationis* L., *Mamestra oleracea* L., and others are usually univoltine; a second generation has been detected rarely and is generally incomplete.

Species requiring a comparatively small number of heat units for growth and development produce two or three generations per year in Belorussia. According to the information compiled by Kozhanchikov (1937a), for a complete cycle of development, the silver Y-moth (*Autographa gamma* L.) requires 515°C of effective temperature. The growth thresholds of different phases are as follows: egg 6°C, I-instar 5°C, II- to V-instars 9°C, pronymph 7°C, and pupa 10°C. The total average threshold for all phases is 7.4°C. The silver Y-moth in the southern part of Belorussia produces three generations almost every year and in the central and northern parts, two generations. In 1964 the silver Y-moth produced three generations in the central part of Belorussia.

The clover moth (*Discestra trifolii* Hufn.) requires, according to our investigations, 403°C of effective temperature for complete growth and development. The lower threshold of egg development is 11.0°C, of larval growth, 10.5°C, and of prepupal and pupal growth, 11.5°C; the total average threshold for all phases is 11°C. This species in the southern part of Belorussia produces three generations, but the third generation is more often incomplete. In the central part of the Republic usually two generations are produced. In 1964 an incomplete third generation was observed in the central part, however.

The black-c owlet moth (*Graphiphora c-nigrum* L.) produces two generations per year in Belorussia. According to our data, the complete cycle of development of this species requires 700°C of effective temperature. The lower developmental threshold of the egg is 7.5°C, larvae, 8.5°C, and prepupae and pupae, 8.5°C; the total average threshold for all phases is 8.0°C. Growth of the second generation of this moth under conditions in the Belorussian Soviet Socialist Republic invariably does not proceed normally; in years with a cold vegetative period, i.e., when the sum total of heat is inadequate, the larvae continue to feed in October and November and many specimens enter hibernation, not as V- and VI-instars, but as III- and IV-instars.

The turnip moth (*Agrotis segetum* Schiff.) and the heart-and-dart moth (*A. exclamationis* L.) produce one generation in Belorussia and, rarely, the turnip moth has an incomplete second generation; only stray specimens of pupae and larvae of a second generation of the heart-and-dart moth have been found even in years with a very warm vegetative

period. According to the experimental data of Kozhanchikov (1941a), the turnip moth requires a total effective temperature of 1,000°C for a complete generation; the lower developmental threshold for the egg is 10°C, larva and prepupa, 9.0°C, and pupa, 10°C. The overall lower threshold for a single generation of the turnip moth is 10°C. Larchenko (1949), using phenological data and temperature indices of meteorological stations, established the total effective temperature for the complete development cycle of the turnip moth as 550 to 750°C at a threshold of 10°C. In the western regions of Belorussia the turnip moth produced a single generation in 1954 (Merzheevskaya, 1956); the total effective temperature was 1,038°C.

The lower developmental threshold established by us for the heart-and-dart moth was 11°C, i.e., 1.0°C more than for the turnip moth; the developmental threshold of the larva was 11.1°C, egg, 10.5°C, prepupa and pupa, 11.6°C, and the total effective temperature required for complete development of the heart-and-dart moth was 703°C. Larval development under temperature conditions of less than 21°C leads to the onset of a stable diapause in the prepupal phase. It may be assumed that the annual development of a single generation of the heart-and-dart moth in Belorussia is explained by an inadequate total effective temperature and the onset of diapause at a comparatively high temperature. In the turnip moth there is no typical diapause and hence, in years with a very warm vegetative period (e.g., 1960 and 1962), an incomplete second generation was found in the southern and western parts of the Republic.

The time required for egg and larval development differs in accordance with conditions of heat and humidity. Data is available in literature on the duration of growth and development for *Agrotis segetum* Schiff. (Kosobutskii, 1928; Kozhanchikov, 1937; Markov, 1958), *Mamestra oleracea* L., *Mamestra suasa* Schiff. (Zorin and Zorina, 1929; Merzheevskaya and Khot'ko, 1960), *Agrotis exclamationis* L. (Sakharov, 1931), *Discestra trifolii* Hufn. (Puzyrnyi, 1931), *Autographa gamma* L. (Kozhanchikov, 1937a), *Barathra brassicae* L. (Kal'bergenov, 1951), *Apamea sordens* Hufn. (*basilinea* F.) (Batiashvili, 1949), *Agrotis ipsilon* Hufn. (Tulashvili, 1952), *Apamea anceps* Schiff. (*sordida* Bkh.) (Bobinskaya, 1960), and *Spodoptera exigua* Hb. (Bogush, 1964). Unfortunately the number of species studied by the foregoing authors is small. In our experiments in raising larvae, mainly for the purpose of describing their structural features, we also obtained some data on the duration of growth. However, many species were grown at different periods and hence, under different conditions of temperature and humidity. Nonetheless the data resulting from these studies are rather interesting (Table 2). Because some species diapause in the larval phase, the Table gives the ages at which they cease to feed before hibernation.

Table 2. Duration of development of larvae of owlet moths (in days) at different atmospheric temperatures and relative humidities

Species	Duration of development	t, °C	Humidity	Pupation or hibernating larval instar
Diphthera coenobita Esp.	40	19.5	74.4	Pupation
Acronicta aceris L.	47	19.3	74.4	Pupation
Acronicta tridens Schiff.	38	18.2	72.3	Pupation
Acronicta rumicis L.	35	18.3	74.0	Pupation
Triphaena pronuba L.	37	21.0	67.0	VI-instar and 2% pupation
Triphaena pronuba L.	44	19.8	70.8	VI-instar
Triphaena augur F.	45	22.2	66.4	V- and VI-instars and 2% pupation
Triphaena augur F.	56	20.5	68.0	V- and VI-instars
Graphiphora c-nigrum L.	30	17.3	62.2	V-instar
Graphiphora baja Schiff.	66	17.7	64.2	V- and VI-instars and 5% pupation
Graphiphora triangulum Hufn.	63	21.1	70.0	V-instar
Graphiphora ditrapezium Schiff.	39	22.8	68.0	VI-instar and 3% pupation
Graphiphora ditrapezium Schiff.	68	19.3	64.0	V- and VI-instars
Graphiphora ashworthii Doub.	72	22.2	64.6	VII-instar and 6% pupation
Graphiphora xanthographa Schiff.	42	17.7	60.7	VI-instar
Lycophotia porphyrea Schiff.	37	19.0	72.2	VI-instar
Lycophotia signum F.	38	21.2	71.5	V-instar
Aplecta prasina Schiff.	47	22.2	63.9	VI-instar and 56% pupation
Aplecta prasina Schiff.	75	17.8	69.0	V- and VI-instars
Axylia putris L.	22	23.0	70.5	Pupation
Axylia putris L.	26	20.0	67.0	Pupation
Diarsia brunnea Schiff.	55	20.2	70.0	V- and VI-instars
Ochropleura plecta L.	41	18.4	67.0	Pupation
Agrotis ipsilon Hufn.	40	20.2	70.0	VI-instar and 5% pupation
Agrotis exclamationis L.	35	22.8	70.0	VI-instar and 20% pupation
Agrotis exclamationis L.	38	20.4	68.0	VI-instar and 3% pupation
Agrotis corticea Schiff.	38	20.9	65.5	VI-instar
Agrotis segetum Schiff.	34	23.0	73.0	VI-instar and 30% pupation
Agrotis segetum Schiff.	36	22.6	69.0	VI-instar and 15% pupation
Orthosia gracilis Schiff.	30	21.4	67.0	Pupation
Orthosia gracilis Schiff.	35	19.6	66.0	Pupation

(*Contd.*)

Table 2 (*Contd.*)

Species	Duration of development	t, °C	Humidity	Pupation or hibernating larval instar
Orthosia incerta Hufn.	29	20.3	63.8	Pupation
Orthosia gothica L.	24	20.8	68.0	Pupation
Orthosia gothica L.	27	18.4	66.0	Pupation
Orthosia populi Ström.	29	18.0	66.6	Pupation
Mythimna turca Ochs.	36	22.4	69.0	VI- and VII-instars
Mythimna pallens L.	27	22.5	68.0	Pupation (July)
Mythimna comma L.	37	21.7	62.0	Pupation (July)
Mythimna comma L.	50	18.2	68.2	V-instar (Sept.)
Dicestra trifolii Hufn.	15	22.6	69.3	Pupation
Dicestra trifolii Hufn.	18	20.8	67.2	Pupation
Mamestra pisi L.	25	22.3	68.0	Pupation
Mamestra pisi L.	29	21.2	66.0	Pupation
Mamestra persicariae L.	23	21.4	74.0	Pupation
Mamestra persicariae L.	26	20.7	67.0	Pupation
Mamestra contigua Schiff.	42	20.0	66.0	Pupation
Mamestra thalassina Hufn.	32	19.6	69.8	Pupation
Mamestra thalassina Hufn.	42	18.4	74.6	Pupation
Mamestra suasa Schiff.	22	21.8	66.4	Pupation
Mamestra suasa Schiff.	30	18.6	68.2	Pupation
Mamestra oleracea L.	22	22.4	68.2	Pupation
Mamestra oleracea L.	29	18.0	65.6	Pupation
Mamestra aliena Hbn.	32	21.8	64.2	Pupation
Mamestra aliena Hbn.	40	17.4	76.3	Pupation
Barathra brassicae L.	19	22.2	70.1	Pupation
Barathra brassicae L.	50	16.0	67.5	Pupation
Polia bombycina Hufn.	46	21.9	68.4	VI-instar
Polia bombycina Hufn.	53	20.4	59.0	VI-instar
Polia hepatica Cl.	55	21.5	68.8	V-instar
Polia nebulosa Hufn.	48	21.3	70.0	VI-instar
Heliophobus reticulata Goeze	51	18.9	69.2	Pupation
Blepharita adusta Esp.	44	18.9	72.0	VI-instar and 30% pupation
Dypterygia scabriuscula L.	29	23.0	70.0	Pupation
Xylena vetusta Hbn.	33	17.6	66.8	Pupation
Trachea atriplicis L.	24	22.5	65.0	Pupation
Trachea atriplicis L.	29	19.9	67.7	Pupation
Euplexia lucipara L.	33	21.6	65.0	Pupation
Thalpophila matura Hufn.	57	16.8	65.0	V- and VI-instars
Eupsilia transversa Hufn.	27	18.2	67.4	Pupation
Eupsilia transversa Hufn.	29	17.5	65.0	Pupation
Caradrina morpheus Hufn.	62	17.6	69.7	VI-instar and 18% pupation
Meristis trigrammica Hufn.	60	21.7	68.5	V-instar
Rusina tenebrosa Hbn.	35	21.0	67.9	VI-instar
Apamea monoglypha Hufn.	65	17.6	72.2	V- and VI-instars
Apamea lateritia Hufn.	70	17.4	70.6	IV-, V-, and VI-instars

Species	Duration of development	t, °C	Humidity	Pupation or hibernating larval instar
Amphipoea fucosa Frr.	40	17.5	67.2	Pupation (July)
Cucullia fraudatrix Ev.	39	18.6	72.0	Pupation
Cucullia umbratica L.	31	19.2	67.6	Pupation
Calophasia lunula Hufn.	23	22.0	66.8	Pupation
Calophasia lunula Hufn.	27	17.9	67.0	Pupation
Chloridea viriplaca Hufn.	39	18.4	69.9	Pupation
Chloridea scutosa Schiff.	24	22.2	63.0	Pupation
Pyrrhia umbra Hufn.	27	19.8	70.2	Pupation
Autographa gamma L.	16	22.6	70.2	Pupation
Autographa gamma L.	21	19.7	68.7	Pupation
Autographa confusa Steph.	15	22.2	64.3	Pupation
Chrysaspidia festucae L.	27	21.9	64.0	Pupation
Emmelia trabealis Scop.	30	18.9	67.5	Pupation
Lygephila pastinum Tr.	70	21.8	69.1	IV-instar
Lygephila viciae Hbn.	32	22.8	62.6	Pupation
Bena prasinana L.	30	22.9	67.1	Pupation

For the species listed in Table 2 a temperature of 23 to 24°C proved most favorable. At a very low temperature the duration of the period of development of larvae was protracted. For species which hibernate as IV- and V-instars (*Lygephila pastinum, Apamea monoglypha, A. lateritia,* and *Meristis trigrammica*), the period required to attain these stages was quite prolonged (65 to 70 days). Larvae of *Discestra trifolii, Barathra brassicae,* and *Autographa gamma* ceased feeding in a very short period, while those of other species maintained at the very same temperature and almost identical levels of humidity took longer to develop.

The period of larval development in the laboratory and in nature terminated almost simultaneously, and the eclosion of moths was also almost concomitant. The diurnal temperature in nature was usually higher than in the laboratory and the night temperature generally lower; however, deviations in mean temperatures were insignificant. As a result differences in the duration of larval and pupal development in the laboratory and in nature were negligible.

It should be noted that the temperature and humidity for many species shown in Table 2 were not optimal, especially for thermophilic species. In Belorussia the mean temperature over a five-year period (1959–1963) of 24 to 25°C did not last long. The warmest years were 1960, 1961, and 1963 when the temperature in July at 1:00 p.m. sometimes rose to 30 to 35°C but fell significantly at night. According to Kozhanchikov (1937), the optimal conditions for *Agrotis segetum* Schiff. are: I-instar, 25 to 30°C and atmospheric humidity 80 to 100%; and II- to VI-instars, 20 to 25°C

and humidity 70 to 90%. For larvae of *Autographa gamma* Schiff., according to the data of the same author (1937a), the optimal conditions for I-instar are 20 to 30°C and humidity 90 to 100%; and II- to V-instars, 25 to 30°C and humidity 90 to 100%. For the larvae of *Barathra brassicae* L. the optimal temperature is 16 to 30°C (Kal'bergenov, 1951) and for the larvae of *Agrotis ipsilon* Rott., 26 to 29°C (Tulashvili, 1952). We established the optimal temperature for *Graphiphora c-nigrum* L. as 19 to 26°C; *Agrotis exclamationis* L., 21 to 26°C; *Mamestra pisi* L., 16 to 23°C, and *Discestra trifolii* Hufn., 21 to 26°C.

Even in 1910 Sanderson had established the effect of temperature on the growth rate of insects. Later, Ludwig (1932), Janisch (1932), and Kozhanchikov (1937b) demonstrated that all the physiological processes are accelerated or inhibited under the influence of temperature. When the temperature drops below optimal level, the digestive process is highly inhibited (Kozhanchikov, 1946) as a result of the weakening of enzyme action. We conducted an experiment to elucidate the relation of food intake by IV-instar larvae of *Agrotis exclamationis* to temperature conditions. It was performed simultaneously on new IV-instars at a constant humidity of 75%. The experiment lasted six days (but since the results were identical we have presented those for three days only). On the first day the larvae fed on scattered orache, the second day on beet leaves, and the third day on medicinal dandelion. The results given in Table 3 reveal that with a temperature drop from 26 to 13°C the amount of food intake per day fell about 3.5 times. At a temperature of 26°C, larval growth con-

Table 3. Effect of temperature on food intake of larvae of *Agrotis exclamationis* L.

Date	Food plant	t, °C	Leaf area eaten, mm^2	Weight of leaf eaten, mg
August 12	Orache	13	178	42.76
		16	235	56.40
		21	572	137.28
		23	620	148.80
		26	625	150.00
August 13	Beet	13	187	51.45
		16	220	60.50
		21	610	167.75
		23	673	185.08
		26	690	189.75
August 14	Dandelion	13	223	30.66
		16	347	47.72
		21	718	98.74
		23	847	116.46
		26	857	117.84

tinued for 26 days and at 13°C for 96 days, i.e., the duration of development rose almost 3.7 times. Thus the increase in duration of larval development as the temperature fell from optimal (humidity remaining constant) was inversely proportional to the reduction in food intake.

It should also be mentioned that the larvae consumed different quantities of different plants in terms of weight as well as leaf area. They consumed larger quantities of more succulent leaves containing more moisture (beet and orache) than less succulent leaves (dandelion).

The growth of eggs of owlet moths proceeds comparatively rapidly but at different rates. With the temperature remaining the same, say 24 to 25°C, the growth of eggs of *Subacronicta megacephala* Schiff., *Acronicta rumicis* L., *A. psi* L., *Hadena bicruris* Hufn., and *Autographa gamma* L. continued for just three days, while the eggs of *Graphiphora triangulum* Hufn., *Lycophotia signum* F., *Polia nebulosa* Hufn., and *P. hepatica* Cl. required five days, and those of *Apamea sordens* Hufn., eight days (Table 4).

In almost every species as the temperature dropped, embryonic development was protracted. An exception was the common rustic moth (*Mesapamea secalis* L.). The eggs of this species developed over a more protracted period at a temperature of 23.4°C than at 19.9°C. The latter temperature may be considered more optimal for this species, found mostly in the northwestern regions of the Soviet Union.

Diapause is very important in the life of insects. Under the conditions of Belorussia diapause aids in the preservation of life in the cold winter period because diapausing insects are stable to drops in temperature. In countries with a warm dry summer many insects enter a diapause that differs somewhat from the usual winter or summer diapause, a state termed "estivation". Diapause represents a physiological state of rest when growth and formational processes in an insect are inhibited or cease altogether. Diapause characterizes a special physiological readiness of the organism. It differs in this respect from cold torpidity. During preparation for diapause processes of accumulation of nutrients occur in the organism—proteins and fats (Larchenko, 1937) and carbohydrates (Ushatinskaya, 1957). Since insects in diapause do not move and their metabolism is greatly suppressed, the accumulated substances suffice to sustain life over the course of several months and in certain cases even several years. Danilevskii (1961) considers diapause the basis for the entire life cycle of insects. During diapause the organism gradually prepares for growth rejuvenation-reactivation. A low temperature is essential for reactivation. This fact was first recorded by Duclaux (1869) in the case of diapausing eggs of the Chinese silkworm but attracted the attention of scientists only many years later. Presently much published information is available on the subject,

Table 4. Duration of development of eggs of owlet moths (in days) at different atmospheric temperatures and humidities

Species	DD	t, °C	H, %	DD	t, °C	H, %	DD	t, °C	H, %
Diphthera coenobita Esp.	12	16.5	71.0.	13	16.5	73.5			
Daseochaeta alpium Osb.	6	24.0	61.5	7	22.0	62.5			
Subacronicta megacephala Schiff.	3	24.2	62.0	5	22.4	63.0	7	20.5	70.3
Acronicta aceris L.	13	17.0	78.8						
Acronicta leporina L.	5	21.6	64.2						
Acronicta tridens Schiff.	6	20.7	70.7	8	17.8	62.0			
Acronicta psi L.	3	22.5	72.0	6	20.4	72.0	7	19.9	73.0
Acronicta auricoma Schiff.	11	16.5	68.6						
Acronicta rumicis L.	3	25.1	62.0	5	23.6	62.6	7	20.0	67.6
Triphaena pronuba L.	7	22.0	68.4	10	16.7	72.7			
Triphaena augur F.	6	21.5	73.0	7	21.0	68.2	8	19.0	74.0
Graphiphora c-nigrum L.	6	21.1	67.5	8	19.8	74.5	11	18.2	68.0
Graphiphora baja Schiff.	5	21.0	64.0	7	19.2	66.0	8	18.0	66.0
Graphiphora triangulum Hufn.	5	24.3	70.0	7	19.8	76.5	8	18.9	70.2
Graphiphora ditrapezium Schiff.	5	23.7	69.9	7	20.3	68.3	9	19.5	72.4
Graphiphora ashworthii Doub.	5	22.3	66.8	7	20.9	63.0	8	19.8	68.0
Lycophotia porphyrea Schiff.	6	19.8	76.7	7	19.0	67.0			
Lycophotia signum F.	5	24.6	65.5	8	20.7	70.2	10	19.2	70.0
Aplecta prasina Schiff.	4	23.6	62.8	4	22.8	70.4	7	19.0	73.0
Axylia putris L.	4	22.7	64.8	5	22.1	66.2	7	21.2	68.2
Diarsia brunnea Schiff.	5	23.2	74.8	7	21.5	70.0			
Ochropleura plecta L.	4	24.3	69.0	7	21.5	72.7			
Agrotis ipsilon Hufn.	4	24.1	70.0	5	22.3	64.0	6	20.8	71.0
Agrotis exclamationis L.	5	23.2	63.2	7	21.5	62.2	9	18.7	70.4
Agrotis segetum Schiff.	7	20.2	60.0	9	18.7	68.6	11	17.4	70.0
Orthosia gracilis Schiff.	7	20.6	63.0						
Orthosia incerta Hufn.	9	16.8	67.0						

Orthosia gothica L.	11	16.7	62.0						
Orthosia populi Strom.	11	16.5	66.1						
Panolis flammea Schiff.	7	18.2	66.2						
Hadena rivularis F.	8	17.7	74.0						
Hadena bicruris Hufn.	3	25.1	62.0	6	22.9	60.6			
Mythimna turca L.	4	23.0	72.4	9	20.3	69.0			
Mythimna pallens L.	5	22.3	60.0	7	22.2	73.3	9	17.5	59.3
Mythimna pudorina Schiff.	7	21.4	63.0						
Mythimna comma L.	6	22.3	63.8	8	19.8	63.0	10	19.5	72.8
Dicestra trifolii Hufn.	4	22.8	63.0	6	20.5	60.0	9	17.9	77.2
Mamestra pisi L.	4	25.4	63.0	5	23.5	62.0	7	20.5	67.0
Mamestra persicariae L.	4	25.0	76.0	6	21.4	72.0	8	18.2	78.0
Mamestra contigua Schiff.	5	23.3	64.6	9	17.3	76.0	8		
Mamestra thalassina Hufn.	4	24.2	67.8	6	21.7	66.6	8	16.8	69.7
Mamestra suasa Schiff.	4	23.8	62.5	5	22.6	63.0	6	21.2	62.6
Mamestra oleracea L.	5	22.6	65.0	6	20.5	75.0			
Mamestra aliena Hbn.	5	22.5	63.8	7	21.3	60.8			
Barathra brassicae L.	4	22.5	67.0	7	19.0	74.0	11	15.3	70.0
Lasionycta nana Hufn.	5	25.3	67.0	6	23.0	60.0	13	16.6	73.0
Polia bombycina Hufn.	6	23.2	65.0	7	22.5	69.9	9	20.6	73.0
Polia hepatica Cl.	5	24.3	67.3						
Polia nebulosa Hufn.	5	24.7	65.5	7	21.4	68.2	8	20.7	72.5
Heliophobus reticulata Goeze	9	17.8	79.4	11	16.5	73.6			
Blepharita adusta Esp.	6	20.0	77.0	8	18.8	78.0	12	17.0	75.0
Dypterygia scabriuscula L.	6	20.0	62.1	10	16.7	70.4			
Xylena vetusta Hbn.	7	18.4	68.3						
Hyppa rectilinea Esp.	7	20.0	71.4	8	17.8	70.8			
Trachea atriplicis L.	4	22.3	84.3	6	25.7	71.4	9	19.2	74.6
Euplexia lucipara L.	7	20.9	63.0						
Thalpophila matura Hbn.	13	22.2	78.2	15	17.2	74.0			
Caradrina morpheus Hufn.	8	20.6	73.6						

(*Contd.*)

Table 4 (*Contd.*)

Species	DD	t, °C	H, %	DD	t, °C	H, %	DD	t, °C	H, %
Meristis trigrammica Hufn.	5	23.2	62.5	7	22.0	62.0	8	20.0	61.0
Rusina tenebrosa Hbn.	8	23.7	76.6	10	24.6	60.5			
Apamea monoglypha Hufn.	8	23.8	63.8	9	22.9	61.4			
Apamea crenata Hufn.	5	21.0	70.0						
Apamea lateritia Hufn.	8	22.0	62.0	10	18.9	73.7			
Apamea sordens Hufn.	8	23.6	66.6	11	21.2	62.0			
Mesapamea secalis L.	15	23.4	66.0	12	19.9	72.4			
Cucullia fraudatrix Ev.	6	20.1	73.0						
Cucullia artemisiae Hufn.	7	21.1	70.0						
Cucullia absinthii L.	8	20.0	70.8						
Cucullia umbratica L.	6	21.5	65.2	7	21.0	72.7			
Chloridea viriplaca Hufn.	4	24.2	59.5						
Chloridea scutosa Schiff.	5	21.0	63.8						
Pyrrhia umbra Hufn.	6	19.7	73.9						
Plusia chrysitis L.	4	24.6	64.6	7	20.4	73.1			
Autographa gamma L.	3	24.7	62.0	4	22.8	64.2	6	20.0	64.2
Chrysaspidia festucae L.	4	24.2	62.4	6	22.3	64.0	6	21.7	63.0
Lygephila pastinum Tr.	6	24.3	67.0	9	20.6	67.0			
Bena prasinana L.	4	20.6	65.5						

with the investigations done by Danilevskii (1950, 1961) being very fundamental. He noted that for insects undergoing diapause, which have adapted to conditions of severe winters, the reactivation temperature is invariably lower than the threshold required for active growth. Danilevskii (1946–1961) and his students (Geispits, 1949, 1953, 1957; Komarova, 1949, 1959, Goryshin, 1955, 1958; Kuznetsova, 1955; Shel'desheva, 1956, 1965; and others) demonstrated that diapause among multivoltine species is determined by the annual course of the day's length. This length differs from other ecological conditions determining the onset of diapause and other seasonal adaptations in its characteristic stability and astronomical precision. It is for this reason that it serves as the main regulator of the seasonal cycle. The length of the day does not influence the physiological processes of insects but serves as a signal for preparation to diapause. Among univoltine species, the period of diapause is fixed genetically and is not regulated by external environmental factors. Univoltine species of owlet moths may diapause, as mentioned above, in the egg stage or as larvae of different periods in different species. Multivoltine species are characterized by a diapause-free summer growth with diapause setting in in autumn under the influence of shortening days.

Two main types of photoperiodic reactions—long-day and short-day—have been established. A characteristic feature of the first type is that diapause-free growth (summer) proceeds during long days, exceeding the critical or threshold value characteristic of a given species. During a short day, below the critical value, diapause sets in. Species of the short-day type are characterized by continuous growth under conditions of a short day, while a long day causes retardation of development or diapause. It is interesting that in the univoltine species, *Graphiphora triangulum* Hufn., found in Belorussia, development is accelerated under conditions of a short day. It has been established (Danilevskii, 1957, 1957a, and 1961) that a given insect species possesses a genetically fixed photoperiodic reaction at different latitudes; for each 5° of geographic latitude the critical threshold varies about 1.5 hrs. Thus, isolated ecotypes or local races are distinguishable within the range of a species.

PART II

External Morphology of the Larvae

EXTERNAL MORPHOLOGY OF THE LARVAL BODY

The larval body is elongated, cylindrical, almost uniform, attenuating only slightly toward the anterior end (many Agrotinae, Hadeninae, and Zenobiinae). In some species and groups, the body is notably tapered cephalad (Plusiinae, some Cuculliinae, and Hadeninae) or expanded (*Bena prasinana* L.) and the eighth segment often bulges. Rarely, the larval body is rather slender and well proportioned (*Panolis flammea* Schiff., *Mamestra pisi* L., etc.). Species are also known that have a highly thickened body (*Meristis trigrammica* Hufn. and species of *Caradrina*). There are also noctuids with a rather distinct fusiform body (e.g., *Cucullia umbratica* L).

The larval body is distinctly segmented, consisting of the head and three thoracic and ten abdominal segments. Gerasimov (1952) numbered the thoracic segments with Roman numerals and the abdominal with Arabic figures. Since this is very convenient and makes for brevity in descriptions, we also have utilized this enumeration without the explanatory words "thoracic" and "abdominal". Each thoracic segment bears a pair of legs. The majority of owlet moth larvae have five pairs of abdominal legs, which occur on segments 3, 4, 5, 6, and 10 (Figure 8). In most Plusiinae abdominal legs are lacking on segments 3 and 4. Sometimes the legs on segments 3 and 4 are far less developed than on 5, 6, and 10 (species of the *Abrostola* and *Catocala*).

The skin is weakly sclerotized and soft. Generally the body is glabrous, i.e., covered with a small number of short, slender, barely visible setae. Among species of the subfamily Acronictinae and very few others, long integumental setae are present; in some species warts and small excrescences are characteristic.

The body color of noctuid larvae is diverse: matte gray, brown, grayish-brown, green, yellowish, with an admixture of other shades, rather prominent longitudinal bands, and often a fairly complex pattern on the head, back, and sides.

Very little literature is available on the morphology of the larvae of Noctuidae. The most complete information is available in the works of Ripley (1923), Crumb (1956), and Beck (1960); and the subfmaily Acronictinae has been described by Kozhanchikov (1950). The morphology of the larval body of the entire order Lepidoptera was detailed by Kuznetsov (1915) and Gerasimov (1952). The latter placed great emphasis on the larval body structure of the owlet moths. Additional information on the morphology of the larval body is available in works by Dyar (1894, 1895, and 1899), Cholodkowsky (1903), Tsou (1914), Fracker (1915), Garman (1921), Tong (1932), Doring (1936), and Hinton (1946).

This paper discusses the characteristics of the external morphology which are significant in diagnosing individual larval groups and species of owlet moths.

STRUCTURE OF THE HEAD

The cephalic capsule is better sclerotized than the rest of the larval body. In most owlet moth larvae the head is hypognathous, i.e., the mouthparts are directed downward; among cutworms the head is semiprognathous, with the mouthparts set somewhat forward. A semiprognathous type of head is characterized by high mobility and can assume hypo- or prognathic positions. According to Gerasimov (1952), this type represents the starting point in the evolution of the larval head.

The cephalic capsule (epicranium) (Figure 9) is divided by an epicranial or coronal and frontal sutures into two hemispheres and an unpaired frontal sclerite (frons), which is triangular among owlet moths. In the terminal larval instar and often in the penultimate larval instar, the adfrontal sutures (Fig. 9, *3*) isolating the adfrontal or frontolateral sclerites (Figure 9, *5*) are distinctly visible. The epicranial suture varies greatly in size (from a length far exceeding the height of the frons to almost total absence). The triangle formed by the hemispheres of the head diverging sideways from the upper end of the epicranial suture is termed the parietal notch, while the upper portions of the hemispheres are called the parietal apices. Among species with a long epicranial suture, the parietal notch is small and the parietal apices are barely separated (Figure 10). Among species with a short epicranial suture, the parietal notch is deep and the parietal apices project notably (Figure 11). Shortening of the epicranial suture is caused by a deviation of the parietal apices. A very short epicranial suture is characteristic of species that have a semiprognathous head and live subteraneanly. Among some Agrotinae the epicranial suture is shortened so much that the adfrontal sutures and sometimes even the apex of the frons rest in the parietal notch, i.e., the epicranial suture is almost totally absent (Figure 74, *1–3*).

By assigning considerable importance to the length of the epicranial suture as a systematic feature, Ripley (1923) established the concept of the epicranial index, i.e., the ratio of the length of the epicranial suture to the height of the frons (Figure 12). According to his data, the mean epicranial index for the Noctuidae is 0.70. The clypeus, delimited by a distinct frontoclypeal suture, joins the base of the frons. It is divided into a posterior sclerotized portion (postclypeus) and an anterior unsclerotized portion in the form of a membrane (anteclypeus), which joins the upper lip (labrum). The occipital foramen, with thickened edges, occurs in the posterior portion of the head, and the adjacent zone is termed the occiput.

The hemispheres of the head are tentatively divided into individual sections or regions. Each region occupies the corresponding position in both hemispheres of the head. The parietal region (vertex) posteriorly borders the occipital region, anteriorly reaches the line of ocellus 2, and ventrally traverses the lateral line of ocelli 1 and 2. The genal region (gena) occupies the lateral sides of the epicranium. Its upper portion borders the vertex and its lower portion, the postgenal suture (Figure 13, a). Two sclerites termed the hypostoma (Gerasimov, 1952) occur in the lower part of the head and form the postgena. Among Noctuidae these sclerites are usually triangular, and the distance between their apices may vary. Taking this into consideration, Beck (1960) promoted the concept of a postgenal index, i.e., the ratio of the distance between the sclerites to the width of a single sclerite (Figure 13, b). It should be noted that Kuznetsov (1915) and Gerasimov (1952) called the lower portion of the gena the postgenal region.

The organs of vision are situated anterior to the gena and consist of simple ocelli, six on each hemisphere. The ocelli are usually set in the form of a semicircle. Their enumeration using Arabic numerals, suggested by Fracker (1915), is most convenient. The ocellus disposed at the beginning of the upper portion of the semicircle is treated as the first; the sixth ocellus is usually shifted somewhat away from the semicircle (Figures 9 and 13, a). In maintaining an arcuate arrangement, the ocelli are often set at different distances from each other, a feature utilized in species diagnoses.

The shape of the labrum is somewhat important as a diagnostic feature. It articulates with the clypeus at the labial suture. The fore end of the labrum is notched, and the size of the notch is used in systematics (Figures 9, a and 14). The upper jaws or mandibles are of great diagnostic importance. They consist of highly sclerotized plates and are used in chewing food. They are located underneath the labrum, and their anterior margin is equipped with teeth disposed in such a way that when chewing food the teeth of one mandible fall into the intervals between the teeth in the other mandible. A normally developed mandible has six teeth (Figure 15, I and II). Beck calls the three central largest teeth the main ones. The two dorsal teeth and one ventral are very small (Figure 15, I). The teeth are not always developed; the ventral and dorsal ones usually are reduced. The ventral tooth is sometimes totally reduced or reduced and deformed to such an extent that it is visible only from the inner surface. The dorsal teeth also may be totally reduced (Figure 15, III) or divided into several small "toothlets" (Figure 15, IV). The main teeth undergo reduction more rarely (Figure 15, V). With total tooth reduction, the anterior margin of the mandible is flat (Figure 15, VI). The outer surface of the mandible is divisible into two zones (Figure 15, VIII), a more sclerotized dark-colored zone (*dZ*) and a lighter-colored proximal zone (*pZ*). Two setae, M_1 and

M_2, usually are present on the proximal zone. The basal margin of the mandible is denoted as *Mi*. The distance from M_1 to M_2 and from M_2 to the basal margin serves as a good diagnostic feature for many species. In some species, seta M_1 is absent (Figure 15, IX). On the inner surface of the mandible, ribs are distinctly isolated and one or two inner teeth often occur on the first or second ribs (Figure 15, X to XIII).

The lower portion of the mouthparts is represented by the labium and the lower jaws (maxillae) (Figure 16). The main part of the maxillae is the cardo with the stipes extending distad and representing the most prominent portion. Its inner rim forms a sclerotized cord to which muscles are attached. The cardo and stipes fuse with the base of the lower jaw and constitute the immobile part of the maxilla. The free portion of the jaw consists of a three-segmented maxillary palpus resting on the palpiger and the inner maxillary lobe or galea. The latter bears a few sensillae of different shapes at its tip. Between the maxillae lies the lower lip (labium) which is fused with the cardo and stipes. The base of the labium is subdivided into the mentum and submentum.

The spinneret is located in the distal portion of the lower lip between the labial palpi (Figure 16). The spinneret is in the form of a tube, often very tender or slightly sclerotized; its width and length differ and are usually compared with the dimensions of the labial palpi. The labial palpus is set on a fairly broad holder and consists of a long, first segment bearing the first seta and a second, short segment bearing the second seta (Figure 17). Setal lengths vary.

The rim of the spinneret opening is usually uneven, i.e., the dorsal edge is often shorter than the ventral. In some species the ventral edge is in-curved or bears small projections and the dorsal edge is fringed or bears small teeth (Figure 17, *2, 4,* and *5*); in some species a fringe occurs on both the dorsal and ventral edges (Figure 17, *4*). According to Ripley (1923), the fringes of the spinneret serve the purpose of smearing the secretion of silk glands on the inner surface of a cocoon constructed in the soil. Among cutworms the distal part of the spinneret has a fringe. It is possible that the spinneret functions in them before pupation because, according to the data of some authors (Znamenskii, 1926) and our observations, the larvae build a tiny cradle in the soil prior to pupation. According to the data of Rossikov (1909) and Kosobutskii (1928), larvae of the turnip moth build a tiny cavity for hibernation. Sakharov (1931) and Markov (1958) dispute this view. However, larvae with a well-developed but fringeless spinneret (e.g., *Cucullia*) also build very strong cocoons in the soil. The spinneret sometimes exceeds the length of the first segment of the labial palpus by 2.0 to 5.0 times, is equal to the first segment, or shorter. Among cutworms and species of *Orthosia,* the spinneret is short and broad (Figure 17, *6*). Table 5 presents the size of the spinneret and labial palpus

Table 5. Size (in μm) of spinneret and labial palpus

Species	Spinneret			Labial palpus			
	Length	Width at center	Width in distal part	Length of 1st section	Width of 1st section	Length of 1st seta	Length of 2nd seta
1. *Cucullia artemisiae*	552	130	58.5	104	39	13	13
2. *Cucullia asteris*	520	117	45.5	123.5	45.5	13	13
3. *Calophasia lunula*	156	58.5	39	91	35	39	58.5
4. *Rusina tenebrosa*	558	60	31	123	42	31	77
5. *Dypterygia scabriuscula*	362	62	31	170	37	37	124
6. *Apamea sordens*	330	58.5	26	84.5	39	19.5	117
7. *Chloridea viriplaca*	422	52	29	85	29	13	23
8. *Barathra brassicae*	305.5	71.5	32.5	78	45.5	13	108.5
9. *Blepharita adusta*	305.5	71.5	52	117	58.5	13	143
10. *Mamestra pisi*	260	84.5	52	130	52	10	104
11. *Mythimna turca*	234	104	71	175.5	65	52	120
12. *Diphthera coenobita*	273	65	22	143	45.5	65	110.5
13. *Panolis flammea*	233	62	42	124	42	15	108
14. *Scoliopteryx libatrix*	227	71	32.5	91	39	13	52
15. *Lygephila viciae*	221	58	39	130	42	45.5	65
16. *Chrysaspidia festucae*	221	45.5	13	104	39	39	104
17. *Autographa gamma*	201	39.5	18	91	42	78	143
18. *Aplecta prasina*	169	117	117	162.5	58.5	13	13
19. *Graphiphora baja*	130	117	97.5	130	52	15	65
20. *Agrotis segetum*	97	117	84.5	97	52	13	32.5

in members of various subfamilies of owlet moths. It is clear that the spinneret is longest among Cuculiinae (the first three species), and exceeds the length of the first segment of the labial palpus by 4.0 to 5.0 or more times, but the setae of the labial palpus are very short. *Calophasia lunula* Hufn. represents an exception; in it the spinneret is longer than the first segment of the labial palpus by less than 2.0 times while the setae of the labial palpus are much longer. Among species of the Zenobiinae and Melicleptriinae, the spinneret may reach 0.50 mm while the setae of the labial palpus among Zenobiinae are fairly long, but among Melicleptriinae, they are short. Among Hadeninae (species 8 to 11) the spinneret is less than 0.30 mm in length, while the second seta of the labial palpus is fairly long. Exceptions in this subfamily are species of *Orthosia* in which the spinneret is very short. Among the Acronictinae, Scoliopteryginae, and Plusiinae, the spinneret is about 0.25 mm long. The width of the spinneret and the length and width of the first segment of the labial palpus are generally constant.

On the inside of the labium lies a highly dilated hypopharynx that extends into the pharyngeal region (Figure 18). Its central part is termed the tongue, and the lateral sections are the lingual lobes. The hypopharynx is usually covered with spinules and platelets of different sizes arranged at various intervals. The size and pattern of arrangement of the spinules are used by some authors (Ryabov, 1960; Beck, 1960) in species diagnoses, but in most cases these features are poorly differentiated. In using the hypopharynx as an identifying feature of a species, it should be separated from the labium and examined under a microscope. We have included in our keys only the more reliable characteristics, and hence, the hypopharynx is excluded.

The antennae are situated between the ocelli and the mandibles, and each is set in a fossa and consists of three segments. Basally the antennae are encircled by a sclerotized antennal ring. The first and second segments of the antenna are almost identical in diameter and are cylindrical, but the second segment is longer than the first. The end of the second segment is truncated and bears a third minute segment with three minute cones at its tip and a fourth rudimentary segment with a terminal hair. The end of the second segment also bears a large seta, a minute one, and some sensory cones and papillae. Ripley (1923) designated the segments of the antennae with Roman numerals and their setae and cones with inferior Arabic numerals, e.g., II_1, II_2, II_3 and so forth (Figure 19).

The thoracic section of the larva consists of three segments. The first or anterior segment differs somewhat from the other two. A fairly sclerotized shield, termed the pronotum or prothoracic shield, occurs on its dorsal surface and a small tubercle, located anterior to the stigma, the prestigmal pinaculum occurs on the lateral surface. Setae IV and V are

situated on the prestigmal pinaculum. In many Noctuidae a small pinaculum also occurs next to the prothoracic shield and bears setae III and IIIa (Figures 8 and 34). In our opinion the prothoracic shield could simply be called the thoracic shield. A few pinacula with primary setae occur on segments II and III and also on the ventral side of the body. The tergite of segment 10 is continuous, significantly sclerotized, and forms the anal shield (Figures 8 and 20).

Each thoracic segment bears one pair of legs (pedes). Each leg consists of five sections: coxa, trochanter, femur, tibia, and tarsus (with unguis). The immovable coxa is usually highly sclerotized and articulates with the subcoxal sclerite (subcoxa). The poorly developed trochanter, in the form of a narrow strip, articulates with the coxa but mostly is fused with the femur. The latter is the first movable section of the leg. It articulates with the tibia connected to the simple tarsus with its immovable unguis (Figure 21). Often a broad circular prominence occurs at the base of the unguis; sometimes it is faint and sometimes absent altogether (Figure 22, *1, 2,* and *3*).

Abdominal prolegs (pedes spurii) consist of soft body projections that are separated into two sections by a deep transverse fold. The distal part of the proleg has a planta. The latter can be extended or folded inside and bears hooks (Figures 8 and 23). The legs disposed on segments 3, 4, 5, and 6 are termed mesoventral and those on segment 10 are termed anal. Among larvae of many Plusiinae, there are only two pairs of mesoventral legs in addition to the anal legs. As a result walking movement takes the form of semiloops as in the larvae of Geometridae. A reduction in number of prolegs is associated with the mode of life and food habits of the larvae. The hooks on the prolegs of species of Noctuidae are generally of the same type, i.e., almost identical in length (uniordinal) (Figure 24, *1*). In some species the hooks are of two types, i.e., larger ones alternate with smaller ones (biordinal) (Figure 24, *2* and *3*).

Among owlet moth larvae the hooks on the prolegs are disposed in a medial row, i.e., only along the inner rim of the planta and absent on the outer. The hooks may occupy one-half, less, or more than one-half of the planta (Figure 24, *4* and *5*). The number of hooks on the planta may be used for species identification when their numbers differ significantly. Among related species the number of hooks is almost constant, though often varying within a species.

Along the sides of the body, on segments I and 1 to 8, spiracles (stigmata) occur. A rudimentary stigma is visible on the sides of segments II and III. In mature larvae of owlet moths, the stigmata are oval, elongated dorsoventrally, fairly broad, dark or light colored, and thinly edged in black (Figures 8 and 25).

The skin of the larval body is not smooth in all species; some bear various projections (Figure 26). By and large these projections consist of small prominences or granules of different shapes. The granules may be small or large and either flat or conically elongated. Some species are armed with dermal spinules. When the granules are so minute and flat that they are not discernible at a magnification of 60 ×, the skin is considered smooth. Small, but distinctly identifiable round, dense, and uniformly disposed granules identical in size are characteristic of some Agrotinae (*Agrotis segetum, A. corticea,* etc.). Larger granules alternating with smaller are characteristic of *Agrotis exclamationis.* Very large granules alternating with smaller ones visible to the naked eye are characteristic of *A. ipsilon.* Even larger granules in the form of conical papillae are seen in *Meristis trigrammica* and species of *Caradrina. Chloridea viriplaca* and *C. scutosa* bear fairly well sclerotized tubercles with firm spinules distinctly visible to the naked eye (Figure 26). In some species the skin is not only granulated, but also rugulose. Spinules and granules are rigid (immovable) cuticular projections.

Contrarily setae, formed from special epidermal cells, articulate with the integument. An annular ridge, representing the site of articulation of the setae with the skin, occurs at the base of each seta. Setae can be divided into primary, subprimary, and secondary setae. Primary setae are found in all larvae of Lepidoptera, though few in number, and situated along the body in a definite sequence. Primary setae are present in larvae from the first to the last stage of development. Setae present only from the second stage or later are called subprimary and also are arranged in a definite pattern. Secondary setae are those that densely cover the larval body or form clusters at certain places. Primary and secondary setae are fairly long in pubescent larvae; and in spite of the considerable density of secondary setae, the primary are often prominent among them because they are much longer and stiffer. Sometimes secondary setae occur in species of Noctuidae even on the first stage, and their number may increase with larval growth. In owlet moths secondary setae are present in species of the subfamily Acronictinae and a few others. To distinguish secondary from primary setae, some authors call the former "hairs". Setae are of different shapes. More often they gradually attenuate toward the tip and are acuminate. Sometimes they are almost identical in thickness at the base and tip and sometimes they broaden at the tip (Figure 27). In some species the setae are straight, in others they are somewhat bent. Usually seta I is arced cephalad and seta II caudad.

In many species of owlet moth larvae, there are tubercles, sclerotized to some extent or totally unsclerotized, present at the bases of the setae. A papilla surrounded by a distinct area of sclerotization is called a scale.

An unsclerotized papilla bearing a single seta is usually called a wart. Let it be noted here that among owlet moth larvae it is difficult to distinguish a wart from a scale since in almost every species, sclerotization of the papilla disappears before molt and before pupation, and remains absent immediately after molt. We, therefore, have termed all sclerotized and unsclerotized papillae "scales" and flat, dark-colored formations which may be weakly or totally unsclerotized "spots". Among some species seta III on the prothorax, III and IIIa on the metathorax, and III on segment 9 are located on very prominent dark spots (Figure 28). [Technical editorial note—The dark "spots" shown in Figure 28 actually are setigerous tubercles, i.e., sclerotized rings, and/or sclerotized bars that extend from certain tubercles to muscles' attachment and are not simply dark-colored.] Among larvae with secondary setae, warts stand out prominently in the form of very large tubercles covered with clusters of setae. In pubescent larvae, warts generally form at the bases of primary setae.

Some formations on the skin are neither scales nor warts. For example, in larvae of *Acronicta psi* L. the warts at the bases of setae I on segment 1 fuse and form a long prominence with a cluster of seta (Fig. 29). In *Cucullia artemisiae* Hufn. papillae I and II on all abdominal segments are greatly lengthened and form two pairs of large prominences on each segment. The significant enlargement of these papillae slightly has altered the arrangement of setae I and II. The latter rest not on the apices of the prominences but somewhat laterally (Figure 30). The importance of setae for the larva is not completely understood; some authors hold that some setae serve as organs of sound perception, while other setae act as (other kinds of) sensory organs. This view is highly probable since larvae react to tactile stimulation of the setae.

[Technical editorial note—Setal bases quite commonly are categorized either as a pinaculum (flattened tubercle bearing a single seta), chalaza (enlarged papilla or tubercle bearing a single seta), scolus (long tuberculate projection bearing numerous spines), verruca (tuberculate projection or wart-like structure bearing multiple setae), or verricule (flattened area bearing multiple setae). For clarity the term pinaculum has been used in place of scale (a translation of щиток) in the remainder of the translation because in English lepidopterous literature "scale" refers to the modified seta which, in numbers, constitutes the covering on the adult wing. "Wart" (a translation of бородавка) is retained and, in the context of this translated paper, may include chalaza (prominence), scolus, verruca, or verricule. "Pinaculum" and "wart" have to be interpreted with a degree of caution because the distinction between the two structures is not always apparent. "Spot" is used only for the coloration of a setal base, not its degree of sclerotization.]

According to Kuznetsov (1915), there are pores or small openings in the skin that represent olfactory organs. Each pore is encircled by a dark, sclerotized ring, and the central portion is usually light colored and transparent. Pores are invariably minute and often faint. They occur on the head, thoracic and anal shields, thoracic and abdominal legs, mouthparts, and antennae.

CHAETOTAXY

Chaetotaxy refers to the arrangement of primary setae throughout the larval body and is extremely important in systematics. The arrangement of primary setae on the body was first described by Dyar (1895). Later Kholodkovskii (1903) described the structure of the setae and their disposition on the hypodermis of *Acronicta alni* L. The arrangement of setae in various groups of Lepidoptera was analyzed by Forbes (1910, 1911, 1916). Fracker (1915) and Hinton (1946) used chaetotaxy in the systematics of the larval phases of Lepidoptera.

Chaetotaxy was further detailed by Gerasimov (1935, 1937, 1939, 1939a, 1952). Characteristics of the chaetotaxy of Noctuidae have been described by Ripley (1923), Crumb (1934, 1956), Beck (1960), and for the subfamily Acronictinae by Kozhanchikov (1950). The data of these authors are presented below.

Chaetotaxy of the head: Setae located in definite sections of the head are designated by inferior Arabic numerals preceded by the capital letter of the Latin word denoting the group to which the seta belongs. Setae disposed on the hemispheres of the head are divided into the following groups, commencing from the foremargin of the head: The Anterior group (Figure 9, a) consists of three setae: setae anteriores (A_1, A_2, and A_3), setae posteriores (P_1 and P_2), the lateral or side seta—setae laterales (L_1), and the parietal group of three microscopic setae—setae verticales (V_1, V_2, and V_3). On the side (Figure 9, b) three setae occur in the zone of the ocelli—setae ommatales (O_1, O_2, and O_3); the suborbital group also comprises three setae—setae subommatales (SO_1, SO_2, and SO_3). In the postgenal region lies a single microscopic setae—setae genales (G_1). Setae located on the frontal part of the head are identified by the sclerite. The frontal sclerite bears a single pair of setae—setae frontales (F_1). There are two pairs of setae on the adfrontal sclerite—setae frontolaterales (Frl_1) and Frl_2). In the rear section of the clypeus two pairs of setae occur—setae clypeales (Cl_1 and Cl_2). The labrum bears 12 setae which may be divided into two groups: The first group (three pairs) is located along the lateral margin of the labrum (L_1, L_2, and L_3) and the other group (three pairs) close to the center of the labrum (M_1, M_2, and M_3)[1] The mandibles

[1]Identification of setae taken from Heinrich (1916).

are also armed with a pair of setae (M_1 and M_2), usually located along the outer rim (Figure 15, I to VIII). These setae occur on the maxillae (Figure 16): Mx_1 on the cardo, Mx_2—stipes, Mx_3—palpiger, and four setae (Mx_{4-7})—base of the galea.[1] The labium bears two pairs of setae—Lb_1 on the submentum and Lb_2 on the mentum, while the labial palpi bear two setae—Lp_1 on the first segment and Lp_2 on the second.

All the cephalic setae are important for diagnostic purposes because they vary somewhat in location in individual groups and species of Noctuidae. However, in the keys we have selected those setae whose change of position is readily perceived. Such setae include the parietal groups P_1 and P_2, frontolateral setae Frl_1 and Frl_2, and the frontal seta F_1. Seta P_1 is often located on the same vertical line as seta P_2, i.e., the two setae are equidistant from the epicranial suture. Sometimes seta P_2 is displaced ventrally, i.e., farther from the epicranial suture than seta P_1 (Figure 31).

Seta Frl_1 is usually situated at the center of the adfrontal sclerite but is sometimes notably shifted caudad toward the apex of the frons; Frl_2 is more often situated at the apex of the frons but may also be shifted posteriorly. Seta P_1 is notably shifted caudad at times; it is usually set, however, on the horizontal line of setae Frl_1-Frl_2 (Figure 31). Seta Frl_1 is located either close to the clypeus or approximate to the center of the frons. Attention must also be drawn to the position of setae A_1, A_2, and A_3. Seta A_2 is often shifted posteriorly or close to the horizontal line of seta A_3 (Figure 32). In some species secondary setae also occur on the head in addition to primary setae (Figure 33).

Prothoracic segment: The presence of a shield is characteristic of this segment (Figure 34). Setae X and IX are located in the anterior section of the shield and I and II in the posterior. At the extreme rear region of the shield margin, roughly between setae I and II, lies the microscopic seta Xa. Close to the ventral margin of the shield, more often on a separate pinaculum, lie setae III and IIIa. In owlet moths seta IIIa is piliform, much weaker than III, and is usually located anterior to III or slightly shifted ventrally. Anterior to the stigma lies the prestigmal group comprising a well-developed rigid seta IV and a weak, piliform V. The latter is usually located ventral to seta IV. Above the leg, two setae of group VII are located on a common pinaculum—the well-developed VIIa and the much weaker and shorter VIIb; VIIc and VIId are microscopic and situated anterior to the coxa. Posterior to the coxa, very close to the medial line, lies the small seta VIII (Figure 34). In *Scoliopteryx libatrix* L., first recorded by Beck (1960), seta Xa is notably shifted posteriorly and found right at the

[1]Identification of setae taken from Gerasimov (1952).

boundary of the segment (Figure 35). In some species, seta III is located on the thoracic shield along the ventral margin, while IIIa is close to the thoracic shield (Figure 36, *2*).

Meso- and metathoracic segments: The disposition of setae on these segments differs sharply from their placement on the abdominal segments. Setae I, II, III, and IIIa are disposed at the center of the segment along a vertical line and almost equidistant from each other (Figure 37). Seta I is usually shorter than II. Seta IIIa is usually weak and piliform. Slightly cephalad and ventrad is located seta IV with seta V ventrad to it. Seta VI is disposed somewhat ventrad and posteriorad to seta IIIa. Along the anterior margin of the segment, slightly ventrad to seta II, the two microscopic setae IXa and IXb form a row. On the mesothorax, ventrad to seta I and along the anterior margin of the segment, lies the microscopic seta Xb, while the two microscopic setae Xa and Xb on the metathorax approximate the same position. The well-developed group VII–VIIa is situated above the base of the legs. The rest of the setae of this group—VIIb, VIIc, and VIId—are microscopic and disposed antérior to the coxa. Posterior to the coxa is the small seta VIII. On the meso- and metathorax, the right and left setae VIII are less proximate than on the prothorax.

Ripley (1923), and later other authors as well, designated the setae on the thoracic legs with Arabic numerals. Eight setae are located on the coxa—five developed and three (6 to 8) microscopic (Figure 21). There are two developed setae on the inside of the femur. Around the tibia, close to the distal end, are located six setae and on the tarsi, four. The first and second are sometimes greatly enlarged, and this serves as a diagnostic feature.

Segments 1 to 9: Seta I on segments 1 to 7 is usually located cephalad and dorsad of seta II (Figure 38). In many Cuculliinae these two setae are situated almost on the same longitudinal line (Figure 39, *1* and *2*). On segment 8 in almost all species these setae rest on the same line. On segment 9 seta I is displaced ventrad. Along the foremargin of the segments, on the line of seta II, occurs the microscopic seta X. Seta III on segments 1 to 8 is located above the stigma and may be significantly shifted proximad or caudad. On segment 9 the stigma is absent but seta III occupies about the same position as in the other segments; it is often thin and piliform. Seta IV on segments 1 to 6 and 8 is usually situated caudad of the stigma and may be insignificantly shifted dorsad. It is highly shifted ventrad on segment 7 and is absent on segment 9. Seta IIIa microscopic, is usually disposed anteriorad of the stigma and may be shifted slightly dorsally on segments 1 to 8; and is absent on segment 9. Seta V is disposed ventrad of the stigma. Setae III, IIIa, IV, and V represent the group since they surround the stigmata from all sides. In this group Beck (1960) detected an additional normally developed seta, IVa (spuria poststigmalis),

in *Scoliopteryx libatrix* L. Crumb (1956) found a similar seta in species of *Anomis* and *Alabama*. Seta VI is located significantly ventrad to V and on segments 3 to 6 occurs above the leg, while it is absent on segment 9. In species of Acronictinae there are two setae VI on segments 1 to 6 (Figure 40). According to Beck, there are two setae VI among the Hypeninae since seta VIIb is proximate to seta VI. Ventrad to seta VI occur setae VIIa, VIIb, VIIc, and VIId (seta VIIc is microscopic and sometimes difficult to detect). Seta VIId is often absent on segment 1 and its presence or absence serves as a diagnostic feature. All four setae of group VII are present on segments 2 to 6, but seta VIIc is microscopic. Setae VIIa, b, and d are disposed on the outer side of the leg on segments 3 to 6, while VIII is located on the inner side (Figure 41). Of the group VII on segments 7 to 9, seta VIIa is developed, VIIc is microscopic, and VIIb and VIId are reduced. In *Acronicta alni* L., two developed setae of group VII occur on segments 8 and 9.

Tenth or anal segment: The anal shield is located on segment 10 (Figures 8 and 20). In the Noctuidae there are four pairs of setae on this shield. Of them, three pairs are disposed along the margin of the shield and one pair of setae I is located almost at the center. Setae II rest on the distal margin of the shield, setae III on the ventral margin, and setae IIIa on the anterior margin. Variation in the location of the setae is negligible, i.e., seta IIIa may be set off from seta III or the distance between setae II—II may be more or less. In addition to the setae on the shield, nine setae occur on each of the anal legs of segment 10 (Figure 42). Setae IV, V, and VI are located centrally on the outer side of the legs while VIIa, VIIB, and VIId occur on the margins. Setae VIIc and VIII are situated on the inner side. The ninth perianal seta (setae paraproctalis) is located on the perianal lobe.

In addition to the primary setae, secondary setae are also present in some species; these setae are disposed either only on warts (Figures 43 and 68) on certain sections of the body or they cover the entire body. In some species they are present only on the outer side of the prolegs. Secondary setae are characteristic of species of Acronictinae and *Conistra rubiginea* L. of the subfamily Zenobiinae.

PIGMENTATION AND COLOR PATTERNS

In the Noctuidae the patterning on the body is extremely diverse and often remarkably complex. Coloration is likewise diverse and often varies within a given species. Patterns are more constant and, in spite of intraspecific variations in color, provide good group and specific features. This explains why body coloration and pattern were used for diagnosis of larvae of Noctuidae long ago by Barrett (1897), Meyrick (1895), Hampson (1903–1908),

Spuler (1910), and others. These authors mainly described color differences and patterns on the trunk, neglecting by and large the pattern on the head.

The importance of the pattern on the head for purposes of diagnosis was recognized only recently (Gerasimov, 1952; Ryabov, 1960; Beck, 1960). We think the pattern on both the trunk and the head is an important diagnostic feature. First of all, the use of color and pattern is extremely convenient in identifying fresh material; secondly, the pattern is essentially preserved even when fixed in 75% alcohol. Mainly the light hypodermal colors—green, yellow, red, and others—are affected. The dark melanin color is usually preserved. Since the pattern on the trunk and head consists mainly of dark shades it is a reliable character in identifying fixed material. In our fixer the body color was preserved almost intact for five to six months. The pattern was still well preserved five years later.

Pattern on head: The color of the head among most species of owlet moths is more often yellow of varying shades with a dark-colored pattern that likewise varies in shade and intensity. Pattern variations are numerous but two are quite prominent and differ notably from each other while having something in common. These two pattern variations were distinguished by Gerasimov, Ryabov, and Beck. Gerasimov (1952) noticed on the heads of cutworms that dark shades occur as pairs of curved submedial bands and a reticulate pattern against a light-colored background. Sometimes, this pattern is absent and replaced with dark-colored spots (Figure 44, *1* and *2*). In the scheme proposed by Ryabov (1960), these variations are called types: the first type of pattern consists of an adfrontal band and reticulate pattern, and the second type of a stellate pattern (Figure 45, *1* and *2*). These same variations (Figure 46, *1* and *2*) were recorded by Beck (1960), but he presented them as a single scheme without separating types. Beck divided the submedial band into two portions. He termed that portion of the band "paralleling" the epicranial suture "coronal" and that portion "paralleling" the adfrontal sclerites "frontal". He also recognised supra- and suborbital pigment deposits.

We examined the pattern on the head in all the species we studied and traced pattern changes during larval development. We concluded that there are two main types of patterns in Noctuidae as distinguished by the above-named authors. However, their second type should be considered the first. The reason for this reversal is based on data from observations on pattern development during the process of larval growth. In our opinion it is also possible to isolate a third type of pattern on the head. It does not differ sharply from the second type and, hence, could be considered a variation. An altogether different development, however, served as the basis for isolating it as a special type.

First type (Figure 47, *1*). Minute dark-colored spots scattered in groups on light-colored background of head. Groups disposed on lateral sections of hemispheres and along epicranial suture. Spots absent along line of setae P_1 and P_2 and microscopic setae V_1, V_2, and V_3; basic background distinctly seen at these sites in form of bands. Anterior portion of head usually basic background color.

Second type (Figure 47, *2*) Fairly broad, dark-colored submedial band extends along line of setae V_3, V_2, and V_1 and farther away along P_2 and P_1. Band continues along adfrontal sclerites and ends at the base of frons. Lateral portions of hemispheres and part of head between band and epicranial suture covered with reticulate structure with cells at base much lighter in color than background of head. Outline of cells show they consist of individual pigment spots. Longitudinal sides of reticulate structure in supraorbital region somewhat enlarged and form supraorbital and suborbital bands in suborbital region.

Third type (Figure 47, *3*). Submedial band and reticulate structure present. Latter follows epicranial suture and forms large cells extending in transverse direction. Submedial band not broad, dark colored, forms truncated projections toward ventral side of hemisphere, and terminates slightly below apex of frons. Main background of head extends toward submedial band in an even, broad fringe, after which reticulate structure extends in form of band, followed by fringe of main background color and next reticulate structure again. Bands of reticulate structure even and branches of cells appear cut. Reticulate structure faint in genal region. Light-colored fringe and cells of reticulate structure covered with extremely minute light-colored spots. Background of adfrontal sclerites light colored, almost white, without spots. First type absent in ontogenesis of this pattern type.

In comparing the first and second types of cephalic patterns, some common features are apparent. However, in the second type the submedial bands are dark and the reticulate structure contains light-colored cells in the form of minute spots, while in the first type the submedial bands are light in color, the reticulate structure is absent, and dark-colored groups of spots fill the cells and form an indefinite structure. Beck termed the dark-colored spots dark reticulate fields. Perhaps they should be so labeled, but let us emphasize that among species with the first type of pattern on the head, the reticulate structure is not seen from the first to the last instars. The pattern of the first type is invariably constant, without sharp variations. Such a pattern on the head is characteristic of several Cuculliinae, some Agrotinae, and Zenobiinae. In *Xylena vetusta* the pattern is well manifested in I- to V-instars, but very faint in the VI-instar although unchanged.

The second type of cephalic pattern is more complex and is seen in older instars. In younger instars, the cephalic pattern of the first type is seen in the majority of species which in the course of ontogenesis represents the starting point for the development of the second type. Therefore, the less complex pattern on the head with groups of minute spots on the epicranial suture and on the sides of the hemispheres with a very light color or base color along setae P_1, P_2, V_1, V_2, and V_3 should be considered primary, which is the reason we have placed it first. Let it be noted that it occurs in some species of other groups of Lepidoptera (Tortricidae, Pyralididae, and Geometridae). Possibly it could be considered basic to the development of a more complex pattern in the order Lepidoptera. The first and second types of patterns exhibit significant variations. For convenience in species identification, some variations are discussed below.

Six variations in the first pattern type have been distinguished (Figure 48, *1–6*). In the first variation (Figure 48, *1*), the pattern consists of fairly large groups of minute, indistinct spots; in the second variation (Figure 48, *2*), small groups of highly prominent spots occur; in the third variation (Figure 48, *3*), groups of minute spots are supplemented by large, black circular spots around the setae; and in the fourth variation (Figure 48, *4*), groups of spots fuse into longitudinal lines, and the black spots around the setae are minute. A characteristic feature of the fifth variation (Figure 48, *5*) is a shaded dark-colored zone along the line of setae P_1, P_2, V_1, V_2, and V_3. In the sixth variation (Figure 48, *6*), the basic pattern is faint and often covered with very large black spots.

Nine variations in the second type have been distinguished (Figure 49, *1–9*). The characteristic features of the first variation (Figure 49, *1*) are a broad submedial band that attenuates gradually anteriorly in the zone of the adfrontal sclerites, a distinct reticulate structure, and lighter coloration of the anterior portion in the zone of setae A_1 and A_2. The submedial band in the second variation (Figure 49, *2*) is broad, notably attenuates, and is flexed at the apex of the frons, somewhat broadens again and later gradually attenuates at the center of the frons; the zone of setae A_1, A_2 and A_3 is lighter in color. In the third variation (Figure 49, *3*), the submedial band in the parietal portion is not broad, but widens at the apex of the frons and farther along the adfrontal sutures is identical in width. The fourth variation (Figure 49, *4*) differs from the third in that the submedial band in the zone of the adfrontal sutures broadens gradually, and the zone of the supraorbital band is lighter in color. In the fifth variation (Figure 49, *5*), the submedial band is broad, attenuates at about one-half the height of the frons, notably widens distad, and joins the supraorbital band encompassing setae A_1, A_2, and A_3 on a dark-colored background. A characteristic feature of the sixth variation (Figure 49, *6*)

is a very broad, slightly pigmented submedial band, truncated at the apex of the frons; the zone of adfrontal sclerites is light-colored. The seventh variation (Figure 49, *7*) differs from all the preceding ones in that the submedial band does not form branches toward the reticulate structure on the ventral side of the hemisphere and attenuates gradually along the adfrontal sclerites; the band is broad and significantly flexed at about the center of the epicranial suture; setae A_1 and A_2 occur on a light-colored background. In the eighth variation (Figure 49, *8*), all of the dorsal portion of the head is notably darkened, the dark coloration forms a flexed projection toward the orbital region; and setae P_1 and P_2 are situated in light-colored spots. The ninth variation differs significantly from the others in the presence of a broad black band surrounding both hemispheres (Figure 49, *9*); the submedial band between setae P_1 and P_2 is light-colored and in the genal region descends as dark-colored smears.

Let us mention here that in the species we studied, some cephaiic patterns did not correspond to any of the variations described above. For example, in many Acronictinae the head is black with light-colored longitudinal spots around the adfrontal sclerites; sometimes the head is light colored (*Orthosia populi*) with only the anterior portion being black (Figure 77). For such species a diagram is hardly needed. These patterns are easy to describe and identify.

It is worthwhile reviewing the changes in the primary cephalic pattern because the pattern of the trunk extends onto the head. This phenomenon is characteristic of species with very distinct, ornamented black spots on the body and bright substigmal bands. An example is *Calophasia lunula* (Figure 48, *6*). In this species broad black transversely extended spots on the dorsal part of the body spread onto the head and cover the primary faint pattern of the first type to a significant extent. That is why several authors (Beck, 1960; etc.) have recorded only the black spots on the head of this species and failed to mention the base (primary) pattern. In *Chloridea scutosa* Schiff., the setae on the trunk are located on very large black warts, while the setae on the head are situated in very prominent black spots (Figure 48, *3*). The same is true of *Cucullia lychnitis* Rbr. In almost all the species of Agrotinae, Hadeninae, and Zenobiinae, as well as others, a yellow- or orange-colored spot occurs in the orbital zone which is part of the bright yellow- or orange-colored substigmal band reflected on the head. In *Ectypa glyphica* L., the pattern on the trunk is distinctly reflected on the head, and furthermore, the poststigmal band on the head retains the same width as on the trunk.

Pattern on the trunk: The pattern on the trunk consists mainly of longitudinal bands and their borders. Bands are usually lighter in color than the main body background (white, yellow, orange, or red) while the

borders or edges are often significantly darker than the general background and generally ornamented with dark shading (black, brown, or cinnamon; more rarely, white or yellow). Kuznetsov (1915) suggested a scheme of patterns (Figure 50). This scheme includes the maximum number of bands present among larvae of Lepidoptera, i.e., eight paired and one unpaired. The unpaired dorsal band extends along the medial line of the back, while the subdorsal lies ventral to it but also on the dorsal side. The suprastigmal band extends along the lateral side of the body. The stigmal band runs directly above the stigmata and the substigmal band below the stigmata. The basal band is situated even lower, and the subbasal band proceeds along the base of the legs. There are two more bands on the ventral surface of the body: the supraventral band proceeds along the base of the legs and the ventral band along the medial line of the ventral surface. Kuznetsov pointed out that these bands may fuse into broad stripes and later split into spots (maculae), sometimes in the form of circles. He also emphasized a feature that is extremely well developed among the Noctuidae, i.e., minute scattered spots or dots.

Beck (1960) delineated the same bands described by Kuznetsov except for labeling the poststigmal band the stigmal. He devised schemes for separating patterns into zones (Figure 51) and subzones (Figure 52). Unfortunately, some bands were not included in these schemes.

In our opinion patterning is a significant diagnostic character, especially the bands—their width, degree of manifestation, and borders; in our pattern scheme, therefore, bands are prominent (Figure 53). The dorsal band extends along the medial line of the back. Among the Noctuidae it may be broad, narrow, or in the form of a chain of minute light-colored spots. When the setae are disposed on very large pinacula or warts and the band is broad, the edges of the band are interrupted. The subdorsal band becomes broader or narrower than the dorsal, with entire or interrupted edges, or splits into a chain of light-colored spots, usually located ventrad to seta II, but sometimes shifted somewhat dorsad. The suprastigmal band is usually situated above seta III. This band is not manifested in all owlet moths. We have termed that band "stigmal" because it follows the line of the stigmata and encompasses it to some extent. This band, too, is not manifested in all species of Noctuidae and hence, constitutes a good character for diagnosis, especially since its expression is distinctive (Figure 55, *1–9*). The stigmal band usually consists of spots disposed along the stigmata. We acknowledge that the stigmal band in some species (*Mamestra oleracea* L.) is rudimentary and more punctate (Figure 55, *1*). However, the stigmata are more often surrounded by spots on at least two sides. Generally black or some other pigment extends in the form of a narrow band outside the stigmata and broadens

notably around them, encompassing them from three or all four sides. Hence, this pigmentation cannot be considered a simple spot; it constitutes a band running along the line of the stigmata and therefore, should be termed the stigmal band. The broad, often bright substigmal band is usually located directly below the stigmal band. If the latter is absent, then sometimes all of the stigmata or only the middle ones are disposed along the substigmal band. In many cases, even when the stigmal band is not visible, the stigmata are located not on the substigmal band but on the ventral region of the subdorsal field. Among Agrotinae, Hadeninae, Zenobiinae, and others, the substigmal band extends to the anal proleg and continues down to the planta; among Cucullinae it does not extend to the anal proleg but surrounds the anal shield (Figure 62, *1–2*). In owlet moths the basal and subbasal bands are rarely distinct. More often a dark-colored pigment collects in the region of the basal band but does not form a band. Supraventral and ventral bands also rarely are seen.

The shields and spots around the setae, like the scattered light-colored spots or dots densely scattered in various sections of the body, are very important in diagnoses. Around the dots thin, fairly dark lines are usually visible in the form of punctate edges, which are seldom entire. More often the dots are densely fringed by a dark-colored pigment around the bands, which forms a margin on the band. For convenience in describing the pigment on definite body sections, we have isolated, in our scheme, fields corresponding to those designated by many authors and to the zones delineated by Beck. The dorsal field (Figure 53, A) occupies the medial portion of the back and extends laterad to the subdorsal bands. The subdorsal field is located on the body from the subdorsal band to the stigmal ôr, if the latter is absent, up to the substigmal band. The basal field is situated between the substigmal band and the base of the legs. The ventral field occupies the medial portion on the ventral side.

The pattern is usually most distinct on the dorsal field in which the borders of the bands often play a major role (Figure 53, B). The borders of the dorsal band are even or diffuse. Sometimes they are highly shaded through the dorsal field in the form of rhomboids (Figure 54, *1*) or semicircular spots in the anterior half of the segments (Figure 54, *2*). The lower border of the subdorsal bands is not very important in the formation of the pattern. It is usually even or slightly shaded. The upper border is often broken around seta II, notably shifted upward, and joined in the posterior portion of the segment by the border of the dorsal band to form distinct minute herringbone branches in the dorsal field (Figure 54, *3*). Sometimes the upper border of the subdorsal band broadens and is deeply pigmented in the anterior half of the segments, forming dark longitudinal, somewhat trimmed spots (Figure 54, *4*). On segments 7 and 8 these spots are often

cuneiform; the right and left spots on segment 8 may be fused or not, constituting a diagnostic feature (Figure 54, *5–6*). Sometimes a light-colored smear occurs posterior to the cuneiform spots on segment 8 (Figure 54, *7*). In some species the dark-colored spot on the ventral segments is arrow-shaped (Figure 54, *8*). The pattern is usually more distinct on the abdominal segments, especially on segments 7 and 8; in other species, contrarily, it is more distinct on segments 1 and 2, sometimes including segments II and III.

CHANGES IN MORPHOLOGICAL CHARACTERS AND DERMAL PATTERNS DURING GROWTH AND DEVELOPMENT OF LARVAE

In the process of growth and development, the larva generally undergoes five molts. However, all Plusiinae, *Calophasia lunula* Hufn., and *Discestra trifolii* Hufn. molt four times. Some Acronictinae (*Acronicta aceris* L. and *A. psi* L.) and Agrotinae (*Graphiphora ashworthii* Doub.) molt six times. Species of the genus *Apamea* of the subfamily Zenobiinae molt seven times. The number of molts, however, is not always constant, and additional molts have been observed among many species under unfavorable ecological conditions.

In the growth process, significant changes occur in structural features and in the coloration pattern of the larva.

Changes in the length of the epicranial suture and spinneret are more readily observed in the structure of the head. Among cutworms, in the I-instar the parietal notch is slight, while the epicranial suture is almost equal to the height of the frons, but later gradually decreases and almost disappears toward the last instar, while the parietal notch enlarges. For the genus *Apamea,* in which the younger instars feed inside plant stalks, a deep notch and small epicranial suture are characteristic features in I- and II- instars. The epicranial suture increases as the larva grows.

The spinneret develops differently among various species and groups. In newly hatched larvae, differences in the dimensions of the spinneret are not significant. The spinneret is invariably 2.0 or 3.0 times longer than the first segment of the labial palpus. Later it enlarges slightly in some species (*Agrotis* and *Orthosia*) and notably in others (Cuculliinae, Melicleptriinae, and some Zenobiinae). Table 6 presents data on changes in the spinneret of some species of owlet moths. In *Agrotis exclamationis*, the spinneret in the I-instar is about 2.0 times less than that of *Cucullia umbratica* and in the VI-instar it is 7.0 times. In *Orthosia gothica* and *O. incerta,* the spinneret in the I-instar is even slightly larger than in *Cucullia umbratica*; in the III-instar the size is identical, but in the last instar the differences are very great. It is significant that in *Agrotis exclamationis*

and *Orthosia gothica* the dimensions of the spinneret are identical in the VI-instar but in the I-instar they are significantly larger in *O. gothica,* indicating an earlier reduction of the spinneret in *Agrotis exclamationis* than in *Orthosia gothica.* This is also supported by the ability of the larvae of *Orthosia* to secrete silky or gossamer threads in the early instars, which is not seen among cutworms of *Agrotis* and *Euxoa.* It may be assumed that the larvae of *Agrotis* and *Orthosia* had a well-developed spinneret in the past and that its reduction represents a secondary phenomenon.

Table 6. Dimensions of spinneret and first segment of labial palpus (in μm) in larvae of various instars

Species	I-instar		III-instar		VI-instar	
	Length					
	Spinneret	First segment of labial palpus	Spinneret	First segment of labial palpus	Spinneret	First segment of labial palpus
Agrotis exclamationis	18	8	35	32	78	110
Orthosia gothica	48	23	93	62	78	93
Orthosia incerta	40	20	78	33	156	110
Cucullia fraudatrix	45	16	110	46	514	117
Cucullia umbratica	32	13	78	36	546	144

The body of just hatched larvae is devoid of tubercles and dilatations; and the width of the head is somewhat larger than that of the trunk. In some genera (*Caradrina, Meristis, Rusina,* etc.), the body in the I- to III-instars is short, thick, and not very mobile. In species of *Lygephila, Trachea, Dypterygia,* and *Thalpophila,* the body of a newly hatched larva is very slender compared to the large heads. Such larvae are very mobile. In some species of Zenobiinae, the body is short, and furthermore, the prothoracic segment is broader than the head. In the process of growth, these deviations disappear by and large. The skin of a recently hatched larva is colorless or yellow, but some segments may be slightly pigmented in many Acronictinae. Often a colored intestine is visible since the larva, on emerging from the egg, eats the chorion. Shields of various size are visible on the body. Sclerotization of the shields commences in the egg, and hence, they are invariably fairly well colored but significantly lighter than the head. Their sclerotization continues even after the emergence of the larva for about 3 to 4 hrs. The anal shield is often lighter in color than the thoracic or altogether colorless. In some species (*Barathra brassicae* L., *Apamea monoglypha* Hufn., *Polia nebulosa* Hufn., and

Agrotis corticea Schiff.), the anterior portion of the thoracic shield is less sclerotized than the posterior so that setae IX and X are located on a light-colored background while the shield has a characteristic shape (Figure 59). Sclerotization of the light-colored sections proceeds for 20 to 40 min, and sometimes several days in *Apamea monoglypha* Hufn. In the second and subsequent instars, the shields are either bordered by a dark line or do not differ from the general color of the body background.

Sclerotization of the shields occurs invariably after the emergence of the larvae and continues for 30 min to 3 to 4 hrs depending on the species and atmospheric temperature. Sometimes the shields are dark-colored but weakly sclerotized or, contrarily, light-colored but highly sclerotized. Shields are present in I- and II-instars of almost all species of owlet moths. Among Agrotinae except for *Agrotis* and *Euxoa,* and also among most Hadeninae and Zenobiinae, shields disappear or are replaced by spots in the IV-instar; sometimes the spots too are absent. Among Melicleptriinae, some Plusiinae, and others, shields are also present in the last instar, and sometimes light colored and unsclerotized. A shagreen skin is manifest to some extent in the I-instar of almost all species of owlet moths. But among many species, as the larva grows, granularity gradually becomes finer, and the skin appears smooth in IV- to VI-instars, e.g., *Graphiphora ashworthii* Doub., *Lycophotia signum* F., *Mamestra thalassina* Hufn., *Aplecta, Ochropleura, Trachea,* etc. More rarely, granularity of the skin increases, e.g., *Agrotis exclamationis* L., *A. ipsilon* Hufn., and *Cucullia umbratica* L. Among species with minute spines on the skin (Melicleptriinae and Plusiinae), there is granularity in the I-instar which by the IV-instar gradually increases in size and in the VI-instar transforms into spines.

Developmental changes in chaetotaxy are manifested in all larvae with the appearance of subprimary seta VI after the first molt. Setae in the I-instar among Plusiinae, Melicleptriinae, several Hadeninae, and Zenobiinae are acuminate, large, and fairly long. In these species, the form of the seta does not alter with larval growth. In species of Agrotinae and Zenobiinae, setae are piliform or slightly pointed in the I-instar; and among *Agrotis, Caradrina, Meristis,* and some *Triphaena* they are clavate (Figure 27, *2*). In the latter, the clavate form of setae is preserved in the II-instar and sometimes even in the III-instar, but the setae become piliform or slightly pointed in the IV- and V-instars; and are usually acuminate in the VI-instar. The setae on the larval body vary in length. Often, seta I is shorter than seta II on the thoracic segments. The setae usually are longer on segments 9 and 10. As the larva grows, the setae lengthen, e.g., in *Agrotis exclamationis* seta III on segment 2 is equal to 0.155 to 0.186 mm in the I-instar, 0.552 to 0.585 mm in the IV-instar and 0.825 to 0.921 mm in the VI-instar.

Stigmata are usually circular in the I- to III-instars and become oval form in the IV-instar. In all species, the stigmata are light-colored in younger instars. Among *Agrotis,* Melicleptriinae, and some others, commencing from the III- to IV-instars, the stigmata darken and are black or brown in the last instar. Among some *Agrotis,* the stigmata are disposed on distinct tubercles which are similar to pinacula in the I- to III-instars.

Among Acronictinae all five pairs of abdominal legs are normally developed in all instars. In nearly all of the remaining species with five pairs of prolegs, the anterior two pairs in the I- and II- and sometimes even the III-instar are underdeveloped. Among *Lygephila* and *Catocala,* the anterior two pairs of prolegs are only rudimentary in the I-instar and slightly shorter and thinner than the rest in the VI-instar. The number of hooks increases gradually. Hooks are absent or only three to five are present in the first pair of prolegs among newly hatched larvae of many species. Their number usually increases after each molt. The formula of hooks, stagewise, for *Agrotis exclamationis* L. is given as an example:

I-instar	0, 2–3, 4–7, 6–7, 7–8
II-instar	0, 2–5, 4–7, 7–8, 8–10
III-instar	2–4, 4–7, 6–9, 7–10, 9–11
IV-instar	3–6, 5–8, 7–8, 9–11, 9–12
V-instar	4–8, 6–10, 8–12, 10–13, 11–16
VI-instar	5–9, 7–11, 10–12, 12–15, 16–20

Pattern changes: Pigmentation of the larval head occurs in the egg and in rare cases changes insignificantly after the larvae hatch. In species in which the head pattern is of the first type in older instars, newly hatched larvae usually have a light-colored head (*Cucullia absinthii* L., *C. fraudatrix* Ev., and *Xylena vetusta* Hbn). In rare cases (*Diphthera coenobita* Esp.), the head in the I-instar is black. Among species in which the pattern on the head is of the second type in older instars, the head of recently hatched larvae is black (*Triphaena pronuba* L., *T. augur* F., *Mamestra persicariae* L., etc.) or light-colored (*Graphiphora ashworthii* Doub., *Lycophotia porphyrea* Schiff., and *Mamestra suasa* Schiff.). The black color of the head in most cases changes immediately after molt to a light color; rarely, does this change take place gradually.

Pattern changes of the first type from the first to the last instars are almost invariably insignificant. In *Xylena vetusta* Hbn. (Figure 56, *1*), there are almost no changes in the pattern on the head from the I- to V-instars. The development of a cephalic pattern of the first type proceeds almost identically in all species. In *Calophasia lunula* Hufn. (Figure 56, *2*), the main pattern varies very little. A sharp change occurs only because of formation of very large black spots which are extensions of the body pattern. The formation of these spots commences with the II-instar. In

Diphthera coenobita Esp., the development of the pattern proceeds gradually. The head is black in the I- and II-instars. Commencing with the III-instar (Figure 56, *3*), a part of the hemisphere along the line of setae P_1, P_2, V_1, V_2, and V_3 is free of black pigment; this portion later becomes totally devoid of spots. In the IV-instar the black pigment on the ventral side of the hemispheres splits into groups of minute spots. However, the black pigment remains along the epicranial suture. In the last instar the black pigment remains only in the anterior portion of the head, while a distinct pattern of the first type is manifested in the hemispheres.

The pattern of the second type develops unevenly and changes among various species are not identical. The pattern of the first type is often present in the II-instar of species which hatch with a light-colored head (*Graphiphora baja* Schiff., *Lycophotia porphyrea* Schiff., *Aplecta prasina* Schiff., and *Mamestra suasa* Schiff.), and sometimes even in the I-instar (*Discestra trifolii* Hufn. and *Mamestra pisi* L.). After the third molt it usually changes into the second type. It is significant that in cases in which the first type of pattern is seen in the I-instar, it is more stable and transits into the second type only in the VI-instar. Among species which hatch with a black head, the head usually acquires a light coloration after the first molt (*Diarsia brunnea* Schiff. and *Triphaena pronuba* L.). Among such species the pattern of the first type is seen more often in the III-instar, transiting from the IV-instar into the second type. Sometimes the color of the head lightens gradually; for example, in the I-instar of *Triphaena augur* F., the head is black, in the II- to IV-instars it is cinnamon or brown, and in the V- and VI-instars, it is yellow. In this species the pattern is absent in the I- to III-instars, while a pattern of the second type is seen immediately in the IV-instar. Similarly, we detected no pattern of the first type in the initial instars of *Graphiphora c-nigrum* L., *G. triangulum* Hufn., and *G. ditrapezium* Schiff. Possibly it is manifested very faintly indeed or these species have crossed the boundary of phylogeny whereby the former pattern reverts.

As mentioned above, transition from the first to the second type occurs quickly, i.e., immediately after molt (more often after the third). The pattern of the second type after molt represents a negative depiction of elements present in the pattern of the first type among younger instars. We were able to detect the elements of transitional stages in only one specimen (of 30) of *Mamestra thalassina* Hufn. (Figure 57, *1*). A pattern of the first type was present in all the larvae of the III-instar, but the rudiments of a reticulate structure and supraorbital band were detected in the genal region in only one specimen.

It should be noted that a pattern of the first type is sometimes visible in younger instars among larvae which hatch with a black head (*Agrotis*

segetum Schiff. and *Autographa gamma* L.), but a pattern of the second type does not develop in older instars; contrarily, the process of return to black pigmentation of the head takes place (Figure 57, *2*).

A pattern of the third type develops in an altogether different manner. Newly hatched larvae have a light-colored head with two narrow dark-colored bands in each hemisphere. The first, or submedial band (Figure 58), extends along the line of setae P_1 and P_2 and ends at the apex of the frons. The second band, deeper in color, commences at the center of the hemisphere and ends at the base of the frontal sclerite. In the II-instar the bands widen somewhat but the pattern remains the same. In the III-instar the submedial band is notably enlarged by the epicranial suture and transformed into a reticulate structure. The second band is also reformed into a reticulate structure. Rudiments of a grid structure are present in the orbital region. Between the narrow bands, broad equal intervals of the main background color of the head are visible. In the V- and VI-instars the only change in pattern is a rather narrow dark submedial band joining the reticulate structure adjacent to the epicranial suture.

Changes in simpler patterns are as follows: in many Acronictinae the head is black in the I- to III-instars and later longitudinal light-colored spots occur next to the frontal sutures; in some species the epicranial suture is somewhat light-colored. In *Orthosia populi* Ström., the black pigment disappears in the V-instar from the occipital and genal regions and in the VI-instar, only the anterior portion of the head remains black (Figure 77).

The pattern of longitudinal bands on the trunk of species of the Noctuidae is usually seen after the first molt. In rare instances (*Lycophotia* and *Mythimna*), the bands are faintly visible in the middle or at the end of the growth of the I-instar. Bands are not seen in the I-instar of *Polia nebulosa* Hufn. and *Lygephila pastinum* Tr., but ventral to seta II and along the line of seta III at the end of this instar, a brownish-yellow pigment accumulates, which later forms the borders of the bands. Dorsal, subdorsal, and substigmal bands are usually the first to be seen. In some species there is a suprastigmal band present in the II-instar which sometimes (*Mamestra suasa* Schiff.) disappears even in the III-instar. In many Cuculliinae, Agrotinae, and others, this band is well manifested from the second to the last instar. The stigmal band is more often defined from the IV- or V-instar but sometimes it is present even in the III-instar. The borders of the band are visible from the III- or IV-instars (Figure 60). The appearance of the borders is associated with the development of scattered light-colored dots on the body, around which dark pigment gathers quite often, especially around dots disposed close to the band. Dense dots form the borders of the band. If dark pigment also collects around dots that lie somewhat away from the band, then the borders appear shaded. Such borders are characteristic of species in which the bands are

represented by light-colored dots or spots. If the bands are light-colored but continuous, then the borders in the III-, IV-, and often even the last instar are not shaded, but uniform. In species in which the longitudinal bands are the same color as the main body color (Plusiinae and Beninae), the borders are light-colored from the III- to last instar. Such borders may be even or uneven, often depending on the presence or absence of large pinacula or warts but never shaded. In such species, scattered light-colored spots are altogether absent or seen in small numbers mostly on the ventral surface of the body.

During the process of growth, the dorsal and subdorsal bands sometimes change their color and width. For example, in *Mamestra pisi* L. the dorsal band is broad until the IV-instar, but becomes narrow after the third molt. In *Cucullia fraudatrix* Ev., the dorsal and subdorsal bands are identical in width in the initial instars, but after the third molt the subdorsal band is twice narrower than the dorsal. The substigmal band is usually broad, and often turns white in the II-instar and later turns bright yellow or reddish. In some species, it is bright with distinct boundaries from the third to the last instar. In many species of Agrotinae, Hadeninae, and Zenobiinae, the substigmal band has distinct boundaries until the V-instar during which the ventral band fuses with the color of the basal field. In such instances, dark lines extend onto the band. In most species the substigmal band extends onto the anal leg or surrounds the anal shield. This is often seen as early as the II-instar (Figure 62). A herringbone pattern on the dorsal field is characteristic of many species of Agrotinae, Hadeninae, and Zenobiinae. It is seen more often in the V- and VI-instars (*Mamestra suasa* Schiff., *M. contigua* Schiff., *Hadena rivularis* F., *H. bicruris* Hufn., etc.). In *Lasionycta nana* Hufn., the herringbone pattern is distinct in the V-instar but almost absent in the VI-instar. In *Mamestra persicariae* L., this pattern is seen in the V-instar but replaced by dark green semicircular spots in the VI-instar. In *Graphiphora baja* Schiff., the herringbone pattern develops in the III-instar and is preserved until the last instar (Figure 61). Usually the larvae of the penultimate and last instars are almost indistinguishable in terms of pattern on the body. The V-instar differs sharply from the VI only in *Lithophane furcifera* Hufn.

EGGS AND OVIPOSITION

Eggs of owlet moths are more often rounded, almost spherical, with a flattened base. Sometimes, however, they are hemispherical (*Aplecta prasina* Schiff., *Orthosia incerta* Hufn., etc.) or in the form of a convex tablet (almost all Acronictinae). In *Emmelia trabealis* Scop. and almost all Cuculliinae, the eggs are somewhat longitudinally elongated (Figure 7). The base of the eggs is almost invariably flat, its diameter depends

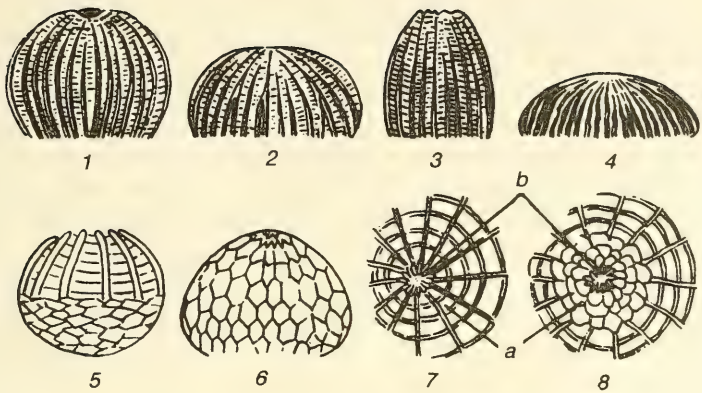


Figure 7. Egg shapes and chorion structure:

(1) *Heliophobus reticulata* Goeze; (2) *Aplecta prasina* Schiff.; (3) *Emmelia trabealis* Scop.; (4) *Acronicta psi* L.; (5) *Cirrhia togata* Esp.; (6) *Euxoa nigricans* L. Chorion structure at apex of egg; (7) *Graphiphora baja* Schiff.; (8) *Diarsia rubi* Viev (a—micropylar zones; b—micropylar rosettes).

on the shape of the egg. In round eggs it is less than the equatorial diameter, but equal to it in hemispherical eggs. The egg is enclosed in a dense shell or chorion. The chorion of noctuid eggs is rather complex in structure and forms ridges. These ridges project in the form of longitudinal and transverse ribs, lobes, tubercles, grids, and other shapes.

Leuckart (1855) laid the foundation for the study of the outer structure of the eggs of Lepidoptera in the middle of the last century. By the end of the nineteenth and early in the twentieth century, considerable data had been published on the structure of lepidopterous eggs (Korschnelt, 1887; Seitz, 1889; Chapman, 1896; Spuler, 1908; Kuznetsov, 1915; and many others). The chorion structure of the eggs of Lepidoptera, including those of the Noctuidae, was later detailed by Doring (1935, 1955).

The structure of the chorion depends on the structure of the epithelium of the ovaries and oviducts. Egg fertilization occurs through an opening in the chorion at the center of the micropylar rosette, and subsequently through thin channels running from the micropyle to the egg yolk. The micropylar rosette is situated at the apex of the egg. The structure of the rosette among Noctuidae usually consists of small, thin ribs forming longitudinal or oval lobes (Figures 7, 7b, and 8b). The number of lobes varies in different species. The micropylar rosette is surrounded by one to four rims or coronae of oval or longitudinal lobes or a tender grid consisting of thin longitudinal and transverse ribs. The zone at the apex of the egg where the rosettes are situated and the rim or tender grid surrounding it is called the micropylar zone (Figures 7, 7a, and 8a).

A distinct meridional ribbing is characteristic of the eggs of owlet moths with minor exceptions. The number of ribs varies in different species. The ribs are pointed, rounded, straight, or sinuous. In the majority of cases, not all the ribs reach the micropylar zone (Figure 7, *1–4*), nor do the ribs extend down to the base of the egg in every species. Sometimes they terminate at the equator or slightly below, and a reticulate structure extends further to the base (Figure 7, *5*). The number of ribs varies from 16 to 120 or more. Thin, transverse ribs are distinctly visible (in the form of striae) between the longitudinal ribs. Döring (1955) assigned much importance to their number and used this feature in his key. In some species the longitudinal ribs are almost (*Mythimna pallens* L.) or totally invisible (*Mythimna turca* L., *M. ferrago* F., etc.). In the latter species the longitudinal and transverse ribs are identical in thickness and, hence, the chorion bears a reticulate pattern (Figure 7, *6*).

Il'inskii (1948) paid particular attention to the method of oviposition employed by insects. This subject is of interest in the context of the Noctuidae because the methods of oviposition among owlet moths are diverse. Many species lay eggs singly, attaching them to leaves, dry plant growths, or simply depositing them on the soil. Other species lay eggs on plant leaves in regular or irregular rows, closely or widely set, and sometimes imbricated in one to five layers. For species feeding inside stalks of cereal plants, oviposition behind the leaf sheath is characteristic. A few species (*Lycophotia signum* F., *Cerapteryx graminis* L., and *Thalpophila malura* Hufn.) disperse eggs, without attaching them to a substratum. The eggs are mostly pale yellow, more rarely yellow, green, or white. In many species a definite pattern is seen during the process of growth (specks, tiny bands around the equator, and a spot at the apex) on the serous membrane and is visible through the chorion. The eggs gradually darken later. In some species, embryonal growth proceeds without a change in egg coloration.

IMPORTANCE OF STUDIES OF LARVAL INSTARS IN THE TAXONOMY OF THE NOCTUIDAE

The systematics of the Noctuidae has yet to be finalized. For a long time, it was postulated on the basis of characters of the imaginal phase. The classification proposed by various authors (Staudinger, 1901; Hampson, 1907; Warren, 1914; Draudt, 1938; Boursin, 1953, 1964) are by and large contradictory, and to date not a single well-substantiated and commonly accepted system exists. Commencing from the 1930's, much attention has been given to the structural characteristics of the larvae (Crumb, 1934; Kozhanchikov, 1950; Beck, 1960) and this has led to significant changes in the formulation of the systematics of the family.

Based on the morphological characteristics of imaginal and larval phases of the species of the Acronictinae, Kozhanchikov (1950) combined this subfamily with Liparidae [Lymantriidae] and established a new family, Orgyidae. He considered the development of the secondary larval setae, which often appear even in the I-instar, the unstable position of seta IV, the absence of seta IIIa on the abdominal segments, the frequent fusion of warts I and II on the thoracic and abdominal segments, as well as other morphological features of the larvae, in bringing Acronictinae close to Liparidae [Lymantriidae].

Having studied in detail the morphology of the larvae of a large number of species of Noctuidae, Beck concluded that the system proposed by Boursin (1953) was the most acceptable, but introduced several changes in it. The most significant of these changes were: separation of the subfamilies Beninae (Hylophilinae), Aediinae, and Rivulinae; and restoration of the subfamily Cryphiinae (Bryophilinae) as in the system of Hampson (1907), including in it not only genera proximate to *Cryphia* Hbn. [placed by Boursin in the subfamily Apatelinae (Acronictinae)], but also the genus *Dasypolia* Gn. from the subfamily Cuculliinae. The genus *Scoliopteryx* Germ. was isolated by Beck into an independent tribe of the subfamily Catocalinae. Beck also treated the large subfamilies Noctuinae (Agrotinae), Hadeninae, and Zenobiinae as merely tribes and combined them into the subfamily Noctuinae. The volume of these groups varies greatly from that in the system of Boursin. For example, many genera of Cuculliinae were included by Beck in Zenobiinae. It is beyond the scope of the present work to discuss all the changes introduced by Beck in interpreting the range and systematics of individual genera. On the whole, Beck's views are of interest and introduce many new aspects in the systematics of the Noctuidae.

The results of our studies on the morphology of larvae and, in particular, of the imaginal phase of owlet moths accord with the major conclusions and generalizations reached by Beck. Hence, we follow his system here with relatively minor deviations.

In accordance with the views of most authors, we have retained the subfamily Acronictinae (Apatelinae) in Noctuidae, but, within it, use the system and nomenclature proposed by Kozhanchikov (1950). Such groups as Agrotinae (Noctuinae), Hadeninae, and Zenobiinae, despite their distinct genetic affinity, can nevertheless be considered independent subfamilies and not tribes, because the differences in most of their distinguishing features are no less great than in other subfamilies. The nomenclature and system of Agrotinae have been adopted from Kozhanchikov (1937) and Ryabov (1951), except that the genus *Naenia* Steph. has been included, which indubitably belongs to this subfamily. The com-

position of all the other subfamilies has been adopted from Beck except we have placed the genus *Panolis* Hbn. in the subfamily Hadeninae, to which it is close, even with respect to the imaginal phase, and altered the system of genera and species in the subfamily Hadeninae as follows: the species *Barathra* (*Mamestra*) *brassicae* L. is retained in the separate genus, *Barathra* Hbn. The genera *Xylena, Dypterygia,* and *Blepharita* are included in the subfamily Zenobiinae. The name of the subfamily Zenobiinae (Amphipyrinae) has been adopted from Boursin (1953) in spite of the fact that the same author, in 1964, referred to this subfamily as Amphipyrinae. In our book, all the species of *Amphipyra* have been placed in the subfamily Cuculliinae, and hence, there is no basis for the name "Amphipyrinae". We consider Scoliopteryginae an independent subfamily since its lone species, *Scoliopteryx libatrix* L., differs notably from all members of Catocalinae in characteristics of both larvae and moths.

It is hoped that an indepth study of the larvae and all phases of development will lead in the future to a well-substantiated and objective, phylogenetic system of the family Noctuidae.

PART III

Classification

Family NOCTUIDAE (Owlet Moths)

The larvae of the Noctuidae have thoracic and abdominal legs. The latter usually consist of five pairs, but the two anterior pairs in some species are underdeveloped or absent. Sometimes only one anterior pair is absent; legs are invariably present on the anal segment. Abdominal legs are invariably equipped with hooks located in a medial row (Figure 23) or in a semicircle (Figure 24, *4, 5*). The hooks of owlet moths are arranged in one tier when equal in size [uniordinal] or in two tiers with longer hooks alternating with shorter ones (Figure 24, *1, 2*) [biordinal]. At times the hooks are arranged in two indistinct tiers (Figure 24, *3*). Stigmata in fully grown larvae are large and oval (Figure 25).

Primary and subprimary setae are always present. In species of the subfamily Acronictinae (except *Acronicta alni* L.), secondary and often long setae are also present and form clusters on warts or even cover the body. In species devoid of secondary setae, the characteristic features distinguishing the family Noctuidae from other groups are: presence of only two setae (IV and V) on the prothorax anterior to the stigmata and the absence of seta VI on the prothorax; two setae of group VII developed above the leg on the prothorax (Figure 34) and only one seta of group VII above the meso- and metathoracic legs (Figure 37). The disposition of setae within the family has already been detailed in the section "External Morphology of the Larval Body".

According to Ryabov (1960), the main feature distinguishing the Noctuidae from other related groups of Lepidoptera is the neck gland situated between the head and the first pair of thoracic legs (Figure 8, e). Its presence is readily detected by maceration, i.e., boiling the larva for 3 to 5 min in a 10% caustic potash solution. According to Gerasimov (1952), a neck gland is also present in the Notodontidae, Nymphalidae, and other families. It should be mentioned that the neck gland is distinctly visible in some owlet moths without maceration.

Key to Subfamilies of Noctuidae

1 (2). More than five setae on outer side of abdominal legs (Figure 23, *2*). If only three setae (*Acronicta alni* L.) seta II long, oar-shaped on thoracic segment I and all abdominal segments except 7 (Figure 27, *6*). Skin in most cases covered with long secondary setae set on warts, often also outside warts; on segments 1 to 6 wart VI with two developed primary setae, and on segment 2 wart VII with three setae. *Conistra rubiginea* F. of sub-

family Zenobiinae also with more than three setae on abdominal legs and secondary setae on trunk, differs from this subfamily in uniform arrangement of setae and characteristic dark-colored spots on dorsal field (Figure 83, *2*)..... 1. **Acronictinae.**

2 (1). Not more than three setae on outer side of abdominal legs (Figure 23, *1*) and seta II not oar-shaped. Secondary setae, except for *Conistra rubiginea,* absent throughout body.

3 (30). Segment 1 with two developed setae of group VII; if three present, which is very rare, abdominal legs consist of just three pairs and hooks on them biordinal (Figure 24, *2*).

4 (21). Seta III on segment 9 weak, piliform. All stigmata disposed dorsad to substigmal band, rarely stigmata of segments 2 to 7 on substigmal band. Abdominal legs, five pairs.

5 (16). Opening of spinneret with fringe, dents, or convolutions.

6 (9). Spinneret shorter than first segment of labial palpus.

7 (8). Skin finely or coarsely grained. Epicranial suture highly reduced, much shorter than frons (Figure 11)..... 2. **Agrotinae** (*Agrotis, Euxoa*).

8 (7). Skin smooth, more rarely covered with minute spines. Epicranial suture equal to or exceeds height of frons (Figure 10)..... 3. **Hadeninae** (*Orthosia*).

9 (6). Spinneret equal to first segment of labial palpus or longer.

10 (13). Dorsal and ventral sides of opening of spinneret with fringe (Figure 17, *4*).

11 (12). Segment 8 considerably dilated. Mandibles with normally developed main teeth (Figure 15, II). Dorsal band in form of light-colored dots..... 2. **Agrotinae** (*Ochropleura*).

12 (11). Segment 8 not dilated. Mandibles with poorly developed main teeth (Figure 15, V). Dorsal band continuous..... 3. **Hadeninae** (*Mythimna*).

13 (10). Only dorsal side of spinneret with fringe, dents, or convolutions.

14 (15). Spinneret equal to first segment of labial palpus or slightly longer, broad, not pinched terminally. Dorsal side of opening of spinneret with long fringe (Figure 73, *1–12*)..... 2. **Agrotinae** (in part).

15 (14). Spinneret 1.5 to 4.0 times length of first segment of labial palpus, often highly pinched terminally. Dorsal side of spinneret opening with short fringe, dents, or convolutions (Figure 79, *1–9, 15, 16*)..... 3. **Hadeninae** (in part).

16 (5). Opening of spinneret without fringe, dents, or convolutions.

17 (18). Seta II on segment 8–5.0 to 7.0 times higher than seta I. Trunk with characteristic pattern (Figure 93, *6–8*). Larvae on nettles..... 7. **Plusiinae** (*Abrostola*).

18 (17). Seta II on segment 8 only insignificantly higher than seta I. Pattern on trunk different.

19 (20). Seta M_1 absent on mandibles. Skin finely grained; setae acuminate. Pattern on head of second type (Figure 49, *6*). Body green with white dorsal and subdorsal bands. Larvae feed on needles of pine and other coniferous trees..... ..... 3. **Hadeninae** (*Panolis*).

20 (19). Setae M_1 and M_2 present on mandibles. If seta M_1 absent, large granules in form of papillae and thick piliform setae present on skin (Figure 27, *3*). Pattern on head of second type (Figure 49, *5*) or first type (Figure 48, *2*); more rarely, head without pattern. Pattern on trunk diverse..... 4. **Zenobiinae.**

21 (4). Seta III on segment 9 not piliform but large, well developed like I and II, or slightly thinner. Stigmata situated on substigmal band; rarely stigmata of segments 2 to 7 dorsal to substigmal band. Abdominal legs, five or three pairs.

22 (25). Abdominal legs, three pairs.

23 (24). Hooks of abdominal legs uniordinal. Skin finely grained. Seta II on anal shield significantly higher than other setae (Figure 88). Head black, with light-colored spots (Figure 89)..... ..... 8. **Jaspidiinae.**

24 (23). Hooks of abdominal legs biordinal. Skin covered with minute spines. Seta II on anal shield does not differ from other setae. Head dark or light colored, often without pattern. In many species body pinched toward anterior end..... 7. **Plusiinae.**

25 (22). Abdominal legs, five pairs.

26 (27). Body expands toward anterior end. Planta of abdominal legs very broad (Figure 90, *1*); hooks uniordinal. Setae on tarsi of thoracic legs enlarged (Figure 90, *2*). Head green, without pattern. Body light green, with characteristic white pattern (Figure 91). Larvae on oaks and birches..... 12. **Beninae.**

27 (26). Body does not expand toward anterior end. Planta of abdominal legs usual in width. Setae on tarsi of thoracic legs not enlarged. Body pattern different.

28 (29). Skin on body covered with spines (Figure 26, *5*); pinacula black, sclerotized (Figure 85). Substigmal band extends onto anal leg (Figure 62, *1*)..... 6. **Melicleptriinae.**

29 (28). Skin on body smooth or granular. If covered with minute spines, pinacula and spots around spines absent. Substigmal band extends onto anal shield (Figure 62, *2*)..... 5. **Cuculliinae.**

30 (3). Segment 1 with three developed setae of group VII. Abdominal legs, five pairs.

31 (34). Abdominal legs on segments 3 and 4 significantly shorter than on segments 5 and 6.

32 (33). Seta IVa developed on segments 1 to 6 between setae II and IV (Figure 97). Seta Xa on prothorax notably shifted backward and situated near margin of segment (Figure 35). Hooks of abdominal legs around sides of planta underdeveloped. Body green, without tubercles and dilatations, with dark green dorsal band and golden-yellow upper margin on subdorsal band. Head with barely visible pattern of first type (Figure 48, *1*)..... ..... 10. **Scoliopteryginae.**

33 (32). Seta IVa absent on body. Seta Xa on prothorax situated along rim of thoracic shield. Hooks of abdominal legs uniformly developed. Body not green, often with tubercle on segment 5. Pattern on head of second (Figure 49, *9*) or third type (Figure 47, *3*)..... 9. **Catocalinae.**

34 (31). All five pairs of abdominal legs short, identical. Skin of trunk and head coarsely grained. Setae on tarsi of thoracic legs greatly enlarged (Figure 96). Pattern on head of second type (Figure 49, *1*). Dorsal band broad, black. Larvae on dry leaves of deciduous trees..... 11. **Herminiinae.**

Subfamily Acronictinae

The presence of secondary, often very long, setae as well as warts is a characteristic feature of species of this subfamily, except for *Acronicta alni* L. Setae set only on warts (*Acronicta rumicis* L. and *Diphthera coenobita* Esp.) or directly on skin close to warts, especially in subdorsal and basal fields (*Acronicta aceris* L., *A. tridens* Schiff., and *A. psi* L.). In some species secondary setae occur on hemispheres of head (Figure 33). On segment III warts I-I often contiguous or fused. In *A. psi, A. tridens,* and *A. cuspis* total fusion and enlargement of warts I-I on segment I form prominence that is a characteristic feature (Figure 29). In *Episema caeruleocephala* L., secondary setae present only on abdominal legs of segments 3 to 6. Setae on tibiae of thoracic legs arranged almost in one row in distal part; tibial girdle often has characteristic notch (Figure 64, *1*). Setae on tarsi of *Daseochaeta alpium* Osb. and *Calocasia coryli* L. broad and enlarged (Figure 64, *2*). Planta of abdominal legs broad with uniordinal hooks. Skin covered with granules or fine spines (*Acronicta rumicis* L., *Subacronicta megacephala* Schiff., and others) (Figure 26, *5*). In *Acronicta aceris,* spines very small with broad base (Figure 26, *4*) and visible only under high magnification. Setae acuminate, papillate, or branched (Figure 27, *4–5*). Body pattern diverse, highly variegated in some species. Head black, often with light-colored adfrontal sclerites or with

dark-colored pattern of first type; seta Frl_2 often located above apex of frons; P_1 in some species notably shifted posteriorad to line of setae Frl_2–Frl_2 (Figure 33). Spinneret circular, somewhat terminally pinched, or length may exceed that of labial palpus.

Key to Genera

1 (8). Only primary setae present on head, secondary setae absent.
2 (5). Secondary setae totally absent on body or present only on outer side of abdominal legs on segments 3 to 6 (Figure 23, *2*).
3 (4). Secondary setae absent on abdominal legs. Segments I and 1 to 9, except 7, with long, oar-shaped seta II (Figure 27, *6*). Larvae black, with yellow spots on dorsal side of each segment.... ..... 6. **Acronicta** (*alni* L.).
4 (3). Secondary setae present on outer side of abdominal legs. Body bluish-gray, with large, round, velvety warts bearing primary setae and minute black spines. Head bluish-white, with faint pattern of first type (Figure 48, *1*), with large spots in occipital-sincipital section and posterior to semicircle of ocelli..... ..... 3. **Episema.**
5 (2). Secondary setae present on body, set either only on warts or extend even onto skin.
6 (7). Head black throughout or black with light-colored adfrontal sclerites. Warts on dorsal side of body with clusters of secondary setae or secondary setae form continuous cover..... ..... 6. **Acronicta** (in part).
7 (6). Head black, with broad light-colored submedial band (Figure 71, *1*). Warts I–III on dorsal side of body only with primary setae. Body brownish-gray, with large whitish spot on dorsal field of segment 7..... 5. **Subacronicta.**
8 (1). Head covered with secondary setae.
9 (10). Warts I–I on segment 1 fused and enlarged, form rather long prominence (Figure 29). Head black throughout or black with light-colored adfrontal sclerites. In subdorsal field variegated spots extend transversely (Figure 43, *2*)..... ..... 6. **Acronicta** (in part).
10 (9). Warts I–I on segment 1 not fused and prominence not formed. Head light-colored with distinct pattern of first type (Figures 48, *1* and 56, *3*).
11 (12). Thoracic legs very thick, especially forelegs (Figure 66, *1*). Thoracic part of body enlarged; dorsal side of segments II, III, and 1 bluish-black, velvety. Pattern on head of first type (Figure

56, *3*). Labrum with insignificant notch (Figure 66, *2*)..... ..... 1. **Diphthera.**

12 (11). Thoracic legs normally developed. Thoracic part of body not enlarged, without velvety bluish-black spots. Head dark-colored with light-colored adfrontal sclerites. Labrum with rather deep notch (Figure 66, *3*).

13 (14). Warts III and IV on segments 1 to 8 fused (Figure 69, *1*); wart III on segment II with cluster of long black setae; unpaired clusters of reddish setae on dorsal side of segments 1 and 2 on proximate warts I–I; segment 8 with similar cluster of black setae. Postclypeus without notch at center..... 2. **Calocasia.**

14 (13). Warts III and IV on segments 1 to 8 separate (Figure 69, *2*). Clusters of setae not long on segment II, same size as on other segments. Body gray. Dorsal field in segments III, 1, 3, and 6 with yellow spots extending transversely. Postclypeus with notch at center (Figure 33)..... 4. **Daseochaeta.**

1. Genus *Diphthera* Ochs.

(One species in Belorussian fauna)

Diphthera coenobita Esp. (spotted night moth)

Mature larva: Head with secondary setae. Epicranial suture longer than height of frons. Seta Frl_2 shifted posteriorad to apex of frons: Frl_1 contiguous to apex of frons; P_1 shifted above line Frl_2–Frl_2 (Figure 33). Dorsal teeth of mandibles form crenulate margin, main teeth identical, large (Figure 70, *2*). Setae III and IIIa on segment I set on minute common wart but separate [from each other]. Thoracic legs thick (Figure 66, *1*).

Body of mature larva pilose. Anterior part of body enlarged. Dorsal side of segments II, III, and I velvety, bluish-black, and in normal posture of larva (with head drawn in) black, velvety, with intense bluish tinge. Head pale yellow, with pattern of first type (Figure 56, *3*). Thoracic shield black, anal shield yellowish. Warts IX + X on thoracic shield black, and with long cluster of setae. Warts absent on anal shield. On segments II and III, warts I + II large, with cluster of long blackish and reddish setae. On abdominal segments, warts I yellowish or reddish, while II, III, and V reddish or red with black setae. Length of black setae up to 9.0 mm. Stigmata oval, white, with black edge and ring of white pigment. Thoracic legs black, abdominal legs brown. Pattern: dorsal band white, on thoracic shield narrow, continuous; on segment II often not seen; on segment III in form of transverse line in posterior part; on abdominal segments, except for 8, 9, and 10, narrow between warts and in anterior and posterior parts of segments forms long transverse lines interrupted in last third of segment. Subdorsal band white, in form of large spots. Suprastigmal band

red, in form of spots. Stigmal band red, surrounds stigmata on each segment, in form of quadrangular spot. Substigmal band on all thoracic segments and abdominal segments 1 and 2 broad, white, and continuous; on rest of segments in form of large white, longitudinal, obliquely disposed spots. Ventral side black, matte. Body length 29 to 47 mm and width of head 3.8 to 4.0 mm.

Development: I-instar. Newly hatched larva matte white, poorly mobile; body short and thick. Head black; cephalic setae significantly shorter than on body. Shields brown; minute secondary setae present on thorax. Warts on body large, colorless. On segments I and II warts I and II fused; four setae set on common wart. On abdominal segments warts I and II not joined; wart I with three setae and warts II and III with one seta each. Sclerotization of warts continues for 10 to 15 hrs, after which they turn brown. Setae black, strong, highly acuminate, and long (over 0.5 mm). Stigmata light-colored, roundish, with dark-colored edge. Thoracic legs black; abdominal legs dark brown and all five pairs developed. Feeding larva green. At middle of instar, light-yellow dorsal, subdorsal, and suprastigmal bands become visible. By end of instar body covered with brownish-red pigment. Warts encircled with light-yellow pigment. Length of newly hatched larva 2.7 to 2.9 mm, before molt 5.0 mm, and width of head 0.58 mm.

II-instar. There are a small number of secondary setae, shorter than the primary on warts; head black. Pattern and body color same as at the end of the I-instar. Body length 5 to 8 mm and width of head 0.83 to 0.85 mm.

III- instar. Body brown and pilose. Head black, with two matte yellow, interrupted submedial bands (Figure 56, *3*). Thoracic shield brown, with minute warts I and II; warts IX and X fused. On prothorax warts IV and V fuse into single large brownish-yellow wart. On meso- and metathorax warts I and II fused. On abdominal segments wart I small, II significantly larger, brownish-gray. On segments III, 1, and 8, warts black; all other warts brownish-gray. Anal shield brownish-gray. Setae black and brownish-gray. Primary setae significantly longer than secondary. Legs yellowish-brown, abdominal legs with large brown spots on outer side. Pattern: dorsal band not broad, white, extends along all segments except segment 8. In posterior part of each abdominal segment, dorsal band intersected by transverse white stria. Subdorsal band in form of light-colored spots. Dorsal field light colored and subdorsal brown. Substigmatal band light brown, bordered dorsally and ventrally by white dots. Ventral side brown. Body length 8.0 to 13.0 mm and width of head 1.28 to 1.30 mm.

IV-instar. Main body color grayish-brown, with admixture of white, black, and orange tones. Head black, with white submedial band; frons

black (Figure 56, *3*). Thoracic shield black; setae I and II set on light-colored spots; warts IX + X small. On segment I warts IV + V very large, reddish. On abdominal segments wart I small, white; II very large, yellowish-orange; and III orange. On segments 1 and 8 wart II very large. Stigmata oval, orange, with black edge. Legs brown, thick. Pattern: dorsal band white, not broad, interrupted at margins of segments. On segment 1 [dorsal band], twice as large [as elsewhere], forming transverse smears. Band enlarged to less extent on other segments except segment 8. Subdorsal band orange, rather broad, extends along line of wart II. Ventral to latter lies very narrow orange suprastigmal band encompassing wart III. Stigmal band orange, in form of rectangular spots surrounding stigmata. Dorsal and subdorsal fields covered with fine silvery-gray striae. Substigmal band broad, white, manifested only in anterior half of each segment. Ventral side brown. By end of instar anterior part of body very prominent due to intensification of black pigment in dorso-anterior parts of segments II, III, and posterior part of segment 1. Warts on these segments large, which somewhat broadens and raises this part of body. Subdorsal bands acquire reddish tinge. Body length 14 to 21 mm and width of head 1.8 to 2.0 mm.

V-instar. In color and pattern larvae almost indistinguishable from the VI-instar. Setae on warts somewhat fewer and shorter, 7.0 mm in length. Body length 20 to 28 mm and width of head 2.6 to 2.8 mm.

In Belorussia larval development from second to third week of August to end of month. Food plants: spruce, pine, fir, and larch.

Recently hatched larvae remain together up to II-instar, then crawl away, live singly, and feed on needles. Pupation of larvae occurs in dense cocoons on old needles. Pupa hibernates.

Eggs laid on needles in regular rows, somewhat imbricate, but not dense. They are ocherous-yellow, hemispherical, 0.96 to 1.10 mm in diameter, and 0.67 to 0.70 mm in height. Ribs dense, 40 to 42, of which 20 to 22 reach micropylar zone. Micropylar rosette consists of 10 to 12 lobes surrounded by 4 or 5 rims. Transverse ribs, 17 to 20. Eggs change color gradually; initially very dense yellow, later reddish-yellow, yellowish-brown, reddish-brown with violet hue, gray, and dark gray. Before larva hatches black head visible through apex of chorion.

2. Genus *Calocasia* Ochs.

(One species in Belorussian fauna)

Calocasia coryli L. (silkworm moth)

Mature larva: Head with secondary setae. Seta P_1 located almost on same horizontal line as setae Frl_2–Frl_2. Labrum with deep notch (Figure 66, *3*). Postclypeus without notch. Mandibles with only two teeth, all other teeth reduced (Figure 70, *1*). Setae on inner side at end of tarsi of thoracic

legs enlarged, lanceolate (Figure 64, *2*). On segments 1 to 8 warts III and IV fused (Figure 69, *1*). On segment 9 warts I, II, and III contiguous (Figure 69, *2*). Skin granulated.

Body color of larvae in our material light-yellow. According to published information (Kozhanchikov, 1950; Beck, 1960), body color varies from yellowish-white to reddish- or dull white. According to Kozhanchikov, larvae recovered from shady and damp places are darker. Head light-yellow with brownish pattern of first type. According to Beck, in darker specimens head black or black with yellow spots. Thoracic shield of light-colored specimens gray, of dark-colored ones black. Anal shield not prominent. Warts not large, with clusters of pinnate setae (Figure 27, *5*). In warts III of thoracic segment II long dense clusters of black setae turned sideways and somewhat forward. On segments 1 and 2 warts I contiguous, with single, rather short cluster each of orange, reddish, or rusty setae turned upward. On segment 8 warts I also contiguous, with single, rather short cluster of black setae turned upward. Pattern: dorsal band black or dark brownish-gray, broad, sometimes interrupted in middle of segments and at their margins. Subdorsal and suprastigmal bands gray. Stigmal band in form of black smears around stigmata. Substigmal band yellow, fairly broad, with uneven borders, and black transverse striae. Ventral side greenish-gray. Body length 38 mm and width of head 3.0 to 3.1 mm.

Larval development from early August to middle or end of September. Food plants: beech, birch, oak, hornbeam, hazelnut, alder, mountain ash, maple, and linden.

From the I-instar, larvae live singly after attaching themselves to leaves with gossamer threads. Larvae of older instars make compact small nests of leaves during molt. Larvae of all instars may feed on birch, oak, hornbeam, beech, and hazelnut; alder and crack willow are unsuitable for young instars. Pupation occurs between leaves bound together by gossamer threads. Pupa hibernates.

According to Döring (1955), eggs pearly white with carmine-red girdle and 20 large ribs. Micropylar rosette with 8 to 9 lobes. According to Kozhanchikov (1950), eggs whitish-yellow; brownish girdle appears 2 or 3 days later; diameter of egg 0.30 to 0.50 mm. Eggs laid singly on underside of plant leaves, mostly on birch.

3. Genus *Episema* Ochs.
(One species in Belorussian fauna)

Episema caeruleocephala L. (figure-of-eight moth)

Mature larva: Head without secondary setae. Seta P_1 almost on same line as Frl_2–Frl_2. Postclypeus without notch at center. Mandibles with

two or three well-developed teeth; dorsal teeth almost reduced. Secondary setae present only on abdominal legs of segments 3 to 6, absent on body (Figure 63). On prothorax seta IIIa dorsal to seta III. On segments II and III, warts I and II fused and form single wart with two setae. Setae IV and V on these same segments also on single wart. Largest warts in these segments bearing setae I and II. On segments 1 to 6 two setae each occur only on warts VI (Figure 63). On segment 9 all warts separate. Skin covered with minute spinules.

Mature larva bluish- or greenish-white with admixture of bright yellow and black, cylindrical. Head bluish-white with barely visible pattern of first type (Figure 48, *1*). In occipital-sincipital section large black spot encompasses seta P_2. Somewhat smaller black spot also present posterior to semicircle of orbits. Labrum bluish-white, mandibles black. Shields not separate. Warts of trunk large, black, rounded, densely covered with fine spines (velvety); warts on shields smaller. Setae black, not long, acuminate. Stigmata oval, black, with thin black edge. Thoracic legs black, with narrow longitudinal light-colored spots. Abdominal legs greenish-yellow. Pattern: dorsal band bright yellow, broad, pinched, and interrupted at margins of abdominal segments; on thoracic shield in form of two spots elongated transversely between setae I, II, and IX, X; on segments II and 8 band broadens into continuous longitudinal spot reaching warts III. Subdorsal band faint, pale yellow, narrow, and continuous. Substigmal band bright yellow; lower border even, upper one sinuate. Ventral side light green. Body length 28 to 43 mm and width of head 3.0 mm.

Larval development in Belorussia from end of April or early May to middle or end of June. Food plants: pear, plum, apple, hazelnut, and hawthorn. Kozhanchikov (1950) also included oak, poplar, and willow. We found larvae on fruit trees, mountain ash, and hawthorn.

Eggs laid in clusters of 7 to 40 and covered with scales and hairs from abdomen. They are grayish-white, hemispherical, 1.0 to 1.0 mm in diameter, and 0.70 to 0.75 mm in height. Ribs 16, large. Micropylar rosette with 15 lobes and surrounded by 4 rims.

4. Genus *Daseochaeta* Warr.

(One species in Belorussian fauna)

Daseochaeta alpium Osb. (lichen moth)

Mature larva: Head with secondary setae. Primary setae fairly prominent. Seta P_1 shifted posteriorad to horizontal line of Frl_2–Frl_2. Seta Frl_1 disposed at very apex of frons. Postclypeus at center with notch (Figure 33). Labrum without notch. Main teeth of mandibles well developed, ventral and dorsal ones reduced (Figure 70, *2*). Secondary setae on body disposed mainly on warts and found singly outside them. On

thoracic legs secondary setae occur only on coxae. Tarsi with weak, flat, lanceolate inner setae (Figure 64, *2*). On segment 9 warts I, II, and III highly contiguous, on all other segments widely set.

Body gray or brownish-gray. Head matte white, with dark brown or black pattern of first type (Figure 48, *1*). Spots so dense that head often appears black. According to Kozhanchikov (1950), head black. Shields not prominent. Warts small, flat, rarely with brownish-yellow tender setae up to 3.0 mm long. Largest warts I, II, and III, located on segment 8. Thoracic legs dark colored while abdominal ones similar in color to sides of abdomen. Pattern: dorsal band white, narrow, manifested only on segments I and II. Subdorsal and suprastigmal bands in form of longitudinal white or yellowish spots. Dorsal field dark brown with white spots. Characteristic feature of this species elongated large spots stretched transversely, not broad, yellowish-white, on dorsal side of metathorax and segments 1, 3, and 6. Sometimes these spots present on other abdominal segments also. Subdorsal field yellowish-gray. Substigmal band reddish-yellow or matte red in form of scattered spots; in early instars this band continuous and not broad. Ventral side pinkish-brown. Body length reaches 37 mm and width of head 3.0 mm.

Larval development from early July to end of August. Food plants: oak, birch, beech, black poplar, and mountain ash.

Young instars confined to nests and live singly during IV- and V- instars. Pupation in bark crevices in light cocoon. Pupae hibernate.

According to Doring (1955), eggs hemispherical, pale yellow, 0.70 to 0.75 mm in diameter, and 0.40 to 0.45 mm in height. Ribs 27 to 28, small, sinuous. Micropylar rosette with 6 to 9 lobes surrounded by reticulate structure. Close to micropylar zone one or two crescent-shaped spots distinct. Color of eggs does not vary. Eggs laid on leaves in clusters of 30 to 40 each.

5. Genus *Subacronicta* Kozh.

(One species investigated)

Subacronicta megacephala Schiff. (gray dagger moth)

Mature larva: Head with no secondary setae. Seta P_1 shifted upward from line of setae Frl_2–Frl_2. Seta Frl_1 located almost at center of frons. Postclypeus without notch. On segments II and III warts I and II contiguous (Figure 71, *2*), and warts IV and V fused. Skin covered with minute spinules.

Larva cylindrical, brownish or cinnamon-brown. Head black, with broad, white, almost straight submedial bands that enlarge anteriorad and encompass antennal bases; bands do not reach adfrontal sclerites; adfrontal sclerites, epicranial suture, and frons white; longitudinal black spot seen on frons. Seta L_1 prominent on white spot against black background of

head. Parietal section of submedial band with groups of minute rust-colored spots (Figure 71, *I*). Shields black. Warts I, II, and III yellow, small, and rounded; IV, V, and VI flat, much larger. On segments II, III, and 1 to 8, warts I, II, and III with single seta (Figure 65); several secondary setae present only on wart II of segment 8. Warts IV, V, and VI with large number of secondary setae so that sides of larva appear pilose. Setae up to 5.0 mm in length. Stigmata black, oval, with narrow black margin that broadens and turns yellowish-red along edge. Legs yellow. Pattern: dorsal band very narrow, light colored, seen only on thoracic shield. Dorsal field rather densely but uniformly covered at center of segment with silver-white spots and along margins with minute round pinkish spots. Characteristic feature of species: large, almost squared spot on segment 7, occupying entire width of dorsal field. Spot encircled by black pigment. Subdorsal and substigmatal bands not seen. Ventral side white, sometimes with dark brownish striae. Body length 26 to 40 mm and width of head 3.50 mm.

I-instar. Newly hatched larva cylindrical. Prothoracic and all abdominal segments except segment 7 yellowish-pink; segments II, III, and 7 colorless. Sometimes these three segments remain colorless throughout the I-instar but more often segments II and III acquire yellowish-pink tone within 24 hrs and only segment 7 remains light-colored. Head black. Thoracic shield broad, gray, gradually turns brown later; anal shield not prominent. Warts prominent, though small on shields. Each wart with one seta. Warts IV of segments 3 to 6 with two setae each. Warts I and II on segments II and III highly contiguous. Setae black, strong, and long (up to 0.70 mm). Thoracic legs dark; abdominal legs gray and all five pairs developed. Body length of recently hatched larva 2.0 mm, before molt 4.0 mm, and width of head 0.42 to 0.43 mm.

Larval development in Belorussia in May, June, August, and September. Food plants: poplar and willow.

Larvae live singly from the I-instar. Pupae hibernate.

Eggs laid singly on underside of plant leaves. They bulge slightly, are greenish-yellow, 1.18 to 1.22 mm in diameter, and 0.20 to 0.30 mm in height. Ribs 60 to 64, of which 30 to 32 reach micropylar zone. Rosette with 12 lobes. Minute brownish specks, 10 to 15, visible on shell after 24 hrs, which later turn black. Egg turns dark gray before larva hatches; body of larva translucent.

6. Genus *Acronicta* Ochs.

Larval body with secondary setae only on warts or throughout body except in *A. alni* (secondary setae totally absent). Head with either secondary (*A. psi, A. tridens,* and *A. cuspis*) or only primary setae. Head black

throughout or black with light-colored adfrontal sclerites. Seta P_1 above line of Frl_2–$Frl._2$. Postclypeus without notch at center. Mandibles with poorly developed ventral tooth, often with well-developed median tooth, and almost reduced dorsal teeth; inner tooth broad. On prothorax seta IIIa slightly ventral to seta III. On meso- and metathorax seta IIIa piliform and isolated; setae IV and V located on same wart; wart VI isolated. Secondary setae present on coxae, femurs, and partly on tibiae of thoracic legs. On abdominal segments warts III and IV isolated, while warts I and III on segment 9 fused. Body granulated or covered with minute spinules.

Characteristic position of setae on head, thorax, and abdomen, as well as other features led Beck (1960) to divide the genus *Acronicta* (*Apatele*) into three groups: I—*A. psi* and *A. tridens*; II—*A. alni, A. megacephala, A. leporina,* and *A. aceris*; and III—*A. rumicis* and *A. auricoma.*

Key to Species

1 (6). Head with secondary setae. Fused warts I–I on segment 1 form rather long prominence (Figure 29). Bright spots extend transversely on subdorsal field.

2 (3). Fused warts I–I on segment 1 long, length 2.0 to 2.5 times width, covered with sparse, rather short setae (Figure 29). Dorsal band broad, yellow. In subdorsal field each segment with two red spots extending transversely. Larvae up to 46 mm long..... ..... 6. **A. psi** L.

3 (2). Fused warts I–I on segment 1 not long, length equal to or less than width.

4 (5). Length of fused warts I–I on segment 1 almost equal to width; warts covered with sparse setae, without clusters. Dorsal band broad, orange. In subdorsal field each segment with two white and two orange spots (Figure 43, *2*). Larvae up to 44 mm long. ..... 5. **A. tridens** Schiff.

5 (4). Length of fused warts I–I on segment 1 less than their width; warts with cluster of long black setae. Dorsal band broad, yellow or greenish-yellow. In subdorsal field each segment with two red spots. Larvae up to 42 mm long..... 4. **A. cuspis** Hbn.

6 (1). Head without secondary setae. Warts I–I on segment 1 not fused but separate. In subdorsal field, variegated transversely extended spots absent.

7 (8). Secondary setae absent throughout body. On segments I and 1 to 9, except 7, seta II long, oar-shaped (Figure 27, *6*). Body black. In dorsal field each segment with whitish-yellow spot. Larva up to 38 mm long..... 3. **A. alni** L.

8 (7). Body with secondary setae. Oar-shaped setae present only in *A. leporina* L. Body pattern different.

9 (14). Secondary setae located only on warts. Warts dilated and rounded.

10 (11). Warts small, light colored. Dorsal field almost monochromatic, reddish-brown, differs sharply from general green color of larval body. Segment 8 highly dilated in form of pecten. Larvae up to 22 mm long..... 7. **A. strigosa** Schiff.

11 (10). Warts large. Color of dorsal field does not differ sharply from general color of larval body. Segment 8 not dilated or slightly so, not in form of pecten.

12 (13). Pattern on body variegated. Dorsal band yellow or red, subdorsal band in form of large oblique white spots (Figure 43, *1*). Substigmal band white, broad, orange in region of stigmata. Warts black, white, and red. Larvae up to 42 mm long..... ..... 9. **A. rumicis** L.

13 (12). Body black throughout or light brown with orange or red warts. Larvae up to 42 mm long..... 8. **A. auricoma** Schiff.

14 (9). Secondary setae located both on warts and outside them. Warts flat, barely protrude.

15 (16). Large clusters of long red setae turned sideways on warts, as a result white rhombic spots fringed with black distinct on dorsal band. Larvae up to 45 mm long..... 1. **A. aceris** L.

16 (15). Long white (at end of last instar smoky-gray or dark brown) setae envelop entire larval body. Dorsal band dark and narrow, or absent. In younger instars dorsal field of segments 1, 3, 4, and 8 with unpaired clusters of black setae. Larvae up to 43 mm long..... 2. **A. leporina** L.

1. **Acronicta aceris** L. (sycamore moth)

Mature larva: Head without secondary setae. Seta P_1 shifted upward, in line with setae Frl_2–Frl_2. Secondary setae dense on skin of trunk, soft, branched, with highly sclerotized base (Figure 27, *4*). Coxae of thoracic legs with secondary setae. Skin of young instars granulated; in older instars granules transform into minute spinelike papillae (Figure 26, *4*). Warts flat but prominent (Figure 67).

Larval body in last instar after molt pinkish, later darkens and acquires lilac tinge. Toward end of instar body turns lilac-brown. Head black with light yellow adfrontal sclerites. Secondary setae long (up to 8.0 mm), yellow and reddish; primary setae do not differ from secondary. Toward end of instar all setae rust-colored. Dorsal setae turned sideways. Warts flat, barely discernible. Stigmata oval, dark, with black edge. Thoracic legs black; abdominal legs color of body. Pattern: dorsal band white, on

segments II and III broad, uneven; on abdominal segments, except 9 and 10, in form of irregular rhombi surrounded by black pigment. Subdorsal band not seen. Substigmal band broad, dirty yellow, somewhat lighter than body in dark-colored specimens, and ventral border barely visible. Color of ventral side same as dorsal. Body length 32 to 45 mm and width of head 4.0 mm.

Development: I-instar. Body of newly hatched larva colorless. Warts I, II, and III on segments 1 to 8, except 2 and 7, edged with pinkish-yellow pigment. Head black. Thoracic shield light brown, anal shield colorless. On segments 1 to 8 wart I with two setae (Figure 67). Abdominal segments 1, 3, 4, and 8 turn brown after 4 or 5 hrs. Setae long, more than 0.50 mm, black, weakly branched. Legs light-colored; all five pairs of abdominal legs developed. In the I-instar segments II, 2, 6, and 7 remain light-colored but warts on them turn dark. Length of just hatched larva 2.0 mm, before molt 4.0 mm, and width of head 0.41 mm.

II-instar. Color of body and setae same as in the I-instar. Number of setae on warts increases (Figure 67). Head black. Dorsal band (one light-colored dot on each segment) barely perceptible. Legs light brown. Body length 4.0 to 6.0 mm and width of head 0.90 mm.

III-instar. Body dark brown except segments 2, 6, and 7, which remain light-colored. Head black with white longitudinal spots on upper section of adfrontal sutures. Two round warts with large number of secondary setae located on thoracic shield. Narrow light-colored dorsal band extends between warts. On segments 2, 6, and 7 warts small, white, with white setae; on segments 1, 3, 4, 5, and 8 warts large and brown. On segments II and III, warts II white with white setae. Legs brown. Pattern: dorsal band in form of single large white dot on each segment, and continues onto thoracic shield. Subdorsal band matte white, weakly manifested. Fairly broad white suprastigmal band extends along line of warts III. Dorsal field brownish-yellow, subdorsal dark brown. Stigmata oval, yellow, slightly edged with white pigment. Substigmal band broad and white. Ventral side brown. Body length 7.0 to 10.0 mm and width of head 1.20 to 1.30 mm.

IV-instar. Color and pattern on head and trunk same as in the III-instar. Major difference, long (over 2.0 mm) white setae turned sideways on warts III of almost all segments. Body length 9.0 to 14.0 mm and width of head 1.60 to 1.70 mm.

V-instar. Body yellowish-gray, with admixture of brownish-red with minute white flecks. Head black, with white longitudinal spots along adfrontal sutures and light-colored setae. On thoracic segments II and III warts I black, II white, and III and IV yellowish-gray; on segments 2, 6, and 7 warts small, white, with white setae; on segments 1, 3, 4, and 5 warts I black, with black setae reddish in distal part. On skin around these

warts, dense rusty-red setae form together with setae of warts I and II clusters that diverge sideways. Setae long, up to 5.0 mm. Pattern same as in the VI-instar. Body length 15 to 20 mm and width of head 2.20 mm.

Larval development in Belorussia from mid-June to end of August. Sometimes larvae encountered until mid-September. Food plants: maple, horse chestnut, walnut, oak, poplar, alder, beech, willow, birch, hazelnut, elm, and mountain ash.

The sycamore moth severely damages maple, horse chestnut, and other deciduous trees in Belorussia in years of mass reproduction. We found this moth in large numbers in 1951 to 1953.

Eggs laid on underside of plant leaves. They are yellowish-green, bulge slightly, 1.10 to 1.20 mm in diameter, and 0.25 to 0.30 mm in height. Ribs minute, 88 to 90, of which 24 to 28 reach micropylar zone. Rosette with 12 to 13 lobes and 1 or 2 rims. Tiny reddish spots visible under chorion on second or third day, which soon fuse and form grid. Chorion later lightens in color while grid darkens, turning reddish-brown. Before larva hatches egg dark gray and head of larva translucent, black.

2. **Acronicta leporina** L. (hare's ear moth)

Mature larva: Head without secondary setae. Warts on trunk flat and barely distinguishable. On segments 1, 3 to 5, and 8 setae of wart I oar-shaped but not as broad as in *A. alni* L. (Figure 27, *6*) and shorter than long (up to 8.0 mm), slender, soft white setae that densely cover entire body. Latter setae not upright but turned sideways and downward: dorsal ones turned to one side in such a way that larval body wholly enveloped in them; setae of thoracic segments turned somewhat anteriorad. On segments II and III warts I and II fused. Coxae of thoracic legs covered with small number of secondary setae. Skin slightly granulated.

Body slightly pinched toward anterior end, thick, and green. Head initially green, without pattern, but turns black at end of instar. Shields not prominent. Stigmata slightly oval, not large, yellowish-gray, with brown edging. Legs green; ungues of thoracic legs and hooks of abdominal legs light brown. Pattern absent initially. At end of instar white setae take on violet hue, thoracic shield turns dark brown, and narrow, light-colored dorsal band on shield darkens on trunk. Head also darkens. Setae later become smoky-gray and before pupation dark brown. Body length 27 to 43 mm and width of head 3.50 mm.

Clusters of black setae on dorsal side of segments 1, 3, 4, and 8 referred to in literature (Spuler, 1910; Beck, 1960) seen in our specimens only in the III- and IV-instars. In the V-instar only traces of such clusters were seen and in the VI-instar even these had disappeared.

In Belorussia larval development in July and August. Pupae hibernate. Food plants: birch, hornbeam, alder, and willow.

Eggs laid singly on underside of plant leaves. They are yellowish, 1.10 to 1.20 mm in diameter, and 0.30 to 0.40 mm in height. Ribs sinuous, 58 to 62, of which 15 to 17 reach micropylar zone. Micropylar rosette consists of 13 to 16 lobes and 2 rims. Egg darkens gradually, turning violet-gray before larva hatches.

3. **Acronicta alni** L. (alder moth)

Mature larva: Secondary setae absent on body and head. Warts I and II on meso- and metathorax separate. On segments 1 to 6 warts VI with two setae each, on segment 9 warts V also with two setae, and on segments 8 and 9 group VII likewise with two setae. Setae II on segments I and 1 to 9, except 7, long (up to 5.0 mm), oar-shaped (Figure 27, *6*). Setae IX and X also oar-shaped on prothorax.

Body of mature larva cylindrical, with slightly dilated segment 8. Color of trunk black. Dorsal side of each segment with large yellow spot extending transversely. Head black. Shields yellow. Warts minute; I and II on all segments pinkish. Stigmata black with thin black edge. Ventral side and legs black. Body length 38 mm and width of head 3.0 mm.

In Belorussia larval development in July and August. Food plants: birch, alder, oak, asp, hazelnut, and dog rose.

According to Kozhanchikov (1950) and Döring (1955), eggs bulge slightly, immediately after laying pale yellow, and acquire bright red or yellowish-brown reticulate pattern in 24 hrs. Diameter of egg 1.10 mm and height 0.34 to 0.38 mm. Ribs sinuous, 62 to 65, of which 27 to 30 reach micropylar zone. Micropylar rosette with 14 to 15 lobes and single rim.

4. **Acronicta cuspis** Hbn. (large dagger moth)

Mature larva: Head with secondary setae. Secondary setae also seen on body, especially in basal part. Warts I and II on meso- and metathorax fused. Coxae of thoracic legs with secondary setae. Skin covered with minute spinules. Warts I–I on segment 1 fused into single rather short (length less than width) black prominence, with long cluster of black setae.

Larva cylindrical, with significantly dilated segment 8. Main body color brown. Head black. Shields grayish-brown. Warts not large and with small number of secondary setae. In ventral section of subdorsal field in stigmal zone significant number of setae present on skin. Wart I on thoracic and abdominal segments, except 1 and 8, yellow with light-colored setae. On segments 1 and 8 these warts black or brownish, with black setae. Warts II and III on all segments black or brown, with black setae. Toward end of instar clusters of setae become rust-colored. Warts II on segment 8 contiguous and enlarge in form of pecten. Clusters of setae on fused warts I–I on segment 1 toward end of instar become rust-colored. Stigmata black,

oval, with thin black edge and light-colored background. Thoracic legs dark and abdominal legs gray. Pattern: dorsal band broad and yellow, acquiring pinkish tinge toward end of instar. This band vivid against brown background of dorsal field. Subdorsal band in form of transverse orangish-yellow spots, two spots on each segment. Subdorsal field brown, acquiring lilac or bluish tinge toward end of instar. Substigmal band grayish-yellow or light yellow, hardly discernible against grayish-yellow background of ventral side. Body length 28 to 42 mm and width of head 3.20 mm.

Species rare in Belorussia. Larval development from mid-July to end of September. Food plants: hazelnut, birch, and alder. Pupae hibernate.

According to Kozhanchikov, eggs bulge slightly, whitish-yellow in middle, about 1.0 mm in diameter, and with radially diverging ribs. They are laid singly on food plants.

5. **Acronicta tridens** Schiff. (trident moth)

Mature larva: Head with secondary setae. Secondary setae on trunk set on both warts and skin. Secondary setae occasional on skin on dorsal side but rather numerous laterally and on shields. On meso- and metathorax warts I and II fused. On slightly dilated segment 8, warts I and II separate, rather large, not high, flat. Warts I–I on segment 1 fused into single black, broad, and fairly high wart (height equal to width). Skin covered with minute spinules.

Body cylindrical, with dilated segment 8. Color yellowish-gray, with pattern of white, black, and orange. Head black, with gray secondary setae; epicranial suture and adfrontal sclerites light-colored, almost white; frons black, with light-colored longitudinal spot at center. Shields black, with black and light-colored secondary setae. Warts I–I on segment 1 covered with small number of setae, of which two primary setae longest and strongest and very prominent. Warts I, II, and III black, with small number of setae, of which primary setae longest and strongest. Setae up to 8.0 mm in length. On thoracic shield primary setae IX, X, I, and II likewise long and strong. Stigmata black, oval, with narrow black edge and white margin outside it. Thoracic legs black, abdominal legs brownish-gray with large black spot on outer side. Pattern: dorsal band orange, broad, uneven, pinched at warts I and enlarges beyond them, and yellow on thoracic segments. Band divided centrally by longitudinal black line that is distinct at margins of segments. Subdorsal band orange and white, in form of transverse spots arranged in a definite sequence: one orange spot in anterior half of segment and two spots in posterior half; one white elongated spot at center of segment and another located obliquely between warts I and II (Figure 43, *2*). Subdorsal band quite prominent against black background. Stigmal band white or gray, broad. Stigmata disposed at

center of stigmal band. Substigmal band orange, with distinct borders above and below, but yellow at margins of segments. In posterior part of segment 8 substigmal band fuses with dorsal band. In central part of segment 8 dorsal band white and warts I and II separated by white lines forming crosswise figure. Ventral side yellowish-gray, with light-colored band along medial line. Body length 28 to 44 mm and width of head 3.0 mm.

Development: I-instar. Body of just hatched larva colorless. Warts I and II on segments 1, 4, 5, and 8 edged with reddish-yellow pigment. Head black. Shields reddish-yellow, with colorless, rather large warts. Latter also colorless and large on trunk except for segment 7 (small). Setae I and II on meso- and metathorax set on common wart. Setae black, up to 0.70 mm long. Body later acquires yellowish tinge, and segments 1, 4, 5, and 8 darken. Legs light-colored; all five pairs of abdominal legs developed. Body length of newly hatched larva 1.90 to 2.0 mm, before molt 3.6 to 3.8 mm, and width of head 0.34 to 0.35 mm.

II-instar. Body yellowish, with very dark segments 1 and 8. Head black. Shields dark brown. Warts on trunk large, brown, smaller than on shields. On segment 1 warts I–I contiguous and enlarged. Setae black, long, longest on wart III. Legs brownish. Pattern: dorsal and subdrosal band light-colored, with uneven edges, and indistinct. Body length 3.80 to 5.50 mm and width of head 0.52 to 0.55 mm.

Larval development in Belorussia from early July through middle or end of September. Food plants: plum, pear, apple, hawthorn, mountain ash, birch, alder, willow, and others. One generation in Belorussia. Pupae hibernate.

Eggs laid singly on underside of plant leaves. They bulge slightly, are 1.0 mm in diameter, and 0.40 mm in height. Ribs sinuous, 52 to 54, of which 16 or 17 reach micropylar zone. Micropylar rosette consists of 10 to 12 lobes surrounded by 2 minute rims. Color of egg pale green. For the first few days eggs light in color but later acquire yellowish tinge. Minute dark specks and dark dots seen two or three days later on shell in micropylar zone. Before larva hatches, black head and much darker body segments translucent.

6. **Acronicta psi** L. (gray dagger moth)

Mature larva: Head with secondary setae. Secondary setae on body long (up to 6.0 mm), denser in basal field. Secondary setae likewise present on coxae of legs. Warts I and II on meso- and metathorax fused. Skin covered with very minute, heterogenous spines. Large warts I–I on segment 1 fused and form long projection 2.5 to 3.0 mm in length (Figure 29).

Body cylindrical, with pectenlike prominence on segment 8. Color of dorsal side dark brown, abdominal and lateral sides gray. Head black with dark red adfrontal sclerites and epicranial suture. Shields black. Protrusion formed by fusion of warts I–I on segment 1 densely covered with short pubescence and rarely with long setae (Figure 29). Warts II on segment 8 high, highly contiguous, resemble small growth. Stigmata black, oval, broad, with black edge. Pattern: dorsal band broad, yellow, entirely or only partly encompasses wart I. On segment 8 band narrows since warts II highly contiguous. Subdorsal band in form of red spots extending transversely. Each segment with two or three spots along sides of warts II and III. Dorsal and substigmal bands toward end of instar acquire bluish hue, subdorsal band retains red color, and ventral side bluish-gray. Body length 29 to 46 mm and width of head 3.10 to 3.20 mm.

Development: I-instar. Recently hatched larva with rust-colored segments 1, 4, 5, and 8; other segments colorless. Head black. Shields light gray. Warts light-colored, large. Setae I and II on meso- and metathorax disposed on single wart. After 4 or 5 hrs warts darken and turn brown, thoracic shield black, and segments 1, 4, 5, and 8 brown. Setae black, up to 0.70 mm long. Thoracic legs dark, abdominal legs light-colored and all five pairs developed. Body length of just hatched larva 1.75 to 1.80 mm, before molt 3.50 to 3.80 mm, and width of head 0.34 to 0.38 mm.

II-instar. Segments 1, 4, 5, and 8 brownish-red; other segments reddish-yellow. Head black, shields brown, almost black, with minute secondary setae. Each wart with five to six secondary setae. Warts I–I on segment 1 black, large, and highly contiguous (Figure 29, *I*). On segment 7 warts small, light yellow. Thoracic legs dark and abdominal light-colored. Pattern: dorsal band broad, on thoracic segments and abdominal segments 2, 3, 6, and 7 band yellow, on segments 4 and 5 gray, and on segments 1 and 8 absent. Substigmal band pale yellow, distinct on thoracic segments and abdominal segments 2, 3, 6, and 8. Body length 3.5 to 5.0 mm and width of head 0.59 to 0.60 mm.

III-instar. Body brown, with broad reddish-yellow dorsal band and well distinguished segments. Head black, with short secondary setae. Shields dark brown, with narrow dorsal band. Warts I–I on segment 1 fused at base, only apices separate (Figure 29, III). Segments 1 and 8 black. Primary setae long and black, while secondary setae half their length. Legs brown. Pattern: dorsal band reddish-yellow, broad, narrow on segment 8, and broken on segment 1. Subdorsal band reddish-yellow, faint. Subdorsal field brown. Substigmal band also reddish-yellow, narrow, distinct only on thoracic segments. All bands at commencement of instar white, turn reddish-yellow later. Body length 5.0 to 8.0 mm and width of head 0.90 to 0.96 mm.

IV-instar. Body yellowish and segments 1 and 8 black. Head black with reddish longitudinal spots around frontal sutures. Shields black with narrow yellow dorsal band. Warts I on all segments except 1 and 8 small, yellow, with large black primary setae and minute light-colored secondary setae. Warts II and III black with black setae. On all warts primary setae strong, up to 1.7 mm long. Close to warts IV, V, and VI, small number of secondary setae present on skin. Stigmata light colored, oval, with black edge. Legs gray; abdominal legs with large black spot on outer side. Pattern: dorsal band very broad, yellow, encompasses warts I, edges even; band absent on segments 1 and 8. Subdorsal band yellow and consists of separate spots. Main color of dorsal and subdorsal fields black. Substigmal band broad, yellow on thoracic segments, and reddish on abdominal segments. Ventral side reddish-brown. Body length 7.0 to 10.0 mm and width of head 1.18 to 1.20 mm.

V-instar. Color of body and pattern same as in the IV-instar. Increased fusion of warts I–I on segment 1 sometimes apparent; warts form prominence 1.5 times greater in length than width with two apices projecting in distal part (Figure 29, V). Secondary setae long, almost same length as primary. Subdorsal band in form of transversely elongated red spots. Body length 8 to 15 mm and width of head 1.51 to 1.52 mm.

VI-instar. Larvae differ very little in color and pattern from those of the VII-instar. It should be noted that the color of the dorsal and substigmal bands remains yellow even at the end of this instar. Ventral side reddish-gray or brownish-pink. Body length 14 to 28 mm and width of head 2.0 to 2.1 mm.

In Belorussia larval development from early June to mid-July and early August to middle or end of September. Two generations. Food plants: birch, alder, hazelnut, hornbeam, oak, birch, mountain ash, hawthorn, apple, plum, pear, willow, and others. According to Kozhanchikov (1950), larvae in the north develop predominantly on birches and in the south, on Rosales and willows. Pupae hibernate.

Eggs laid singly on underside of plant leaves. They are light yellow, flat, bulge slightly on dorsal side, 0.96 to 0.99 mm in diameter, and 0.25 to 0.30 mm in height. Ribs 52 to 56, of which 20 to 24 reach micropylar zone. Micropylar rosette consists of 13 to 15 lobes and is surrounded by 2 rims. Eggs gradually lighten in color and turn pale yellow to almost white; larval body apparent. Before larva hatches, brownish and later black head and four rust-colored spots, two disposed in a row, become apparent; these spots represent rust-colored segments 1, 4, 5, and 8.

7. **Acronicta strigosa** Schiff. (little bristly moth)

Mature larva: Head without secondary setae. Secondary setae on trunk few and located only on warts. On segment 8 prominence pectenlike. Warts

small, notably more prominent on segments 1 and 8, especially II and I, with those on II larger than on I. Warts encircled by ring of black pigment.

Body slightly pinched toward anterior end, green; dorsal field reddish-brown. Head dark brown, with light yellow or whitish adfrontal sclerites. Setae dark brown, warts light-colored. Wart II on segment 1 with 9 to 10 setae, wart I with 5 to 7. Wart II on other segments with 5 or 6 setae, wart I with 3 or 4. Setae variable (2.0 to 4.0 mm). Stigmata oval, yellowish, with dark brown edge. Legs green; abdominal legs five pairs, with reddish hooks. Pattern: dorsal field yellowish, on thoracic shield and segments I and III narrow, with distinct margins; somewhat shaded on abdominal segments. Subdorsal band yellowish, narrow, and faint. Dorsal field monochromatic, reddish-brown. Subdorsal field green. Substigmal band yellowish-green, almost not differing from green ventral side and subdorsal field. Body length 15 to 22 mm and width of head 1.8 to 2.0 mm.

In Belorussia larval development in July and September. Pupae hibernate. Food plants: hawthorn, house plum, black thorn, apple, and buckthorn.

8. **Acronicta auricoma** Schiff. (brownish-gray dagger moth)

Mature larva: Head without secondary setae. P_1 almost on same transverse line as Frl_2–Frl_2. Femur and tibia of abdominal legs with secondary setae. Latter occur on trunk only on warts. Skin covered with minute spines. On segment 8 wart I larger than wart II.

Body black, cylindrical, with slightly dilated segment 8. Head black with yellowish-brown adfrontal sclerites. Warts rounded, orange. Wart I somewhat larger than wart II and brighter. Setae long (up to 3.0 mm), rust, yellow, or orange. Shields black. Stigmata light brown or black, with thin black edge. Legs black or dark brown. Body without pattern. Length of body 26 to 42 mm and width of head 3.0 mm.

According to Kozhanchikov (1950), color of mature larvae variable and in this respect, can be divided into two types: larvae of first type rust-colored, with light yellowish head, trunk, legs, and light yellow warts; second type with black body and blackish-brown warts. In some specimens color of body and warts dark or black while setae yellow. Sometimes in dark-colored specimens not only setae, but also warts yellow. Kozhanchikov established experimentally that the color of the larvae of *A. auricoma* represents a genetic phenomenon.

In Belorussia larval development in June and August. Evidently two generations per year. Food plants: birch, willow, raspberry, oak, hornbeam, mountain ash, elm, pear, plum, and others. Kozhanchikov pointed out that typical habitats for this species are forest clearances, marshy places (old peat bogs) covered with heath, and shrubs of birch and willow. Pupae hibernate.

According to Kozhanchikov (1950) and Doring (1955), eggs bulge slightly, yellowish, 0.90 mm in diameter, and 0.40 to 0.45 mm in height. Ribs slightly sinuous, 50 in number, of which 25 reach micropylar zone. Micropylar rosette consists of 11 lobes and 2 rims.

9. **Acronicta rumicis** L. (knot-grass moth)

Mature larva: Secondary setae located only on warts but rather dense and hence, larva appears highly pubescent (Figure 68, *2*). Head without secondary setae. Femurs and tibiae of thoracic legs with secondary setae. Warts I on segment 8 significantly larger than warts II. Skin covered with minute spines.

Body thick, pilose, with slightly enlarged segments 1 and 8, due mainly to intense development of warts on these segments. Color brown. Head black, with yellowish-red or pinkish adfrontal sclerites and epicranial suture. Shields black; two large black warts separated by narrow white dorsal band on thorax. Setae long (up to 3.50 mm). On segment 1 warts I, II, and III black and large; on segment 8 warts II and III black, ventral region of wart I white. Wart V on all these segments red. Stigmata oval, broad, white, with thin black edge. Legs brown, with black wart on outer side. Pattern: dorsal band on meso- and metathorax yellow, not broad, and interrupted; on abdominal segments in form of irregularly round, large red spots, two on each segment. Spot located in posterior part of segment often extends notably in transverse direction. Subdorsal band white, also consists of large spots. Each spot encompassing ventral part of wart I, later enlarges downward and forward (Figure 43, *1*). Main color of dorsal and subdorsal fields black, speckled with fine brownish-gray transverse striae. Stigmal band black, narrows outside stigmata, enlarges around them, encompassing them on all sides. Substigmal band white and broad, red around wart V; wart also red. Ventral side brown. Body length 26 to 42 mm and width of head 2.9 to 3.0 mm.

Development: I-instar. Body of newly hatched larva short, yellowish-gray, and pilose. Head black. Thoracic shield light brown and anal shield grayish. Only primary setae set on small warts present on thoracic shield. On meso- and metathorax setae I and II share common wart together with single secondary seta. On segments 1 to 8 wart I with five setae. All other warts with one seta each (Figure 68, *1*). On segments 1, 4, 5, and 8 warts rimmed with yellowish-brown striae, as a result of which these segments prominent among other colorless ones. After 3 or 4 hrs these segments acquire a dark brown tone. During the course of instar development secondary setae develop on warts I and II. Legs light-colored; all five pairs of abdominal legs developed. Body length of just hatched larva 2.0 mm, before molt 3.5 to 4.0 mm, and width of head 0.30 mm.

II-instar. Immediately after molt body same color as in the I-instar. On second day light-colored segments turn dark and entire body acquires brown tone. Many secondary setae appear on warts, especially on wart I of segments 1 and 8. Secondary setae also present on thoracic shield. Thoracic legs dark-colored and abdominal legs light-colored. Body length 4.0 to 6.0 mm and width of head 0.54 to 0.56 mm.

III-instar. Body brown. Head black. Thoracic shield with two large warts. Warts I and II of abdominal segments with up to 10 secondary setae. Setae [relatively] long (up to 0.8 mm), black. Stigmata small, rounded, light-colored, with thin black edge. Skin coarse grained. Thoracic legs black, abdominal legs brown. Pattern: dorsal band whitish, on thoracic segments narrow and continuous, and on abdominal segments in form of individual dots, one on each segment. Subdorsal band whitish, fairly broad, and uneven. Substigmal band reddish-yellow and broad. Ventral side light brown. Body length 5.0 to 10.0 mm and width of head 0.80 to 0.82 mm.

IV-instar. Body thick, dark brown, with somewhat enlarged segment 1. Head and shields black. Orange dorsal and subdorsal bands extend along shields. Warts black, with black setae. Warts II and III on dorsal side surrounded by white pigment. White pigment extends gradually to around wart I. Stigmata white and oval, with thin black edge. Thoracic legs black, abdominal legs brown, with black flat warts on outer side. Pattern: dorsal band orange, in form of large spots located anterior and posterior to warts I–I. Subdorsal band broad, yellow, with admixture of orange, continuous on thoracic and abdominal segments 7 and 8, and interrupted at places on rest of segments. Main background of dorsal field dark brown. Substigmal band broad, yellow, with even ventral and uneven dorsal border. In region of wart V band shifted dorsad, encompasses wart, and forms an orange spot there. Setae on wart V white. Ventral side light brown. Body length 10 to 16 mm and width of head 1.10 to 1.20 mm.

V-instar. Body cylindrical, with slightly enlarged segment 1 and dilated segment 8. Color grayish-brown, with pattern of black, white, and orange. Head black, with white or pink adfrontal sclerites. Warts on thoracic shield quite large and separated by narrow yellow dorsal band. Skin coarsely grained in form of papillae, between which minute spines scattered. Setae up to 2.5 mm long. Stigmata white, oval, with thin black edge. Thoracic legs black, abdominal legs reddish-brown. Pattern: dorsal band in form of separate yellowish-orange spots anterior and posterior to warts I–I. Subdorsal band considerably shifted dorsad and white; on meso- and metathorax band encompasses wart I completely, absent on segment 1, and encompasses ventral half of wart I on segments 2 to 8, influencing color of this wart in such a way that ventral part of wart white with whitish setae, and dorsal part with black setae. Subdorsal field

grayish-brown with white ringlets around warts II and III. Stigmata disposed on dark background of ventral region of subdorsal field. Substigmal band fairly broad with distinct borders, orange in region of wart V. Ventral side reddish-brown, with brown warts. Body length 15 to 27 mm and width of head 1.9 to 2.0 mm.

In Belorussia larval development from early June to mid-July and last few days of July to end of August. Two generations. Highly polyphagous species. Main food plants: willows (mostly with smooth leaves), birches, beeches, Rosales, buckwheat, and others. Sometimes larvae damage fruit trees and apple gardens. Pupae hibernate.

Eggs laid in clusters of 30 to 50 each on plant leaves in single imbricate layer. They are light yellow, bulge slightly on dorsal side, 0.9 to 1.0 mm in diameter, and 0.48 to 0.50 mm in height. Ribs 54 to 56, of which 17 to 19 reach micropylar zone. Micropylar rosette consists of 14 to 16 lobes and 2 rims.

Subfamily Agrotinae

Larvae mostly colored in dark shades. Body usually almost cylindrical; considerably pinched toward anterior end with dilated segment 8 in *Axylia putris* and *Ochropleura plecta*. Skin in most species smooth, but in some *Agrotis,* coarsely shagreen. Head light-colored, with very dark pattern of second type (Figure 49, *1, 3, 7,* and *8*). Epicranial suture equal to height of frons or slightly shorter; in some species exceeds height of frons and very short in *Euxoa* and *Agrotis* . Spinneret broad, almost not pinched toward end, even slightly enlarged in some species. Length of spinneret variable: in *Aplecta* and *Diarsia* exceeds length of first segment of labial palpus; in *Triphaena, Axylia, Lycophotia, Graphiphora,* and *Ochropleura* almost equal to it; in *Agrotis* and *Euxoa* reaches only half length of first segment of labial palpus (Figure 17, *6*). Distal end of spinneret with fringe of dents (Figure 73, *1–16*). First seta of labial palpus small, truncated, often equal to second segment. In *Graphiphora ashworthii, Aplecta prasina,* and almost all *Agrotis,* first seta extremely minute and may be considered rudimentary; second seta longer than first but also very short except in *Ochropleura plecta* in which it is almost equal to first segment of palpus. Mandibles in Agrotinae with well-developed main teeth; dorsal tooth often with notch. Setae short, dark-colored, and acuminate. In *Agrotis* and *Euxoa* presence of large pinacula characteristic feature. Substigmal band extends onto anal leg. Abdominal legs, five pairs. Members of this subfamily undergo five molts; only *Graphiphora ashworthii* molts six times.

Kozhanchikov (1937) divided the subfamily Agrotinae into two tribes—Triphaenini and Agrotini. The tribe Agrotini includes (from among

those described by us in this work) the genera *Axylia, Diarsia, Ochropleura, Agrotis,* and *Euxoa.* Ryabov (1951) established that, based on the structure of the genitalia of moths and especially on the morphology and biology of the larval phases (length of epicranial suture, structure of spinneret, etc.), the genera *Axylia, Diarsia,* and *Ochropleura* should be removed from the tribe Agrotini. In this case the tribe Agrotini would represent a separate group of cutworms. We concur in Ryabov's suggested revision.

Key to Tribes

1 (2). Epicranial suture very short, not more than half height of frons or adfrontal sclerites extend to parietal notch. Parietal apices project notably (Figure 11). Skin coarsely or finely grained. Setae on moderately sclerotized pinacula. Spinneret not longer than half first segment of labial palpus..... 2. **Agrotini.**

2 (1). Epicranial suture long, equal to height of frons or slightly shorter, more rarely exceeds height of frons. Skin smooth, pinacula absent. Setae on dark- or light-colored spots. Spinneret longer than half first segment of labial palpus or equal to it ..... 1. **Triphaenini.**

Tribe Triphaenini

Larvae live freely on herbaceous plants or trees. During the day they hide between leaves or in leaf litter. Body cylindrical, sometimes with dilated segment 8; color green, with admixture of dark, rarely light and even bright (red and yellow) tones. Pattern on trunk distinct. Head with long epicranial suture, sometimes exceeding height of frons. Spinneret equal to first segment of labial palpus or somewhat longer. In younger instars silky threads attach larvae to plants.

Key to Genera

1 (4). Segment 8 highly dilated, resembles tubercle. Body notably pinched anteriorad.

2 (3). Dorsal band in form of chain of minute and large white spots, with largest spot located in posterior part of each segment. Upper border of subdorsal band on abdominal segments greatly enlarged and shaded in form of semicircular shadows up to setae I and II (Figure 72, *9*)..... 5. **Axylia.**

3 (2). Dorsal band in form of small, white equal-sized spots. Upper border of subdorsal band not enlarged, narrow, barely visible. ..... 8. **Ochropleura.**

4 (1). Segment 8 slightly dilated or not at all. Body only slightly pinched anteriorad.

5 (10). On segment III setae I and II, microscopic setae IXa, IXb, and sometimes Xa and Xb located on large white spots (Figure 72, *2*).

6 (9). Stigmal band absent. Subdorsal band without oblique light-colored striae.

7 (8). Anterior part of head ventrad to submedial band light colored or totally white. Dorsal band in form of minute light-colored dots. Dorsal field significantly lighter than subdorsal; latter without oblique dark-colored striae between segments..... ..... 6. **Diarsia.**

8 (7). Anterior part of head not light-colored. Dorsal band continuous, whitish. Dorsal field not lighter than subdorsal; dark-colored oblique striae extend from setae IV to III of preceding segment. ..... 1. **Triphaena** (in part).

9 (6). Stigmal band present, black, greatly enlarged in stigmal zone. Dorsal band very narrow, light-colored. Dorsal and subdorsal fields concolorous. Each segment of subdorsal field with two light-colored oblique lines commencing in region of stigmata and ending at posterior boundary of segment..... 7. **Naenia.**

10 (5). On segment III setae I and II located in minute black or white spots. Light-colored spots absent around microscopic setae Xa and Xb and IXa and IXb.

11 (14). Stigmal band distinct, black, highly enlarged in region of stigmata.

12 (13). Dorsal and subdorsal bands continuous, narrow, whitish. Middle of dorsal field on each abdominal segment with large velvety, black semicircular spots (Figure 72, *10*). Setae located on minute, light-colored spots..... 4. **Aplecta.**

13 (12). Dorsal and subdorsal bands interrupted in form of row of minute, light-colored dots. If dorsal band continuous, then subdorsal considerably wider. Velvety, black semicircular spots absent in dorsal field; instead fairly distinct herringbone pattern present or upper border of subdorsal band in form of longitudinal dark-colored spots (Figure 54, *3, 4*)..... ..... 1. **Triphaena** (in part).

14 (11). Stigmal band absent. Sometimes small concentrations of dark-colored pigment visible around stigmata.

15 (16). Dorsal band very broad, interrupted (Figure 72, *7*), or in form of minute yellowish spots. In latter case characteristic pattern visible on dorsal field (Figure 72, *1*)..... 3. **Lycophotia.**

16 (15). Dorsal band continuous or in form of row of dots. In dorsal field pattern of herringbone, rhombic, or rectangular spots

distinct (Figure 72, *3, 6*) and on segment 8 cuneate spots often visible; edges of spots do not reach dorsal line (Figure 54, *6*). ..... 2. **Graphiphora.**

1. Genus *Triphaena* Hbn.

Body slightly pinched toward anterior end. Skin smooth. Pinacula absent. Setae located on general background of dark- or light-colored spots. Head light-colored, with pattern of second type (Figure 49, *1, 7*). Submedial bands broad, with distinct reticulate structure. Spinneret somewhat longer than first segment of labial palpus, sometimes pinched toward end, with length greater than width; dorsal side of spinneret opening with fringe or dents (Figure 73, *1, 2, 3*).

Key to Species

1 (4). Stigmal band black, narrow, greatly enlarged around stigmata (Figure 55, *3*).

2 (3). Dorsal band in form of minute light-colored dots. Upper border of subdorsal band forms herringbone pattern. Pattern on head of second type (Figure 49, *1*). Dorsal region of spinneret opening with dents (Figure 73, *3*). Larvae up to 45 mm long..... ..... 3. **T. augur** F.

3 (2). Dorsal band continuous, narrow, yellowish: subdorsal band yellow, broad, even. Upper border or subdorsal band in form of black longitudinal spots; cuneate spots absent on segment 8. Pattern on head of second type (Figure 49, *7*). Dorsal region of spinneret opening with long fringe (Figure 73, *2*). Larvae up to 55 mm long. ..... 2. **T. pronuba** L.

4 (1). Stigmal band absent. Dorsal and subdorsal bands continuous, not broad, whitish. Upper border of subdorsal band in form of dark longitudinal spots; cuneate spots present on segment 8. Setae I, II, and X located on white spots. Dorsal region of spinneret opening with long fringe (Figure 73, *1*). Larvae up to 40 mm long. ..... 1. **T. orbona** Hufn.

1. **Triphaena orbona** Hufn. (small lunar yellow underwing moth)

Mature larva: Spinneret equal to first segment of labial palpus. Dorsal region of spinneret opening with large, sharply pointed fringe (Figure 73, *1*). Second seta of labial palpus 2.0 times longer than first. Postgenal sclerites not contiguous (Pi = 1/5). Distance between Frl_1 and Frl_2 1.5 times distance between Frl_1 and F_1. Mandibles with large inner tooth. Metathoracic coxae contiguous. Hooks on abdominal legs: 17–22, 18–24, 20–25, 28–32, and 34–38.

Body cylindrical, slightly pinched toward anterior end, reddish-yellow or reddish-brown. Head dull yellow, with dark brown pattern of second type (Figure 49, *7*). Shields slightly darker than general body color. Dorsal and subdorsal bands fairly broad on thoracic shield, while only subdorsal bands distinct on anal shield. Setae rusty-brown, acuminate, set on light-colored spots; large white spots of setae I, II, and X very prominent. Stigmata oval, light yellow, with thin black edging. Thoracic legs brownish-yellow, abdominal legs greenish-gray. Pattern: dorsal band whitish, continuous, and not broad; subdorsal band same width and color as dorsal. Ventral border of subdorsal band narrow, fairly even, light brown, barely perceptible or imperceptible; dorsal border in anterior half of each segment darker, narrow on thoracic segments, and gradually broadens on abdominal segments to form indistinct cuneate spots on segments 7 and 8; cuneate spots on segment 8 reach dorsal line, i.e., merge (Figure 54, *5*). Dorsal field yellowish-gray, densely covered with yellow and reddish dots, grouped in posterior part of each segment. Fine light brown striae sparsely interspersed among light-colored dots and denser in anterior part of segments and around dorsal band. Subdorsal field yellowish-gray, almost uniformly covered with yellowish and reddish dots; reddish dots slightly denser in stigmal zone; fine brownish striae sparsely scattered but posterior to stigmata denser and form oblique smears. Substigmal band fairly broad, orange-yellow below and above, and with reddish-brown minute smears at center. Ventral side greenish-gray with yellow and reddish dots. Body length 28 to 40 mm and width of head 3.0 mm.

Larvae found in Belorussia in August. Food plants: *Galium,* nettle, clover, *Stellaria,* primula, and sheep's sorrel.

According to Döring (1936), eggs yellowish-white, spherical, with flat base, 0.50 to 0.53 mm in diameter, and 0.30 mm in height. Ribs 27 to 28, of which 9 or 10 reach micropylar zone. Micropylar rosette consists of 11 to 12 lobes.

2. **Triphaena pronuba** L. (large lunar yellow underwing moth)

Mature larva: Spinneret slightly longer than first segment of labial palpus. Opening on dorsal side with long, sharply pointed fringe (Figure 73, *2*). Second seta of labial palpus 2.0 times shorter than first segment and 2.5 times longer than first seta. Postgenal sclerites not contiguous (Pi = 1/6). Distance between setae Frl_1–Frl_2 slightly more than distance between Frl_1–F_1. Mandibles with strong inner tooth. Metathoracic coxae not contiguous, distance between them 5.0 times less than between setae VIII–VIII. Hooks of abdominal legs: 12–13, 15–17, 16–18, 18–21, and 22–26.

Body greenish-brown, slightly pinched toward anterior end. Head hazy yellow, with pattern of second type (Figure 49, *7*). Submedial bands dark brown or black, reticulate structure reddish-brown, and frons black. Setae dark brown, acuminate, without pinacula and spots at base. Shields not prominent. Stigmata reddish-yellow with black edge and legs greenish. Pattern: dorsal band whitish, continuous, and extremely narrow. Subdorsal band broad, light yellow or greenish-yellow, its borders black, narrowing ventrally, very broad in form of longitudinal spots from dorsal to anterior half of abdominal segments (Figure 54, *4*). Dorsal field dark, violet-brown, especially in anterior half of segments. Subdorsal field greenish-brown or reddish-brown, with dark brown or black shaded spots. Stigmal band black, narrow, broadening notably around stigmata (Figure 55, *3*). Substigmal band fairly broad, yellow, with distinct borders; pattern similar to that of light green or yellowish-green venter, but scattered yellow and reddish dots denser than on ventral side. Body length 34 to 55 mm and width of head 3.8 to 4.0 mm.

Development: I-instar. Just hatched larva yellowish, with translucent yellowish-red intestine, light brown shields and pinacula, and black head. Compared to body width, head quite large. Setae black, on head and shields acuminate, on segments I, II, III, 7, 8, and 9 piliform; on remaining segments clavate with minute heads. In feeding larvae, body remains yellowish, turning green only in region of intestine. Pinacula brown, fairly well sclerotized, and large; pinacula III largest. Stigmata rounded, light-colored, with brown edge. Thoracic legs yellowish; abdominal legs light-colored, with large dark spots on outer side. Legs underdeveloped on segments 3 and 4. Length of just hatched larva 1.7 to 1.8 mm, before molt 3.2 to 3.5 mm, and width of head 0.27 mm.

II-instar. Body yellowish, cylindrical, with translucent green intestine. Head pinkish-yellow, with brown spots around setae and poorly discernible pattern of first type. Pinacula fairly high, weakly sclerotized, with short black setae that broaden somewhat at center of abdominal segments. Thoracic shield yellowish-brown, anal shield not prominent. Pinacula on shields dark brown, small. Stigmata light-colored, with brown edge. Thoracic legs dark colored; abdominal legs light-colored, underdeveloped on segments 3 and 4. Pattern: dorsal and subdorsal bands light-colored, whitish, narrow, and faintly visible. Substigmal band broad, whitish, distinct. Body length 3.3 to 7.0 mm and width of head 0.50 to 0.55 mm.

III-instar. Body cylindrical, well proportioned, green; in some specimens admixture of brown present, especially in subdorsal fields. Head yellowish, with faintly visible submedial band and reticulate structure. Pinacula small and black. Shields not prominent. Stigmata slightly oval, light-colored, with thin black edge. Thoracic legs yellowish; abdominal

legs green, anterior pair poorly developed. Pattern: dorsal and subdorsal bands white, fairly broad, with even borders; by end of instar very narrow green or light brown edging formed along borders of bands. In green specimens dorsal field green, subdorsal field dark green; in dark-colored specimens admixture of brown and red pigments occurs in dorsal field, more particularly in subdorsal field. Substigmal band broad, white above and below, green at some places in center. Ventral side green. Body length 8.0 to 13.0 mm and width of head 0.90 to 0.98 mm.

IV-instar. Body green or yellowish-brown. Head greenish-yellow or brownish-yellow, with very dark submedial bands and reticulate structure. Sometimes bands very faintly visible. Setae light brown, attenuate slightly toward end but not pointed, and located on minute dark spots. Pinacula absent. Shields not prominent; pinacula and spots absent around setae on shields. Stigmata oval, light-colored on all segments, disposed on substigmal band, and same color as band except on prothoracic segment and segment 8. Thoracic legs light-colored; abdominal legs green or reddish-brown and all five pairs developed. Pattern: dorsal band quite broad, even; in green specimens yellow and in brownish ones with admixture of reddish-violet; in green specimens rather narrow dark green edging and in brownish specimens dark brown. Subdorsal band same color and width as dorsal; upper border in anterior half of segments broad and black, in form of smears, and identical on all segments. Dorsal field green or light yellowish-brown. Subdorsal field somewhat darker. Both dorsal and subdorsal fields with scattered, rather dense yellow dots edged and fine brown striae. Substigmal band broad, yellow in green specimens, and with admixture of reddish-brown pigment in brown ones. Body length 14 to 22 mm and width of head 1.50 to 1.60 mm.

V-instar. Body cylindrical, green or greenish-brown. In color and pattern of head and trunk, larva almost indistinguishable from the VI-instar. Dorsal field densely covered with yellowish dots and fine brown striae, which concentrate around dorsal band and form large, faintly discernible rhombi at center of segments. Body length 23 to 35 mm and width of head 2.30 to 2.50 mm.

In Belorussia larval development from early August to September. Larvae of the VI-instar hibernate. Larvae which successfully complete feeding pupate and hibernate as pupae. Food plants: Compositae, cereals, buckwheat, Chenopodiaceae, and others. This moth is widely polyphagous.

Eggs laid on underside of plant leaves in large clusters (100 or more eggs in each) in a single contiguous layer. They are spherical, with flat base, 0.53 to 0.54 mm in diameter, and 0.38 to 0.40 mm in height. Ribs 32 to 34, of which 15 to 18 reach micropylar zone. Micropylar rosette con-

sists of 12 to 14 lobes and single rim. On second day large light brown spot and girdle of same color at equatorial line distinct in micropylar zone. Spot and girdle broaden and fuse so that upper part of egg turns light brown, while lower part remains light yellow. Before larva hatches egg dark brown and larva with translucent, black head.

3. **Triphaena augur** Fg. (augur moth)

Mature larva: Spinneret somewhat narrow toward end, slightly longer than first segment of labial palpus, and 2.0 times more than its width. Ventral region of opening concave, dorsal region with sharp dents (Figure 73, *3*); second seta equal to first segment and 3.0 times longer than first seta. Postgenal sclerites not contiguous (Pi = 1/6). Mandibles with large inner tooth. Metathoracic coxae not contiguous; distance between them half distance between setae VIII–VIII. Hooks of abdominal legs: 26–27, 27–28, 29–32, 36–38, and 46–48.

Body greenish-brown, slightly pinched toward anterior end; segment 8 somewhat dilated. Head yellow, with brown pattern of second type (Figure 49, *1*). Setae light brown, set on small black spots, with rather large light yellow spots present on outer side. Shields brown; small dark-colored spot occurs next to seta IX on thoracic shield. Stigmata yellow, oval, with thin black edge. Legs light-colored, abdominal legs with small dark-colored spots on outer sides. Pattern: dorsal and subdorsal bands in form of chain of minute, light yellow spots and bordered with fine brown striae. Upper border of subdorsal band interrupted and shifted dorsad at center of segments, resulting in herringbone pattern. At end of instar herringbone pattern almost absent. On segment 7 upper border broad and dark; cuneate spots on segment 8 joined at one corner (Figure 54, *5*). Dorsal field lighter then subdorsal. Both dorsal and subdorsal fields with mass of light yellow dots and bordered with fine brown striae; latter denser on subdorsal field. Stigmal band black, uneven, broadens around stigmata (Figure 55, *3*). Substigmal band orangish-yellow, with distinct borders above and below. Toward end of instar brown striae form on band. Ventral side greenish or pinkish with mass of yellowish dots; in some specimens brown striae occur in basal field. Body length 28 to 42 mm and width of head 3.0 to 3.1 mm.

Development: I-instar. Body of newly hatched larva muddy yellow, cylindrical. Head black and lustrous. Pinacula not large, not sclerotized. Shields light brown; setae fairly long, brown, and acuminate. Stigmata on small tubercles, light-colored, rounded, with dark-colored edge. Legs dark-colored; abdominal legs on segments 3 and 4 underdeveloped. Green intestine visible in feeding larvae. Pinacula brown and sclerotization proceeds for 2 to 3 hrs. Body length of just hatched larva 3.0 mm, before molt 4.5 mm, and width of head 0.36 to 0.38 mm.

II-instar. Body green. Head brownish, with very dark spots around setae. Pinacula black. Shields light brown, with dark pinacula. Setae brown, acuminate. Stigmata with dark-colored edge. Thoracic legs dark-colored; abdominal legs light-colored and first two pairs underdeveloped. Pattern: dorsal and subdorsal bands in form of chain of large white spots. Substigmal band white, with indistinct lower border. Body length 5.0 to 8.0 mm and width of head 0.56 to 0.58 mm.

III-instar. Body dark green, with admixture of brown. Head brownish and lustrous. Pinacula large, flat, dark brown. Thoracic shield brown, with admixture of gray, with very dark shaded spots around setae. Setae slender, rusty-brown, and acuminate. Stigmata round, light-colored, with thin black edge. Thoracic legs dark-colored; abdominal legs light-colored and all five pairs developed. Pattern: dorsal band in form of chain of white spots, with spots at end of segment largest. On first five abdominal segments, at center and along sides of band, two large spots disposed crosswise on each segment. Border of band dark green, with admixture of brown, broadest at margins of segments where it forms two oblique smears—one extending forward on anterior segment, the other backward on posterior segment. Subdorsal band in form of uniformly disposed dots. Upper border brownish, broadens in first half of segment. Suprastigmal band in form of row of faint white dots. Stigmal band seen as even dark line. Substigmal band light-colored, greenish-brown at places. Ventral side grayish-brown. Body length 7.0 to 12.0 mm and width of head 0.77 to 0.86 mm.

IV-instar. Body green, with admixture of brownish-red. Head yellowish-brown, with dark brown pattern of second type (Figure 49, *1*). Setae brownish-red, strong, acuminate, and located on round black spots. Shields greenish or brown; spots with setae on them small, black. Stigmata light-colored and oval. Thoracic legs dark-colored; abdominal legs light-colored, with rounded black spots on outer side. Pattern: in this instar light-colored, yellowish-gray dorsal field well distinguished from dark-colored subdorsal field. Black spots around setae, large white spots of dorsal band, and dense white spots encircling black spot around seta I very distinct. Dorsal band border with green or brownish-yellow pigment. Subdorsal band consists of white spots which in posterior half of segment are shifted upward to seta II. Upper border of band at center of segment also shifted upward. Subdorsal field dark with sparse scattered white spots. Stigmal band not prominent against dark-colored background. Substigmal band bordered by yellow dots, and yellowish-red at center. Ventral side green, with yellow dots; light brown striae scattered on basal field. Body length 13 to 18 mm and width of head 1.20 to 1.30 mm.

V-instar. Larvae differ little from the VI-instar. Dorsal field ash-gray, significantly lighter in color than subdorsal; large white spots encircling

microscopic setae X distinctly visible. Upper border of subdorsal band interrupted and shifted upward at center of segments to form faint herringbone pattern. Stigmal band black and uneven; descends in zone of stigmata, contouring upper border of substigmal band. Borders of latter distinct. Basal field with scattered brown striae. Body length 17 to 27 mm and width of head 2.0 to 2.1 mm.

In Belorussia larval development from mid-July to end of August. Larvae of the VI-instar hibernate. Small percentage of larvae pupate mid-September. Food plants: raspberry, hawthorn, Compositae, willow, beech, and others.

Eggs laid in large clusters in single layer of irregular rows. They are almost spherical, with flat base, 0.75 to 0.78 mm in diameter, 0.56 to 0.63 mm in height, lustrous, and light green. Ribs 32 to 34, of which 12 to 15 reach micropylar zone. Micropylar rosette consists of 12 to 14 lobes surrounded by single rim of large lobes. Within 24 hrs dark lines appear on egg which gradually broaden and fuse into ellipsoidal girdle. Shell turns yellowish, but before larva hatches becomes gray. Head of larva translucent, black.

2. Genus *Graphiphora* Ochs.

Body slightly pinched toward anterior end. Color dark. Dorsal field with herringbone pattern of dark longitudinal spots. Skin in younger instars granulated but smooth in IV- to VI-instars. In the I- to III-instars, setae located on pinacula and dark spots, but outside them [dark spots] in the IV- to VI-instars. Pattern on head of second type (Figure 49, *7*). Teeth of mandibles normally developed; inner tooth present in some species. Distance between M_1 and M_2 almost same as distance between M_2 and *Mi*. Spinneret equal to second segment of labial palpus, rarely longer, with length equal to its width, and sometimes broadens toward end. Ventral edge of spinneret opening often dome-shaped and dorsal edge fringed or dentate (Figure 73, *4, 8*). First seta of labial palpus shorter than second segment and second seta 2.0 to 5.0 times shorter than first segment. Postgenal sclerites not contiguous (Pi = 1/5, 1/6). Metathoracic coxae not contiguous.

Key to Species

1 (2). Dorsal and subdorsal fields rather broad, light yellow, and continuous. Subdorsal field sharply separated into light-colored dorsal section and dark-colored ventral section. Larvae up to 40 mm long..... 6. **G. xanthographa** Schiff.

2 (1). Dorsal and subdorsal bands narrow, often interrupted, or in

form of row of minute spots. Subdorsal field monotoned or with dark striae, but not separated into two sections.

3 (6). Herringbone pattern occurs on dorsal field of abdominal segments; long, broad, cuneate spots present on segments.

4 (5). On thoracic shield setae IX, X, I, and II located on black spots. Dorsal band in form of minute hazy white dots. Body yellowish-brown with admixture of red. Ventral region of spinneret opening convoluted, dorsal with long fringe (Figure 73, *6*). Larvae up to 35 mm long..... 3. **G. triangulum** Hufn.

5 (4). On thoracic shield only setae IX and X located on minute black spots, I and II situated on general background of shield. Dorsal band narrow, almost continuous (Figure 72, *3*), light yellow. Body yellowish-green. Ventral edge of spinneret opening with irregular dentation, dorsal with long fringe. Larvae up to 38 mm long..... 2. **G. baja** Schiff.

6 (3). Herringbone pattern not seen on dorsal field. Upper border of subdorsal band in form of black longitudinal spots, which become narrower and cuneate on segments 7 and 8.

7 (8). Dorsal field at center of abdominal segments dark-colored, matte, in form of irregular rhombi. Subdorsal field with dark oblique smears extending from middle of segment back to stigmata of successive segment (Figure 72, *5*). Ventral region of spinneret opening divided by deep fissure, dorsal with tender fringe (Figure 73, *7*). Larvae up to 45 mm long..... ..... 4. **G. ditrapezium** Schiff.

8 (7). Dark rhombic spots absent on dorsal field and oblique smears absent on subdorsal field. Ventral edge of spinneret opening not divided.

9 (10). Cuneate spots on segments 7 and 8 black and velvety. Substigmal band almost not demarcated. Ventral edge of spinneret opening raised, dorsal with small fringe (Figure 73, *8*). Head yellow, with reddish-brown submedial bands and faint reticulate structure. Larvae up to 45 mm long.... 5. **G. ashworthii** Doub.

10 (9). Cuneate spots on segments 7 and 8 black but not velvety. Substigmal band yellow, but orange in stigmal zone. Ventral edge of spinneret opening with two dents, dorsal with fringe (Figure 73, *4*). Head yellow, with distinct brown pattern of second type (Figure 49, *7*). Larvae up to 42 mm long..... ..... 1. **G. c-nigrum** L.

1. **Graphiphora c-nigrum** L. (black-c owlet moth)

Mature larva: Spinneret slightly enlarged toward end, as long as first segment of labial palpus; length of spinneret equal to width; ventral edge of opening round, with two projections at middle; dorsal edge with fringe (Figure 73, *4*). First seta of labial palpus equal to second segment while second seta equal to 0.25 length of first segment. Seta P_1 somewhat closer to epicranial suture than to P_2. Hooks of abdominal legs: 17–19, 20–23, 25–27, 30–31, and 32–33.

Body pinched anteriorad, greenish-gray, with admixture of yellow. Head yellow, with brown pattern of second type (Figure 49, *7*); frons and adfrontal sclerites dark brown. Setae brown, sharply acuminate, and short (0.80 mm). Setae I and II on abdominal segments located on minute black spots; on thoracic shield setae set on general background. Shields barely discernible. Stigmata oval, white, with black edge. Thoracic legs yellowish-gray, abdominal legs greenish-gray. Pattern: dorsal band light yellow, narrow, simply dots at places (Figure 72, *4*). Borders of dorsal band light brown; at margins of segments dark brown or black in form of large spot masking the band; at center of segments borders highly shaded. Subdorsal band lighter colored and more prominent. On ventral side border dark gray, shaded; on dorsal side border in anterior half of each segment black, narrow on thoracic segments, and farther, toward posterior part of body, gradually enlarges to form increasingly broad black longitudinal spots. On segments 7 and 8 spots cuneate, not connected on segment 8 (Figure 72, *4*). Dorsal field yellowish-gray, subdorsal slightly darker; dark pigment intense around stigmata. Substigmal band broad, whitish, but orange in region of stigmata. Stigmata of segments 4 to 6 disposed in upper part of band. Ventral side greenish-gray, basal part somewhat darker. Body length 28 to 42 mm and width of head 2.90 to 3.0 mm.

Development: I-instar. Newly hatched larva cylindrical, yellowish, translucent with reddish-gray intestine. Head brown, shields light brown, pinacula light-colored, setae brittle, long (up to 0.155 mm), slightly pointed, and dark-colored; stigmata grayish rounded, and with brown edge. Thoracic legs dark-colored; abdominal legs light-colored, two anterior pairs underdeveloped. After 2 or 3 hrs head and pinacula turn blackish and shields brown. Body of larva green. Length of just hatched larva 1.7 to 1.8 mm, before molt 4.0 to 4.2 mm, and width of head 0.34 to 0.35 mm.

II-instar. Body green. Head yellowish, with large brown spots around setae. Pinacula black, well sclerotized, with white edge. Shields yellowish, slightly fringed with brown striae. Pinacula on shields small and brown. Setae dark-colored, fainter than in the I-instar. Stigmata light-colored, rounded, with black edge. Thoracic legs dark-colored; abdominal legs light-

colored and underdeveloped on segments 3 and 4. Pattern: dorsal and subdorsal bands not broad, white, and continuous. Color and width of suprastigmal band similar. Substigmal band white, not broad. Body length 4.5 to 7.0 mm and width of head 0.55 to 0.58 mm.

III-instar. Body green. Head greenish-yellow, with small brown spots around setae. Pinacula extremely small and black. Shields not prominent; small black spots visible around setae. Setae light brown, slender, slightly pointed. Stigmata light-colored, rounded, with black edge. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands in form of chain of minute yellowish dots, fused here and there. Dorsal field with dense yellowish dots. Suprastigmal band absent. Upper part of subdorsal field lighter in color, but with scattered yellowish dots; lower part dark green. Substigmal band not broad, light yellow, with distinct borders. Ventral side green, with scattered yellowish dots. Body length 7.0 to 12.0 mm and width of head 0.87 to 0.90 mm.

IV-instar. Body cylindrical, dark green. Head yellowish-green, with light brown pattern of first type. Pinacula absent; minute dark brown or black spots distinct around setae on body and on shields. Shields not so prominent. Setae short (0.80 mm), acuminate, dark. Stigmata light-colored, somewhat oval, with thin black edge except for first and last, and disposed on substigmal band. Legs green; all five abdominal pairs developed. Pattern: dorsal and subdorsal bands in form of faint chains of white dots. Dorsal band margined with dark green pigment. Margin enlarges at center of segment, forming moderately distinct large rhombic spots; corners of dorsal field on each segement yellowish-green. Subdorsal field dark green, with sparse scattered yellowish dots. Substigmal band bright yellow, with distinct borders. Ventral side green, slightly lighter than dorsal, with large number of yellowish dots. Body length 13 to 20 mm and width of head 1.25 to 1.30 mm.

V-instar. In color and pattern of head, and color of stigmata and setae, larvae do not differ from the VI-instar. Differ in setae IX and X located on black spots and I and II on general background on thoracic shield. Upper border of subdorsal band forms distinct herringbone pattern. Substigmal band broad and yellow, but white along dorsal border. Body length 19 to 27 mm and width of head 2.0 mm.

Two generations, from mid-June to mid-July and early August to mid-September. Larvae of IV- to VI-instars hibernate. Food plants: buckwheat, Chenopodiaceae, Cruciferae, Rosales, legumes, Solanaceae, Plantaginaceae, Compositae, and others. Species highly polyphagous.

Eggs laid singly, mostly on underside of plant leaves. They are almost spherical, with flat base, 0.60 to 0.62 mm in diameter, 0.40 to 0.50 mm in height, and pale yellow. Ribs 28 to 30, of which 13 to 15 reach

micropylar zone. Micropylar rosette consists of 15 to 18 lobes surrounded by single rim of large longitudinal lobes. After 24 hrs brownish-yellow spot and broad girdle of same color visible at apex, which later turn brownish. Subsequently egg turns brownish-gray.

2. **Graphiphora baja** Schiff. (bipunctate owlet moth)

Mature larva: Spinneret equal in length to first segment of labial palpus, even, broad, its length less than width; ventral edge of opening uneven and angular, dorsal edge with long fringe (Figure 73, *5*). First seta of labial palpus equal to second segment and second seta shorter than first segment. Hooks of abdominal legs: 24–28, 26–29, 30–33, 32–34, and 34–37.

Body significantly pinched toward anterior end, yellowish-green, with dark brown, almost black pattern. Head dark yellow with dull brown pattern of second type (Figure 49, *7*). Setae light brown, acuminate, and set on minute black spots on trunk. Thoracic shield slightly edged with brownish pigment. Anal shield not prominent; minute black spots present at base of setae IX and X, absent at base of setae I and II. Stigmata reddish, oval, with black edge. Legs light-colored. Pattern: dorsal and subdorsal bands light yellow, not broad, interrupted here and there (Figure 72, *3*). Dorsal band with brownish, almost black border around margins of segments. Upper border of subdorsal band dark and broad. Band and border shifted dorsad at center of segments; farther away border extends backward and fuses with that of dorsal band to form herringbone pattern. On segment 8 border enlarged in form of triangles. Right and left corners not fused. Subdorsal field at commencement of instar dark brown with minute yellowish dots. At end of instar sparse dark striae seen and subdorsal field indistinctly differentiated from dorsal. Stigmal band absent. Stigmata of segments 3 to 6 disposed in upper part of substigmal band. Substigmal band light yellow with admixture of orange and yellow. Ventral side dull green with mass of yellow dots and dark brownish striae in basal field. Body length 27 to 38 mm and width of head 2.9 to 3.0 mm.

Development: I-instar. Newly hatched larva colorless or feeble gray, cylindrical. Head dark yellow, without spots around setae of pattern. Pinacula large, not sclerotized; sclerotization proceeds for 60 to 90 min. Setae dark and acuminate. Shields light brown and thorax not fully sclerotized (Figure 59). Sclerotization of shield proceeds for 20 to 30 min. Stigmata round, light-colored, with dark-colored edge. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Feeding larvae take on green coloration. Shields brown and pinacula black. By end of instar darker but barely visible pattern of first type seen (Figure 48, *1*). Body length 1.8 to 2.0 mm, before molt 4.5 mm, and width of head 0.38 to 0.39 mm.

II-instar. Body green. Head yellow, with very distinct pattern of first type (Figure 48, *1*), and brown spots around setae. Pinacula on trunk black and small. Setae light brownish, acuminate. Shields light brown, with very dark pinacula. Stigmata round, light-colored, with brownish edging. Thoracic legs dark-colored; abdominal legs light-colored, and two anterior pairs underdeveloped. Pattern: dorsal and subdorsal bands white, narrow, and continuous. Substigmal band white, broad, with indistinct ventral border. Body length 4.5 to 6.5 mm and width of head 0.55 to 0.58 mm.

III-instar. Body green or with admixture of brown. Head dark brownish with distinct pattern of first type and dark brown spots around setae. Shields, pinacula, and legs same as in the II-instar. Pattern: dorsal and subdorsal bands white, narrow, and almost continuous. Dorsal band with brownish-green border that enlarges at center on each abdominal segment. Upper border of subdorsal band around setae II shifted upward and backward, on joining border of dorsal band forms branch of herringbone pattern. Subdorsal field brownish-green with prominent suprastigmal band of white dots. Substigmal band bordered above and below by white dots and green at center. Ventral side light green with yellowish dots. Body length 7.0 to 11.0 mm and width of head 0.78 to 0.80 mm.

IV-instar. Body light or dark brown with reddish-yellow dorsal field. Head reddish-yellow with pattern of second type; submedial bands brown, reticulate structure brownish-red (Figure 49, *7*). Setae brown, slightly pointed, located on black spots on body and shields. Stigmata oval, dark yellow, with thin black edge. Legs green with admixture of brown or reddish-brown; thoracic legs with large brown spot on outer side. Pattern: dorsal band in form of large white dots and subdorsal smaller with yellowish-brown border. Dorsal field reddish-yellow with brownish herringbone pattern. Subdorsal field dark brown with minute yellowish dots. Stigmata disposed around ventral edge of field. Substigmal band broad and yellow, or only bordered by yellow dots, with reddish-yellow or light brown striae at center. Ventral side yellowish with mass of white and yellowish dots. Body length 12 to 17 mm and width of head 1.27 to 1.30 mm.

V-instar. Body slightly pinched toward anterior end. In color and pattern larva almost indistinguishable from the IV-instar. Upper border of subdorsal band on posterior abdominal segments broader and on segment 8 in form of triangular spots. Dark-colored pigment accumulates somewhat more in subdorsal field. Center of substigmal band with admixture of orange. Body length 16 to 20 mm and width of head 1.8 to 2.0 m.

In Belorussia, larval development from last ten days of July to first few days of September. Larvae of IV- and VI-instars hibernate. Species

polyphagous. Food plants: Cruciferae, Plantaginaceae, Rosales, buckwheat, Chenopodiaceae, Saxifragaceae, Compositae, and others.

Eggs laid in clusters (5 to 200 eggs in each) in a single compact layer of regular rows. They are pale green, almost spherical, with flat base, 0.65 to 0.68 mm in diameter, and 0.55 to 0.60 mm in height. Ribs 30 to 34, of which 12 to 14 reach micropylar rosette. Latter consists of 12 to 14 lobes; rims absent. During embryonal development almost no change seen in color of eggs. One day before larva hatches, dark-colored mandibles visible and chorion turns ash-gray.

3. **Graphiphora triangulum** Hufn. (triangular owlet moth)

Mature larva: Spinneret equal in length to first segment of labial palpus, broad, not pinched toward end, longer than wide. Ventral edge of spinneret opening dome-shaped, dorsal edge with small but long fringe (Figure 73, *6*). First seta of labial palpus significantly shorter than second segment and second seta smaller than first segment about 5.0 times. Hooks on abdominal legs: 21–23, 23–25, 26–28, 29–32, and 33–35.

Body significantly pinched toward anterior end, greenish-yellow-brown, with small admixture of red. Head greenish-yellow, with dark brown pattern of second type (Figure 49, *7*). Setae rusty-brown, short, acuminate, disposed on minute black spots on body; large yellow dot occurs on ventral side of spots. On segment 8 seta I set on large black spot. Shields fringed with brown striae; minute black spots surround setae. Stigmata oval, yellow, with thin black edge. Legs same color as abdominal side of body. Pattern: dorsal field in form of row of very minute, dull yellow dots, covered at places with brown borders. Borders mostly broad and dark at margins of segments. Subdorsal band in form of chain of yellow dots, bordered with striae of brown pigment. At center of segment borders interrupted, shifted upward, forming indistinct herringbone pattern, and small cuneate spots on segments 7 and 8. Subdorsal field densely covered with yellow dots and fine brown striae. Substigmal band broad, yellowish, with admixture of red. Distinctly bordered on dorsal side by sparse yellow dots, which are scattered together with fine brown striae along band. Stigmata of segments 1 to 6 disposed in upper part of band. Ventral side yellowish-green with mass of yellow dots and fine brown striae. Body length 22 to 35 mm and width of head 2.8 to 3.0 mm.

Development: I-instar. Just hatched larva colorless, with visible intestine. Head dark brown, almost black, lustrous. Anal shield light-colored, thoracic brown, not completely sclerotized (Figure 59). Pinacula on body minute, unsclerotized; sclerotization continues for 1.5 to 2.0 hrs. Setae dark-colored, pointed, and slender. Stigmata light-colored, rounded, with thin black edge. Thoracic legs dark-colored; abdominal legs colorless and two anterior pairs underdeveloped. Skin finely grained. Feeding

larvae acquire green coloration; pinacula black. Body length of just hatched larva 2.5 to 2.6 mm, before molt 4.5 mm, and width of head 0.41 to 0.42 mm.

II-instar. Body green. Head light yellow, with black spots around setae. Pinacula on body very minute, dark brown, significantly larger on shields. Anal shield not prominent and thoracic shield pale yellowish-pink. Setae dark-colored and acuminate. Stigmata rounded, light-colored, with thin black edge. Thoracic legs dark-colored; abdominal legs green and underdeveloped on segments 3 and 4. Dorsal and subdorsal bands in form of chain of white rounded or longitudinal spots. Substigmal band barely perceptible, white. Body length 4.5 to 7.0 mm and width of head 0.58 to 0.62 mm.

III-instar. Body green, cylindrical. Head yellowish, with pink tinge and brown spots around setae. Pinacula absent; minute brown spots present at base of setae, significantly larger on thoracic shield. Shields margined with light brown striae. Dorsal and subdorsal bands faintly visible on shields. Setae rust-colored, slender, slightly pointed. Stigmata light-colored, rounded, with thin black edge. Thoracic legs dark-colored; abdominal legs light-colored and underdeveloped on segment 3. Pattern: dorsal band in form of row of longitudinal spots formed by fusion of individual dots, bordered with dark green pigment. Subdorsal band in form of chain of white dots, without distinct borders. Suprastigmal band white, rather prominent as independent stripe. Substigmal band fairly broad, bordered above and below by white striae and dots, green at center. Body length 6.8 to 10.5 mm and width of head 0.86 to 0.90 mm.

IV-instar. Larva yellowish-green, thick. Head dark yellow, with admixture of green, with brown spots around setae, indistinct submedial band, and reticulate structure. Setae rust-colored, short, acuminate, located at commencement of instar on small dark-colored spots; spots later disappear and setae rest on general background. Spots around setae preserved throughout instar on thoracic shield. Stigmata oval, light-colored, with thin black edge. Legs light-colored; all five abdominal pairs developed. Pattern: dorsal band consists of rather large white spots grouped mainly at margins of segments and bordered with dark brown pigment. Subdorsal band in form of row of very minute white spots uniformly but not densely arranged. In anterior half of each abdominal segment subdorsal band frilled with dark-colored pigment. Dorsal field covered with minute white dots, bordered at many places by striae of brown pigment. These striae intensely colored around subdorsal band in anterior half of segment and around dorsal field in posterior half, forming an indistinct herringbone pattern. Subdorsal field dark green with smaller number of light-colored dots than on dorsal field. Substigmal band bordered above and below by minute yellow dots, at center pinkish with scattered yellow dots.

Ventral side green with small number of yellow dots and dark brown spots around setae. Body length 10 to 16 mm and width of head 1.42 to 1.45 mm.

V-instar. In color and pattern larvae not distinguishable from the IV-instar. Body length 15 to 23 mm and width of head 1.9 to 2.0 mm.

Larval development in July and August. Larvae of the IV- and V-instars hibernate. Species polyphagous. Food plants: Compositae, legumes, Plantaginaceae, Cruciferae, willows, and birches. Under laboratory conditions, left free to choose their food, larvae avidly consumed leaves of cultivated plants: beet, lettuce, poppy, sunflower seeds, buckwheat, clover, and cucumber; sometimes they also fed on leaves of potato and oats.

Eggs laid on underside of plant leaves in clusters of 5 to 40 each, in one compact but not contiguous layer. Color pale yellow; shape cylindrical with flat base. Diameter 0.80 to 0.82 mm and height 0.68 to 0.71 mm. Ribs 38 to 44, of which 12 or 13 reach micropylar zone. Micropylar rosette consists of 15 or 16 lobes surrounded by 1 or 2 rims. Eggs darken gradually, turning ash-gray.

4. **Graphiphora ditrapezium** Schiff. (double trapezium owlet moth)

Mature larva: Spinneret equal in length to first segment of labial palpus, its length and width equal. Ventral region of spinneret opening rounded, with two projections; dorsal edge with fringe (Figure 73, *7*). First seta of labial palpus significantly smaller than second segment, while second seta 5.0 times smaller than first segment. Hooks of abdominal legs: 22–24, 25–27, 28–32, 34–37, and 39–42.

Main body color reddish-gray, with dark brown shading on dorsal side. Body somewhat pinched toward anterior end. Head reddish-yellow, with reddish-brown pattern of second type (Figure 49, *7*); labrum and antennae light-colored. Setae brown, short, sharply acuminate, located on minute black spots; white spots of same dimensions present on ventral side of black ones. Shields at end of instar devoid of spots with setae. Stigmata oval, reddish-yellow, with black edge. Shields somewhat darker than general color of body. Thoracic legs yellowish, abdominal legs light gray. Pattern: dorsal band in form of very small, reddish-yellow, sparse dots, marked at margins of segments with black pigment, and at center with light reddish-brown pigment. Dorsal field darkens on each abdominal segment; dark matte part in form of irregular rhombus. Subdorsal band formed by same dots as in dorsal band but dots more distinct. In anterior part of segments on dorsal side, border black, rather broad, enlarging and elongating toward posterior segments, and reaching posterior margin of segment 8. Light-colored sites visible on dorsal field in posterior part of segments around subdorsal band and hence, some semblance of her-

ringbone pattern seen. Lower margin of subdorsal band not prominent on dark pigment of subdorsal field. Subdorsal field with dark brown oblique smears extending from middle of segment back to stigmata of successive segment, and encompassing up to half of stigmata. Lower part of stigmata disposed on substigmal band. Substigmal band broad, with distinct borders, pale yellow, with admixture of pink, and fine brownish striae in zone of stigmata. Ventral side greenish-gray, with sparse pale yellow dots and brown striae in basal field. Body length 27 to 45 mm and width of head 2.9 to 3.0 mm.

Development: I-instar. Newly hatched larva pale yellow, translucent with visible reddish intestine. Pinacula fairly large, not sclerotized; sclerotization takes about 1.2 to 2.0 hrs, after which pinacula turn black. Skin of feeding larva light yellow, green only in region of filled intestine. Body length of just hatched larva 2.60 to 2.70 mm, before molt 4.50 mm, and width of head 0.42 to 0.44 mm.

II-instar. Body yellowish-green. Head dull yellow, with black spots around setae. Setae brownish, short, almost not pointed, and set on small black pinacula on body and shields. Shields greenish-yellow. Stigmata light-colored, rounded, with thin black edge. Thoracic legs yellowish, abdominal legs light-colored and underdeveloped on segments 3 and 4. Pattern: three narrow bands present, much lighter in color than body background—one unpaired dorsal and two subdorsal. Body length 4.5 to 7.0 mm and width of head 0.563 mm.

III-instar. Body green. Head pinkish-yellow. Setae rust-colored, piliform, and short. Pinacula very small. Shields slightly edged with brown pigment, significantly more on thoracic pinacula IX and X than on I and II. Dorsal and subdorsal bands represented on shields as light-colored spots. Stigmata round, dull pink, with black edge. Thoracic legs yellowish; abdominal legs green and underdeveloped on segment 4. Pattern: dorsal band consists of row of rather large longitudinal light-colored spots and subdorsal band of much smaller spots. Toward end of instar rather narrow, shaded brown margin develops around dorsal band. Substigmal band green at center and bordered by large white spots above and below. Ventral side green with sparse white dots. Body length 7.0 to 11.0 mm and width of head 0.86 to 0.88 mm.

IV-instar. Larva reddish-brown, with violet tinge. Head reddish-yellow, with brown submedial band and reticulate structure. Pinacula absent and setae set on minute dark-colored spots on body. White spot on ventral side of dark spot of setae I and II. Shields not prominent; spots at base of setae absent; dorsal band on thoracic shield narrow, continuous, white; and subdorsal band in form of dots. Setae reddish-brown, acuminate. Stigmata oval, light-colored, with black edge. Legs light-colored; all five abdominal pairs developed. Pattern: dorsal band in form

of white dots of different size, small at center of segments and very large at margins. Latter bordered with almost black pigment. In center of segments border of dorsal band lighter in color, highly shaded in form of fine striae. Similar striae fill entire middle region of dorsal field of segment extending up to subdorsal bands and form dark, matte, irregular rhombic spots on abdominal segments. Margins of segments with triangular reddish-yellow areas with violet tinge. Subdorsal band in form of chain of rather large white dots bordered below with brown striae; on dorsal side in anterior part of segment border dark-colored, continuous, almost black, narrow on anterior segments, much broader on posterior ones, and in form of cuneate spot on segment 8. Subdorsal field densely covered with reddish-yellow dots and brown striae. Striae very dense at center of segments and form oblique brown smears extending from ventral margin of subdorsal band downward and back to enlargement of stigmal band. Stigmal band dark brown, narrow, greatly enlarges around stigmata, and encompasses them from all sides. Substigmal band fairly broad, with distinct borders above and below densely covered with yellowish and reddish dots, with brown striae scattered in-between. Subdorsal fields covered with dull green striae. Ventral side yellowish-green. Body length 12 to 19 mm and width of head 1.56 to 1.57 mm.

V-instar. Body slightly pinched toward anterior end, with greater admixture of violet than in the IV-instar. Color and pattern of head remain the same except submedial band not brown but black. Setae and legs turn somewhat darker. Pattern remains the same as in the IV-instar except dark coloration and violet hue more intense. Body length 20 to 28 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development from early July to end of August. Larvae of the V- and VI-instars hibernate; some pupate in early September. Species polyphagous. Food plants: primula, dead nettle, dandelion, daisy, house leek creeper, birch, alder, oak, plum, lettuce, thistle, burdock, and others.

Eggs laid in small clusters (10 to 15 each), in one compact layer, on underside of plant leaves. They are almost spherical, with flat base, 0.85 to 0.86 mm in diameter, and 0.70 to 0.72 mm in height. Ribs 42 to 44, of which 17 or 18 reach micropylar zone. Micropylar rosette consists of 17 to 19 lobes, surrounded by 1 or 2 rims. Eggs light yellow. Color pales gradually and acquires pink tone. Before larvae hatch egg ash-gray, and head of larva translucent, black.

5. **Graphiphora ashworthii** Doub.

Mature larva: Spinneret broad, shorter than first segment of labial palpus, and length 1.5 times less than width. Ventral edge of opening with small flexure and dorsal with fringe (Figure 73, *8*). First seta of labial

palpus as long as second segment, and second seta half size of first.

Body slightly pinched toward anterior end, dark green, with admixture of brownish or brown pigment, velvety. Head dark yellow, with brownish-red pattern of second type (Figure 49, *7*); sometimes pattern faint. Setae short, reddish-brown, set on general background of body. Shields outlined with black striae. Stigmata oval, white or yellowish, with thin black edge. Thoracic legs yellow, abdominal legs green. Pattern: dorsal hand consists of gray dots, fused at places, often prominent only here and there. Subdorsal band perceptible only along upper black border which, in anterior half of each abdominal segment, forms black smears. Toward posterior part of body, smears gradually thicken and on segments 7 and 8 form black, velvety, cuneate spots, which are not connected on segment 8. Dorsal and subdorsal fields same color, brown or cinnamon-brown. This uniform coloration is formed by borders of dense, fine striae of gray or yellowish-gray dots. Substigmal band faint, seen only as scattered white dots bordered with fine brown striae; at middle of band these fuse and form very prominent striae. Ventral side green with sparse brown striae. Body length 30 to 44 mm and width of head 3.0 to 3.2 mm.

Development: I-instar. Recently hatched larva yellowish, translucent with visible violet-gray intestine. Head yellow, without pattern. Setae dark brown, slightly pointed, set on rather large, high, unsclerotized scales. Sclerotization proceeds within 20 to 40 min. Thoracic shield yellow; anal shield not prominent. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Body hazy yellow in feeding larvae and green in region of filled intestine. Head acquires reddish tinge and toward end of instar, faint pattern of first type visible (Figure 48, *1*). Pinacula black, distinctly sclerotized. Body length of just hatched larva 2.5 mm, before first molt 3.8 to 4.0 mm, and width of head 0.40 mm.

II-instar. Body green. Head yellowish, with black spots around setae, and faintly visible pattern of first type. Setae brown, short, piliform, set on minute flat black pinacula on body and shields. Shields slightly margined with light brown pigment. Stigmata light-colored, rounded, with narrow black edge. Legs light-colored; abdominal legs on segment 3 underdeveloped. Pattern: dorsal and subdorsal bands narrow, white, and continuous. Substigmal band not broad, whitish, with distinct borders above and below, and extends onto anal leg. Body length 4.0 to 8.0 mm and width of head 0.53 to 0.57 mm.

III-instar. Larvae differ little from the II-instar. Form of setae changes; they are slightly pointed in the III-instar. Substigmal band white, broad; suprastigmal band consists of row of whitish dots. Body length 7.0 to 11.0 mm and width of head 0.80 to 0.85 mm.

IV-instar. Body green. Head yellowish or yellowish-green, with pale reddish-yellow reticulate structure along sides of hemispheres; submedial

bands not seen. Setae light brown, slightly pointed, set on minute light yellow spots on body and minute brown spots on thoracic shield. Shields not prominent. Stigmata oval, light-colored, with thin black edge. Thoracic legs light-colored; abdominal legs green and all five pairs developed. Pattern: dorsal and subdorsal bands white and each represented by row of very minute dots. Similar dots dense along dorsal field. Close to dorsal band, dots with dark green pigment forming distinct borders. Suprastigmal band similarly represented by row of white dots. Subdorsal field densely covered with white dots, in lower part densely bordered with dark green pigment. Substigmal band broad and yellow, with even distinct borders above and below. Ventral side bright green with sparse white dots. Body length 11 to 17 mm and width of head 1.10 to 1.20 mm.

V-instar. Body slightly pinched toward anterior end, green, yellowish-brown, or brown. Head light pink or yellowish, with pattern of second type, more distinct in dark specimens. Setae, spots at bases of setae, stigmata, and legs similar to larvae of the IV-instar. Pattern on trunk changes somewhat. At commencement of instar subdorsal band bordered with light brown pigment; upper border in anterior part of segment darkens gradually and forms black smears. Subdorsal field dark-colored and striae of border consist of dense concentration of yellowish-violet dots. Substigmal band yellow or reddish-raspberry, with yellow dots. Ventral side green, with large number of yellow dots; dots in basal field outlined with brown striae. Body length 16 to 23 mm and width of head 1.50 to 1.60 mm.

VI-instar. Larvae almost indistinguishable from the VII-instar but setae I, II, and III set on minute black spots. Substigmal band broad, with black borders, reddish-brown, with mass of whitish dots outlined with brownish-red pigment. Central part of ventral side green and basal field brown. Body length 23 to 29 mm and width of head 2.20 to 2.30 mm.

In Belorussia larval development from mid-July to end of August. Larvae of the VI-instar hibernate; some (5 to 10%) pupate in early September. Larvae molt six times. Food plants: whortleberry, heath, raspberry, dandelion, lady's mantle, currants, and others.

Eggs laid in clusters of 100 to 150 each, in a single contiguous layer of irregular rows. They are almost spherical, with flat base, 0.81 to 0.82 mm in diameter, and 0.60 mm in height, and light yellow. Ribs 28 to 30, of which 12 to 14 reach micropylar zone. Micropylar rosette consists of 12 to 14 lobes. Within 24 hrs dark yellow spot visible at apex and girdle of same color at equator. These gradually turn dark brown and shell gray with violet tone. Before larva hatches entire eggshell gray with violet tone.

6. **Graphiphora xanthographa** Schiff.

Mature larva: Spinneret equal in length to first segment of labial palpus, narrowing in steps toward end, each step almost twice longer than

wide. Ventral edge of opening with two processes and dorsal with fringe (Figure 17, *5*). First seta of labial palpus equal to second segment; second seta half length of first segment. Hooks of abdominal legs: 15–16, 17–18, 20–22, 23–24, and 25–26.

Body slightly pinched toward anterior end, green, with admixture of brownish-gray. Head yellow, with reddish-brown pattern of second type (Figure 49, *7*). Reticulate structure faint. Setae yellowish, acuminate, set on very small black spots on trunk; spots absent around base of setae on shields. Shields brownish, with narrow dorsal and subdorsal bands. Stigmata light yellow, broad, with thin black edge. Thoracic legs light yellow, abdominal legs light green. Pattern: dorsal and subdorsal bands quite broad, light yellow, even; dorsal narrow, light brown, with slightly shaded borders. Subdorsal band on ventral side with narrow light brown border; on dorsal side, in anterior half of segment, border broad, in form of black longitudinal spots (Figure 72, *6*). Dorsal field covered with large number of light yellow dots and fine dark brown striae. Subdorsal field sharply divided into upper light-colored, grayish-yellow part and lower dark part. All stigmata situated on dark background of subdorsal field. Substigmal band broad, light green, bordered by row of white dots. Similar dots scattered at center of band also. Ventral side green, with white dots and brown striae in basal part. Body length 26 to 40 mm and width of head 3.0 mm.

Development: I-instar. Newly hatched larva grayish-yellow. Head dull yellow, with brownish spots around setae; shields brownish-yellow, faintly oultined with light brown pigment. Setae dark-colored, slender, with insignificant clavate thickening at apex and set on light-colored pinacula. After 2.0 hrs pinacula turn brownish, then black; on trunk pinaculum I larger than II, and on thoracic shield pinacula IX and X larger than I and II. Legs light-colored; abdominal legs with large pinacula. Feeding larva green in zone of filled intestine. Length of just hatched larva 1.2 mm, before molt 3.5 to 4.0 mm, and width of head 0.41 mm.

II-instar. Body yellowish-green. Head yellow, with minute black spots around setae. Latter short, piliform, brownish, set on large yellowish-brown, weakly sclerotized scales. Pinacula on shields small, dark, and identical. Shields brownish-yellow. Stigmata round, light-colored, with brownish edge. Thoracic legs gray; abdominal legs light yellow, with yellowish-brown spots on outer side, and underdeveloped on segments 3 and 4. Pattern: dorsal and subdorsal bands white, narrow, and continuous. Substigmal band white, broad, and extends onto anal leg. Ventral side grayish-yellow. Body length 4.50 to 6.80 mm and width of head 0.62 to 0.63 mm.

III-instar. Body green. Head yellowish, with very dark but vague pattern of first type, and small black spots around setae. Pinacula minute

and black. Shields not prominent. Setae short, piliform. Stigmata on segments 1 and 8 somewhat oval, others rounded, with black edge. Thoracic legs light-colored; abdominal legs light green, and two anterior pairs underdeveloped. Pattern: dorsal band white, not broad, with broad, even dark green borders. Subdorsal band white, narrower than dorsal, with very narrow dark green borders. Suprastigmal band broad, dark green, with admixture of brown. Dorsal and subdorsal fields light green. Substigmal band broad, white, with light green spots; extends onto anal leg and also noticeable in orbital zone. Ventral side light green. Body length 7.0 to 12.0 mm and width of head 0.97 to 0.98 mm.

IV-instar. Body green, with admixture of red and brown. Head yellow, with light greenish-brown pattern of second type (Figure 49, *7*). Reticulate structure faintly visible. Setae rust-colored, slightly pointed, set on trunk and shields on minute black spots. Stigmata yellow, oval, with thin black edge. Thoracic legs yellowish; adbominal legs pinkish and all five pairs developed. Pattern: dorsal band broad, light yellow, with reddish-brown borders. Subdorsal band far narrower, with very narrow, even borders. Dorsal field around subdorsal bands densely covered with reddish-yellow dots, as a result of which border of field lighter in color. Upper part of subdorsal field with reddish-yellow dots. Substigmal band broad, bright yellow above and below, pinkish at center. Stigmata of segments 3 to 6 disposed in upper part of substigmal band. Ventral side pinkish, with sparse yellow dots. Body length 12 to 17 mm and width of head 1.50 to 1.60 mm.

V-instar. Larva differs from the VI-instar in minute black spots around base of setae on thoracic shield; dorsal and subdorsal fields broader. Upper part of subdorsal field same color as dorsal field but lower part much darker. Body length 17 to 27 mm and width of head 2.0 mm.

In Belorussia larval development from second week of August and, after hibernation, from mid-May. Food plants: clover (younger stages predominantly on flowers), bitter pea, *Stellaria*, violets, and others.

Eggs laid singly, randomly. They are light yellow, 0.55 to 0.64 mm in diameter, and 0.40 mm in height. Ribs 26 to 28, of which 12 or 13 reach micropylar zone. Micropylar rosette consists of 14 to 16 lobes surrounded by single rim. Within 24 hrs dark brown equatorial girdle and spot at apex visible.

3. Genus *Lycophotia* Hbn.

Key to Species

1 (2). Dorsal and subdorsal bands light-colored, narrow, and continuous. Dorsal field of segments 1 to 8 divided by dark- and light-colored

tranverse smears along line of seta II (Figure 72, *1*). Medium-sized (29 to 43 mm)..... 2. **L. signum** F.

2 (1). Dorsal and subdorsal bands light yellow, broad, interrupted (Figure 72, *7*); more rarely, dorsal band of base color. Dorsal field of segments 1 to 8 without transverse dark and light-colored smears. Small (20 to 28 mm)..... 1. **L. porphyrea** Schiff.

1. **Lycophotia porphyrea** Schiff. (variegated owlet moth)

Mature larva: Spinneret 1.5 times longer than first segment of labial palpus and twice longer than wide; dorsal edge of opening with short fringe. First seta of labial palpus slightly longer than second segment and second seta shorter than first segment. Mandibular teeth developed except for inner tooth. Metathoracic coxae contiguous. Hooks of abdominal legs: 15–16, 16–17, 19–20, 22–23, and 25–26.

Body brownish-green, brownish-yellow, or reddish; rather thick. Head reddish-yellow, with very dark pattern of second type (Figure 49, *7*). Setae rust-colored, acuminate, set on very minute dark brown spots on trunk, with light-colored arcuate smear on ventral side; spots around setae IX and X on thoracic shield larger than around I and II. Shields brownish-yellow. Stigmata dark-colored, oval, with thin black edge. Thoracic legs reddish or reddish-brown, abdominal legs yellowish-green. Pattern variable. More often dorsal and subdorsal bands light yellow, interrupted in posterior part of each segment to form broad longitudinal smears. Around dorsal band pinched anteriorly and rounded posteriorad, with broad black shaded borders. Subdorsal band in form of rectangular spots (Figure 72, *7*). Dorsal field brownish-green with sparse whitish spots. Suprastigmal band in form of very narrow and short smears, with broad black border on ventral side. Substigmal band broad, dull yellow at borders, and gangrenous green at center. Ventral side yellowish-green.

In some larvae dorsal band not discernible. Dorsal field green with large number of yellowish and reddish dots. Subdorsal and suprastigmal bands distinct on segments 1 to 6. Stigmal band raspberry-red, uneven, in region of stigmata descends and encompasses seta IV and stigmata. Substigmal band broad, yellow, with distinct borders, and reddish-green at center. Basal field raspberry-red. Ventral side yellowish-green at center. Body length 20 to 28 mm and width of head 2.0 to 2.1 mm.

Development: I-instar. Newly hatched larva colorless, translucent with visible reddish-lilac intestine. Head yellow. Pinacula colorless, large, and turn brown after 1.5 to 2.0 hrs. Thoracic shield yellowish; anal shield not prominent. Setae rust-colored, slightly pointed. Body of feeding larva dark yellow. Pattern: toward end of instar light-colored, rather narrow dorsal, subdorsal, and substigmal bands present together with weakly

developed pattern of first type on head. Body length of just hatched larva 1.8 to 2.0 mm, before molt 3.3 mm, and width of head 0.32 mm.

II-instar. Body light reddish-brown. Head reddish-yellow, with very dark pattern of first type. Setae rust-colored, slightly pointed, almost piliform, and set on minute brownish-red scales. Thoracic shield faintly fringed with dark pigment; anal shield not prominent. Stigmata round, light-colored, with thin black edge. Legs light-colored, sometimes thoracic legs dark; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal, subdorsal, and suprastigmal bands white, not broad, and continuous. Ventral part of subdorsal field brownish-red. Substigmal band yellowish, broad, and extends onto anal leg. Body length 3.5 to 6.0 mm and width of head 0.47 to 0.50 mm:

III-instar. Larvae differ from the II-instar only in pattern on trunk: dorsal and subdorsal bands white, fairly broad, even, not broadly fringed with brownish-red pigment. Suprastigmal band narrow, white. Ventral part of subdorsal field reddish-brown. Substigmal band very broad, white, with distinct borders. Ventral side reddish-green. Body length 6.0 to 10.0 mm and width of head 0.72 to 0.78 mm.

IV-instar. Body slightly pinched toward anterior end, reddish-yellow. Head same color, with faint but much darker pattern of second type. Pinacula on trunk very minute, brownish-red, with rust-colored, slightly pointed setae. Shields not prominent. Stigmata faintly oval, reddish, with black margin. Thoracic legs light-colored; abdominal legs reddish and all five pairs developed. Pattern: dorsal band white, broad, but at margins of segments pinched and interrupted. Subdorsal band also broad, interrupted at margins of segments, but less pinched at interruptions. Bands broadly fringed with reddish-brown pigment. Suprastigmal band dull white, faint. Lower part of subdorsal field reddish-brown. Substigmal band very broad, white. Ventral side reddish-green. Body length 10.0 to 14.5 mm and width of head 1.0 to 1.1 mm.

V-instar. Larva does not differ from the VI-instar. Similar in pattern, with some variation on trunk. Variations: dorsal band green, subdorsal band also often green; dorsal and upper part of subdorsal field reddish-yellow; ventral part of subdorsal field and basal part raspberry-red. Body length 14 to 19 mm and width of head 1.20 to 1.30 mm.

In Belorussia larval development from end of July and, after hibernation, until May. Food plant: heath.

Eggs laid singly on the under- and upper sides of heath leaves. They are light yellow, almost spherical, with flat base, 0.66 to 0.67 mm in diameter, and 0.50 to 0.56 mm in height. Ribs 34 to 36, of which 12 to 15 reach micropylar zone. Micropylar rosette consists of 20 lobes; rims absent. Yellowish girdle at equator and spot at apex seen within 24 hrs

as chorion gradually lightens in color. Girdle and spot enlarge gradually and turn yellowish-red. Before larva hatches egg brownish-red.

2. **Lycophotia signum** F. (syn. *sigma* Schiff., *signa* F.) (reddish-brown owlet moth)

Mature larva: Spinneret broad, width equal to length, and one-third shorter than first segment of labial palpus. Dorsal edge of spinneret opening with small fringe (Figure 73, *9*). First seta of labial palpus somewhat smaller than second segment; second seta equal to one-third size of first segment. Mandibles with inner tooth. Thoracic shield broad and hence, setae III and IIIa set right on its edge. Metathoracic coxae contiguous. Hooks of ventral legs: 22–24, 25–28, 30–32, 34–35, and 36–39.

Body slightly pinched toward anterior end, reddish-gray or reddish-brown. Head pinkish-yellow, with reddish-brown pattern of second type (Figure 49, *7*). Setae rusty-brown, acuminate; setae II and III on dark spots on trunk. Shields not prominent, with three narrow yellowish bands. On thoracic shield setae I on minute light-colored spots. Stigmata light yellow with black edge. Thoracic legs light brown and abdominal legs green. Pattern: dorsal band narrow, yellow, even, and continuous, fringed with reddish-brown pigment. Between setae I and II border significantly lighter in color. Subdorsal band same width and color as dorsal but not even. In anterior half of segment band on dorsal side fringed with reddish-brown pigment. Around setae II border shifts upward, reaches dorsal band, and forms dark transverse line as though dividing dorsal field of segment into two halves. Posterior to dark-colored line lies narrow light-colored line. Latter on segment 8 fairly broad (Figure 72, *1*). Dorsal field grayish-yellow and subdorsal same color. Substigmal band around dorsal region yellow; center and lower regions do not differ from gray coloration of ventral side. Body length 29 to 44 mm and width of head 3.0 to 3.2 mm.

Development: I-instar. Newly hatched larva pale yellowish-pink. Head light yellow, without spots. Pinacula small, not sclerotized; sclerotization continues for 1.5 to 2.0 hrs. Setae rust-colored, slender, acuminate. Thoracic shield light yellow, anal shield not prominent. Yellowish-pink color of skin preserved in feeding larvae. Pinacula minute, dark-colored. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Body length 1.66 to 1.70 mm, before molt 4.0 mm, and width of head 0.36 mm.

II-instar. Body light gray, green in region of intestine. Head yellow. Setae reddish-brown, set on very minute black pinacula. Stigmata round, light colored, with brown edge. Legs light-colored; two anterior abdominal pairs underdeveloped. Pattern: dorsal and subdorsal bands light yellow, not broad, and continuous. Suprastigmal band same color, narrower, in form of separate striae. Substigmal band not broad, whitish. Body length 4.0 to 7.0 mm and width of head 0.53 to 0.54 mm.

III-instar. Body green. Head yellowish, with very dark but faint pattern of first type. Setae rust-colored, short, and acuminate; pinacula and spots absent at their base. Stigmata round, light-colored, with dark edge. Legs light-colored; abdominal legs on segment 3 underdeveloped. Pattern: dorsal, subdorsal, and suprastigmal bands narrow, yellowish, and continuous. Substigmal band broad, bright yellow. Ventral side light green. Body length 6.0 to 12.0 mm and width of head 0.77 to 0.82 mm.

IV-instar. Body greenish-yellow or reddish-yellow. Head pinkish-yellow with reddish-brown pattern of second type. Setae rust-colored, short, weak, set on minute reddish-brown spots on trunk; ventral side of each spot with large reddish-yellow dot. Shields not prominent. Setae set on minute light-colored spots on shields. Stigmata oval, yellowish-red. Legs light-colored; all five pairs of abdominal legs developed. Pattern: dorsal and subdorsal bands pinkish-yellow, narrow, and continuous. Dorsal band at margins of segments fringed with reddish-cinnamon pigment and subdorsal with reddish-brown pigment. Upper border of subdorsal band between setae I and II shifted upward and encompasses seta II, and continuing farther toward dorsal band divides segment into two parts. Subbasal field uniformly covered with yellowish-red dots and fine dark-colored striae. Ventral side green or pinkish-yellow, with yellow dots and reddish striae. Body length 13 to 17 mm and width of head 1.30 to 1.40 mm.

V-instar. Compared to the IV-instar, there are no differences in color and pattern in this instar. Dorsal and subdorsal bands and divisions of segments in transverse direction by reddish-brown and yellow striae somewhat more distinct. Yellow line sharper on segment 8. Body length 16 to 27 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development from second week of July and, after hibernation, until second and third weeks of May. Food plants: Chenopodiaceae, lady's mantle, Plantaginaceae, burdock, celandine, dandelion, whortleberry, raspberry, dewberry, currant, hop, maple, alder, willow, and oak.

Females disperse their eggs without attaching them to leaves. Eggs light yellow, somewhat flat, 0.60 to 0.62 mm in diameter, and 0.50 to 0.54 mm in height. Ribs 31 to 33, of which 11 or 12 reach micropylar zone. Micropylar rosette consists of 12 or 13 lobes; rims absent. Chorion initially pink and later accumulates an admixture of brown pigment. Before larva hatches chorion ash-brown.

4. Genus *Aplecta* Gn.

(one species in Belorussian fauna)

Aplecta prasina Schiff. (greenish owlet moth)

Mature larva: Postgenal sclerites not contiguous (Pi = 1/8). Spinneret broad, even, somewhat longer than first segment of labial palpus,

with two pointed projections on ventral edge of opening, and thin fringe of dorsal edge. First seta of labial palpus almost rudimentary; second equal to one-sixth length of first segment. Mandibles with inner tooth. Bases of third pair of abdominal legs not contiguous. Hooks of abdominal legs: 23–25, 24–26, 27–30, 32–34, and 36–39.

Body slightly pinched toward anterior end, light or dark brown. Head yellow, with reddish-brown pattern of second type (Figure 49, *7*). Setae brown, slender, acuminate, set on minute white spots on trunk. Shields not prominent. Stigmata light-colored, oval, with black edge. Legs light-colored or light brown. Pattern: dorsal and subdorsal bands narrow, continuous, dull white or yellowish, uneven, with dark brown or black border. Subdorsal band fringed on dorsal side in anterior half of segment. Farther away, dark-colored pigment extends toward dorsal band and fuses with its border to form on each segment, except first thoracic, black velvety semicircles (Figure 72, *10*). Area free of semicircles, light-colored, with yellowish dots and fine brown striae. Subdorsal field covered with similar dots and striae. Stigmal band black, uneven. Substigmal band broad, with distinct border above and indistinct one below, dull green, with dense yellow dots. Ventral side dull green, with yellow dots and minute black spots around setae. At end of instar brown striae visible in basal field. Body length 29 to 50 mm and width of head 3.30 to 3.50 mm.

Development: I-instar. Newly hatched larva yellowish, translucent with visible raspberry-pink intestine. Head light yellow, with brown spots around setae. Setae brownish, rather long, sharply acuminate, and set on minute unsclerotized pinacula. Shields yellowish. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Feeding larvae acquire green coloration. Head brown. Pinacula minute, dark brown, almost black. Body length of just hatched larva 2.20 to 2.30 mm, before molt 4.0 mm, and width of head 0.37 mm.

II-instar. Body yellowish, intestine green at places filled with food. Head light yellow, with dark brown spots around setae, and faint pattern of first type. Setae, shields, stigmata, and legs same as in the I-instar. Pattern: dorsal and subdorsal bands fairly broad, white, and continuous. Suprastigmal band considerably narrower, white. Dorsal and subdorsal fields yellowish-brown. Substigmal band light yellow, extends onto anal leg. Basal field yellowish, with insignificant admixture of brown. Ventral side whitish. Body length 4.0 to 7.0 mm and width of head 0.55 to 0.66 mm.

III-instar. Main body color green, varying from greenish-brown to brown at middle and end of instar. Sometimes larvae preserve green coloration until end of instar. Head yellow, with pattern of second type. Setae short, light brown, acuminate, and set on small dark-colored spots. Shields light brown. Thoracic legs yellowish; abdominal legs green and under-

developed on segment 3. Pattern: dorsal and subdorsal bands pinkish, not broad, continuous. At commencement of instar dorsal band fringed with fine dark brown striae. Later striae fuse and form continuous dark border. Dorsal field green, with scattered brown striae in dark-colored specimens. Suprastigmal band in form of chain of light-colored spots; stigmal band broad, black. Light-colored stigmata with black edge located on stigmal band. Substigmal band broad, light yellow, with fine dark yellow longitudinal striae. Ventral side light green, with scattered brownish striae in basal field. Body length 7.0 to 12.0 mm and width of head 0.78 to 0.86 mm.

IV-instar. Main body color green, with dark green, cinnamon, or brown inclusions. Head yellow or greenish-yellow, with dark brown pattern of second type. Setae short, rusty-brown, acuminate, and set on minute black spots. Spots around setae I larger than around II. Shields not prominent; setae IX and X set on minute black spots on shields. Stigmata oval, light-colored, with thin black edge. Thoracic legs yellowish; abdominal legs light-colored and all five pairs developed. Pattern: dorsal band in form of white dots fused at many places, fairly broad, even, and fringed rather narrowly with dark brown or black pigment. Subdorsal band narrower, in form of row of white dots. Border of band on ventral side negligible, on dorsal side in anterior part of each segment dark brown or black; later border shifts upward and backward and fused with border of dorsal band in posterior part of segment to form herringbone pattern. In some specimens herringbone pattern not visible. Dorsal and subdorsal fields yellowish-green with dense white dots and fine brown striae. Stigmal band dark brown or black, varies in width. Substigmal band bright yellow, broad, at center orange. Toward end of instar many green or brown striae visible on substigmal band. Ventral side dark green, with dense light-colored dots and brown striae in basal field. Body length 11 to 19 mm and width of head 1.25 to 1.37 mm.

V-instar. Color and pattern of dark-colored specimens same as in the VI-instar. In light-colored specimens velvety semicircles on dorsal field replaced by dark brown broad branches of herringbone pattern. Substigmal band bright yellow, with distinct boundary above and below, and yellowish-red with black longitudinal striae at center. Ventral side reddish-yellow, with dark-colored striae. Body length 18 to 28 mm and width of head 2.22 to 2.36 mm.

In Belorussia larval development from last 10 days of June and, after hibernation, until mid-May. Under laboratory conditions larvae emerged on June 26, completed feeding, and pupated on August 31. Moths took to wings on September 8th. Food plants: lady's mantle, sorrel, plantain, clover, burdock, cinquefoil, dandelion, celandine, raspberry, currant, acacia, mountain ash, alder, willow, maple, oak, and birch.

Eggs laid in large clusters of up to 100 each, in 3 to 6 layers, in no particular order, and compactly. They are greenish-yellow, 0.69 to 0.70 mm in diameter, and 0.60 mm in height. Ribs 43 to 45, of which 20 or 21 reach micropylar zone. Micropylar rosette consists of 16 to 18 lobes surrounded by single rim. Color gradually pales and large rust-colored spot becomes visible at apex; this spot later turns brown and before emergence of larva fuses with brownish-gray color of lower part of egg.

5. Genus *Axylia* Hbn.
(one species in genus)

Axylia putris L. (dark-edged owlet moth)

Mature larva: Postgenal sclerites not contiguous (Pi = 1/4). Spinneret equal in length to first segment of labial palpus and longer than wide. Ventral edge of opening flexed at center and dorsal edge with long fringe (Figure 73, *10*). First seta of palpus almost rudimentary; second 6.0 times shorter than first segment. Mandibles with inner tooth. Coxae of third pair of thoracic legs touch. Hooks of abdominal legs: 23–24, 24–25, 26–28, 29–30, and 32–34.

Body highly pinched toward anterior end, with significantly dilated segment 8, grayish-green with violet tinge, and with brown or black pattern. Head light brown, with pattern of second type (Figure 49, *7*) and greatly developed supraorbital bands, or brown with faint pattern. Setae rust-colored, slender, acuminate, and set on minute light-colored and black spots. Shields not prominent. Narrow, yellow, continuous dorsal band extends along thoracic shield; subdorsal band in form of single large dot in anterior part. Stigmata light colored, oval, with thin black edge. Legs brownish-green. Pattern: dorsal band on thoracic segments narrow, yellow, continuous, and terminates at end of segment III in large dot; on abdominal segments consists of small and large dots, with large dots seen at end of segments 1 to 4. Borders of band dark green or brown, faint at end of segments. Subdorsal band in form of minute white dots with an insignificant border below, and broad dark green, brown, or black pattern above and between setae I and II (Figure 72, *9*), in form of oblique smears more distinct on segments 1, 2, 3, 7, and 8. Stigmal band black, narrow, broadening notably around stigmata. Substigmal band broad, yellow on segment 8, and with fine brown striae on other segments which concentrate into longitudinal spot at center of each segment. Ventral side green with fine brown striae. Body length 23 to 32 mm and width of head 2.70 to 2.80 mm.

Development: I-instar. Newly hatched larva colorless, with visible reddish-yellow intestine. Head black. Thoracic shield brownish but not fully sclerotized (Figure 59). Pinacula large, not sclerotized. Abdominal

legs on segments 3 and 4 underdeveloped. Feeding larva green, with black pinacula, thoracic shield, and dark-colored thoracic legs. Sclerotization of pinacula and shield continues for 1.5 to 2.0 hrs. Body length of just hatched larva 1.8 mm, before molt 3.0 to 3.5 mm, and width of head 0.33 mm.

II-instar. Body green, shape uneven, broadening somewhat in segments III, 1, and 2. Head light yellow, with large brown spot around seta L_1, and faint submedial band. Setae on body set on small light brown pinacula surrounded by pigment lighter in color than background of body. Stigmata rounded, light-colored, with light brown edge. Thoracic legs brown; abdominal legs light-colored, with rounded brownish spot on outer side. Pattern: dorsal and subdorsal bands in form of chain of identical white dots. Substigmal band broad, whitish. Ventral part of subdorsal field brownish. Basal field light brown. Body length 4.0 to 6.5 mm and width of head 0.51 mm.

III-instar. Body green. Segments 1, 2, and 8 slightly dilated. Head dull yellow, with large dark-colored spot around seta L_1, lighter colored submedial band, and faint reticulate structure. All five pairs of abdominal legs developed. Shields, setae, stigmata, and pattern on trunk same as in the II-instar. Body length 7.0 to 12.0 mm and width of head 0.73 to 0.74 mm.

IV-instar. Body green, with brownish tinge. Segments III, 1, and 8 dilated. Head greenish-yellow, with same pattern as in the III-instar but pattern more distinct. Setae brown, slender, acuminate, and set on minute dark spots on shields. Stigmata oval, with thin light brown edge. Legs greenish. Pattern: dorsal band white; on segments I and II continuous, narrow; on segments III and 1 consists of large dots; and on rest of segments consists of minute dots. Subdorsal band in form of chain of identical white dots; bordered laterally by dense light-colored dots that shift toward dorsal band on segments 1 to 5 between setae I and II. Substigmal band broad, yellow along edges, and yellowish-red at center. Body length 13 to 18 mm and width of head 1.60 to 1.62 mm.

V-instar. Differs little from the VI-instar. Substigmal band more distinct, yellow along borders, and violet-pink with brownish longitudinal striae at center. Ventral side greenish-brown, with dull yellow dots. Thoracic legs dark-colored, with very dark ringlets; abdominal legs green with large black spot on outer side. Body length 15 to 26 mm and width of head 1.60 to 1.62 mm.

In Belorussia larval development from early June to end of September. Food plants: plantain, sorrel, *Galium,* bindweed, and others.

Eggs laid on underside of leaves in clusters, in single layer of irregular rows, and not compact. They are light yellow, with reddish hue, 0.59 to 0.61 mm in diameter, and 0.47 to 0.50 mm in height. Ribs 40 to 42, of which 15 to 18 reach micropylar zone. Micropylar rosette consists of 14

or 15 lobes surrounded by 1 to 2 rims. Within 24 hrs thin light brown margin above equator and spot at apex visible, which later darken while main color takes on grayish tone. Before larva hatches egg ash-gray and head of larva translucent, black.

6. Genus *Diarsia* Hbn.

Key to Species

1 (2). Upper border of subdorsal band on abdominal segments interrupted around seta II and band fuses with light-colored spot located at base of seta. Segment 8, posterior to setae II-II, with light-colored transverse band (Figure 72, *2*). Second segment of antennae brownish-yellow. Larvae up to 30 mm long..... ..... 2. **D. brunnea** Schiff.

2 (1). Upper border of subdorsal band not interrupted. Segment 8, posterior to setae II–II, without light-colored transverse band. Second segment of antennae dark brown. Larvae up to 34 mm long..... 1. **D. rubi** View.

1. **Diarsia rubi** View (plantain owlet moth)

Mature larva: Second segment of antennae 1.5 times longer than width. Distance between setae VIII–VIII on segment 7, 2.0 times more than on segment 8. Hooks of abdominal legs: 20–23, 22–24, 23–25, 23–26, and 27–30.

Body slightly pinched toward anterior end, brownish-gray. Head light yellow, with dark brown pattern of second type (Figure 49, *3*). Setae light brown, set on minute light-colored spots. Shields not prominent and spots absent around setae. Stigmata oval, dark yellow, with dark brown edge. Legs greenish-gray. Pattern: dorsal and subdorsal bands light yellow, narrow, almost continuous, consist of minute yellow dots. Dorsal band fringed with fine brown striae fused at many places. Ventral margin of subdorsal band same, while dorsal slightly lighter in color. Dorsal field densely covered with yellow dots and sparse fine light brown striae, yellowish-gray, monochromatic. Subdorsal field somewhat darker. Substigmal band broad, yellow at borders, and yellowish-brown at center. Ventral side greenish-gray. Body length 25 to 34 mm and width of head 2.9 to 3.0 mm.

In Belorussia larval development in June and July, and August and September. Two generations. Food plants: dead nettle, sorral, nettle, hedge nettle, burr marigold, raspberry, blackberry, strawberry, and others.

According to Döring, eggs light yellow, with light red girdle and spot at apex, 0.75 mm in diameter, and 0.45 to 0.50 mm in height. Ribs 27 or 28, of which 14 to 16 reach micropylar zone. Micropylar rosette consists of 14 lobes surrounded by reticulate structure.

2. **Diarsia brunnea** Schiff. (whortleberry owlet moth)

Mature larva: Second segment of antennae 2.0 times longer than width. Distance between setae VIII–VIII on segment 7 equal to distance between them on segment 8. Hooks of abdominal legs: 25–26, 27–28, 30–32, 32–34, and 33–35.

Body pinched toward anterior end, with dilated segment 8, reddish-yellow dorsal field, and much darker subdorsal. Head dark yellow or yellowish-pink, with reddish-brown pattern of second type (Figure 49, *3*). Submedial band in upper part of hemispheres lighter and narrower, but around adfrontal sclerites broad, dark, and not pinched toward end. Along edge of dark part of band white background visible. Setae strong, acuminate, set on small white spots, including microscopic seta X. Large white spot on segment III around microscopic setae IXa and IXb. Shields somewhat darker than body color and setae on them set on general background. Stigmata dark yellow, oval, narrow, with black edge. Legs yellowish; abdominal legs, five pairs. Pattern: dorsal band in form of minute white dots, continuous only on shields, fringed with fine dark brown striae, more intense on margins of segments. Subdorsal band in form of very large dots, rather narrowly fringed with brown pigment. Upper margin interrupted at seta II and band joined with white spot at base of this seta (Figure 72, *2*). Dorsal field reddish-yellow with fine dark striae at center. Segment 8 with narrow white transverse band at end. Subdorsal field uniformly covered with dark striae and represents very dark section of body. Substigmal band white, continuous only on thoracic segments; on other segments does not differ from ventral side. Latter dull pink, with scattered white dots and brown striae. Body length 35 to 38 mm and width of head 2.8 to 3.0 mm.

Development: I-instar. Just hatched larva yellowish. Head black. Pinacula conical; unsclerotized. Setae brown, strong, acuminate. Stigmata light brown with black edge. Thoracic legs dark-colored; abdominal legs light-colored and on segments 3 and 4 underdeveloped. Body of feeding larvae in region of filled intestine green, pinacula black. Length of just hatched larva 1.8 mm, before molt 4.0 mm, and width of head 0.35 mm.

II-instar. Body cylindrical, with slightly dilated segment 8, green, with admixture of violet color that becomes denser as larva grows. Head green, with admixture of brown. Setae light brown, acuminate, set on small brown pinacula on trunk. Pinacula on shields light-colored. Stigmata rounded. Legs light-colored. Pattern: dorsal and subdorsal bands white, narrow, continuous, at places interrupted. Dorsal field green or with admixture of lilac. Substigmal band broad, white, with admixture of lilac at center. Ventral side lilac-green. Body length 4.0 to 7.0 mm and width of head 0.50 to 0.70 mm.

III-instar. Body light brown, with admixture of lilac. Segment 8 slightly dilated. Head dark yellow with faint pattern of first type and brown spots around setae. Pinacula very minute, brown, and with adjacent small white spot on ventral side. Pinaculum I somewhat larger than rest. Pinacula on shields similar. Stigmata rounded. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal band in form of chain of white dots. Dorsal field brownish-red, subdorsal brownish-green, it ventral part reddish-brown. Substigmal band broad, white at borders, and brownish-red at center. Ventral side brownish-red. Body length 6.0 to 10.0 mm and width of head 0.80 to 0.82 mm.

IV-instar. Body cylindrical, with slightly dilated segment 8, and yellowish-red dorsal field well distinguished from dark brown subdorsal. Head dark yellow, with indistinct pattern of second type. Pinacula absent. Setae rust-colored, short, acuminate, and set on brown spots. Largest spots around seta I. Shields not prominent; spots at base of setae not seen on thoracic shield. Stigmata light-colored, oval with brownish edge. Thoracic legs reddish-brown; abdominal legs light-colored with violet shade, and all five pairs developed. Pattern: dorsal and subdorsal bands narrow, white, in form of longitudinal spots. Dorsal band with narrow black border; similar border seen only above subdorsal band. Lower border fused with dark brown or almost black subdorsal field. Substigmal band dark brown, bordered above and below by white dots. Ventral side reddish-brown. Body length 10 to 17 mm and width of head 1.10 to 1.30 mm.

V-instar. Larvae almost indistinguishable from the VI-instar. In some specimens faint herringbone pattern discernible in dorsal field and subbasal field lighter in color. Body length 16 to 24 mm and width of head 1.8 to 2.0 mm.

In Belorussia larval development from July until autumn and, after hibernation, until first few days of May. Food plants; celandine, whortleberry, figwort, primula, raspberry, heather, dead nettle, willow, barberry, and others.

Eggs laid on underside of leaves singly. They are light yellow, 0.70 mm in diameter, and 0.67 mm in height. Ribs 38 to 40, of which 16 to 18 reach micropylar zone. Micropylar rosette consists of 12 to 14 lobes surrounded by single rim. Within 24 hrs reddish-yellow girdle and spot at apex visible, which later acquire brown coloration, while eggshell turns pinkish. Before larva hatches egg gray.

7. Genus *Naenia* Steph.
(one species in Belorussian fauna)

Naenia typica L. (dark-colored owlet moth)

Mature larva: Postgenal sclerites not contiguous (Pi = 1/6, 1/7). Spinneret equal in length to first segment of labial palpus. Ventral edge of opening with flexure and dorsal with long fringe (Figure 73, *12*). First seta of labial palpus equal to second segment while second seta half length of first segment. Mandibles with inner tooth. Metathoracic coxae contiguous. Hooks of abdominal legs: 26–28, 30–31, 31–32, 32–34, and 33–36.

Body greenish-gray, with admixture of reddish-yellow. Head pinkish-yellow, with brownish-green pattern of second type (Figure 49, *7*). Cells of reticulate structure large. Supraorbital band colored more deeply than submedial. Setae brownish, acuminate, set on minute black spots, on outer side of which lies very large white spot. Setae IX and X on segment III set on large white spots. Shields darker than base color of body and spots at base of setae absent. Dorsal bands in anterior part of shield enlarged; dorsal band on anal shield narrow; subdorsal band broad, flexed. Stigmata reddish-yellow, oval, with thick black edge. Legs light-colored. Pattern: dorsal band in form of chain of dull yellow dots and bordered with fine brown striae. Subdorsal band continuous, broader, extends from posterior margin of segments up to seta II, then arcs downward and ends by seta III. Dorsal field in anterior half of segment uniformly covered with yellow dots and fine brown striae; in posterior half of segment striae grouped around band. Suprastigmal band forms bend posterior to subdorsal band and ends posterior to stigmata. Dorsal and subdorsal fields reddish-yellow-gray. Ventral region of subdorsal field dark. Stigmal band black, narrow, enlarges around stigmata, especially on segments 1 and 2. Substigmal band and ventral side grayish-green, with yellow dots and fine brown striae. Body length 25 to 38 mm and width of head 3.0 mm.

Development: I-instar. Newly hatched larva colorless, with dark brown head, light brown thoracic shield, colorless anal shield, and large colorless pinacula. After 2.0 to 3.0 hrs pinacula turn black. Setae slender, long, slightly clavate. Body of feeding larva yellowish, green in region of filled intestine. Length of just hatched larva 1.85 mm, before molt 4.0 mm, and width of head 0.33 mm.

II-instar. Body light green. Head light brown with minute brown spots around setae. Thoracic shield brownish, anal shield not prominent. Setae on shields set in minute brown spots. On other segments setae III and IV largest but slightly sclerotized. On abdominal segments, except 5 and 6, large brown spot in region of seta IV encompasses stigma, and pinaculum III represents commencement of stigmal band formation. Stigmata rounded. Legs light-colored; abdominal legs on segments 3 and 4 under-

developed. Pattern: dorsal and subdorsal bands consist of fairly large white dots. Substigmal band white, broad, with indistinct border below. Body length 4.0 to 7.0 mm and width of head 0.52 mm.

III-instar. Color of trunk, head, legs, and also stigmata same as in the II-instar. All five pairs of abdominal legs developed. Setae on body and shields not set on pinacula but on dark-colored spots. Pattern: dorsal band in form of chain of white dots, most prominent of which occur at end of segment. Dark border of band distinct at margins of segments. Dots of subdorsal band identical, with same border as dorsal. Dorsal and subdorsal fields identical, grayish-green. Stigmal band in form of large black spots, encompassing stigmata. Substigmal band broad, yellow, consists of two rows of longitudinal spots. Ventral side green, with white dots. Body length 8.0 to 12.0 mm and width of head 0.75 to 0.76 mm.

IV-instar. Body green. Head grayish-green, with brown pattern of second type (Figure 49, *7*). Setae brownish, slender, acuminate, set on minute black spots. Shields not prominent, dorsal bands on them greatly enlarged anteriorly. Stigmata light-colored, oval, with thin black edge. Thoracic legs yellowish; abdominal legs green, with black spots around setae. Pattern: dorsal band consists of different sized white dots, which on thoracic segments larger at center and on abdominal in posterior half of segment. Border of band dark green at margins of segments. Subdorsal band in form of chain of identical dots, its lower border rather broad, upper border interrupted around seta II, but herringbone pattern not formed. Stigmal band black, narrow, enlarging around stigmata. Substigmal band bordered by yellow dots, green at center with yellowish and reddish dots. Body length 13 to 17 mm and width of head 1.26 to 1.37 mm.

V-instar. Differs from the VI-instar only in pattern of dorsal and subdorsal fields. In the V-instar dorsal and subdorsal bands consist of chain of white dots. Subdorsal band straight and suprastigmal not seen. Dorsal and subdorsal fields identical, same color, brownish-gray, with yellow dots and fine brown striae. Body length 18 to 25 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development from end of July to autumn and, after hibernation, until May. Food plants; dead nettle, sorrel, primula, nettle, willow herb, willow, raspberry, and others.

Eggs laid on underside of leaves in clusters, in single layer of irregular rows, and not compact. They are yellow, 0.57 to 0.59 mm in diameter, and 0.58 mm in height. Ribs 30 to 32, of which 12 to 13 reach micropylar zone. Micropylar rosette consists of 12 to 14 lobes with 1 or 2 rims. After three or four days some dark-colored dots seen at apex. Before larva hatches eggs yellowish-gray, larva with translucent, black head.

8. Genus *Ochropleura* Hbn.
(one species investigated)

Ochropleura plecta L. (white-rimmed owlet moth)

Mature larva: Postgenal sclerites not contiguous (Pi = 1/4). Spinneret equal in length to first segment of labial palpus; spinneret opening with fringe on all sides (Figure 73, *13*). First seta of labial palpus somewhat longer than second segment, while second seta equal to first segment. Mandibles with inner tooth. Coxae of thoracic legs contiguous. Hooks of abdominal legs: 15–17, 18–19, 21–23, 24–26, and 26–28.

Body highly pinched toward anterior end, with dilated segment 8. Head yellow, with brownish pattern of second type (Figure 49, *7*) and spots around setae. Setae brown, acuminate, and set on black, almost round spots. Shields barely prominent; dorsal bands on thoracic shield in anterior part greatly enlarged, and setae set on black spots. Stigmata white, oval, with black edge. Legs yellowish-green; abdominal with large dark-colored spots on outer side. Pattern: dorsal and subdorsal bands consist of chain of white dots fringed rather narrowly with fine brown striae. Dorsal and subdorsal fields yellowish, with large number of yellow dots and sparse brownish striae. Substigmal band very broad, white on dorsal and ventral borders, and with admixture of reddish pigment at center. Ventral side green, with mass of yellow dots, and small admixture of reddish pigment. Body length 23 to 33 mm and width of head 3.0 mm.

Development: I-instar. Just hatched larva colorless, translucent with yellowish-red intestine. Skin coarsely grained. Head black, very large compared to body width. Thoracic shield brown; anal shield and pinacula colorless. Feeding larva green with brown pinacula. Body length of just hatched larva 1.60 to 1.80 mm, before molt 3.5 to 4.0 mm, and width of head 0.20 mm.

II-instar. Body dull yellow, green at places of filled intestine. Head yellow, with brown spots around setae. Setae rust-colored, not pointed, set on minute black pinacula, and on very large black spots on shields. Stigmata light-colored, rounded, with brown edge. Legs green; two anterior pairs of abdominal legs underdeveloped. Pattern: dorsal and subdorsal bands consist of chain of white dots. Substigmal band white, continuous, broad. Body length 4.0 to 7.0 mm and width of head 0.51 to 0.53 mm.

III-instar. Body green, with slightly dilated segment 8. Head greenish-yellow, with brown spots around setae. Skin fine grained. Setae rust-colored, short, slightly pointed, set on very minute brown spots. Thoracic shield dark brown. Abdominal legs on segments 3 and 4 underdeveloped. Pattern same as in the II-instar. White dots scattered on dorsal field. Body length 6.0 to 10.0 mm and width of head 0.89 to 0.91 mm.

IV-instar. Body green or slightly brownish, with dilated segment 8. Head yellowish, with brownish spots around setae, and faint pattern of first type. Setae slender, acuminate, and set on very minute dark-colored spots. On thoracic shield, around setae IX and X, spots larger than around I and II. Stigmata yellow, oval, with thin brownish edge. Legs brownish; all five abdominal pairs developed. Pattern: dorsal and subdorsal bands consist of white dots, fringed rather narrowly by brownish pigment. Subdorsal field dark brown, with indistinct light-colored dots. Substigmal band broad and bright yellow. Body length 10 to 14 mm and width of head 1.20 to 1.30 mm.

V-instar. Body brownish, notably pinched toward anterior end, with dilated segment 8. Head light yellow, with brownish pattern of second type (Figure 49, *7*). Setae on trunk set on dark-colored spots. Pattern: dorsal and subdorsal bands same as in the VI-instar. Stigmal band brown, rather narrow, and even. Substigmal band broad, yellow above and below, and orange at center. Basal field brown. Ventral side greenish, with mass of white and yellowish dots. Body length 15 to 25 mm and width of head 1.78 to 1.80 mm.

In Belorussia larval development from early June to autumn. Two generations. Larvae and pupae hibernate. Food plants: orache, burdock, sorrel, dandelion, lettuce, hop, ragweed, celery, chicory, and others.

Eggs laid singly on underside of leaves. They are light yellow, 0.56 to 0.58 mm in diameter, and 0.44 to 0.54 mm in height. Ribs 23 to 25, of which 13 or 14 reach micropylar zone. Micropylar rosette consists of 12 or 13 lobes with 1 or 2 rims. Within 24 hrs eggs take on pinkish coloration and brown spot at apex and brown girdle visible. Egg gradually turns gray and black head of larva visible through shell at apex before larva hatches.

Tribe Agrotini

Species of this tribe live in the upper soil layer. Body slightly flattened, without enlargements or bulges, with short legs. Color of body earthy. Head semiprognathous, with very short epicranial suture, deep parietal notch, and highly projecting parietal apices (Figure 11). Spinneret very short, often half length of first segment of labial palpus (Figure 17, *6*). Secretion of silky threads in younger instars not seen.

Key to Genera

1 (2). Pattern on head of first type; frons with three pairs of dark-colored spots (Figure 48, *5*)..... 2. **Euxoa.**

2 (1). Pattern on head of second type; frons with single dark-colored spot (Figure 49, *7, 8*)..... 1. **Agrotis.**

1. Genus *Agrotis* Ochs.

Larvae quite large (up to 40 to 50 mm), earth-colored, with faint pattern on back. Head light-colored, with pattern of second type (Figure 49, *7, 8*), or dark brown to black, somewhat lighter in color in lower part. Adfrontal sclerites end at epicranial suture or parietal notch, their apices pointed or truncated (Figure 74). Distance between coxae of third pair of thoracic legs equal to, or 0.25 less than distance between setae VIII–VIII. Ventral region of spinneret opening bulges or is slightly concave; dorsal edge with slender short fringe (Figures 17, *6* and 73, *14, 15*). Skin often coarsely and unevenly granulated. Pinacula on ventral side lighter than on dorsal side.

Key to Species

1 (4). Skin coarsely and unevenly granulated.
2 (3). Granules on skin visible to naked eye. Head highly rugulose, brown, and supraorbital band slightly lighter in color dorsally. Adfrontal sclerites rest in epicranial suture, slightly pointed. Species large, up to 50 mm long..... 1. **A. ipsilon** Hufn.
3 (2). Granules on skin discernible only at magnification of 10 ×. Head smooth or slightly rugulose, light-colored, with pattern of second type (Figure 49, *7*). Larvae up to 45 mm long..... ..... 3. **A. exclamationis** L.
4 (1). Skin finely and uniformly granulated.
5 (6). Head smooth, light-colored, with pattern of second type (Figure 49, *7*). Submedial bands narrow. Reticulate structure faint. Adfrontal sclerites rest in epicranial suture, pointed. Dorsal field slightly darker than subdorsal. Pinacula on ventral side light gray. Larvae up to 40 mm long..... 2. **A. vestigialis** Rott.
6 (5). Head rugulose, dark-colored (Figure 49, *8*) or black throughout.
7 (8). Head not drawn in. Labrum with rather deep notch (Figure 74, *5*). Anal shield not darker than dorsal field. Distance between setae II–II on anal shield equal to distance between setae I–I. Larvae up to 48 mm long..... 5. **A. segetum** Schiff.
8 (7). Head highly drawn in. Labrum almost without notch (Figure 74, *4*). Anal shield significantly darker in color than dorsal field. Distance between setae II–II on anal shield half distance between I–I. Larvae up to 45 mm long..... 4. **A. corticea** Schiff.

1. **Agrotis ipsilon** Hufn. (dark sword grass moth)

Mature larva: Skin coarsely and unevenly granulated. Head highly rugulose. Seta IV on segment 8 greatly shifted ventrally, its upper edge almost at level of lower edge of stigma. Distance between setae VIII–VIII

on segment 8, 0.50 distance between them on segment 9, and 0.33 distance between them on segment 7. Distance between setae II–II on anal shield equal to, or slightly less than, that between I–I. Distance between metathoracic coxae equal to distance between setae VIII–VIII or slightly less. Hooks of abdominal legs: 13–15, 16–18, 17–18, 17–20, and 20–22.

Body greenish-brown or grayish-brown. Head brown, slightly lighter in color only in supraorbital and suborbital regions. Shields dark brown, with light-colored dorsal and subdorsal bands, without pinacula. Pinacula on trunk large, almost black, weakly sclerotized ventrally. Pinaculum IV larger than stigmata, pinaculum II larger than pinaculum I. Setae strong, slightly pointed, brown. Stigmata black, oval, with black edge. Legs light-colored. Pattern: dorsal band yellowish-green, narrow, with broad uneven brown border covering band at some places. Subdorsal band indistinct, discernible only at some places. Dorsal field yellowish, with brown striae. Subdorsal field dark brown. Substigmal band whitish-gray, without distinct borders, fuses with gray ventral side. Body length 37 to 50 mm and width of head 3.40 to 3.70 mm.

Development: I-instar. Just hatched larva colorless or grayish with large unsclerotized pinacula; sclerotization continues for 2.0 to 3.0 hrs. Head dark brown, almost black. Setae short, clavate. Shields light brown. Feeding larva yellowish-green. Body length of just hatched larva 2.1 mm, before molt 4.0 to 4.2 mm, and width of head 0.32 to 0.33 mm.

II-instar. Body yellowish or reddish, and green in region of filled intestine. Head light brown, with very dark pattern of first type. Setae short (0.044 mm), rust-colored, clavate, set on dark brown pinacula, surrounded by light-colored pigment. Light-colored pigment not seen around pinacula on shields. Stigmata light-colored, rounded, with brown edge. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal band pale yellow, continuous; subdorsal and suprastigmal bands consist of dots at places. Substigmal band white, continuous, uneven. Dorsal, and especially subdorsal, field slightly darker in color toward end of instar. Body length 4.0 to 7.0 mm and width of head 0.52 to 0.54 mm.

III-instar. Body thick, short. Head yellowish-green with brown pattern of first type and spots around setae. Setae brown, short, clavate, set on brown pinacula surrounded by light-colored background. Toward end of instar sclerotization remains only at apex. Stigmata dark-colored, rounded, with dark edge, and ring of dark pigment. Legs light-colored; abdominal legs on segment 3 underdeveloped. Pattern: dorsal, subdorsal, and substigmal bands dull white, not broad, often interrupted. Dorsal band with narrow brownish-green border; subdorsal and suprastigmal bands with brown border. Dorsal and subdorsal fields yellowish-green with sparse yellowish dots and fine brown striae. Substigmal band light yellow, broad,

with brown shaded spots. Body length 7.0 to 13.0 mm and width of head 0.82 to 0.83 mm.

IV-instar. Body greenish-brown. Head dark brown, almost black, with small clearances in supraorbital region, along epicranial suture and frontal sutures. Shields brown, with light-colored dorsal bands and minute pinacula. Setae brownish, piliform, set on brown pinacula. Pinaculum IV largest and I smaller than II. Stigmata oval, black, with black edge. Legs light-colored; all five abdominal pairs developed. Pattern: dorsal, subdorsal, and suprastigmal bands narrow, dull yellow, fringed with greenish-brown pigment. Dorsal field brown, with admixture of reddish striae, and covered with dense yellowish dots. Subdorsal field considerably darker in color. Substigmal band dull yellow with brown striae, with distinct border at commencement of instar; ventral border lacking at end of instar. Ventral side greenish. Body length 14 to 25 mm and width of head 1.40 to 1.60 mm.

V-instar. Larva does not differ from the VI-instar, except that light-colored background on head increases in supraorbital region. Body length 25 to 37 mm and width of head 2.30 to 2.50 mm.

In Belorussia larval development from early June to autumn. Larvae and pupae hibernate. Species highly polyphagous, damaging vegetable and farm crops and nurseries.

Eggs laid singly or in groups of 2 to 15 each on leaves, close to the ground, on plant residue, or on the soil. Diameter of eggs 0.45 to 0.48 mm and height 0.38 to 0.42 mm. Ribs 38 to 40, of which 14 or 15 reach micropylar zone. Micropylar rosette consists of 11 or 12 lobes surrounded by rim of large lobes. Color of eggs milk-white, light yellow, or yellow. Within 24 hrs eggs acquire pinkish coloration, and reddish-rusty girdle and spot at apex. Before larva hatches egg ash-violet.

2. **Agrotis vestigialis** Rott. (gray owlet moth)

Mature larva: Skin finely and uniformly granulated. Head smooth, not rugulose. Pinaculum IV on segment 8 posterior to stigma. Distance between setae VIII-VIII on segment 8, 1.5 times less than on segment 9 and 0.25 less than on segment 7. Distance between setae II–II on anal shield almost equal to distance between setae I–I. Distance between metathoracic coxae 2.0 times less than distance between setae VIII–VIII. Hooks of abdominal legs: 5–7, 6–9, 8–11, 8–12, and 14–17.

Body brownish-gray. Head grayish-yellow with pattern of second type (Figure 49, *7*), with dark or light brown narrow submedial bands, and faint reticulate structure. Thoracic shield not prominent and anal shield somewhat darker than general coloration. Pinacula on thoracic shield minute, light brown. Setae light brown, slightly pointed; brownish-gray setae seen on trunk. Pinacula on ventral side light gray. Pinaculum II larger

than pinaculum I and pinaculum IV larger than II and slightly larger than stigmata. Stigmata dark-colored, oval, with black edge. Legs light-colored or yellowish. Pattern: dorsal and subdorsal bands dull yellow, narrow. Dorsal band slightly fringed with fine brownish-gray striae. Dorsal and subdorsal fields covered with yellowish dots and gray striae. Substigmal band slightly prominent only around dorsal border and, as on ventral side, covered with pale yellow dots and light gray striae. Body length 28 to 40 mm and width of head 3.10 to 3.20 mm.

In Belorussia larval development from latter half of July to autumn and, after hibernation, to mid-May. Food plants: wheatgrass, meadow grass, brome grass, dead nettle, bindweed, and lettuce. Feed preferentially on roots and damage farm and vegetable crops and nurseries.

3. **Agrotis exclamationis** L. (heart-and-dart moth)

Mature larva: Skin coarsely grained, with granules of different sizes. Head smooth, not rugulose. Distance between setae VIII–VIII on segment 8, 2.0 to 2.5 times less than on segment 9 and 1.5 times less than on segment 7. Distance between metathoracic coxae equal to distance between setae VIII–VIII. Distance between setae II–II on anal shield 1.5 times less than between I–I. Pinaculum IV on segment 8 posterior to stigmata. Hooks of abdominal legs: 5–8, 7–10, 11–15, 13–16, and 16–20.

Body yellowish-brown or grayish-brown. Head dull yellow with brown to black pattern of second type (Figure 49, *7*). Reticulate structure less sharp than submedial bands. Supraorbital band narrow and suborbital in form of large spot. Adfrontal sclerites rest in epicranial suture at a fairly acute angle. Spot on frons triangular. Thoracic shield brown, anal shield lighter in color. Dorsal bands on shields distinct. Setae attenuate slightly toward end, dark-colored. Pinacula on dorsal side dark brown, large, on ventral side minute, not sclerotized, and on throacic shield sclerotized only at commencement of instar. Stigmata black, oval, broad, with broad black edge. Legs light-colored. Pattern: dorsal band dull yellow, perceptible only at places. Subdorsal band covered by border almost completely, so that dorsal and subdorsal bands take the form of dark bands on light brown or light cinnamon dorsal field. Suprastigmal band dull yellow, narrow, with brown border. Substigmal band greenish-yellow due to scattered dull yellow dots. Lower part of band merges with greenish-yellow coloration of ventral side. Body length 29 to 45 mm and width of head 3.30 to 3.40 mm.

Development: I-instar. Just hatched larva thick, short. Prothorax almost equal to width of head. Body yellowish. Skin coarsely grained. Head dark brown, almost black. Thoracic shield light brown, anal shield not prominent. Pinacula on thoracic shield light brown and in form of light-colored tubercles on trunk. Their sclerotization continues for over

6.0 hrs. Setae short, colorless, clavate, but piliform on legs, anal shield, and abdominal side. On head, setae P_2, L_1, A_3, Frl_1, and Frl_2 clavate; other setae piliform or slightly pointed. Feeding larva yellowish-green with dark brown pinacula. Stigmata light-colored, rounded, with dark brown edge. Legs light-colored; abdominal legs on segments 3 and 4 barely developed. Body length of just hatched larva 1.60 to 1.80 mm, before molt 3.20 to 3.50 mm, and width of head 0.34 to 0.35 mm.

II-instar. Body dull yellow, with translucent green intestine. Main color of head dull yellow but appears darker due to accumulation of minute brownish spots in region of submedial, supraorbital, and suborbital bands. Setae set on brown spots. As in the I-instar, setae on dorsal side and P_2, L_1, Frl_1, and Frl_2 on head clavate. Pinacula on dorsal side dark brown, on abdominal side and shields light-colored. Thoracic shield brown, anal shield not prominent. Dorsal bands extend along them. Shagreen granulation denser than in the I-instar and darker than body color. Heterogeneity of granulation faintly distinguishable. Stigmata same color as body, with fine brown edge, and located on tubercles in form of pinacula. Legs light-colored; abdominal legs on segments 3 and 4 poorly developed. Pattern: dorsal, subdorsal, and suprastigmal bands pale yellow, narrow. Substigmal band same color, broad, and faint since covered at places by yellowish-brown pigment. Body length 3.5 to 7.0 mm and width of head 0.52 to 0.54 mm.

III-instar. Larvae brownish-green. Head yellow with admixture of brown, with very dark submedial bands that broaden notably in parietal region, attenuate thereafter, and terminate at center of frons. Setae clavate; pinacula also as in the II-instar but additionally with dermal granulation. Shields not prominent. Stigmata light brown, set on brown pinacula and round; on segment I and 8 somewhat oval. Legs green; all five abdominal pairs developed. Pattern: dorsal, subdorsal, and suprastigmal bands yellowish, narrow, with rather narrow brown border or without it. Dorsal field somewhat brownish, subdorsal slightly darker. Substigmal band light-colored, broad, but faint. Body length 6.5 to 10.0 mm and width of head 0.88 to 0.91 mm.

IV-instar. Body green, with admixture of brown. Head dull yellow with brown pattern of second type (Figure 49, *7*). Reticulate structure faint. Setae brownish, thick, piliform, set on trunk on large dark brown pinacula; pinacula on shields smaller. Shields light brown with light-colored dorsal bands. Stigmata black with black edge, not on tubercles but somewhat raised. Legs light-colored. Pattern same as in the III-instar. Dorsal band more distinct and lower border of substigmal band merges with color of ventral side. Body length 10 to 18 mm and width of head 1.30 to 1.40 mm.

V-instar. Body earth-colored with different shades—yellowish, grayish, brownish. Pattern on head and trunk same as in the VI-instar. Body length 19 to 28 mm and width of head 2.20 to 2.30 mm.

In Belorussia larval development from June 10 to 20 until autumn. Second generation almost every year, numbers small. Species polyphagous, feeding on dicotyledons and cereal plants. Damages farm and vegetable crops and nurseries.

Eggs laid on the soil, dry or moist, mostly on plant residue and plant leaves growing close to the ground. Eggs light yellow, 0.74 to 0.78 mm in diameter, and 0.61 to 0.62 mm in height. Ribs 44 to 46, of which 14 to 16 reach micropylar zone. Micropylar rosette consists of 14 to 16 lobes with 1 or 2 rims. Within 24 hrs light brown girdle and spot at apex visible. Girdle and spot later turn dark brown and shell of egg dark yellow. Before larva hatches egg brownish with ashen bloom.

4. **Agrotis corticea** Schiff. (bark-colored owlet moth)

Mature larva: Skin finely and uniformly granulated. Head rugulose. Ventral edge of spinneret opening bulges (Figure 17, *6*). Labrum almost without notch (Figure 74, *4*). Distance between setae VIII-VIII on segment 8 almost 3.0 times less than on segment 9 and 2.0 times less than on segment 7. On anal shield distance between setae II–II 2.0 times less than between I–I. Upper edge of pinaculum IV on segment 8 set at level of center of stigma. Hooks of abdominal legs: 6–7, 9–10, 11–12, 13–15, and 15–17.

Body earth-colored, greenish-brown. Head greatly drawn in, dark yellow, with black pattern of second type (Figure 49, *8*). Zone of supraorbital band light-colored, all of suborbital part black. Adfrontal sclerites rest in parietal notch (Figure 74, *2, 3*). Setae brown, rather distinctly pointed. Pinacula flat, I, II, III, and IV dark brown, and rest brownish-green; pinacula IX and X on thoracic shield large but flat, I and II small. Pinaculum II on trunk smaller than IV but longer than I. Stigmata oval, broad, black, with black edge. Legs brownish-gray. Pattern: dorsal and subdorsal bands yellowish-gray, narrow. Borders of dorsal band brown, narrow, at many places covers band. Upper border of subdorsal band broad, lower border very narrow. Borders almost cover entire band. Suprastigmal band more prominent than dorsal and subdorsal, with narrow brown border. Dorsal field yellowish-gray, densely covered with fine brown striae, but lighter colored than subdorsal. Substigmal band grayish-green and indistinguishable from color of ventral side. Body length 27 to 45 mm and width of head 3.0 mm.

Development: I-instar. Just hatched larva colorless, thick. Head dark brown. Thoracic shield light brown, not completely sclerotized (Figure 59). Anal shield colorless. Pinacula large, colorless, raised, turning light

brown after 4.0 or 5.0 hrs. Body of feeding larva yellowish with pinkish tone, and green in region of filled intestine. Setae rust-colored, thick, clavate, with large club. Stigmata rounded, light-colored, with dark edge. Thoracic legs dark-colored; abdominal legs light-colored and underdeveloped on segments 3 and 4. Skin coarsely grained. Length of just hatched larva 2.0 mm, before molt 3.5 to 3.7 mm, and width of head 0.34 to 0.35 mm.

II-instar. Body greenish-brown. Head dark brown, almost black. Shields light brown, thoracic shield with narrow light-colored dorsal and subdorsal bands. Setae brown, clavate, set on large brown pinacula. Stigmata round, gray, with black edge. Legs light gray, underdeveloped on segments 3 and 4. Pattern: dorsal, subdorsal, and suprastigmal bands dull white, color much darker [*sic*] than body background, with borders. Dorsal and subdorsal fields brownish-green. Substigmal band broad, grayish, unevenly colored. Ventral side light gray. Body length 4.0 to 7.0 mm and width of head 0.50 to 0.52 mm.

III-instar. Body pigmentation same as in the II-instar. Head light brown, with very dark pattern of first type and spots around setae (Figure 48, *2*). Setae brown, with small club, set on large brown, rather low pinacula; pinacula on shields small. Stigmata light brown, round, with black edge. Legs light gray. Pattern: dorsal, subdorsal, and suprastigmal bands light-colored, even, more distinct than in the II-instar; borders light brown, uneven. Substigmal band dull white, broad, with distinct borders. Body length 6.0 to 11.0 mm and width of head 0.77 to 0.80 mm.

IV-instar. Body yellowish-gray, with admixture of brown. Head dark brown with very dark pattern of second type (Figure 57, *2*). Setae brownish, piliform. Shields brown or only fringed with brown pigment, and with narrow light-colored dorsal bands. Pinacula brown, slightly sclerotized. Skin coarsely grained. Stigmata black, oval with black edge. Legs brownish-green; all five abdominal pairs developed. Pattern: dorsal, subdorsal, and suprastigmal bands yellowish-gray, same color as dorsal field. Bands prominent only because of brown borders. Subdorsal field light brown. Substigmal band lighter than other bands, broad, bordered ventrally with brownish pigment. Ventral side grayish-green. Body length 10 to 17 mm and width of head 1.07 to 1.10 mm.

V-instar. Body grayish-brown or light brown. Pattern on trunk the same as in the VI-instar. Head with brown or black pattern of second type (Figure 49, *8*) or black throughout. Frons light-colored or with round black spot. Labrum black. First segment of antenna light-colored, second black at base and later reddish-yellow. Dermal granulation fine, but coarser than in the VI-instar. Body length 16 to 27 mm and width of head 1.86 to 1.94 mm.

In Belorussia larval development from end of June to autumn. Food plants: burdock, bindweed, lady's mantle, plantain, raspberry, whortleberry, dandelion, and lettuce.

Eggs laid singly, haphazardly, on plant leaves close to the ground. They are pale yellow with pinkish tone, 0.71 to 0.72 mm in diameter, and 0.54 to 0.55 mm in height. Ribs 32 to 34, of which 10 to 12 reach micropylar zone. Micropylar rosette consists of 12 to 14 lobes. Within 24 hrs eggs acquire very intense pink color; yellowish-brown girdle at equator and spot at apex visible. Eggshell later turns light pink while girdle and spot turn brownish-red. Before larva hatches egg ash-gray with reddish tone, translucent and head of larva black.

5. **Agrotis segetum** Schiff. (turnip moth)

Mature larva: Skin finely and evenly granulated. Head rugulose. Ventral edge of spinneret opening somewhat convoluted (Figure 73, *15*). Labrum with fairly deep notch. Distance between setae VIII–VIII on segment 8, 2.0 times less than on segment 9 and 0.33 less than on segment 7. On anal shield distance between setae II–II almost same as distance between setae I–I. Pinaculum IV on segment 8 slightly shifted ventrally; its upper edge at level of center of stigmata. Distance between metathoracic coxae equal to distance between setae VIII–VIII. Hooks of abdominal legs: 7–12, 12–14, 13–14, 13–16, and 14–17.

Body brownish-gray or cinnamon-gray; abdominal side hazy green. Head dark yellow with dark brown or black pattern of second type, variety 8 or more rarely variety 7 (Figure 49, *7, 8*). Setae brownish, rather thick, acuminate, short (0.56 mm). Pinacula at commencement of instar dark green with admixture of brown, and brown mid-instar. Pinacula IV, V, VI, VII, and VIII very weakly sclerotized, light brown. Pinacula on shields barely visible. Thoracic shield dark green, with admixture of brown; anal shield not prominent. Dorsal and subdorsal bands on shields fairly distinct. Stigmata oval, black, with broad black edge. Legs dull green. Pattern: dorsal and subdorsal bands dull white or grayish, narrow, with greenish-brown borders. Borders uneven, narrow on dorsal band, and very broad on subdorsal. Dorsal field light gray with scattered, very light-colored spots that group mainly around pinacula and between fine, scattered, yellowish-brown striae. Subdorsal field darker; dull green striae scattered on it against light gray background. Substigmal band light gray with indistinct borders. Body length 33 to 48 mm and width of head 3.10 to 3.20 mm.

Development: I-instar. Just hatched larva yellowish, short, and thick. Head dark brown, almost black. Thoracic shield light brown. Pinacula quite large, light-colored, and sclerotization proceeds for 4.0 or 5.0 hrs; shields and pinacula later turn dark brown. Setae short (0.078 mm), clavate on thoracic shield and dorsal side, piliform on anal shield, ventral side,

and legs. On head, setae P_2 and Frl_2 clavate, others piliform or somewhat acuminate. Feeding larva dull yellow, translucent with visible green intestine. Thoracic legs dark-colored; abdominal legs light-colored and underdeveloped on segments 3 and 4. Skin coarsely grained. Body length of just hatched larva 1.50 to 1.70 mm, before molt 3.50 mm, and width of head 0.32 to 0.34 mm.

II-instar. Body light-colored, yellowish-brown, with very dark shagreen granulation on skin. Head brown, lustrous. Setae rust-colored, same as in the I-instar. Pinacula brown, fairly large, and smaller on shields. Thoracic shield brown, anal shield significantly lighter. Stigmata rounded, same color as body, disposed on tubercles in form of pinacula. Legs light-colored; abdominal legs underdeveloped on segments 3 and 4. Pattern: dorsal, subdorsal, and suprastigmal bands narrow, continuous, and dull white. Substigmal band broad, slightly lighter than general color of body. Body length 4.0 to 7.0 mm and width of head 0.48 to 0.60 mm.

III-instar. Body thick, short. Skin somewhat dry, with fine uniform granulation. Head light brown, with very dark pattern of first type (Figure 57, *2*), or dark brown without pattern. Setae clavate on thoracic shield and dorsally, and piliform or slightly pointed on head. Pinacula brown, fairly large. Shields slightly fringed with brown pigment. Stigmata light brown, round, slightly oval on segments I and 8. Legs green; all five abdominal pairs developed. Pattern: dorsal and subdorsal bands dull white, narrow; dorsal fringed with narrow line of brown pigment, and subdorsal with broad upper border and narrow lower one. Suprastigmal band broader, with narrow brown border. Substigmal band broad, whitish, covered at many places with brown pigment. Body length 9.0 to 15.0 mm and width of head 0.80 to 0.92 mm.

IV-instar. Body light brown, earth-colored. Head light brown, its main color hazy yellow, with groups of brown spots at apex of hemispheres. In some specimens cells between spots shaded and apex of hemisphere dark throughout, surrounded by dark-colored spots. Area of submedial band not covered with spots but with dark-colored pigment throughout. Base color preserved around parietal notch, epicranial suture, lower part of head, and in zone of supraorbital band. Frons light-colored, with rounded dark spot (Figure 57, *2*). Shields slightly fringed with brown pigment. Pinacula absent on shields. Setae set on small dark-colored spots on shields. Pinacula on rest of trunk large, high, dark brown. Setae brown, slightly pointed. Stigmata black, oval, with broad black edge. Legs light-colored. Pattern: dorsal and subdorsal bands almost same color as body and faint. Both bands slightly fringed with brown pigment. Substigmal band broad, slightly lighter in color than brownish-green ventral side. Body length 13 to 20 mm and width of head 1.30 to 1.40 mm.

V-instar. Body greenish-brown or brownish-gray. Color and pattern of head in most cases same as in the IV-instar (Figure 57, *2*); more rarely pattern as in the VI-instar. Pattern on trunk not different from that of the VI-instar. Body length 20 to 31 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development from mid-June to end of July or mid-August. In some years in the second to fourth weeks of August small number of second generation seen. Highly polyphagous species. Damages farm and vegetable crops and forests.

Eggs laid haphazardly on leaves close to the ground, on plant residue, and on the soil, and singly or in groups (5 to 20). They are light yellow, almost spherical, with flat base, 0.60 to 0.63 mm in diameter, and 0.53 to 0.56 mm in height. Ribs 44 to 47, of which 12 to 16 reach micropylar zone. Micropylar rosette consists of 13 or 14 lobes surrounded by single rim. On second day chorion acquires pinkish color and light brown, broad, uneven girdle above equator and spot at apex visible. Girdle and spot later darken, enlarge, and cover almost entire egg, with only apex and base retaining yellowish-pink tone. Before larva hatches egg dark gray, sometimes with violet tinge. Black head of larva apparent at apex of egg.

2. Genus *Euxoa* Hbn.

Larvae slightly smaller than those of *Agrotis* (up to 35 to 38 mm), gray or dark gray, with admixture of brown and violet tones. Pattern faintly visible. Head yellow, sometimes with admixture of brown, and dark brown or black pattern of first type (Figure 48, *5*). Zone of subdorsal band somewhat darkened throughout or only around adfrontal sclerites. Adfrontal sclerites end on epicranial suture. Spinneret considerably shorter than first segment of labial palpus. Ventral edge of spinneret opening convoluted and dorsal with two sharp projections (Figure 73, *16*). Abdominal legs short, broad at base, notably pinched toward plantae. Skin finely and evenly granulated. Pinacula not large, dark brown, similar in pigmentation dorsally and ventrally.

Key to Species

1 (2). Thoracic shield dark brown or black, with distinct light-colored dorsal band. Head hazy yellow, with pattern of first type (Figure 48, *5*). Entire region of submedial band from seta V_1 to V_2 darkly shaded. Larvae up to 35 mm long..... 1. **E. tritici** L.

2 (1). Thoracic shield gray or brownish-gray; light gray dorsal band indistinct. Head hazy yellow, with dark brown or black pattern of first type. Region of submedial band somewhat darkened only around adfrontal sclerites. Larvae up to 38 mm long..... 2. **E. nigricans** L.

1. **Euxoa tritici** L. (white-line dart moth)

Mature larva: Postgenal sclerites not contiguous (Pi = 1/3). Distance between metathoracic coxae 2.0 times less than between setae VIII–VIII. Hooks of abdominal legs: 9–11, 10–13, 12–15, 13–17, and 16–19.

Body dark gray, brownish-gray, or light brown. Head yellow, with dark brown pattern of first type (Figure 48, *5*). Distinguishing feature compared to other patterns of first type, shaded darkening in region of submedial bands. Thoracic shield dark brown, with distinctly visible light-colored dorsal and subdorsal bands. Sometimes dark pigment concentrated mainly in anterior part of shield, especially around setae X. Anal shield usually lighter in color than thoracic, with minute dark-colored spots. Pinacula brownish, not raised. Setae light brown, slightly pointed. Stigmata oval, broad, black, with black edge. Thoracic legs light-colored, with admixture of yellow; abdominal legs greenish-gray. Pattern: dorsal band narrow, dull yellow, with grayish-brown, almost even borders. Sometimes borders extend into band and covers it at places. Subdorsal band same color and width as dorsal but more distinct. Its dorsal border dark brown, not broad, and almost even; ventral border slightly lighter in color and narrower. Dorsal field light gray, with insignificant admixture of violet, dense yellowish-gray dots, and more rarely with fine brownish-gray striae. Subdorsal field slightly lighter in color than dorsal. Substigmal band faint, yellowish-gray, its upper border distinct at places, and lower one almost absent. Ventral side greenish-gray. Body length 22 to 35 mm and width of head 2.8 to 3.0 mm.

In Belorussia larval development in May and June. Embryonal growth in summer–autumn period but larva hibernates in chorion. Food plants: many varieties of buckwheat, Cruciferae, Solanaceae, Chenopodiaceae, Plantaginaceae, and others. Damages vegetable and farm crops.

Eggs laid haphazardly on soil. They are white, 0.67 to 0.70 mm in diameter, and 0.45 to 0.48 mm in height. Ribs very faint. Micropylar rosette consists of 16 lobes with single rim.

2. **Euxoa nigricans** L. (garden dart moth)

Mature larva: Postgenal sclerites not contiguous (Pi = 1/4). Distance between metathoracic slightly less than between setae VIII–VIII. Hooks of abdominal legs: 11–14, 13–16, 16–18, 19–20, and 22–24.

Body gray. Head brownish-gray, with black pattern of first type and some darkened shading around adfrontal sutures. Thoracic shield gray, with faint dorsal bands; anal shield not prominent. Pinacula dark brown, almost black, flat, lustrous. Setae brown, somewhat pointed. Stigmata black, oval, broad, with black edge. Thoracic legs grayish-yellow, abdominal legs gray with dark pinacula. Pattern: dorsal band dull yellow, not broad, continuous, with grayish-brown, somewhat shaded borders.

Subdorsal band same width as dorsal but its border lighter in color. Dorsal field gray, with insignificant admixture of violet, and scattered yellowish-gray dots and dark gray striae. Subdorsal field lighter in color than dorsal. Substigmal band broad, yellowish-gray, with quite distinct border above and shaded below. Ventral side greenish-gray, with distinct dark pinacula. Body length 22 to 28 mm and width of head 3.0 mm.

In Belorussia one generation. Larvae seen from spring to middle or end of June. According to Beck (1960), larvae hibernate in Germany. Food plants: Compositae, buckwheat, Chenopodiaceae, and others. Damages vegetable and farm crops.

According to Döring (1955), eggs white, 0.70 to 0.75 mm in diameter, and 0.50 mm in height. Micropylar rosette consists of 12 lobes with single rim. Ribs not seen. Chorion with reticulate structure.

Subfamily Hadeninae

Larvae moderate in size, up to 40 to 45 mm, more rarely 50 to 53 mm long. Body color in most cases dark, with faint dorsal bands, and very prominent dark-colored borders; sometimes bands distinct while borders faint or absent. Substigmal band extends onto anal leg. Abdominal legs five pairs, usually long, rarely short. Hooks cover one-half or more of planta, usually uniordinal; among *Discestra* and *Hadena* second tier barely distinguishable. Dorsal teeth of mandibles normal or highly reduced. In *Cerapteryx, Tholera,* and *Mythimna* only two barely developed main teeth present (Figure 15, V). Spinneret longer than first segment of labial palpus by 1.5 to 4.0 times, often pinched toward end (Figure 17, *2*); in *Orthosia* spinneret short, broad, and not pinched toward end. Dorsal region of spinneret opening with small fringe, dents, or convolutions (Figure 79, *1–11*). In *Mythimna* dorsal and ventral edges of spinneret with fringe (Figure 79, *12–14*). Most species undergo five molts, but four molts occur in *Discestra,* and six in some *Mythimna.*

Key to Genera

1 (2). Seta M_1 absent on mandible. Body green, with broad white dorsal and subdorsal bands. Larvae on coniferous trees. Up to 38 mm long..... 4. **Panolis.**

2 (1). Seta M_1 present on mandible. Pattern on trunk different. Larvae not on coniferous trees.

3 (20). Head with pattern of second type (Figure 49, *1, 6*), without pattern or with black spots on anterior part. Mandibles with normally developed teeth, sometimes extreme dorsal tooth reduced. Dorsal band more often in form of chain of light-colored dots, rarely continuous.

4 (5). Spinneret significantly shorter than first segment of labial palpus. All stigmata except first and last disposed on substigmal band. Larvae up to 32 to 47 mm long..... 1. **Orthosia.**

5 (4). Spinneret 1.5 to 4.0 times longer than first segment of labial palpus, more rarely equal to it in length. All stigmata disposed above substigmal band; rarely stigmata of segments 2 to 5 on substigmal band.

6 (9). Hooks of abdominal legs indistinctly biordinal (Figure 24, *3*). Dorsal band on thoracic shield narrow, subdorsal significantly broader.

7 (8). Upper border of subdorsal band in form of dark longitudinal spots. Stigmal band black, greatly enlarged around stigmata (Figure 53, A). Stigmata light-colored. Larvae up to 33 mm long. ..... 7. **Discestra.**

8 (7). Upper border of subdorsal band not in form of dark longitudinal spots. Dorsal field often with herringbone pattern. Stigmal band absent. Stigmata dark-colored. Larvae up to 30 to 33 mm long. ..... 5. **Hadena.**

9 (6). Hooks of abdominal legs uniordinal. Dorsal and subdorsal bands on thoracic shield narrow, identical; rarely, subdorsal band slightly broader than dorsal.

10 (19). Stigmata light-colored. Upper border of subdorsal band does not form dark-colored longitudinal smears.

11 (12). Spinneret 4.0 times longer than first segment of labial palpus; spinneret opening rounded, with minute dents on dorsal edge (Figure 79, *1*). Head light-colored, with pattern of second type (Figure 49, *1*). Stigmal band black (Figure 55, *7*). Herringbone pattern sometimes visible on dorsal field (Figure 75, *8*). Larvae up to 40 mm long..... 10. **Barathra.**

12 (11). Spinneret not more than 3.0 times longer than first segment of labial palpus.

13 (14). Dorsal field of each abdominal segment with large, dark, rhombic spot. On thoracic shield small dark-colored spot occurs between setae II and IX (Figure 76); if spot absent, then dark-colored oblique smears present on abdominal segments between setae II and III (Figure 75, *5*). Larvae up to 52 mm long... ..... 11. **Polia.**

14 (13). Rhombic spots absent on dorsal field of abdominal segments. Other features also different.

15 (18). Thoracic shield lustrous, dark- or light-colored, distinct. Setae on trunk without spots at base.

16 (17). Thoracic shield lighter in color than body, grayish-yellow. Head yellow, with brownish pattern of second type (Figure 49, *1*).

Body green, with red or reddish-violet hue. Larvae up to 45 mm long..... 13. **Heliophobus.**

17 (16). Thoracic shield darker in color than body, light brownish. Head green, without pattern. Body green, with admixture of brown, but without red and violet hues. Larvae up to 42 mm long. ..... 12. **Siderids.**

18 (15). Thoracic shield not lustrous, often not distinguishable from body background. Setae on trunk set on light- or dark-colored spots, more rarely without them. Larvae up to 45 mm long. ..... 9. **Mamestra.**

19 (10). Stigmata black. Upper margin of subdorsal band in form of dark longitudinal smears. Body brown. Larvae up to 37 mm long. ..... 8. **Lasionycta.**

20 (3). Head with pattern of second type (Figure 49, *2*). Mandibles with just two weakly developed teeth (Figure 15, V); all other teeth reduced. Dorsal band continuous.

21 (24). Ventral edge of spinneret opening convoluted. Skin coarsely grained. Dorsal and subdorsal bands broad.

22 (23). Mandibles with inner tooth. Larvae up to 35 mm long..... ..... 2. **Cerapteryx.**

23 (22). Mandibles without inner tooth. Larvae up to 45 mm long.. ..... 3. **Tholera.**

24 (21). Spinneret opening with fringe on dorsal and ventral edges. Skin smooth. Dorsal and subdorsal fields not broad. Larvae up to 38 to 50 mm long..... 6. **Mythimna.**

1. Genus *Orthosia* Ochs.

Larvae up to 40 to 47 mm in length, green, with light-colored, distinctly visible dorsal bands. Dorsal band more often continuous and considerably broader than subdorsal, in rare cases bands in form of dots. Stigmata light-colored, broad, and all except first and last disposed on substigmal band. Lower margin of subdorsal field highly darkened in some species—dark green or black. Mandibles with inner tooth. Spinneret broad, short, shorter than first segment of labial palpus; dorsal edge of opening minutely dentate (Figure 79, *10, 11*). Second seta of labial palpus shorter than first segment and first seta shorter than second segment. Metathoracic coxae separate or contiguous; variations even within a given species known. Hooks of abdominal legs: 20 to 26 on first pair and 30 to 35 on anal pair. Skin smooth, more rarely covered with minute spines.

Key to Species

1 (2). Skin covered with minute spines. Head dark-colored. Setae on black spots. Transverse yellowish smear present on thoracic shield posterior to setae I–I, and on segment 8 posterior to setae II–II..... 1. **O. cruda** Schiff.

2 (1). Skin smooth. Head light-colored with pattern of second type (Figure 49, *1*), light-colored without pattern, or light-colored with black anterior part (Figure 77). Transverse smear on thoracic shield and on segment 8 present or absent.

3 (8). Head green, without pattern. Entire body light green.

4 (5). Yellow transverse smear present in anterior part of thoracic shield and posterior to setae II–II on segment 8. Substigmal band narrow, not broader than dorsal. Body green, with scattered yellowish dots..... 2. **O. stabilis** Schiff.

5 (4). Light-colored smear absent in anterior part of thoracic shield and posterior to setae II–II on segment 8. Substigmal band broad.

6 (7). Setae on black spots on thoracic shield and thoracic legs. Substigmal band continuous, bright yellow, broad, reaches setae V..... 6. **O. gothica** L.

7 (6). Setae on light-colored spots on thoracic shield, and without spots at base on thoracic legs. Dorsal region of substigmal band white, middle of band green with white dots, and lower border or band in form of row of white dots extending along line of setae V. ..... 5. **O. incerta** Hufn.

8 (3). Head light-colored with black anterior part, or with pattern of second type (Figure 49, *1*). Body green throughout or with admixture of gray or brown.

9 (10). Head pale yellow, black in anterior part (Figure 77). Body green, with white bloom. Subdorsal field monochromatic green... ..... 7. **O. populi** Ström.

10 (9). Head with pattern of second type (Figure 49, *1*). Lower part of subdorsal field black.

11 (12). Dorsal field of segments 7 and 8 with dark cuneate spots. Substigmal band yellow, with raspberry tinge at center..... ..... 3. **O. munda** Schiff.

12 (11). Dorsal field of segments 7 and 8 without dark cuneate spots. Substigmal band yellow, with white upper border..... ..... 4. **O. gracilis** Schiff.

1. **Orthosia cruda** Schiff. (syn. *pulverulenta* Esp.) (yellowish-gray early moth)

Mature larva: Mandibles with large inner tooth disposed at center. Distance between setae Frl_1–Frl_2 considerably greater than between Frl_1–F_1; distance between Frl_2–P_1 and P_1–P_2 almost equal. Metathoracic coxae not contiguous; distance between them equal to distance between setae VIII–VIII. Skin covered with minute spines (Figure 26, *4*).

Body slightly pinched toward anterior end, yellowish-green, or greenish-gray. Head dark brown, with light yellowish spots on dilatations of hemispheres. Setae light brownish, I and II set on small black spots. Thoracic shield black; dorsal and subdorsal bands on it quite broad; small, transverse, light-colored striae occur posterior to setae I–I. Stigmata oval, broad, white, with thin black edge. Thoracic legs dark, abdominal legs grayish-green. Pattern: dorsal band yellowish, quite broad, continuous, even slightly fringed with gray pigment; terminates on segment 8 in rather broad transverse line. Subdorsal band in form of dots, slightly fringed with gray pigment ventrally. Dorsal and subdorsal fields yellowish-green. Substigmal band broad, yellow. Stigmata, except for first and last, disposed on substigmal band. Ventral side grayish-green. Body length 22 to 32 mm and width of head 2.8 to 3.0 mm.

According to information available in literature, body color of larvae varies from yellowish-gray to dark brown, and head black throughout in dark-colored specimens.

In Belorussia larval development from end of April to mid-June. Pupae hibernate. Food plants: oak, hornbeam, linden, elm, and other deciduous trees.

According to Döring (1955), eggs white, with broad light brown girdle and spot at apex, 0.70 to 0.75 mm in diameter, and 0.30 to 0.35 mm in height. Ribs 42 to 48 and sinuous; 22 to 25 ribs reach micropylar zone. Micropylar rosette consists of 10 or 11 lobes with single rim.

2. **Orthosia stabilis** Schiff. (yellowish-brown early moth)

Mature larva: Mandibles with inner tooth. Distance between setae Frl_1–Frl_2 greater than between Frl_1–F_2; distance between Frl_2–P_1 less than between P_1–P_2. Stigmata of segments I and 8 disposed above substigmal band; all others on substigmal band. Skin smooth.

Body yellowish-green. Head pale green. Setae light-colored, acuminate, and without pinacula and spots at base. Shields not prominent. Stigmata white, oval, with black edge. Thoracic legs yellowish, abdominal legs yellowish-green. Pattern: dorsal band light yellow, quite broad. Subdorsal band consists of large yellowish dots. Bands extend onto shield. Narrow, transverse yellow smear occurs in anterior part of thoracic shield, and very broad transverse smear in posterior part of segment 8.

Dorsal and subdorsal fields densely covered with yellow dots. Substigmal band yellow, narrow, not broader than dorsal. Ventral side yellowish-green with dense yellow dots. Body length 28 to 40 mm and width of head 2.9 to 3.0 mm.

In Belorussia larval development in May and June. Food plants: linden, poplar, oak, plum, and maple.

According to Döring (1955), eggs light yellow, 0.60 to 0.75 mm in diameter, and 0.45 to 0.53 mm in height. Ribs about 20 at apex and 44 to 47 at equator. Carmine-red spot at apex and girdle at equator.

3. **Orthosia munda** Schiff. (rust-colored early moth)

Mature larva: Mandibles with large inner tooth located at center. Distance between setae Frl_1–Frl_2 almost 1.5 times greater than between Frl_1–F_1; distance between setae Frl_2–P_1 and P_1–P_2 almost equal. Metathoracic coxae not contiguous; distance between them equal to half distance between setae VIII–VIII. Skin smooth.

Body slightly pinched toward anterior end, yellowish-gray or slightly brownish. Head pale green with brownish pattern similar to pattern of second type (Figure 49, *1*); pattern differs in dark-colored pigment from submedian band above setae A_1 and A_2 extends ventrally and merges with supraorbital band. Setae A_1 and A_2 set on light-colored and A_3 on dark-colored background. Thoracic shield significantly darker than general color of body; dorsal and subdorsal bands on it same color as on trunk. Setae on thoracic shield set on minute light-colored spots. Setae I and II on trunk set on rather large light-colored spots, faintly surrounded by dark-colored pigment; base of other setae without spots. Setae light brown, acuminate. Stigmata greenish-gray, oval, broad, with thin black edge. Legs green. Pattern: dorsal band yellowish, on thoracic segments continuous, narrow, and on abdominal segments in form of chain of dots that fuse at many places. Subdorsal band also consists of dots but more uniformly disposed. Dorsal field covered with whitish and yellowish dots and to some extent with very fine brownish striae. On segments 7 and 8 striae somewhat denser and form cuneate spots (Figure 54, *6*). Subdorsal field almost identical to dorsal; lower margin of subdorsal field on thoracic segments dark-colored, right up to black; ventral margin dark only above stigmata in form of fairly broad longitudinal spots. All stigmata, except first and last, disposed on light-colored background of substigmal band. Substigmal band yellow above, with admixture of raspberry-red at center, and bordered by yellowish dots below. Stigmata surrounded by yellow pigment. Ventral side grayish-green. Body length 28 to 47 mm and width of head 3.30 to 3.40 mm.

In Belorussia larval development from early May to end of June. Pupae hibernate. Food plants: oak, linden, poplar, alder, willow, plum, elm, and hornbeam.

Eggs with bulging apex, light yellow, 0.80 to 0.90 mm in diameter, and 0.50 to 0.55 mm in height. Ribs 40 to 43, of which 26 to 28 reach micropylar zone. Micropylar rosette consists of 14 to 16 lobes, with 3 rims. Within 24 hrs reddish-brown girdle at equator and spot at apex visible. Before larva hatches egg dark gray.

4. **Orthosia gracilis** Schiff. (dark gray early moth)

Mature larva: Mandibles with inner tooth. Distances between setae Frl_1–Frl_2 and between Frl_1–F_1 equal. Distance between setae Frl_2–P_1 less than between P_1–P_2. Stigmata of segments 1 to 7 disposed on substigmal band. Skin smooth.

Body green, with admixture of brown. Head dull white or somewhat brownish, with reddish-brown pattern of second type (Figure 49, *1*). Color of thoracic shield similar to that of head; anal shield yellowish-green. Setae pointed, and light brown or rust-colored. Setae on shields set on minute light-colored spots; setae I and II on trunk set on spots around which dorsal side black and ventral white; all other setae without spots at base. Stigmata white or slightly brownish, oval, broad, with thin black edge. Thoracic legs yellow, abdominal legs green. Pattern: dorsal band narrow, white at commencement of instar, and yellowish at end of it. Subdorsal band in form of dots. Dorsal field covered with white or yellowish dots, fringed with black striae at commencement of instar, and with light brownish pigment at end of it. Hence dorsal field blackish-green and brownish-yellow. Both dorsal and subdorsal bands without contrasting borders. Ventral band of subdorsal field black. Substigmal band broad, yellow, with white dorsal margin bordered below by yellowish dots. Ventral side yellowish-green with yellow dots. Body length 28 to 45 mm and width of head 3.10 to 3.20 mm.

Development: I-instar. Body of just hatched larva colorless, with reddish intestine. Head black, lustrous. Shields light brown, thoracic not fully sclerotized; setae IX and X set on light-colored background (Figure 59). Pinacula colorless, turning brown after 1.5 to 2.0 hrs. Legs reddish. Feeding larva green, with dark brown pinacula and shields. Length of just hatched larva 1.73 to 1.75 mm, before molt 3.5 mm, and width of head 0.33 to 0.34 mm.

II-instar. Body green. Head brownish-yellow with brown pattern of first type. Setae brownish, somewhat pointed, set on small black pinacula. Stigmata light-colored, rounded, with dark margin. Thoracic legs black; abdominal legs green, with brown spots on outer side, and underdeveloped on segment 3. Pattern: dorsal and subdorsal bands narrow, substigmal band broader. All bands dull white. Body length 3.5 to 6.0 mm and width of head 0.63 to 0.64.

III-instar. Body green. Head light yellow, with light brown pattern of first type. Setae rust-colored, set on minute black pinacula. Shields yellowish, slightly fringed with brownish pigment, with minute black pinacula. Dorsal bands barely discernible on shields. Stigmata rounded, light-colored, with black margin. Thoracic legs dark-colored; abdominal legs light-colored and all five pairs developed. Pattern: dorsal and subdorsal bands white, dorsal slightly broader than subdorsal. Substigmal band white, broad. Body length 6.0 to 10.0 mm and width of head 0.75 to 0.82 mm.

IV-instar. Color and pattern of body and head same as in the III-instar. Sometimes subdorsal band darker than dorsal. Shields light green, almost white, with minute black pinacula. Pinacula on body minute, black, flat, surrounded by black pigment, but along edges with light-colored pigment. Stigmata light-colored, somewhat oval, with black edge. Body length 10 to 18 mm and width of head 1.20 to 1.30 mm.

V-instar. Body green, with white and black pattern. Head yellowish-green, with faint yellowish pattern of first type (Figure 48, *1*). Shields green, with narrow white dorsal bands; setae I and II set on white round spots and IX and X on general background. Pattern same as in the VI-instar. Body length 17 to 29 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development in May and June. Food plants: pimpernel, *Erodium,* dog rose, catchfly, burnet, *Filipendula,* plum, poplar, linden, and oak.

Eggs laid in clusters haphazardly, with up to 300 per cluster. They are ocherous-yellow, 0.58 to 0.60 mm in diameter, and 0.38 to 0.39 mm in height. Ribs 45 to 48, of which 18 to 20 reach micropylar zone. Micropylar rosette consists of 9 to 10 lobes, with 2 rims.

5. **Orthosia incerta** Hufn. (violet-gray early moth)

Mature larva: Mandibles with inner tooth. Distances between setae Frl_1–Frl_2 and Frl_1–F_1 equal and almost so between setae Frl_2–P_1 and P_1–P_2. Stigmata of segments 1 to 7 disposed on substigmal band.

Body green, with whitish bloom at commencement of instar and with yellowish bloom at end of it. Head green. Shields not prominent, setae rust-colored, and spots at bases absent. Stigmata white, broad, oval, with thin black edge. Thoracic legs light-colored, abdominal legs green. Pattern: dorsal band white, quite broad; dark borders at commencement of instar disappear in two or three days. Subdorsal band narrow, without borders even at commencement of instar. Dorsal field rather sparsely covered with white dots, around which sometimes dark-colored pigment deposited, which disappears in two or three days; subsequently dorsal field, like subdorsal, becomes monochromatic green with white dots. Ventral border of subdorsal field black. Substigmal band broad, white at dorsal

border, green at center, fringed with white dots ventrally. Ventral side greenish, with dense white dots. Body length 29 to 44 mm and width of head 3.0 mm.

Development: I-instar. Body of just hatched larva yellowish-gray or brownish-gray. Head black. Pinacula gray, turning black in 40 min. Shields light brown, turning dark brown in 2.0 hrs. Thoracic legs dark-colored; abdominal legs grayish and underdeveloped on segments 3 and 4. Skin coarsely grained. Feeding larva light green. Length of just hatched larva 2.3 mm, before molt 4.0 mm, and width of head 0.39 mm.

II-instar. Body green, with grayish tone. Head yellow, with black spots around setae. Setae brown, somewhat pointed, set on black pinacula. Pinacula on shields similar in size. Legs light-colored. Pattern: dorsal band dull white, continuous, and rather broad; subdorsal band same color, narrower. Substigmal band white, broad. Body length 4.0 to 7.0 mm and width of head 0.59 to 0.60 mm.

III-instar. Body green. Head yellowish, with large black spots around setae and dark green pattern of first type. Setae light brown, acuminate, set on flat black pinacula surrounded by background pigment lighter in color than body. Setae V largest. Shields greenish-yellow; on thoracic shield pinacula IX and X larger than I and II. Stigmata light-colored, rounded, with black edge. Legs light-colored; all five abdominal pairs developed. Pattern: dorsal and subdorsal bands white, former quite broad and latter 2.0 times narrower. Bands at commencement of instar with narrow dark green margin. White dots seen here and there on dorsal field. Subdorsal field dark green. Substigmal band white in upper part and green at center. Ventral side light green. Body length 7.0 to 13.0 mm and width of head 0.98 to 0.99 mm.

IV-instar. Body green, somewhat pinched toward anterior end. Head greenish-yellow, with large black spots around setae. Setae I and II set on minute black spots; seta III and setae on thoracic shield set on very large black spots. Stigmata light-colored, oval, with black edge. Pattern same as in the III-instar. Body length 13 to 19 mm and width of head 1.46 to 1.51 mm.

V-instar. Body green, with whitish bloom. Head yellowish or green, with large black spots at base of setae. At commencement of instar whitish pattern of first type faintly discernible. Setae acuminate, light brown, set on minute black spots; spots larger on shields. Pattern same as in the VI-instar. Body length 19 to 28 mm and width of head 2.20 mm.

In Belorussia larval development in May and June. Food plants: oak, linden, maple, willow, poplar, birch, hornbeam, plum, pear, dog rose, and also sorrel and dandelion.

Eggs laid in small clusters and light yellow, 0.73 to 0.74 mm in diameter, and 0.50 to 0.55 mm in height. Ribs 42 or 43 and sinuous; 18

to 24 ribs reach micropylar zone. Micropylar rosette consists of 9 or 10 lobes. Eggs darken gradually, turning dark gray.

6. **Orthosia gothica** L. (brownish-gray early moth)

Mature larva: Mandibles with inner tooth. Distance between setae Frl_1–Frl_2 somewhat greater than between Frl_1–F_1. Distance between setae Frl_2–P_1 less than between P_1–P_2. Skin smooth. Stigmata of segments I and 8 disposed on dark-colored margin of subdorsal field and others on substigmal band.

Body slightly pinched toward anterior end, light green, with ashen bloom dorsally. Head greenish-yellow, with minute black spots around setae. Adfrontal suture distinct only in upper half of frons. Shields green, with dorsal bands same width as on trunk. Shields prominent only because ashen bloom and white dots do not extend onto them; dots numerous on dorsal and subdorsal fields. Setae rust-colored, acuminate, and short (0.58 mm). Setae on shields and thoracic legs set on minute black spots; spots larger on head, and absent at base of other setae. Stigmata white, oval, broad, with thin black edge. Thoracic legs yellowish, abdominal legs green. Pattern: dorsal and subdorsal bands yellow, continuous, former slightly broader. Borders of bands almost nil. Sometimes insignificant collection of dark green pigment seen around dorsal band. Dorsal and subdorsal fields identical. Lower margin of subdorsal field black at commencement of instar and dark green at end of it. Substigmal band bright yellow, continuous, very broad, encompasses seta V. Ventral side green, darker than dorsal side, without ashen bloom but with white dots that turn yellow at end of instar. Body length 30 to 45 mm and width of head 3.0 mm.

Development: I-instar. Just hatched larva grayish, with reddish intestine. Head black. Pinacula not sclerotized. Skin finely grained. Legs light-colored; abdominal legs underdeveloped on segments 3 and 4. Feeding larva green, well proportioned, with brown shields and black scales. Body length of just hatched larva 2.0 to 2.1 mm, before molt 4.0 mm, and width of head 0.37 to 0.39 mm.

II-instar. Larva slender, green. Head yellow, with large black spots around setae. Seate black, set on round black pinacula. Stigmata round, light-colored, with black edge. Thoracic legs black, abdominal legs yellowish. Pattern: dorsal band white, quite broad, subdorsal considerably narrower. Substigmal band white and quite broad. Body length 4.0 to 8.0 mm and width of head 0.59 to 0.63 mm.

III-instar. Color of trunk and head same as in the II-instar. Setae I and II set on minute pinacula, setae III, V, and VI on large (up to 0.09 mm) pinacula. Thoracic legs gray; abdominal legs greenish-yellow and all five pairs developed. Pattern: dorsal and subdorsal bands quite broad, pinkish-white. Dorsal band fringed broadly but unevenly with brownish

pigment; subdorsal band with similar dorsal fringe but much darker pigment ventrally. Lower margin of subdorsal field dark brown, almost black. Substigmal band broad, bright yellow. Ventral side yellowish-green. Body length 8.0 to 14.0 mm and width of head 0.96 to 0.97 mm.

IV-instar. Body light green, even. Head greenish-yellow, with large black spots around setae. Shields somewhat surrounded by brownish striae. Setae dark-colored, acuminate, I and II set on minute black spots, III, V, and VI on very large spots. Stigmata somewhat oval, white, with black edge. Legs light-colored. Pattern: dorsal and subdorsal bands yellowish-white. Borders of bands dark green, indistinct. Lower margin of subdorsal field dark green. Both dorsal and subdorsal fields with sparse white dots. Substigmal band broad and yellow. Ventral side light green. Body length 14 to 21 mm and width of head 1.48 to 1.49 mm.

V-instar. In larvae of this instar, unlike larvae of the VI-instar, ashen bloom absent on dorsal and subdorsal fields, and large black spots present around setae on head and shields. Body length 20 to 31 mm and width of head 2.0 to 2.1 mm.

In Belorussia larval development from second half of April to middle or end of June. Food plants: linden, maple, oak, poplar, black thorn, alder, mountain ash, birch, willow, and also sorrel, nettle, and *Galium*.

Eggs laid in clusters, in two to four layers, in quite regular rows. Cluster consists of up to 250 or more eggs, which are yellowish-green, 0.75 mm in diameter, and 0.43 mm in height. Ribs 40 to 42, of which 24 to 26 reach micropylar zone. Micropylar rosette consists of 8 to 9 lobes. Within 24 hrs eggs turn yellowish-gray and yellowish-brown girdle and spot at apex visible. Before larva hatches egg dark gray.

7. **Orthosia populi** Ström. (syn. *populeti* Fr.) (poplar early moth)

Mature larva: Mandibles with large triangular inner tooth. Distance between setae Frl_1–Frl_2 notably greater than between setae Frl_1–F_1; distance between setae Frl_2–P_1 less than between P_1–P_2; and between setae II–III on anal shield 0.25 more than between II–II. Skin smooth.

Body light green, with white bloom, slightly pinched toward anterior end. Head pale yellow, black in anterior part (Figure 77). Setae rust-colored, highly acuminate, quite long (1.10 mm); spots at base absent on trunk and shields. Shields not prominent. Stigmata oval, whitish, with narrow black edge. Legs green. Pattern: dorsal band white and quite broad; subdorsal also white but narrow. Bands without contrasting borders. Substigmal band same color as body, somewhat enclosed by fine, uneven, white line dorsally and ventrally. Body length 28 to 40 mm and width of head 3.0 to 3.2 mm.

Development: I-instar. Just hatched larva grayish, translucent with visible violet-brown intestine. Head black, lustrous. Thoracic shield black.

Shields light-colored; sclerotization continues for 1.0 to 1.5 hrs after which they turn black. Stigmata light-colored, rounded, with thin black edge. Setae light-colored, piliform, long (0.11 mm). Thoracic legs dark-colored; abdominal legs light-colored and underdeveloped on segments 3 and 4. Feeding larva yellowish-green. Body length of just hatched larva 2.0 to 2.2 mm, before molt 4.0 mm, and width of head 0.40 to 0.41 mm.

II-instar. Body green. Head black. Shields broad, black. Setae light-colored, somewhat pointed, set on minute black pinacula. Stigmata light-colored, rounded, with thin black edge. Thoracic legs dark-colored; abdominal legs light-colored and first two pairs underdeveloped. Pattern absent. Body length 4.0 to 7.5 mm and width of head 0.63 to 0.65 mm.

III-instar. Body grayish-green. Head black, lustrous. Thoracic shield black, anal shield gray. Setae slender, acuminate, long (0.22 mm), and set on dark gray pinacula (0.043 mm). Pinacula III, IV, and V larger than I and II. Stigmata somewhat oval, light-colored, with thin black edge. Thoracic legs black; abdominal legs light-colored, with large gray spot ventrally. Pattern: dorsal, subdorsal, and substigmal bands faint, lighter in color than general body color. Body length 7.0 to 11.0 mm and width of head 0.94 to 0.96 mm.

IV-instar. Body light green. Main color of head black, light-colored at epicranial suture around frontal sutures in upper part (Figure 77). Thoracic shield in anterior part light-colored, in posterior part black. Setae light-colored, acuminate; setae I and II on minute gray pinacula, III and IV on large flat black or brown pinacula. Stigmata light-colored, oval, with very thin black edge. Thoracic legs black; abdominal legs almost white and all five pairs developed. Pattern; dorsal and subdorsal bands white and narrow. Substigmal band slightly broader, white, faint. Stigmata disposed at upper margin of band. Body length 10 to 18 mm and width of head 1.33 to 1.37 mm.

V-instar. Body light green. Head in anterior part black; posterior part of hemispheres light-colored (Figure 77). Thoracic shield fringed with black pigment, anal shield not prominent. Setae light-colored, slender, acuminate; I and II at commencement of instar on minute light green pinacula, III on very large grayish-brown pinaculum; setae IV, V, and VI on segment I, II, and 8 also set on very large gray pinacula. Toward end of instar pinacula disappear. Stigmata oval, white, with thin black edge. Thoracic legs black, abdominal light green. Pattern: dorsal and subdorsal bands white, not broad, without contrasting borders. Substigmal band white at margins and dull white at center. Stigmata of segments 1 to 7 disposed on band. Ventral side greenish-white. Body length 17 to 27 mm and width of head 2.0 to 2.1 mm.

In Belorussia larval development from second half of April to early June. Food plants: poplar, maple, and oak.

Eggs laid haphazardly in clusters of 100 to 200. They are grayish-yellow, 0.80 to 0.90 mm in diameter, and 0.40 to 0.50 mm in height. Ribs 56 to 58, of which 32 to 34 reach micropylar zone. Micropylar rosette consists of 12 or 13 lobes.

2. Genus *Cerapteryx* Curt.
(one species in Belorussian fauna)

Cerapteryx graminis L. (grass owlet moth)

Mature larva: Mandibles with two poorly developed main teeth and single inner tooth set in an alveolus (Figure 15, XI). Spinneret 1.5 times longer than first segment of labial palpus. Spinneret opening on dorsal edge convoluted. Tubercles of setae IIIa and V on segment I, IIIa on II and III, and III on segment 9 black and notably larger than other setae (Figure 28). Distance between setae Frl_2–P_1 less than between P_1–P_2. Stigmata black. Skin densely granulated.

Body dark brown, insignificantly pinched toward anterior and posterior ends. Head light yellow or rust-colored, with brown pattern of second type (Figure 49, *2*). Setae brown, somewhat pointed, set on pinacula; spots absent at base of pinacula. Shields brown, highly sclerotized, lustrous. Dorsal and subdorsal bands extending onto shields white; on anal shield same width as on back but on thoracic shield narrower. Stigmata black, oval, with black edge. Thoracic legs dull yellow, abdominal legs brown, with large dark brown spot on outer side. Pattern: dorsal and subdorsal bands dull yellow, fairly broad, continuous. Fine brown or reddish-brown striae scattered on bands. At commencement of instar striae few and bands more vivid. Suprastigmal band same width and color as subdorsal. Dorsal and subdorsal fields dark brown with faint darker striae. On subdorsal field, slightly posterior to stigmata, rather small longitudinal spot set aslant. Stigmal band dark brown, not broad, even, merges into brown color of subdorsal field. All stigmata disposed on stigmal band. Substigmal band broad, dull yellow at borders, and covered with brown striae at center. Ventral side dull yellow, with yellow dots and brown striae. Body length 28 to 35 mm and width of head 3.20 to 3.60 mn.

In Belorussia larval development in May and June. Food plants: cereals—bent grass, reed grass, hair grass, fescue, meadow grass, brome grass, mat grass, rye, barley, oats, and others, as well as sedges and rushes. Damage meadows and pastures.

Eggs laid haphazardly and singly. They are hemispherical, yellowish-white or greenish, 0.80 mm in diameter, and 0.50 mm in height. Ribs absent. Minute papillae in form of warts visible on chorion. Micropylar rosette consists of 12 to 14 lobes.

3. Genus *Tholera* Hbn.

Spinneret 1.5 times longer than first segment of labial palpus; dorsal side of spinneret convoluted (Figure 79, *15, 16*). Seta P_1 shifted caudally from line of dispositions of setae Frl_2–Frl_2. Setae P_1 and P_2 equidistant from epicranial suture. Epicranial suture almost 1.5 times longer than height of frons. Main teeth of mandibles considerably reduced (Figure 15, V); inner tooth absent. Thoracic shield highly sclerotized and broad, considerably proximate to setae III and IIIa. Ungual base of thoracic legs reduced (Figure 22, *2*). Abdominal legs short, with black chitinous girdle around planta. Skin on trunk and head granulated (Figure 26, *2*). Stigmata black.

Key to Species

1 (2). Ventral side of spinneret opening with two projections (Figure 79, *16*). Body dark brown, with violet hue..... 1. **T. cespitis** F.

2 (1). Ventral side of spinneret opening concave (Figure 79, *15*). Body dark brown, without violet hue..... 2. **T. decimalis** Poda.

1. **Tholera cespitis** Schiff. (dark brown ryegrass moth)

Mature larva: Ventral edge of spinneret opening with two projections, dorsal edge convoluted (Figure 79, *16*). Second seta of labial palpus equal to first segment and 1.5 times longer than first seta. Distances between setae Frl_1–Frl_2 and Frl_1–F_1 equal. Hooks of abdominal legs: 13–14, 14–15, 16–17, 18–20, and 20–23.

Body slightly pinched toward posterior end and more so toward anterior, dark brown with violet hue, and with broad light-colored dorsal bands. Head reddish-brown-gray, with dark brown pattern of second type (Figure 49, *2*). Shields dark brown, almost black. Dorsal bands on shields same width as on trunk. Setae brownish, I and II somewhat pointed, short (0.56 to 0.60 mm); all other setae longer and more acuminate. Setae set on minute light-colored flat pinacula. Stigmata oval, black, with black edge. Thoracic legs dark yellow; abdominal legs yellowish-gray, with broad black girdle around planta. Pattern: dorsal band broad, dull white, with violet hue. Subdorsal band same width and color. At middle and especially end of instar band covered with fine dark-colored striae; subsequently borders appear somewhat abraded. Dorsal and subdorsal fields monochromatic dark brown, with violet hue and dull yellow dots. Suprastigmal band consists of longitudinal spots. Substigmal band considerably wider than dorsal, even, hazy white; all stigmata disposed above band. Ventral side light gray with faint violet hue. Body length 26 to 45 mm and width of head 3.9 to 4.0 mm.

According to Meyrick (1895), Spuler (1910), and Koch (1958), larval development in September and, after hibernation, up to July. We were not able to collect larvae from eggs in autumn. Mature larvae were found from June 18 to 25. Food plants: cereal grasses—wheatgrass, hair grass, and others.

Eggs laid haphazardly, singly, on underside, more rarely upper side, of leaves. They are ocherous-yellow, 0.60 to 0.65 mm in diameter, and 0.45 to 0.55 mm in height. Ribs sharp, 42 to 45. Almost all the ribs reach micropylar zone. Micropylar rosette consists of 17 to 18 lobes.

2. **Tholera decimalis** Poda (syn. *popularis* F.) (white-banded ryegrass moth)

Mature larva: Ventral edge of spinneret opening flexed and dorsal edge convoluted (Figure 79, *15*). Second seta of labial palpus equal to first segment and 1.5 times longer than first seta. Distance between setae Frl_1–Frl_2 greater than between Frl_1–F_1. Hooks of abdominal legs: 10–11, 10–13, 12–14, 15–17, and 16–19.

Body slightly pinched toward anterior and posterior ends, dark brown, without violet hue, with broad light-colored dorsal bands. Head rusty-brown or brownish-gray, with dark brown pattern of second type (Figure 49, *2*). Shields dark brown, not very prominent. Dorsal bands on shields almost same width as on body. Setae rusty-brown, somewhat pointed, short, set on very minute gray spots. Stigmata oval, black, with black edge. Thoracic legs yellowish; abdominal legs yellowish-gray, with broad black girdle around planta. Pattern: dorsal band dull yellow, broad, continuous, even; subdorsal of same width and color with brown, shaded, scattered striae, but borders of band distinct. Suprastigmal band considerably narrower, at places interrupted. Dorsal and subdorsal fields light brown, with yellowish dots and fine dark brown striae. Latter at commencement and middle of instar fuse and form thin transverse lines. Toward end of instar fields monochromatic dark brown. Substigmal band broad, dull yellow, toward end of instar covered with fine light brown lines. Basal field dark gray, as on ventral side. Body length 27 to 47 mm and width of head 4.0 to 4.1 mm.

According to Meyrick (1895), Spuler (1910), and Koch (1958), larval development in September and, after hibernation, up to July. According to our observations, developing larvae hibernate in chorions. We found mature larvae from June 25 to 28. Food plants: cereal grasses—ryegrass, wheat-grass, and others.

Females scatter eggs without attaching them to leaves. Eggs light yellow, almost round, 800 to 850 mm in diameter, and 785 to 840 mm in height [*sic*]. Ribs 20 to 23 and sharp. All ribs reach micropylar zone. Micropylar rosette consists of 18 or 19 lobes. On second day eggs acquire

pink tone and later brown; after five or six days developing larva visible through shell.

4. Genus *Panolis* Hbn.
(one species in genus)

Panolis flammea Schiff. (pine beauty moth)

Mature larva: Postgenal sclerites closely contiguous. Spinneret broad, somewhat pinched toward end, and 2.0 times longer than first segment of labial palpus (Figure 17, *3*). Second seta long, almost equal in length to first segment and 5.0 times longer than first seta. Seta P_1 almost on same line as Frl_2–Frl_2. Distance between setae Frl_2 and P_1 equal to distance between P_1–P_2. On thoracic shield distance between setae I–II, 2.0 times less than between II and IX; between setae I–I and X–X distance almost equal. On the anal shield distance between setae II–II, 1.5 times more than between II and III. Mandibular teeth normal; inner tooth and seta M_1 absent (Figure 15, IX). Skin finely grained. Hooks on abdominal legs arranged in one tier: 25–26, 27–28, 28–30, 30–32, and 33–36.

Body slightly pinched toward posterior end, well proportioned, green. Head light yellow with brownish-red pattern of second type (Figure 49, *6*). Setae brown, distinctly acuminate, short (0.78 mm), disposed on general background. Shields green with white dorsal and subdorsal bands. Stigmata reddish-yellow, oval, with black edge. Thoracic legs yellowish-brown or reddish, abdominal legs green. Pattern: dorsal and subdorsal bands broad, even, white; dorsal without contrasting borders; subdorsal above with narrow, even, black border. Dorsal and subdorsal fields green; large whitish-green smears occur at center of subdorsal field; black line extends along bottom part of subdorsal field. At commencement of instar latter touches substigmal band; at end of instar green clearance seen between the two. Substigmal band broad, with distinct borders, its upper part white, and lower orange. Band extends onto anal leg. Ventral side green, with single unpaired white band along median line, and paired bands along line of legs. Body length 26 to 38 mm and width of head 2.90 to 3.10 mm.

Development: I-instar. Just hatched larva grayish with minute light-colored pinacula that turn brown in 60 to 90 min. Head yellow. Shields yellowish. Setae black, somewhat pointed. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Skin coarsely grained. Feeding larva yellowish-green. Body length of just hatched larva 2.0 mm, before molt 4.0 to 4.5 mm, and width of head 0.282 to 0.300 mm.

II-instar. Body green, slender, well proportioned. Head yellow, without pattern. Setae black, somewhat pointed, on minute brown pinacula. Thoracic shield yellowish or green, anal shield not prominent. Stigmata light-colored, round, with black edge. Thoracic legs yellowish; abdominal

legs greenish and first two pairs underdeveloped. Pattern: dorsal, subdorsal, and suprastigmal bands whitish, not broad; substigmal band faint, somewhat broader, with an indistinct bottom border. Body length 4.0 to 7.5 mm and width of head 0.521 to 0.564 mm.

III-instar. Larvae differ from those of the II-instar in very distinct white longitudinal bands. Subdorsal and suprastigmal bands somewhat narrower than dorsal band. Substigmal band broad, white. Body length 7.0 to 12.0 mm and width of head 0.78 to 0.80 mm.

IV-instar. Body well proportioned, green, with whitish bloom dorsally. Head yellow, without pattern. Setae black, somewhat pointed. Pinacula minute, black at apex. Thoracic shield green, without whitish bloom; anal shield not prominent. Dorsal and subdorsal bands extending along shields same width as on body. Stigmata light-colored, round, slightly oval on segments I and 8. Thoracic legs yellowish-brown; abdominal legs green and all five pairs developed. Pattern: dorsal band greenish-white, fairly broad; subdorsal and suprastigmal bands same color but narrower. Dorsal and subdorsal fields green with whitish bloom. Substigmal band broad, light yellow. Stigmata, except for first and last, disposed in upper part of band. Ventral side green, white at center. Body length 12 to 21 mm and width of head 1.246 to 1.375 mm.

V-instar. Body green with ashen bloom. Head whitish, with brownish-yellow pattern of second type (Figure 49, *6*). Shields green, without ashen bloom. Dorsal and subdorsal bands on thoracic shield broad, narrow on anal shield. Pinacula minute, black, well sclerotized. Stigmata yellowish, slightly oval. Thoracic legs dark-colored, abdominal legs green. Pattern differs from that of the VI-instar in that upper border of subdorsal band not black but dark green. Striae in lower part of subdorsal field also dark green or totally absent. Suprastigmal band present but very narrow. Ventral side green, slightly darker than dorsal. Body length 18 to 29 mm and width of head 2.07 to 2.20 mm.

In Belorussia larval development in May and June. Pupae hibernate. Larvae feed mainly on Scotch pine and more rarely on spruce.

Eggs laid on underside, more rarely upper side, of needles (leaves) of pine in form of chain, but do not touch. They are greenish-yellow, 0.910 to 0.911 mm in diameter, and 0.671 to 0.682 mm in height. Ribs 44 to 46, of which 18 to 21 reach micropylar zone. Micropylar rosette consists of 15 or 16 lobes. During embryonal development eggs acquire pinkish tinge.

5. Genus *Hadena* Schrk.

Larvae moderate in size, with distinct herringbone pattern or extremely prominent continuous bands. Head with pattern of second type (Figure

49, *1*). Postgenal sclerites almost touch (Pi = 1/10), more rarely widely set (Pi = 1/3 and 1/2). Spinneret somewhat pinched toward end, 2.0 times longer than first segment of labial palpus, with minute dents along dorsal edge of opening (Figure 79, *5, 6*). Second seta of labial palpus somewhat shorter than first segment. First seta equal to second segment. Mandibular teeth developed; inner tooth may be present or absent. Stigmata dark-colored. Hooks of abdominal legs indistinctly biordinal.

Key to Species

1 (4). Mandibles with one or two inner teeth. Coxae of thoracic legs touch. Herringbone pattern visible on dorsal field. Dorsal and subdorsal bands consist of large light-colored dots.

2 (3). Body yellowish-green, with reddish-brown pattern and fine arced striae on subdorsal field that descend toward stigmata (Figure 78). Ends of postgenal sclerites almost touch (Pi = 1/10)..... ..... 2. **H. rivularis** F.

3 (2). Body yellowish-gray, with dark or light brown pattern. Arcuate lines on subdorsal field absent. Ends of postgenal sclerites do not touch (Pi = 1/3, 1/2)..... 3. **H. bicruris** Hufn.

4 (1). Mandibles without inner tooth. Herringbone pattern absent. Dorsal and subdorsal bands continuous, with brownish shaded border ..... 1. **H. lepida** Esp.

1. **Hadena lepida** Esp. (syn. *carpophaga* Bkh.) (pupating owlet moth)

Mature larva: Mandibles without inner tooth. Distances between setae Frl_2–P_1 and P_1–P_2 almost equal. Seta IIIa on segment 1 slightly above line of seta IV. Body with sparse, very minute spines. Hooks of abdominal legs: 21–23, 23–24, 26–27, 27–30, and 33–36.

Body gray, with admixture of brown. Dorsal bands continuous, light-colored. Head light brownish, with dark brownish pattern of second type (Figure 49, *1*). Setae light brownish, acuminate, and set on common background on trunk and shields. Thoracic shield dark brown or dark cinnamon, with narrow white dorsal band and broader subdorsal. Anal shield not prominent. Stigmata oval, light brown, with black border. Thoracic legs yellowish, abdominal legs light gray. Pattern: dorsal band whitish, dull white, or brownish-white, not broad, continuous. Subdorsal band considerably broader than dorsal, white, continuous. Suprastigmal band narrower than subdorsal, dull white. Borders of bands brownish, narrow, slightly shaded. Dorsal and subdorsal fields monochromatic light gray, with sparse, fine brownish striae. Stigmal band not prominent. Substigmal band broad, white, with distinct borders. Ventral side light gray. Body length 19 to 30 mm and width of head 2.40 to 2.50 mm.

In Belorussia larval development in July and August. Food plants: catchfly, *Saponaria,* and others.

2. **Hadena rivularis** F. (syn. *cucubali* Schiff.) (violet-brown seed moth)

Mature larva: Mandibles with single tetragonal inner tooth. Distance between Frl_2–P_1 equal to distance between P_1–P_2. Seta IIIa on segment 1 considerably above line of seta IV. Skin smooth. Hooks of abdominal legs: 20–22, 23–24, 27–29, 25–27, and 31–33.

Body slightly pinched toward anterior end, yellowish-green, with reddish-brown herringbone pattern. Head yellow, with brown pattern of second type (Figure 49, *1*). Supraorbital band distinct. Setae light brown, acuminate, set on large white spots. Seta II set on spot much larger than spots of I and X. On thoracic shield setae set on minute white spots. Shields brown, with white dorsal bands; on thoracic shield dorsal band narrow and subdorsal quite broad. Stigmata brown, almost black. Legs yellowish; abdominal legs with large brown spot ventrally. Pattern: dorsal and subdorsal bands in form of chain of fairly large white dots. Dots on subdorsal band larger and sparser. Dorsal and subdorsal fields covered with large number of minute white dots which, around dorsal band, are surrounded by reddish-brown pigment forming borders of band; borders broadest at margins of segments, and almost absent in region of seta II. Upper border of subdorsal band broad and dark-colored only in anterior part of segment; later shifts upward between setae I and II and fuses with border of subdorsal band to form broad herringbone branches. Lower border of subdorsal band faint. Dorsal and subdorsal fields yellow. Substigmal band yellow, on anal leg and segment 1 white, its borders indistinct on thoracic segments. Stigmata surrounded by reddish-brown pigment. Fine reddish-brown line extends along subdorsal field, arcs upward, and descends downward toward each stigma (Figure 78). Basal field reddish-brown. Center of ventral side brownish-yellow. Body length 22 to 32 mm and width of head 2.60 mm.

Development: I-instar. Body of just hatched larva short, thick, almost equal to width of head, light yellow. Head black. Shields broad, black. Pinacula quite large, colorless, turning brown after 3.0 hrs. Setae black, strong, acuminate. Thoracic legs dark-colored; abdominal legs light-colored and all five pairs weakly developed. Skin coarsely grained; granules turn brown after 2.0 to 3.0 hrs. Feeding larva pinkish-yellow, with black pinacula and brown shields. Body length of just hatched larva 1.64 mm, before molt 2.70 mm, and width of head 0.325 mm.

II-instar. Body yellowish-green. Head black. Setae brownish, set on minute round brown pinacula. Shields brown. Stigmata round, light-colored. Thoracic legs black; abdominal legs light-colored with large dark-colored spots on outer side. Pattern: dorsal and subdorsal bands in form of chain of yellowish-white dots. Substigmal band not seen. Body length 3.0 to 5.0 mm and width of head 0.54 mm.

III-instar. Body yellowish-green. Head hazy green, with very dark-colored pattern of first type. Shields yellowish-green, with minute dark-colored pinacula; on thoracic shield pinacula IX and X larger than I and II. Pinacula on trunk small, black only at apex. Setae brownish, acuminate, 0.173 mm long. Stigmata light green, round, with broad brownish-black edge. Legs light-colored. Pattern: dorsal band in form of chain of minute yellowish dots that fuse on thoracic segments; subdorsal band consists of very large, more distinct dots; substigmal band not seen. Body length 5.0 to 9.0 mm and width of head 0.80 to 0.82 mm.

IV-instar. Larva light green. Head yellowish-green, without pattern. Setae light brown, I and II set on fairly large, almost identical white spots; seta X on minute white spot; spots absent at base of rest of setae. Shields not prominent. Stigmata light-colored, somewhat oval, with narrow black edge. Pattern: dorsal and subdorsal bands in form of chain of rather large white dots; dorsal and subdorsal fields with minute scattered white dots; substigmal band yellow, faint, with white dots denser than on subdorsal field. Body length 10 to 14 mm and width of head 1.18 to 1.20 mm.

V-instar. Body slightly pinched toward anterior end, green. Head yellowish-green, with faint pattern of second type (Figure 49, *I*). Shields not prominent and dorsal bands on them faint. Setae dark-colored, acuminate; I, II, and X on trunk set on round white spots; setae on thoracic shield set on minute spots. Stigmata light-colored. Hooks of abdominal legs reddish. Pattern: dorsal and subdorsal bands seen as dots which are larger on subdorsal band; border of band reddish-brown, faint, or absent. Dorsal and subdorsal fields with mass of white dots; substigmal band faint, broad, uneven (descends on stigmata and rises at margins of segments); margins in form of dots, band green at places in center. Ventral side light green, with white dots. Body length 14 to 22 mm and width of head 0.61 to 0.66 mm.

In Belorussia larval development early June to last 10 days of July, and in August–September. Food plants: catchfly, *Saponaria,* and other Caryophyllaceae.

Eggs laid singly, haphazardly. They are light yellow, with slightly displaced apex, 0.65 mm in diameter, and 0.58 mm in height. Ribs absent and chorion structure reticulate. Micropylar rosette consists of 16 or 17 lobes. During embryonal growth, spot and girdle not formed on chorion. Eggs darken gradually; initially light brownish, later dark brown.

3. **Hadena bicruris** Hufn. (syn. *capsincola* Esp.) (common seed moth)

Mature larva: Mandibles with two inner teeth. Distance between Frl_2–P_1 slightly less than between P_1–P_2. Seta IIIa on segment 1 notably higher than line of seta IV. Skin finely grained. Hooks of abdominal legs: 30–31, 32–33, 34–36, 36–39, and 40–43.

Body notably pinched toward anterior end, yellowish-gray, with slight admixture of red. Head yellow or reddish-yellow, with reddish-brown pattern of second type (Figure 49, *1*). First segment of antenna white, second yellowish. Thoracic shield grayish-brown, with narrow dorsal band and fairly broad subdorsal; minute, rounded, light-colored spots occur at bases of setae. Setae light brown; seta I on trunk set on dark-colored spot and II on light-colored spot. Stigmata dark-colored, oval, with dark brown fairly broad edge. Legs light-colored. Pattern: dorsal band yellow or grayish-yellow, continuous only on thoracic segments, in form of spots on trunk, most distinct in second half of segment. Subdorsal band also seen as dots but faint. Dorsal band fringed with light or dark brown pigment in anterior third and in second half of segment. Borders of subdorsal band less vivid. Upper border in anterior part of segment darker and broad, shifts upward around seta II and backward between setae I and II, encompasses seta I, and merges with border of dorsal band to form herringbone pattern with broad branches. Lower border of subdorsal band at center of segment shifts downward and forward and merges with dark-colored background of lower part of subdorsal field, close to stigma of successive segment. Some continuation of herringbone branches seen on subdorsal field. Dorsal and subdorsal fields densely covered with light yellow dots. Lower part of subdorsal field dark-colored. Stigmata disposed on dark-colored background. Substigmal band broad, yellow, with distinct border above and indistinct one below; accumulation of reddish-yellow pigment seen at center and in upper part in region of stigmata. Ventral side whitish, with large number of yellow dots. Body length 22 to 32 mm and width of head 2.4 to 2.5 mm.

Development: I-instar. Just hatched larva hazy yellow, short, not thick; compared with body, head appears large. Head black. Thoracic shield black. Pinacula minute, turning brown after 3.0 hrs. Setae light brown, somewhat pointed, and 0.085 mm long. Thoracic legs dark-colored; abdominal legs light-colored and all five pairs poorly developed. Skin coarsely grained. Body length of just hatched larva 1.20 mm, before molt 2.30 mm, and width of head 0.314 to 0.323 mm.

II-instar. Body yellowish, even. Head black. Shields brown. Setae brown, somewhat pointed, 0.125 mm long, set on large, brown, round pinacula. Pinacula not seen on shields. Stigmata round, light-colored, with broad black edge. Thoracic legs black, abdominal legs light-colored, with gray spots on outer side, and all five pairs poorly developed. Pattern absent. Body length 2.5 to 5.5 mm and width of head 0.58 to 0.59 mm.

III-instar. Body hazy green, thick, short. Head dark brown. Shields light brown; spots and bands not seen on thoracic shield. Setae light brown, somewhat pointed, on trunk set on flat brownish pinacula. Pinaculum III larger than I and II. Stigmata rounded, light-colored, with broad brown edge.

Thoracic legs dark-colored; abdominal legs light-colored, with brown spots around setae. Pattern: dorsal band narrow, light green; subdorsal band broader than dorsal; substigmal band light yellow, fairly broad. Stigmata disposed on upper part of band and surrounded by light yellow girdle. Body length 6.0 to 9.0 mm and width of head 0.80 to 0.85 mm.

IV-instar. Larva of this stage differs from the III-instar in narrow dorsal and very broad subdorsal bands extending along thoracic shield. Dorsal and subdorsal bands on trunk seen as dots and insignificantly fringed with brown pigment. Body length 9.0 to 14.0 mm and width of head 1.10 to 1.20 mm.

V-instar. Body brownish-gray, with very dark herringbone pattern. Head reddish-light brown, with faint pattern of second type (Figure 49, *1*). Setae rust-colored, less pointed, set on minute brown spots, surrounded by yellowish-pink pigment. Spot around seta III larger than spots around II and I. Shields brown, with narrow dorsal and very broad subdorsal bands; setae set on general background. Stigmata pinkish-yellow, oval, with broad black edge. Thoracic legs dark-colored; abdominal legs light-colored, with large brown spot on ventral side. Pattern differs from that of the VI-instar in that herringbone pattern seen as grayish-brown pigment and its branches do not extend onto subdorsal field. Subdorsal field slightly darker than dorsal. Ventral side light yellow, with sparse dots darker than main background. Body length 14 to 21 mm and width of head 1.50 to 1.60 mm.

In Belorussia larval development early June to mid-July, and August–September. Food plants: *Saponaria,* catchfly, and other Caryophyllaceae.

Eggs laid singly, haphazardly. They are light yellow, 0.548 to 0.552 mm in diameter, and 0.342 to 0.350 mm in height. Ribs absent and chorion with reticulate structure. Micropylar rosette consists of 15 to 17 lobes. On second day eggs acquire pinkish tinge but later darken and turn brownish.

6. Genus *Mythimna* Ochs.

Larvae moderate in size or large (up to 50 mm). Body light-colored; dorsal, subdorsal, and often suprastigmal bands distinct, not broad, even. Borders of bands narrow, dark-colored, more often even. Pattern on head of second type (Figure 49, *2*). Spinneret notably longer than first segment of labial palpus, more rarely equal to it; dorsal and ventral edges of spinneret with long fringing (Figure 79, *12, 13, 14*). Mandibles with two weakly developed teeth; all other teeth reduced (Figure 15, V); inner tooth present (Figure 15, XI) or absent. Stigmata dark-colored. Skin finely grained. Hooks of abdominal legs uniordinal. Number of molts six; in *M. conigera* and *M. pallens*—five.

Key to Species

1 (8). Base of unguis of thoracic legs with broad growth (Figure 22, *1*). Spinneret less than 0.33 length of first segment of labial palpus.
2 (7). Dorsal and subdorsal bands continuous.
3 (4). Setae I and II on trunk set on minute black spots. Upper border of subdorsal band in form of longitudinal black spots..... ..... 4. **M. albipuncta** Schiff.
4 (3). Black spots absent at base of setae I and II on trunk. Upper border of subdorsal band narrow, continuous.
5 (6). Dorsal and subdorsal bands narrow, identical..... ..... 3. **M. ferrago** F.
6 (5). Dorsal band notably narrower than subdorsal..... ..... 2. **M. conigera** Schiff.
7 (2). Dorsal band continuous, narrow; subdorsal band in form of light-colored dots. Upper border of subdorsal band at center of each abdominal segment shifts upward to form characteristic pattern (Figure 75, *7*)..... 1. **M. turca** L.
8 (1). Growth at base of unguis of thoracic legs considerably reduced (Figure 22, *2*). Spinneret 0.33 to 0.50 length of first segment of labial palpus.
9 (10). Upper border of subdorsal band in anterior half of each abdominal segment broad, in form of longitudinal black spots. ..... 7. **M. comma** L.
10 (9). Upper border of subdorsal band even, not enlarged in anterior half of abdominal segment.
11 (12). Dorsal field almost uniformly covered with fine dark-colored striae. Main yellow coloration of dorsal field does not form prominent band..... 6. **M. pallens** L.
12 (11). Dark-colored striae absent on dorsal field. Main yellow coloration of dorsal field forms prominent band..... ..... 5. **M. pudorina** Schiff.

Subgenus *Mythimna* Ochs.

1. Mythimna turca L. (frilled banded moth)

Mature larva: Mandibles with two poorly developed main teeth and one inner tooth (Figure 15, XI). Spinneret slightly longer than first segment of labial palpus with fringe on dorsal and ventral edges of opening (Figure 79, *12*). First seta 2.0 times longer than second segment of palpus, while second seta considerably shorter than first segment. Seta P_1 notably closer to Frl_2 than to P_2; seta IIIa on meso- and metathorax set on black

spot. Base of unguis of thoracic legs with broad growth (Figure 22, *1*). Hooks of abdominal legs: 24–27, 26–28, 26–30, 28–34, and 34–38.

Body somewhat pinched toward posterior end, brown, with admixture of red. Head yellowish-red, with brownish-red pattern of second type (Figure 49, *2*). Submedial bands narrow, highly shifted toward epicranial suture; reticulate structure with minute cells. Setae light brown, acuminate; setae I set on minute light-colored spot surrounded by dark pigment, and setae II on light-colored background; all other setae, including those on shields and legs, set on minute brown spots. Shields not very prominent. Dorsal and subdorsal bands on shields continuous, of same width as on body. Stigmata black, oval, with black edge. Legs reddish-yellow. Pattern: dorsal band rusty, light-colored, narrow, with brown border along margins of segments. Subdorsal band consists of dots. Upper border darkest at center of segment where it shifts upward (Figure 75, *7*). Dorsal field reddish, with yellow dots and fine brown striae; striae on subdorsal field few and light-colored. Stigmal band in form of accumulation of dark-colored pigment surrounding stigmata. Substigmal band broad, brownish-yellow. Body length 35 to 50 mm and width of head 4.0 mm.

Development: I-instar. Body of just hatched larva light-colored, pinched toward posterior end. Thoracic segments broad, almost as wide as head. Head brownish-yellow, with brown spots around setae. Shields yellowish. Pinacula small, light-colored. Setae piliform. Feeding larva green with brown pinacula. Borders of subdorsal and suprastigmal bands seen at end of instar. Accumulation of pigment commences from segments 8 and 7. Body length of just hatched larva 2.0 to 2.2 mm, before molt 4.0 mm, and width of head 0.37 mm.

II-instar. Body green. Head pinkish-brown, with brownish spots around setae. Shields not prominent. Setae brownish, piliform. Stigmata round, dark reddish-yellow, with black edge. Legs light brown, abdominal legs on segment 3 underdeveloped. Pattern: dorsal, subdorsal, and suprastigmal bands consist of dense white dots. Dorsal band with broad light brown borders. Substigmal band yellow, broad, green at center. Body length 4.0 to 8.0 mm and width of head 0.65 to 0.73 mm.

III-instar. Body broad and short. Main dorsal color light yellow. Head yellow, with faint brownish pattern of second type. Setae brownish, short, faint, and spots absent at their base. Shields not prominent; dorsal bands on them distinct. Stigmata dark-colored, oval, with black edge. Legs brownish; abdominal legs with large brown spots on outer side, and all five pairs developed. Pattern: dorsal and subdorsal bands white, narrow, even. Dorsal band with broad brownish borders and subdorsal with narrow borders. Between borders light-colored body background seen in form of even bands and hence larva appears to have multiple bands.

Suprastigmal band narrow, yellowish. Subdorsal field brown. Substigmal band broad and yellow, at center light brown. Stigmata of segments 2 to 6 disposed in upper part of substigmal band. Basal field brownish. Ventral side yellowish-green. Body length 7.0 to 13.0 mm and width of head 1.10 to 1.20 mm.

IV-instar. Body yellowish-green. Head yellow, with brown pattern of second type (Figure 49, *2*). Shields not prominent, with minute brown spots around setae. Setae light brown, acuminate, short (0.50 mm), and set on minute black spots. Stigmata black. Thoracic legs light-colored, abdominal legs green. Pattern: dorsal band narrow, white, with narrow dark-colored, almost black, borders. Subdorsal band in form of chain of white dots, fringed above with brownish pigment, below with dark yellow pigment. Suprastigmal band also seen as dots. Dorsal field light brownish-yellow, with yellow dots and brownish-yellow striae. Subdorsal field darker. Stigmal band brownish, not broad; all stigmata disposed on band. Substigmal band orange, with yellow borders. Ventral side green, with yellow dots. Body length 11 to 18 mm and width of head 1.70 to 1.80 mm.

V- and VI-instars. These instars have much in common in body color and pattern. While pattern on head in the IV-instar accords entirely with that depicted in Figure 49, *2*, in the V- and VI-instars submedian band narrower and somewhat shifted toward epicranial suture. Pattern on dorsal field in the V-instar differs notably from pattern in the IV-instar. Dorsal border of subdorsal band darker and broad in anterior part of segment, shifts upward and backward around seta II, and fuses with border of dorsal band in posterior part of segment to form fairly distinct herringbone pattern. Rather narrow, even, dark brownish stigmal band quite distinct. In the VI-instar herringbone pattern remains only on segments 7 and 8; on other segments pattern on dorsal field same as in the VII-instar. Stigmal band in VI-instar uneven, broader around stigmata. In the VII-instar band seen only around stigmata. Body length of V-instar 17 to 26 mm and width of head 2.2 to 2.3 mm; body length of VI-instar 26 to 35 mm and width of head 3.0 to 3.1 mm.

In Belorussia larval development from July to autumn and, after hibernation, to early or mid-May. Food plants—cereals, preferably soft cereals.

Female lays eggs on back of leaf sheaths haphazardly, in clusters of 10 to 400 each. In one day a single female may lay as many as 1,500 eggs. Diameter of egg 0.64 to 0.65 mm and height 0.46 to 0.48 mm. Ribs faint, very slender, and extend only up to equator. Micropylar rosette consists of 10 to 12 lobes with 3 rims.

2. **Mythimna conigera** Schiff. (yellowish-brown banded moth)

Mature larva: Spinneret barely exceeds length of first segment of labial palpus; first seta longer than second segment. Dorsal and ventral edges

of spinneret opening with fringe (Figure 17, *4*). Unguis of throacic legs with broad growth at base (Figure 22, *1*).

Main body color yellowish, with white and brown pattern. Head dull yellow with dark brown pattern of second type (Figure 49, *2*). Shields dark brown. Dorsal and subdorsal bands on shields broader than on trunk. Setae yellowish-brown, slender, acuminate, without spots at base. Stigmata dark brown, oval, with black edge. Legs light-colored. Pattern: dorsal band narrow, white, not broadly fringed with dark brownish pigment. Borders almost even, somewhat less vivid in zone of seta I. Subdorsal band broader, white. Border of band dark brown above and brownish below. Main yellowish color of body between borders of dorsal and subdorsal bands looks like band. Suprastigmal band dull white, equal in width to dorsal, its borders yellowish-brown. Yellowish and reddish dots of main body color also form bands between subdorsal and suprastigmal bands. Basal part of subdorsal field light brown; ventral margin somewhat darker. Substigmal band very broad, at borders yellow with yellow dots, and at center orange. Ventral side yellow, with yellow dots and fine light brownish striae. Yellow dots scattered in large numbers on dorsal and subdorsal fields also. Body length 26 to 37 mm and width of head 3.2 to 3.3 mm.

In Belorussia larval development in July and August and, after hibernation, to early or mid-May. Food plants: cereals.

3. **Mythimna ferrago** F. (syn. *lithargyria* Esp.) (silver banded moth)

Mature larva: Spinneret almost not longer than first segment of labial palpus. Fringe of spinneret opening on ventral side somewhat longer than on dorsal (Figure 79, *13*). Seta P_2 somewhat farther from epicranial suture than P_1. On segment 6 seta III located above stigma at a distance 3.0 or 4.0 times length of stigma. Base of unguis of thoracic legs with growth. Hooks of abdominal legs: 16–18, 17–19, 20–22, 25–26, and 27–30.

Body slightly pinched toward anterior end, light yellow, with white and brownish pattern. Head dull whitish-yellow, with brownish pattern of second type (Figure 49, *2*). Thoracic shield slightly darker in color than general body background; anal shield not prominent. On thoracic shield dorsal bands somewhat broader than on trunk. Setae rusty-brown, acuminate; I, II, III, and IV without spots at base; all others set on light brownish spots. Stigmata brown, oval, with dark brown edge. Legs yellowish. Pattern: dorsal, subdorsal, and suprastigmal bands narrow, continuous. Dorsal band whitish, with narrow dark brown, slightly shaded borders. Subdorsal and suprastigmal bands yellowish or yellow. Upper border of subdorsal band narrow, light brown, faint; lower border darker and broad. Upper and lower borders of suprastigmal band considerably shaded. Body covered with yellowish dots. Main yellow body coloration

of dorsal field in form of two bands; bands faint on subdorsal field. Lower margin of subdorsal field brownish. Substigmal band broad, yellow along borders, orange at center. Ventral side grayish-yellow. Body length 25 to 38 mm and width of head 3.8 to 4.0 mm.

In Belorussia larval development from July to autumn and, after hibernation, to mid-May. Food plants: cereals.

4. **Mythimna albipuncta** Schiff. (white-spotted banded moth)

Mature larva: Fringe of spinneret opening on ventral edge longer than on dorsal (Figure 79, *13*). Distance between setae P_1 and Frl_2 less than between P_1 and P_2. Seta P_2 slightly farther from epicranial suture than P_1. On segment 6 seta III located dorsal to stigma at a distance exceeding 2.5 to 3.0 times length of stigma. Base of unguis of thoracic legs with growth. Hooks of abdominal legs: 23–25, 24–28, 28–29, 28–31, and 31–32.

Body somewhat pinched toward anterior end, yellowish, with admixture of red. Head reddish-yellow, with reddish-brown pattern of second type (Figure 49, *2*). Thoracic shield reddish-yellow, anal shield not prominent. Dorsal bands on shields broader than on body. Setae light-colored, acuminate, set on minute black spots. Stigmata oval, yellowish-brown, with broad black edge. Legs light-colored; abdominal legs with black spot on outer side. Pattern: dorsal and subdorsal bands narrow, light yellow, almost white. Dorsal band with narrow dark brownish, slightly shaded borders. Upper border of subdorsal band in anterior half of each abdominal segment consists of black longitudinal spots, in posterior half of segment of yellowish-red spots; lower border yellowish-red, not broad. Dorsal field densely covered with yellow dots, slightly fringed with yellowish-red pigment. Yellowish-red pigment less along margins of dorsal field. Upper part of subdorsal field reddish-yellow, lower part with admixture of violet and significant number of black striae. Substigmal band yellow, with admixture of red at center. Ventral side yellow. Body length 24 to 38 mm and width of head 3.8 to 4.0 mm.

In Belorussia larval development in August and September and, after hibernation, in May. Food plants: cereals and some dicotyledons—dandelion, plantation, *Galium*, and others.

According to Döring (1955), eggs yellowish, 0.55 to 0.60 mm in diameter, and 0.45 to 0.50 mm in height. Ribs 40, almost all reaching micropylar zone. Micropylar rosette consists of 14 or 15 lobes.

5. **Mythimna pudorina** Schiff. (brownish banded moth)

Mature larva: Spinneret 1.5 times longer than first segment of labial palpus. Setae VIII–VIII, 3.0 times closer to each other on prothorax than on mesothorax. Distance between setae II–II on anal shield half distance between I–I. Growth at base of unguis of thoracic leg highly reduced.

Body pale yellow, with admixture of gray and red. Head reddish-yellow, with dark brown pattern of second type (Figure 49, *2*). Setae rust-colored, acuminate, fairly strong, set on large black spots; spots on shields smaller. Stigmata oval, black, with black edge. Legs reddish-yellow. Pattern: dorsal band dull white, narrow, with violet-brown border; subdorsal band white, very broad. Upper border of band brown with vivid admixture of violet. Dorsal field not homogeneous: around dorsal band rusty-yellow up to seta I; borders of subdorsal band with narrow gap revealing main body color in form of band. Suprastigmal band dull yellow, narrow. Reddish-brown lower border of subdorsal band and upper suprastigmal almost fused, separated by yellow line of main body color. Lower part of subdorsal field brownish-gray, and all stigmata disposed on it. Substigmal band broad, yellow at borders, orange or rusty-yellow at center. Ventral side with yellow dots and light brownish striae. Body length 32 to 44 mm and width of head 3.4 to 3.6 mm.

Development: I-instar. Just hatched larva milk-white, slightly pinched toward posterior end. Head yellowish-pink; darker in parietal region. Setae colorless. Pinacula very minute. Skin coarsely grained. Thoracic shield yellowish-pink, light-colored. Legs colorless. Feeding larvae remain milk-white. Pinacula very minute, brownish. At middle of instar faint, narrow, light-colored dorsal, subdorsal, and suprastigmal bands visible, interrupted at many places. Substigmal band somewhat broader. Thoracic legs yellowish, abdominal legs light-colored with dark spots. Body length of just hatched larva 2.0 mm, before molt 4.1 mm, and width of head 0.31 mm.

II-instar. Body pale yellow. Head light yellow with minute brown spots around setae and very large spots around epicranial suture. Thoracic shield dark brown with light-colored dorsal and subdorsal bands. Setae rust-colored, set on minute brown spots. Stigmata round, light-colored, with dark-colored edge. Legs light-colored; abdominal legs on segment 3 underdeveloped. Pattern: dorsal band rather broad, white, with yellowish-brown borders. Subdorsal and suprastigmal bands white, slightly narrower, with similar borders. Main body color between bands again forms bands and larva appears to sport multiple bands. Ventral part of subdorsal field yellowish-brown. Substigmal band broad, white. Ventral side yellowish. Large brown spot occurs along median line on each segment. Body length 4.0 to 7.0 mm and width of head 0.57 to 0.58 mm.

III-instar. Body reddish-brown, grayish-brown, or yellowish-brown. Head light brown, in parietal region and around epicranial suture darker, with dark brown spots around setae. Shields dark-colored. Setae light-colored, short (0.10 mm), somewhat pointed, with brown spots at base. Thoracic legs brown, abdominal legs light-colored, with large brown spots.

Stigmata round, light-colored, with black margin. Pattern same as in the II-instar. Body length 6.0 to 12.0 mm and width of head 0.72 to 0.73 mm.

IV- and V-instars. Body color varies in same manner as in the III-instar. Significant changes in color and pattern of head. In the IV-instar head yellow, with dark brown spots around setae and faint reddish pattern of second type. In the V-instar reddish-brown pattern of head of second type distinct (Figure 49, *2*). From the IV-instar all five pairs of abdominal legs developed; stigmata oval, dark-colored. Body pattern in the IV- and V-instars same as in the III-instar except dorsal band in the IV-instar slightly broader than subdorsal; dorsal and subdorsal bands in the V-instar equal in width. Body length in the IV-instar 12 to 20 mm and width of head 1.10 to 1.20 mm. In the V-instar body length 18 to 25 mm and width of head 1.50 to 1.70 mm.

VI-instar. Almost all characteristics of the VII-instar present but violet tinge faint. Substigmal band not orange at center as in the VII-instar but rust-colored. Ventral side yellow, with admixture of rust. Brown striae absent on abdomen. Body length 23 to 35 mm and width of head 2.30 to 2.40 mm.

In Belorussia larval development from July to autumn and, after hibernation, to early or mid-May. Food plants: sugar cane, moor grass, and sedge.

Eggs laid on back of leaf sheaths in form of chain in two or three imbricate rows. Chain length sometimes exceeds 2.0 cm. Eggs light yellow, almost spherical, but being laid one over the other lose their shape and become flat. Chorion very tender. Diameter 0.59 to 0.60 mm and height 0.56 to 0.57 mm. Ribs absent; reticulate structure barely perceptible and only up to equator. Micropylar rosette consists of 10 to 12 lobes. Eggs darken gradually and turn brownish-gray before larvae hatch.

6. **Mythimna pallens** L. (pale banded moth)

Mature larva: Spinneret 1.5 times longer than first segment of labial palpus; first seta almost 2.0 times longer than second segment. Setae VIII–VIII on prothorax 2.5 times closer to each other than on mesothorax; on segments 7 and 8 setae VIII–VIII almost equidistant. Ungual base of thoracic legs highly reduced.

Body yellowish-brown, somewhat enlarged at center. Head dull yellow, with brownish pattern of second type (Figure 49, *2*). Dorsal and subdorsal bands extend along shields. Setae light brownish, acuminate, with minute black spots at base; spots on shields in form of dots. Stigmata dark-colored, oval, broad, with black edge. Legs light-colored. Pattern: dorsal and subdorsal bands yellowish or dull white, not broad; subdorsal band somewhat broader than dorsal. Dorsal band with narrow dark brown or greenish-brown borders. Upper border of subdorsal band broad and

brown, while lower border narrow. Dorsal field covered with yellow dots and fine brown striae, which are denser close to dorsal band. Suprastigmal band same as subdorsal, fringed with dark-colored pigment. Ventral part of subdorsal field dark brown, with reddish-yellow dots. Stigmata disposed on lower margin of subdorsal field. Substigmal band light yellow or yellow along borders, yellowish-pink with yellow dots at center. Ventral side yellowish-pink with yellow dots. Body length 25 to 40 mm and width of head 2.9 to 3.0 mm.

Development: I-instar. Just hatched larva pinkish-white, with very prominent segments. Head dark brown. Pinacula very minute. Thoracic shield brown; anal shield light-colored. Setae rust-colored, slightly pointed. Feeding larva yellowish, translucent with visible green intestine and black pinacula. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Stigmata light-colored, round, with dark-colored edge. At end of instar subdorsal field reddish-yellow. Body length of just hatched larva 1.7 to 2.0 mm, before molt 3.8 to 4.0 mm, and width of head 0.33 to 0.34 mm.

II-instar. Body green or yellowish-green. Head light brown or reddish-brown. Setae rust-colored, acuminate, with minute brown pinacula at base. Shields light brown. Stigmata round, light-colored, with dark-colored edge. Thoracic legs light brown; abdominal legs yellowish and underdeveloped on segment 3. Pattern: dorsal and subdorsal bands interrupted at many places, not broad. Substigmal band broad. All bands slightly lighter than body color and faint. Body length 4.0 to 6.0 mm and width of head 0.55 to 0.58 mm.

III-instar. Body yellowish-green. Head light yellowish-brown with minute brown spots around setae. Setae, pinacula, and stigmata same as in the II-instar. Pattern: dorsal and subdorsal bands light-colored but not white, narrow, fringed with dark green pigment. Suprastigmal band pale green. Between bands main body color seen as bands. Subdorsal field brown. Substigmal band faintly differentiated from light yellow ventral side. Body length 5.0 to 10.0 mm and width of head 0.84 to 0.87 mm.

IV-instar. Body brownish-yellow. Head reddish-yellow, with dark brown pattern of second type (Figure 49, *2*). Setae rust-colored, acuminate, with minute black spots at base. Shields not prominent. Dorsal and subdorsal bands on shields distinct. Suprastigmal band also extends onto prothorax. Stigmata oval, broad, pinkish-yellow. Legs light-colored; all five pairs of adbominal legs developed. Pattern: dorsal band white, narrow, with fairly broad, slightly shaded brownish borders. Subdorsal and suprastigmal bands broader than dorsal, with narrow brownish borders. Main body color between all bands seen as bands. Ventral part of subdorsal field brown. Substigmal band broad, white along borders, and

orange at center. Ventral side reddish-yellow. Body length 9.0 to 17.0 mm and width of head 1.35 to 1.38 mm.

V-instar. Larva of this instar differs from that of the VI-instar in that borders of dorsal and subdorsal bands light brown with admixture of reddish pigment. Dark striae few on dorsal and subdorsal fields and hence main body color between bands seen as band. Yellow and reddish dots scattered in dorsal and subdorsal fields. Body length 16 to 26 mm and width of head 1.60 to 1.80 mm.

In Belorussia larval development from late May to mid-July and August and September. Two generations. Food plants: cereals, sorrel, dandelion, dead nettle, and knotweed. Younger instars feed exclusively on cereal plants.

Eggs laid very compactly on back of leaf sheath of cereal plants in form of chain. They are light yellow, 0.63 to 0.70 mm in diameter, and 0.59 to 0.60 mm in height. Ribs 64 to 68, very faint; 30 to 32 reach micropylar zone. Micropylar rosette consists of 12 or 13 lobes.

Subgenus *Leucania* Ochs.

7. Mythimna (Leuc.) comma L. (comma moth)

Mature larva: Spinneret 0.33 length of first segment of labial palpus; first seta of palpus 2.5 times longer than second segment. Setae II–II on anal shield 1.5 times closer to each other than setae I–I; setae VIII–VIII on segments 8 and 7 equidistant. Distance between setae VIII–VIII on prothorax 0.25 less than on mesothorax. Ungual base on thoracic leg considerably reduced.

Body broad, reddish-yellow. Head reddish-yellow, with black submedian band and brown reticulate structure (Figure 49, *2*). Shields not prominent. Dorsal band on thoracic shield broader than on body. Setae rust-colored, acuminate, slender, and set on minute dark brown spots. Stigmata oval, black, with black edge. Legs light-colored. Pattern: dorsal and subdorsal bands light yellow, with pinkish tinge. Dorsal band slightly narrower than subdorsal, with brown, almost black borders. Upper border of subdorsal band in anterior half of segment black, broad, in form of individual longitudinal spots consisting of fused striae. Ventral border of subdorsal band narrow, yellowish-red. Dorsal field almost uniformly covered with yellow and reddish dots and brownish striae. Substigmal band same width as dorsal, pinkish-yellow, without contrasting border. Subdorsal field in lower part darker dorsally. Dark-colored striae far more numerous around stigmata than away from them. Substigmal band broad, yellow along borders, and brownish-pink at center. Ventral side brownish-pink, with yellow dots. Yellow dots also numerous

on dorsal and subdorsal fields. Body length 29 to 39 mm and width of head 3.50 to 3.60 mm.

Development: I-instar. Body of just hatched larva broad, especially in region of thoracic segments, dull yellow. Head brownish. Pinacula very minute, same color as body. Setae rust-colored, acuminate. Stigmata light-colored, round, with light brown edge. Legs yellowish; abdominal legs on segments 3 and 4 underdeveloped. Color of skin of feeding larvae nearly unicolorless, translucent with green-colored intestine. At end of instar pattern distinguishable, i.e., light-colored continuous dorsal and subdorsal bands. Subdorsal field reddish-yellow. Length of just hatched larva 2.0 to 2.1 mm, before molt 3.30 to 3.5 mm, and width of head 0.23 mm.

II-instar. Body dull yellow, broad. Head brownish. Pinacula very minute, brown. Setae rust-colored, acuminate, short (0.10 mm). Thoracic shield fringed with brown striae. Stigmata light-colored, round. Legs dull yellow; abdominal legs on segment 3 underdeveloped. Pattern: dorsal, subdorsal, and suprastigmal bands white with even brownish borders. Between bands main color seen as bands and hence larva seems to sport several bands. Lower part of subdorsal field brown. Substigmal band white, broad. Basal field brown. Body length 3.5 to 5.5 mm and width of head 0.46 to 0.48 mm.

III-instar. Body broad, short, yellowish-green. Head hazy yellow. Pinacula absent. Setae rust-colored, acuminate. Shields hazy yellow, faint. Stigmata dark yellow, with black edge. Thoracic legs yellowish; abdominal legs brown, with light-colored plantae, and all five pairs developed. Pattern same as in the II-instar except bands whitish-pink and borders reddish-brown. Body length 6.0 to 9.0 mm and width of head 0.75 to 0.76 mm.

IV-instar. Larva of this instar differs from the III-instar in bands acquire yellow tone and light brownish pattern of second type seen on head (Figure 49, *2*). Submedian bands distinct while reticulate structure faint. Dorsal and subdorsal bands extend onto shield. Minute dark-colored spots occur at base of setae. Body length 10 to 15 mm and width of head 1.10 to 1.20 mm.

V-instar. Body brownish-yellow, with reddish tinge. Head dull yellow, with brownish pattern of second type. Dorsal and subdorsal bands on shields as wide as on back. Setae light brown, with minute black spots at base. Stigmata dark-colored. Legs yellowish. Pattern: dorsal and subdorsal bands yellowish, narrow, even; dorsal with reddish-brown shaded borders. Upper border of subdorsal band narrow, continuous, black; border absent on lower side. Suprastigmal band consists of yellowish dots. Lower part of subdorsal field brownish; stigmata disposed along ventral margin and surrounded by reddish-yellow girdle. Substigmal band broad, yellow along borders, yellowish-orange at center. Yellow dots dispersed throughout entire body. Body length 14 to 21 mm and width of head 1.70 to 1.90 mm.

VI-instar. Larva of this instar differs from the VII-instar only in dorsal border of subdorsal band more often continuous, broad, black; in the VII-instar this border in form of black longitudinal spots. Body length 20 to 29 mm and width of head 2.40 to 2.70 mm.

In Belorussia larval development from June to autumn. Food plants: cereals.

Eggs laid on back of leaf sheaths in irregular compact rows. They are pinkish-yellow or white with an admixture of yellow, 0.61 to 0.69 mm in diameter, and 0.64 to 0.65 mm in height. Ribs absent, only reticulate structure of shell visible. Micropylar rosette consists of 13 to 15 lobes.

7. Genus *Discestra* Hmps.

(one species in Belorussian fauna)

Discestra trifolii Hufn. (clover moth)

Mature larva: Spinneret broad, slightly pinched toward end, significantly longer than first segment of labial palpus. Dorsal edge of opening dentate (Figure 79, *2*). First seta of labial palpus half length of second segment and second seta one-third length of first segment. Postgenal sclerites not contiguous (Pi = 1/4, 1/5). Mandibles without inner tooth. Seta III on segment III on dark-colored spot (Figure 28, *1*). Metathoracic coxae not contiguous. Hooks on abdominal legs arranged in two tiers, second one indistinct: 16–18, 17–19, 19–21, 22–24, and 25–27. Larva undergoes four molts.

Larva green. Head dull yellow, with faint light brown pattern of second type (Figure 49, *1*). Setae brownish, acuminate, with black setigerous tubercles, set on minute light-colored spots on trunk, and fringed with dark-colored pigment. Shields brownish-green, with narrow dorsal band and very broad subdorsal bands. Stigmata reddish-yellow, oval, and with thin black edge. Legs green. Pattern: dorsal band narrow, light-colored, distinct on thoracic shield, less so on segments II and III, and almost entirely marked with dark green striae along borders at many places on abdominal segments. Subdorsal band yellow, quite broad, even. Border absent below and dark green or black above; in anterior half of segments broad, reaching setae I and II, in posterior half of segments narrow, more often dark green; on segments 8 and 9 forms cuneate spots that fuse around dorsal band. Dorsal field green, with large number of yellowish-green dots and dark green or black, uneven, encompassing stigmata from all sides. At commencement and middle of instar band narrow outside stigmata (Figure 53, A) and at end of instar broad, continuous. Substigmal band greenish-yellow at center and bright yellow at borders. Ventral side light green, with large number of minute yellowish dots. Body length 20 to 34 mm and width of head 2.20 to 2.50 mm.

Development: I-instar. Body with very prominent segments and thoracic segments very broad (I as wide as head), light-colored, translucent with violet-colored intestine, unsclerotized pinacula, and light brown thoracic shield. Head yellowish-brown, lustrous, with brownish spots around pinacula and pattern of first type. Setae brownish, somewhat pointed. Feeding larva green. Pinacula black, stigmata light-colored, round, with dark-colored edge. Abdominal legs on segments 3 and 4 underdeveloped. Body length of just hatched larva 2.0 to 2.1 mm, before molt 4.3 to 4.4 mm, and width of head 0.33 mm.

II-instar. Body with dilated segment 8, green. Head green, with gray pattern of first type. Shields green with minute dark-colored pinacula. Pinacula on trunk black, large. Legs green; thoracic legs with gray ringlets, abdominal wide set in the I- and II-instars, and poorly developed on segments 3 and 4. Pattern: dorsal and subdorsal bands white, continuous, uneven; substigmal band broad, white. Body length 4.5 to 7.0 mm and width of head 0.55 to 0.57 mm.

III-instar. Body green. Head yellowish-green, with pattern of first type. Setae rust-colored, strong, acuminate, and set on very minute black pinacula; on thoracic shield set on minute black spots. Stigmata round, light-colored, with thin black edge. Legs green; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands in form of fused white dots, with rather narrow fringe of green pigment, darker than body background. Substigmal band yellowish, extends onto anal leg. Large number of white dots on dorsal and subdorsal fields, fewer on ventral side. Body length 6.0 to 11.0 mm and width of head 0.92 to 1.10 mm.

IV-instar. Body green. Head yellowish-green, with brownish pattern of first type (Figure 48, *1*). Setae brownish, acuminate, set on general background. Shields dark green, with admixture of brown. Stigmata oval, dark yellow, with black edge. Thoracic legs grayish; abdominal legs green with brownish-gray spots around setae. Pattern: dorsal band greenish-yellow, continuous on thoracic segments, and in form of dots on abdominal segments. Dots differ somewhat from dense scattered dots of dorsal field. Subdorsal band bright yellow, in form of large spots. Borders absent on both bands. Subdorsal field covered with dots to lesser extent; along ventral margin of field, especially around stigmata, concentration of dark-colored pigment seen. Substigmal band bright yellow, not broad, with distinct borders, and orange at center. Ventral side green with dense dots. Body length 11 to 20 mm and width of head 1.44 to 1.56 mm.

In Belorussia larval development from early or mid-June to mid-July to September (two or three generations). Pupae hibernate. Food plants: goosefoot, orache, sorrel, burdock, clover, plantain, and others. Damage vegetable plants, sugar beet, etc.

Eggs laid haphazardly, singly or in groups (two to five), on underside of leaves. They are light yellow, almost spherical, 0.61 to 0.62 mm in diameter, and 0.46 to 0.48 mm in height. Ribs 47 to 50, of which 15 to 17 reach micropylar zone. Micropylar rosette consists of 14 or 15 lobes, with single rim of large longitudinal lobes. Within 24 hrs rusty-yellow spot at apex and girdle close to apex visible; these later enlarge and cover entire upper surface of egg. Shell gradually takes on grayish tone and ash-gray before larva hatches.

8. Genus *Lasionycta* Auriv.

(one species in Belorussian fauna)

Lasionycta nana Hufn. (syn. *dentina* Esp.) (dentate moth)

Mature larva: Spinneret 2.0 times longer than first segment of labial palpus; dorsal edge of opening with minute dents. Mandibles without inner tooth. Distance between setae I–II on thoracic shield slightly more than between I–X. Coxae of thoracic legs not contiguous; distance between them half distance between setae VIII–VIII. Skin uniformly finely grained. Hooks of abdominal legs: 16–17, 18–19, 22–24, 23–25, and 26–29.

Larva somewhat pinched toward anterior end, dark brown; abdominal side greenish-brown. Head dull yelow, with black pattern of second type (Figure 49, *1*). Setae strong, acuminate, reddish-brown, with light-colored round spots, encircled by black pigment at base. Shields not prominent, narrow, light-colored; dorsal bands distinct on them. Stigmata oval, black, with black edge. Thoracic legs dark-colored; abdominal legs light-colored; with large blackish-brown spot on outer side. Pattern: dorsal band narrow, distinct on thoracic and initial abdominal segments, and almost not visible on rest. Subdorsal band narrow, light-colored, and distinct throughout trunk. Dorsal band faintly fringed; subdorsal more distinctly fringed with dark brown pigment. Upper border of subdorsal band in anterior part of segment black, in form of short broad smears. Dorsal field almost monochromatic brown, and subdorsal dark brown in lower part; black smears on it distinct and encircle stigmata. Substigmal band yellowish-brown, with dark brown striae. Basal field dark brown. Body length 22 to 37 mm and width of head 2.50 mm.

Development: I-instar. Body of just hatched larva short, thick, yellowish-violet. Head yellow, with small spots around setae. Pinacula light-colored, turn brown after 2.0 to 2.5 hrs. Setae brown, clavate. Thoracic shield yellow. Feeding larva greenish-yellow, with black pinacula. Stigmata round, light-colored, with brown edge. Abdominal legs on segments 3 and 4 underdeveloped. Larvae poorly mobile. Length of just hatched larva 1.8 to 2.0 mm, before molt 3.0 to 3.5 mm, and width of head 0.30 to 0.33 mm.

II-instar. Body thick, short, green anteriorly, and light brown posteriorly. Abdominal side reddish. Head, setae, shields, stigmata, and legs same as in the I-instar. Pattern: dorsal, subdorsal, and substigmal bands white, narrow, even. Substigmal band broad, white. Body length 3.50 to 5.50 mm and width of head 0.53 mm.

III-instar. Body somewhat flat, green in thoracic region and brown in abdominal. Head reddish-yellow, with large black spots around setae. Pinacula large (0.066 mm), light brown, encircled by light-colored background. Setae brown, slightly thickened toward end. Shields not prominent, with narrow light-colored dorsal bands and large black spots around setae. Stigmata dark-colored, slightly oval, with brownish edge. Thoracic legs light-colored; abdominal legs dark-colored and all five pairs developed, short. Pattern: dorsal band white, narrow, broadens at end of each segment; borders reddish-brown, broad. Subdorsal band even, with narrow even borders. Substigmal band broad, pinkish, with distinct borders. Basal field brownish. Body length 5.5 to 8.0 mm and width of head 0.74 to 0.75 mm.

IV-instar. Body thick, short, brown. Head dull yellow, with brown pattern of second type (Figure 49, *I*). Setae brownish, slightly attenuate toward end, set on minute brown spots, and encircled by light-colored background. Shields not prominent. Stigmata oval, with black edge. Legs light-colored. Pattern: dorsal band white, narrow, and continuous only on thoracic segments; on abdominal segments in form of dots, covered at many places by dark brown pigment of borders. Subdorsal band narrow, white, continuous, interrupted at places, and fringed with dark brown pigment. Upper border in anterior part of segments very broad. Dorsal field light brown; subdorsal in lower part dark brown. Sites of stigmata ringed with light-colored pigment. Substigmal band yellow, with brownish striae. Basal field brown; ventral side light-colored. Body length 8.0 to 14.0 mm and width of head 1.10 to 1.20 mm.

V-instar. Larva differs from the VI-instar only in pattern of dorsal field. Dots on dorsal band pink, barely perceptible. Dark brown borders of band broaden somewhat at middle of abdominal segments and darkest at end of segments. Subdorsal band in form of fused pinkish dots, fringed with dark brown pigment. Upper border in anterior part of segments broadest and dark-colored; between setae I and II shifts upward and backward, fusing with dark-colored border of dorsal band to form herringbone pattern. Body length 15 to 24 mm and width of head 1.65 to 1.67 mm.

In Belorussia larval development in June and August–September. Food plants: dandelion, plantain, spurge, lettuce, hawkweed, and dead nettle.

Eggs laid singly on underside of leaf, light yellow, 0.69 to 0.71 mm in diameter, and 0.58 to 0.60 mm in length. Ribs 44 to 46, of which 10 to 12 reach micropylar zone. Micropylar rosette consists of 16 to 18 lobes with single rim. On second day reddish-yellow spot at apex and girdle at equator visible, which gradually darken and turn dark brown. Before larva hatches egg dark gray.

9. Genus *Mamestra* Ochs.

Body pattern variable. More often, dorsal and subdorsal bands seen as dots. In *M. pisi* L. subdorsal band broad, continuous. In *M. persicariae* L. segment 8 highly dilated. Spinneret 2.0 to 2.5 times longer than first section of labial palpus. Mandibles with one or two inner teeth. Metathoracic coxae contiguous. Stigmata light-colored (dark in *M. dysodea* Schiff.). Hooks of abdominal legs arranged in one tier.

Key to Species

1 (2). Segment 8 highly dilated, forms dorsal tubercle. Dorsal band yellow, continuous; subdorsal in form of spots. Segments 1, 2, and 8 with dark green, velvety semicircles (Figure 75, *1, 10*); other segments with light-colored semicircles. Yellow substigmal band in region of stigmata intersected by broad dark green oblique smears (Figure 55, *4*)..... 4. **M. persicariae** L.

2 (1). Segment 8 not dilated. Dorsal band consists of dots. Pattern on dorsal field different.

3 (4). Body green, with blackish-green dorsal field, speckled with five light-colored striae. Subdorsal field light green, with black zigzag striae (Figure 75, *3*). Subdorsal band broad..... ..... 3. **M. pisi** L.

4 (3). Dorsal field not blackish-green. Subdorsal field without zigzag lines. Subdorsal band consists of dots.

5 (20). Stigmata light-colored.

6 (11). Setae I and II set on black spots on trunk.

7 (8). On thoracic shield setae IX and X on black spots, I and II on light-colored spots..... 10. **M. oleracea** L.

8 (7). On thoracic shield setae IX, X, I, and II on light-colored spots, or spots absent at base of setae.

9 (10). On thoracic shield spots absent at base of setae IX, X, I, and II. Large white dots of dorsal and subdorsal bands ringed with dark-colored pigment (Figure 75, *2*). Black stigmal band with white spots forms semicircle around stigmata..... ..... 9. **M. splendens** Hbn.

10 (9). On thoracic shield light-colored spots present at base of setae IX, X, I, and II. White dots on dorsal and subdorsal bands without ring of dark-colored pigment. Stigmal band black, without white spots, encircles stigmata completely (Figure 55, *6*). ..... 8. **M. suasa** Schiff.

11 (6). Setae I and II set on minute light-colored spots on trunk, or spots absent at base of setae.

12 (15). Setae I and II on minute light-colored spots on trunk.

13 (14). Mandibles with single large inner tooth. Stigmal band reddish-brown, enlarges around stigmata only on segments 7 and 8. Body yellowish-green, with reddish-brown herringbone pattern.... ..... 6. **M. contigua** Schiff.

14 (13). Mandibles with two inner teeth. Stigmal band absent. Body grayish-green or reddish-yellow, with brown herringbone pattern..... 7. **M. thalassina** Hufn.

15 (12). Spots absent at base of setae on trunk. Setae located on general background of back.

16 (17). Head yellowish-green, with minute brown spots around epicranial suture. Borders of dorsal band adjoin band only close to margins of segments; at center of segments separate from band to form fork-shaped figure, more rarely small rhombic darkening (Figure 75, *4*). Mandibles with two inner teeth..... ..... 1. **M. bicolorata** Hufn.

17 (16). Head with distinct pattern of second type (Figure 49, *1*). Borders of dorsal band form neither fork-shaped figure nor rhombic darkening. Mandibles with single inner tooth.

18 (19). Seta X on trunk on light-colored spot. Body green or yellowish-gray, with dark brown arrow-shaped pattern on dorsal field (Figure 54, *8*)..... 5. **M. w-latinum** Hufn.

19 (18). Light-colored spots absent at base of seta X on trunk. Arrow-shaped pattern absent on dorsal field. Borders of dorsal and subdorsal bands reddish-brown, not sharp, even..... ..... 11. **M. aliena** Hbn.

20 (5). Stigmata dark-colored. Body yellowish-green. Borders of dorsal band brownish-yellow, shaded. Abdominal side light green, sharply delineated from much darker dorsal side..... ..... 2. **M. dysodea** Schiff.

1. **Mamestra bicolorata** Hufn. (syn. *serena* Schiff.) (bright moth)

Mature larva: Spinneret slightly pinched toward end and 2.5 times longer than first segment of labial palpus; dorsal margin of spinneret opening with minute dents (Figure 79, *4*). Mandible with two triangular inner

teeth. Distance between setae I–II on thoracic shield slightly less than between I–X. Skin uniformly granulated. Hooks of abdominal legs: 16–18, 17–19, 20–22, 23–24, and 26–28.

Body yellowish-green. Head greenish-yellow or light brownish, with minute brownish spots around epicranial suture. Setae light brownish, acuminate, 0.56 mm; spots absent at base of setae on trunk. Thoracic shield yellow, anal shield green. Setae I, X, and Xa set on light-colored spots on thoracic shield. Stigmata oval, light yellow, with black edge. Thoracic legs yellowish, abdominal legs green. Pattern: dorsal band in form of chain of minute dense dots, continuous, and narrow on thoracic shield. Band fringed along margins of segments by dark brown, almost black pigment. Here, borders mask dots, then shift slightly sideways to form short branches; almost absent at center of segments. Subdorsal band also in form of minute dense dots. Border absent below and covers dots at margins of segments above (Figure 75, *4*). Dorsal and subdorsal fields light green, densely covered with yellow dots. Substigmal band yellow, with yellowish dots and indistinct lower border. Ventral side light green, with yellowish dots. Body length 25 to 33 mm and width of head 3.0 mm.

In Belorussia larval development from mid-July and in August. Food plants: hawkweed and lettuce.

According to Doring, eggs light carmine-red, 0.70 to 0.75 mm in diameter, and 0.30 to 0.35 mm in height. Ribs 30, of which 12 or 13 reach micropylar zone. Micropylar rosette with 12 to 14 lobes, with single rim.

2. **Mamestra dysodea** Schiff. (syn. *chryzosona* Bkh., *spinaciae* View.) (lettuce moth)

Mature larva: Spinneret pinched toward end, 2.0 times longer than first segment of labial palpus, with minute dents on dorsal edge of opening (Figure 79, *4*). First seta of labial palpus 2.0 times longer than second segment, while second seta shorter than first segment. Distances between setae I–II and I–X on thoracic shield equal. Distance between setae II–III on anal shield 1.5 times greater than between II–II. Mandibles with single triangular inner tooth (Figure 15, X). Skin finely grained. Hooks of abdominal legs: 17–18, 18–20, 21–23, 24–26, and 27–30.

Body yellowish-green. Head yellowish-green, with light brown pattern of second type (Figure 49, *1*). Setae rust-colored, rather pointed, 0.40 mm in length, located on trunk on light-colored spots, and encircled from dorsal side by semicircle of yellowish-green pigment. Shields brownish-green, with light-colored spots around setae. Stigmata light brown, with black edge. Thoracic legs light-colored and abdominal legs green. Pattern: dorsal band on shields and thoracic segments narrow, continuous, dull yellow, and on rest of segments in form of row of minute dull yellow dots indistinguishable from dots scattered along dorsal field. Dots close

to band encircled by brownish-yellow pigment and constitute shaded borders of dorsal band. Subdorsal band consists of similar dots but faint; borders also faint. Dorsal and subdorsal fields almost similar, covered with yellow dots and fine yellowish-green striae. Ventral side light green, differs sharply from dorsal. Substigmal band similar in color to ventral side; at commencement of instar yellow along its dorsal border. Body length 28 to 35 mm and width of head 2.50 to 2.60 mm.

In Belorussia larval development in July and August. Larvae feed on lettuce seeds.

According to Döring (1955), eggs white, 0.70 to 0.75 mm in diameter, and 0.50 mm in height. Ribs 24 to 28, of which 9 or 10 reach micropylar zone. Micropylar rosette consists of 15 or 16 lobes.

3. **Mamestra pisi** L. (broom moth)

Mature larva: Spinneret slightly pinched toward end, 2.0 times longer than first segment of labial palpus, with minute dents on dorsal edge of opening (Figure 79, *3*). Mandibles with inner tooth. Distance between setae I–II on thoracic shield slightly less than between I–X. Distance between setae II–III on anal shield 0.25 greater than between II–II. Stigmata on segment 8, 0.33 larger than stigmata on segment 7. Hooks of abdominal legs: 19–22, 21–23, 22–24, 24–26, and 27–32.

Body green, with black, velvety dorsal and broad yellowish subdorsal bands. Head pinkish or yellowish, with faintly visible reddish-brown pattern of second type (Figure 49, *6*). Setae dark brown, acuminate. Shields not prominent, dorsal pattern extends onto them. Stigmata white, oval, large, with thin black edge, and disposed on substigmal band on segments 3 to 6. Legs green. Pattern: dorsal band very narrow, light-colored, visible only on thoracic segments. Dorsal field velvety, dark green, with light-colored spots, sometimes almost black. Subdorsal band broad, yellow, white with narrow black border above and below. Subdorsal field green, with black zigzag striae, between which various sized green cells visible. Stigmal band narrow, black. Substigmal band yellow, broad along stigmata, with distinct borders. Subbasal field with black striae (Figure 75, *3*). Ventral side light green. Body length 29 to 43 mm and width of head 3.0 to 3.1 mm.

Development: I-instar. Body of just hatched larva yellowish, translucent with visible violet-red intestine. Head dark yellow, with reddish-brown pattern of first type. Pinacula light-colored, their sclerotization continuing for 1.5 to 2.0 hrs. Feeding larva green, with black pinacula. On thoracic shield setae IX and X of same size as on trunk; I and II considerably smaller. Setae dark brown, acuminate. Stigmata light-colored, round, with dark-colored edge. Legs light-colored; thoracic legs on

segments 3 and 4 underdeveloped. Body length of just hatched larva 2.5 to 2.7 mm, before molt 4.5 to 5.0 mm, and width of head 0.36 mm.

II-instar. Body dark green. Head light green, with gray pattern of first type. Pinacula small, dark brown. Setae, stigmata, and legs same as in the I-instar. Pattern: dorsal, subdorsal, and suprastigmal bands greenish-yellow, quite broad, and continuous. Body length 6.0 to 8.0 mm and width of head 0.58 to 0.59 mm.

III-instar. Body green, well proportioned. Head green or yellowish, with brownish pattern of first type. Setae brownish, slender, acuminate, set on minute dark-colored spots. Shields not prominent. Stigmata on segments I and 8 oval, and round on rest. Legs green; all five abdominal pairs developed. Pattern: dorsal band narrow, light green, faint. Subdorsal band broad, yellow, significantly shifted dorsally. Suprastigmal band narrower and light green. Dorsal and subdorsal fields light green. Substigmal band yellow. Ventral side green. Body length 8.0 to 13.0 mm and width of head 0.89 to 0.90 mm.

IV-instar. Body dark green, with admixture of black. Abdominal side light green. Head opaque green, with brownish pattern of first type (Figure 48, *1*). Setae black, acuminate, without spots at base. Shields not prominent, dorsal pattern extends onto them. Stigmata oval, light-colored, with thin black edge. Pattern: dorsal band light green, very narrow. Subdorsal band extremely broad, highly shifted dorsally so that seta II falls at center of band. Band fringed above with dark green or black pigment. Dorsal and subdorsal fields covered with black zigzag striae. Stigmal band narrow, dark green or black. Stigmata of segments I and 8 disposed on band and others ventral to it. Substigmal band broad and orange, yellow along upper border. Body length 12 to 18 mm and width of head 1.30 to 1.40 mm.

V-instar. Color and pattern of head same as in the IV-instar. Color and pattern of trunk in most cases correspond to the IV-instar. Some specimens totally identical to those of the IV-instar. Body length 18 to 28 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development from June 10 to 20 through mid-August. Food plants: legumes, Chenopodiaceae, Plantaginaceae, and lettuce. The following food plants have also been reported in literature: willow, birch, plum, honeysuckle, raspberry, potato, and strawberry. Species often damages legumes.

Eggs laid on underside of leaf in clusters, in a single layer of regular rows, and not compactly. One cluster consists of up to 50 light yellow eggs 0.74 to 0.75 mm in diameter, and 0.48 to 0.54 mm in height. Ribs 27 or 28, of which 14 or 15 reach micropylar zone. Micropylar rosette consists of 12 to 14 lobes. Color darkens gradually and eggs turn light yellowish-red, dark yellowish-red, and finally ash-gray.

4. **Mamestra persicariae** L. (dot moth)

Mature larva: Spinneret 2.5 to 3.0 times longer than first segment of labial palpus, with minute dents on dorsal edge of opening (Figure 79, *3*). Distance between setae I–II and I–X on thoracic shield equal. Distance between setae II–III on anal shield 1.5 times greater than between II–II. Mandibles with large tetragonal inner tooth. Stigmata on segment 8 almost 2.0 times larger than stigmata on segment 7. Hooks of abdominal legs: 24–26, 25–28, 30–33, 30–35, and 35–38.

Body considerably pinched toward anterior end, with highly dilated segment 8, and green or somewhat brownish. Head green or yellow, with brown pattern of second type (Figure 49, *1*). Thoracic shield dark green or dark brown, velvety, with fairly broad white dorsal and subdorsal bands; spots absent at base of setae. Setae on body light-colored, long (0.98 to 1.22 mm), slender, and distinctly acuminate. Setae I and II set on barely perceptible light-colored spots, encircled by dark-colored pigment. Stigmata oval, white, with thin black edge. Thoracic legs yellowish, abdominal legs green. Pattern: dorsal band quite broad, light yellow, with narrow dark green border. Subdorsal band in form of faint spots. Upper border thin, uneven, dark green or black, and close to seta II interrupted and shifted upward and backward, joining dark green semicircles covering anterior part of dorsal field (Figure 75, *1, 10*). On segments 1, 2, and 8 semicircles dark green, velvety; on rest of segments color less vivid. Main color of dorsal field yellowish with fine green striae. Stigmal band dark green, narrow, even, but not straight; around stigmata shifts abruptly downward and backward, encircling stigmata with dark-colored pigment that extends obliquely toward leg of next segment; posterior to stigmata, band interrupted (Figure 55, *4*). Substigmal band yellow, broad, interrupted on each segment due to downward extension of stigmal band. Ventral side green, with large number of yellowish dots. Body length 29 to 43 mm and width of head 3.20 to 3.40 mm.

Development: I-instar. Just hatched larva grayish-yellow, with colorless pinacula that turn black after 1.5 to 2.0 hrs. Head black; thoracic shield light brown; anal shield light-colored. Abdominal legs on segments 3 and 4 underdeveloped. Feeding larva greenish. Body length of just hatched larva 1.8 to 2.0 mm, before molt 4.0 to 4.5 mm, and width of head 0.33 to 0.35 mm.

II-instar. Body greenish-yellow, with translucent green intestine and slightly dilated segment 8. Head yellowish, with brown spots at base of setae, and faint gray pattern of first type. Setae dark-colored, acuminate, 0.16 mm long, and set on minute (0.022 to 0.044 mm) black pinacula; pinacula on shields similar. Shields yellowish. Stigmata round, light-colored, with thin black edge. Legs light-colored; abdominal legs on

segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands white, seen as elongated spots. Substigmal band white, not broad. Body length 4.5 to 7.0 mm and width of head 0.67 to 0.75 mm.

III-instar. Larvae differ little from the II-instar. Pattern: dorsal and subdorsal bands seen as white dots, without contrasting borders. Ventral part of subdorsal field brownish-green. Substigmal band whitish, broad, with distinct borders. Body length 8.0 to 12.0 mm and width of head 0.82 to 0.85 mm.

IV-instar. Body green with significantly dilated segment 8. Head greenish-yellow, with faintly perceptible light brown pattern of second type (Figure 49, *1*). Setae rusty-brown, acuminate, set on extremely minute dark green spots. Spots absent around setae on shields. Stigmata oval, light-colored, with thin brown edge. Legs green; all five abdominal pairs developed. Pattern: dorsal band white, almost continuous; subdorsal in form of chain of yellowish spots. Dorsal and subdorsal fields green, with diffuse white spots. Lower margin of subdorsal field covered with black striae. Substigmal band yellowish-white, broad, with distinct borders. Ventral side green. Body length 13 to 19 mm and width of head 1.46 to 1.56 mm.

V-instar. Body green, with dilated segment 8. Head greenish-yellow, with distinct brownish pattern of second type. Setae rust-colored, acuminate, and set on minute round white spots. Legs light-colored. Pattern: dorsal band light yellow, continuous, fairly broad; subdorsal band consists of dots. Band fringed with dark green pigment. Usual herringbone pattern on dorsal field formed by shifting of upper border of subdorsal band around setae II and its fusion with borders of dorsal band. Herringbone branches more vivid between setae I and II and bulging portion of segment 8. Lower part of subdorsal field very dark-colored. Substigmal band light yellow, broad. Ventral side green. Body length 20 to 28 mm and width of head 2.0 to 2.1 mm.

In Belorussia larval development in July and August. Species highly polyphagous and feeds on various herbaceous plants, shrubs and deciduous trees.

Eggs laid on underside of plant leaves in a single layer, and not contiguous. They are light yellow, 0.58 to 0.63 mm in diameter, and 0.40 to 0.43 mm in height. Ribs 34 to 36, of which 12 or 13 reach micropylar zone. Rosette consists of 12 to 14 lobes. On second day eggs pinkish, with faintly visible margin and spot at apex that turns yellowish-red and later light brown. Before larva hatches egg ash-violet, with head of larva translucent, black.

5. **Mamestra w-latinum** Hufn. (syn. *genistae* Bkh.) (broom moth)

Mature larva: Spinneret slightly pinched toward end, 2.5 times longer than first segment of labial palpus, with minute dents along dorsal edge

of opening (Figure 79, *4*). Distance between setae I–II on thoracic shield somewhat more than between setae I–X. On anal shield distance between setae I–II, 1.5 times greater than between II–II. Stigmata of segment 8 larger than those of segment 7 by 0.33. Mandibles with broad tetragonal inner tooth. Hooks of abdominal legs: 22–24, 23–25, 24–26, 28–33, and 35–38.

Body green or brownish-yellow, with admixture of grayish pigment. Head opaque yellowish, with dark brown pattern of second type (Figure 49, *1*). Shields not prominent. Dorsal bands on thoracic shield light-colored, narrow, continuous; subdorsal slightly broader than dorsal. Setae I, II, and X on trunk set on minute whitish or yellowish spots encircled with dark-colored pigment. Setae on shields set on minute light-colored spots. Stigmata oval, brownish-yellow, with black edge. Thoracic legs yellowish-gray, abdominal legs greenish-gray. Pattern: dorsal band greenish-white, narrow, continuous only on thoracic segments, on abdominal segments in form of dots, often faintly visible. Borders of band dark brownish, narrow in anterior part of segment, farther along shaded, broad, reaching setae I and II, after which borders gradually narrow again to form fairly distinct rhombic spots. Subdorsal band in form of faint dots, its upper border broad in anterior part of segment; close to setae II border shifts upward and joins rhombic spot to form arrow-shaped spot (Figure 54, *8*). Main color of dorsal and subdorsal fields green or grayish-green, with yellow dots and fine brown striae. Stigmal band in form of collection of dark brownish pigment around stigmata. Substigmal band grayish-green; its lower border fuses with similar color of ventral side. Body length 26 to 43 mm and width of head 3.0 to 3.1 mm.

In Belorussia larval development from June until September. Food plants: broom, heath, and birch.

6. **Mamestra contigua** Schiff.

Mature larva: Spinneret slightly pinched toward end, with minute dents on dorsal edge of opening (Figure 79, *3*). On thoracic shield distance between setae I–II equal to distance between I–X. On anal distance between II–III, 2.0 times greater than between II–II. Stigmata on segment 8 almost 2.0 times larger than on segment 7. Mandibles with tetragonal inner tooth. Hooks of abdominal legs: 20–23, 23–25, 25–26, 28–30, and 33–35.

Body light green, with dark or light brown pattern with admixture of red. Head green, with brownish pattern of second type (Figure 49, *1*). Shields not prominent. Dorsal band on shields narrow, subdorsal slightly broader. Setae reddish-rust, short (0.50 mm), acuminate. Setae I, II, and X set on minute light-colored spots, surrounded by dark brown pigment. Setae on shields likewise on light-colored spots. Stigmata white, oval, with

very thin black edge. Legs light-colored; abdominal legs reddish around planta. Pattern: dorsal band narrow, continuous only on thoracic and first four abdominal segments; on successive segments in form of dots fringed with fine reddish-brown striae. On thoracic segments borders broad, on abdominal broad only at center of segment. Subdorsal band in form of chain of yellowish dots. Toward end of instar chain barely visible. Borders reddish-brown, narrow on thoracic segments, and fairly broad on abdominal segments; around setae II upper border interrupted, shifted upward, and at end of segment joins with border of dorsal band to form herringbone pattern. Main color of dorsal and subdorsal fields identical; in light-colored specimens yellowish-green or reddish-yellow, and in dark-colored with admixture of brown. Herringbone pattern reddish-brown, dark brown, or velvety black. Stigmal band same color as herringbone pattern, narrow, broadens at stigmata only on segments 7 and 8. Substigmal band not broad, with distinct borders at commencement of instar; later lower border remains only on thoracic segments and segment 9 (white on latter and reddish on former). Ventral side green. Entire body densely covered with yellowish dots. Basal field with scattered brownish-red striae. Body length 25 to 38 mm and width of head 3.0 to 3.1 mm.

Development: I-instar. Body of just hatched larva slender relative to head, yellowish, and translucent with visible dark-colored intestine. Head yellowish, with minute dark-colored spots around setae. Setae dark brown, somewhat pointed (0.16 mm), and set on light-colored pinacula. Sclerotization of pinacula continues for 20 to 30 min, after which they become black. Legs light-colored; two anterior pairs of abdominal legs underdeveloped. Feeding larva in zone of filled intestine green. Length of just hatched larva 2.0 to 2.1 mm, before molt 4.0 mm, and width of head 0.31 to 0.32 mm.

II- and III-instars. Body yellowish-green. Head yellowish-green, with minute brown spots around setae and green pattern of first type. Setae brown, somewhat pointed, set on minute black pinacula (0.02 mm). Stigmata round, light-colored, with black edge. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. In the II-instar pattern consists of continuous, narrow, pale yellow dorsal, subdorsal, and suprastigmal bands, and narrow whitish substigmal band. In the III-instar these bands are slightly broader, dorsal and subdorsal bands with narrow dark green borders. Lower margin of subdorsal field dark green. Body length in the II-instar 4.0 to 6.0 mm and width of head 0.48 to 0.50 mm. Body length in the III-instar 6.0 to 10.0 mm and width of head 0.70 to 0.72 mm.

IV-instar. Body green. Head yellowish-green, with greenish-brown pattern of first type. Setae brown, set on general background. Shields not prominent. Stigmata light-colored, oval, with thin black edge. Thoracic

legs light-colored; abdominal legs green and all five pairs developed. Pattern: dorsal and subdorsal bands same as in the III-instar; suprastigmal band not visible. Dorsal and subdorsal fields rather densely covered with white dots; many dots fuse and form mosaic. Substigmal band white, not broad. Ventral side light green, with sparse scattered white dots. Body length 10.5 to 15.0 mm and width of head 1.10 mm.

V-instar. Larvae differ from the VI-instar only in pattern. Herringbone pattern faint or altogether absent. In latter case borders of dorsal band shaded. Upper border of subdorsal band broader and darker than lower one. Lower margin of subdorsal field dark brown or black. Substigmal band quite broad; upper margin white, lower bounded by white dots, center green with white dots. Body length 16 to 25 mm and width of head 2.0 to 2.2 mm.

In Belorussia larval development in July and August. Pupae hibernate. Food plants: bilberry, raspberry, dandelion, burdock, lady's mantle, and lettuce. Feed avidly on leaves of beans, sunflower, and lettuce.

Eggs laid in clusters, in two or three imbricate layers. They are dark brown with a lilac tinge, 0.67 to 0.70 mm in diameter, and 0.30 to 0.32 mm in height. Ribs 62 to 65, of which 50 to 56 reach micropylar zone. Micropylar rosette consists of 18 to 20 lobes, surrounded by reticulate structure. Color of egg does not change during embryonal growth.

7. **Mamestra thalassina** Hufn.

Mature larva: Spinneret somewhat pinched toward end, 2.5 times longer than first segment of labial palpus; dorsal edge of opening with minute dents (Figure 79, *3*). Mandibles with two inner teeth. Setae I–II and I–X on thoracic shield set at equal distances. Distance between setae II–III on anal shield 1.5 times greater than between II–II. Stigmata on segment 8 larger than on segment 7 by 2.0 times. Hooks of abdominal legs: 21–23, 22–24, 27–29, 28–29, and 29–32.

Body grayish-green or reddish-yellow, with brownish pattern. Head dark yellow with brownish pattern of second type (Figure 49, *1*). Shields somewhat darker than general body background, with light-colored dorsal bands and light-colored spots at base of setae. Setae light brown, acuminate. Setae I, II, and X on trunk set on light-colored spots, surrounded by brownish semicircle on dorsal side. Stigmata oval, pinkish-yellow, with black edge. Thoracic legs whitish, abdominal legs yellowish-green. Pattern: dorsal and subdorsal bands consist of minute light yellow dots. Dots on dorsal band smaller and faint. Bands fringed by fine brownish striae broadest in posterior part of segment. Border of subdorsal band most intense in anterior part of segment. Around setae II border shifted upward and joins border of dorsal band in posterior part of segment to form herringbone branches that are not very sharp. Dorsal field

densely covered with yellowish dots and rarely with fine brownish striae that are denser at center of segment, but do not form rhombic spot. Subdorsal field uniformly covered with striae. Stigmal band not seen. Stigmata of segments 2 to 6 set on substigmal band. Substigmal band broad, yellow on top and bottom, orange at center, and covered with yellow dots. Lower border lost toward end of instar. Ventral side green, yellowish-pink along sides, with dark-colored lines in basal field. Body length 28 to 44 mm and width of head 3.0 to 3.2 mm.

Development: I-instar. Body of just hatched larva colorless, translucent with reddish intestine. Head yellow, with black spots around setae. Pinacula large, colorless, turning black after 3.0 hrs. Setae black and pointed. Stigmata light-colored, round, with black edge. Feeding larva green. Body length of just hatched larva 2.3 mm, before molt 4.0 to 4.2 mm, and width of head 0.39 mm.

II-instar. Body yellowish, with translucent green intestine. Head yellowish-green with pinkish tinge, with gray pattern of first type and black spots around setae. Setae brownish, somewhat pointed, set on black, rather small pinacula; latter smaller on shields. Shields slightly fringed with brown pigment. Stigmata round. Legs light-colored; two anterior pairs of abdominal legs underdeveloped. Pattern: dorsal and subdorsal bands in form of row of dense white dots. Substigmal band white, narrow, with an indistinct lower border. Body length 4.5 to 7.5 mm and width of head 0.60 mm.

III-instar. Body green. Head yellowish-green, with brownish-yellow pattern of first type. Setae brownish, somewhat pointed, set on minute pinacula extremely lighter in color than body background; apex of pinacula black. Setae on thoracic shield set on black spots. Stigmata white, round, with black edge. Thoracic legs light-colored; abdominal legs green and all five pairs developed. Pattern: dorsal and subdorsal bands in form of row of fairly large white dots that also extend onto shields. Both bands fringed with green pigment darker than body background. Substigmal band white, broad. White dots seen here and there on dorsal and subdorsal fields. Ventral side light green. Body length 8.0 to 12.0 mm and width of head 0.90 mm.

IV-instar. Body green or reddish-brown with violet tinge. Head light yellow, with brownish pattern of second type (Figure 49, *I*). Thoracic shield darker than general background but without violet tinge. Base of setae consists of minute white spots. Light-colored spots distinctly seen on trunk around setae at commencement of instar; toward end of instar lost among mass of other light-colored dots. Stigmata on segments I and 8 slightly oval, round on others, light-colored, with black edge. Legs light-colored. Pattern: dorsal and subdorsal bands consist of chain of white dots with narrow, even borders. In green specimens borders dark green and in dark-

colored specimens brown. Dorsal and subdorsal fields densely covered with pinkish and lilac-colored dots, more rarely with brownish striae. Lower margin of subdorsal field brownish. Substigmal band broad, yellow along boundaries, and lilac-red with yellow dots at center. Ventral side green or greenish-brown with yellow dots. Body length 13 to 18 mm and width of head 1.3 to 1.4 mm.

V-instar. Larva differs from the VI-instar only in herringbone pattern less distinct. Body length 17 to 27 mm and width of head 2.0 to 2.1 mm.

In Belorussia larval development from July through September. Sometimes second incomplete generation develops. Food plants: whortleberry, raspberry, blackberry, black thorn, *Melandrium,* loosestrife, dandelion, lettuce, etc.

Eggs laid in clusters in two layers, not very close to each other. They are light yellow, 0.72 to 0.76 mm in diameter, and 0.46 to 0.48 mm in height. Ribs 34 to 38, of which 9 or 10 reach micropylar zone. Micropylar rosette consists of 12 to 14 lobes. Initially shell acquires pinkish tone, then turns brownish.

8. **Mamestra suasa** Schiff. (syn. *dissimilis* Knoch.) (dog's tooth moth)

Mature larva: Spinneret somewhat pinched toward end, 2.5 times longer than first segment of labial palpus, with narrow fringe on dorsal edge of opening (Figure 79, *3*). First segment of labial palpus somewhat longer than second segment; second seta slightly longer than first segment. Mandible with two inner teeth. Distance between setae I–II on thoracic shield less than between I–X, or equal to it. Distance between setae II–III on anal shield 1.5 times greater than between II–II. Hooks of abdominal legs: 22–23, 24–25, 26–28, 29–30, and 33–34.

Body green or brownish-green, with brownish or cinnamon pattern. Head greenish or brownish-yellow, with brown pattern of second type (Figure 49, *1*). Shields somewhat darker than general body background. Setae brownish, acuminate, short (0.78 mm), set on light-colored spots on thoracic shield, and on black spots on trunk except for setae X and IV, which rest on light-colored spots surrounded by dark-colored pigment. Stigmata light-colored, oval, with thin black edge. Thoracic legs yellowish, abdominal legs green or brownish. Pattern: dorsal and subdorsal bands in form of white, rather large, sparse dots that are well differentiated from dense minute white dots scattered on dorsal and subdorsal fields. Bands fringed with striae of dark green or brown pigment. Upper border of subdorsal band broader and darker in anterior part of segment and shifted upward and backward around setae II, in posterior part of segment, it adjoins border of dorsal band to form herringbone pattern. Sometimes herringbone pattern absent. Both dorsal and subdorsal fields with scat-

tered fine dark-colored striae. Stigmal band black (Figure 55, *6*), its lower border even. Substigmal band broad, yellow or orange. Ventral side green, with yellow dots. Body length 28 to 40 mm and width of head 3.0 to 3.3 mm.

Development: I-instar. Body of just hatched larva translucent greenish-yellow with colorless anal region and visible violet-red intestine and large unsclerotized pinacula that turn black after 1.5 to 2.0 hrs. Head rust-colored, with brownish pattern of first type. Stigmata round, light-colored, with thin black edge. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Feeding larva acquires green color. Body length of just hatched larva 2.0 to 2.5 mm, before molt 4.5 to 5.5 mm, and width of head 0.28 to 0.34 mm.

II-instar. Body green. Head light brown, with brownish spots around setae and pattern of first type. Setae light brown, acuminate, and set on black pinacula. Stigmata round, light-colored, with narrow black edge. Thoracic legs light-colored; abdominal legs green and underdeveloped on segments 3 and 4. Pattern: dorsal and subdorsal bands narrow, consist of longitudinal spots, whitish. Suprastigmal band greenish-white, narrow, continuous. Substigmal band white, uneven. Body length 5.0 to 8.5 mm and width of head 0.48 to 0.57 mm.

III-instar. Body bright green. Head greenish-yellow, with light brown pattern of first type. Shields not prominent. On thoracic shield setae I and II set on light-colored spots and IX and X on black spots. Setae on trunk set on flat, dull black pinacula. Stigmata and legs same as in the II-instar. Pattern: dorsal and subdorsal bands consist of white, rather large dots fringed with dark green or brown pigment. Substigmal band fairly broad, pale yellow. White dots on dorsal and subdorsal fields not dense. Body length 9.0 to 14.0 mm and width of head 0.76 to 0.88 mm.

IV-instar. Body greenish-brown. Head dull yellow, with brownish pattern of second type (Figure 49, *1*) and minute spots around setae. Setae light brown, acuminate, set on dull black spots on trunk and on light-colored spots on thoracic shield. Shields not prominent but dorsal bands on them distinct. Stigmata oval, light-colored, with black edge. Thoracic legs light-colored; abdominal legs green or brownish and all five pairs developed. Pattern: dorsal and subdorsal bands in form of chain of white dots fringed with dark green or brown striae. White dots on dorsal and subdorsal fields considerably denser than in the III-instar, with fine dark green or brownish striae scattered in between. Lower part of subdorsal field dark-colored. Posterior to each stigmata, except for those on segments 7 and 8, black smears representing rudiment of stigmal band distinct. Substigmal band broad, yellow, or with orange tinge. Ventral side green, with fewer white dots than on subdorsal field. Body length 15 to 23 mm and width of head 1.35 to 1.47 mm.

V-instar. Color and pattern same as in the VI-instar except that herringbone pattern fainter, more often absent. Body length 20 to 28 mm and width of head 2.0 to 2.3 mm.

In Belorussia larval development from late May to mid-July and in August–September. Two generations. Polyphagous species feeding on various weeds and wild grasses. Damages many cultivated and vegetable crops.

Eggs laid on underside of leaves in clusters consisting of one to four layers. They are light yellow, 0.60 to 0.62 mm in diameter and 0.50 to 0.53 mm in height. Ribs 54 to 57, of which 26 to 28 reach micropylar zone. Micropylar rosette consists of 14 to 16 lobes. Within 24 hrs light brownish spot at apex and girdle at equator visible. Eggs darken gradually and before larvae hatch turn dark violet-brown.

9. **Mamestra splendens** Hbn. (brown moth)

Mature larva: Spinneret 2.0 times length of first segment of labial palpus, somewhat pinched toward end. Dorsal edge of opening of spinneret with minute dents (Figure 79, *4*). Mandible with tetragonal inner tooth. Distances between setae I–II and I–X on thoracic shield equal. On anal shield distance between setae II–III greater than between II–II by 1.5 times. Stigmata of segment 8 larger than those of segment 7 by 0.33. Hooks of abdominal legs: 20–23, 24–25, 26–28, 29–33, and 34–36.

Body green or yellowish-brown with admixture of red. Head yellowish-brown, with very dark, faintly visible pattern of second type (Figure 49, *1*). Setae light brown, set on minute black spots surrounded by light-colored pigment. Thoracic shield grayish-brown with narrow white dorsal band; subdorsal bands in form of dots. Anal shield not prominent. Stigmata white, oval, with narrow black edge. Thoracic legs pinkish-yellow, abdominal legs greenish-yellow-gray. Pattern: dorsal and subdorsal bands consist of round white spots (0.23 mm); each spot surrounded by brownish pigment (Figure 75, *2*). Dorsal field covered with large number of minute white and yellowish dots fringed with very fine striae of reddish-brown pigment. Striae denser in upper part of subdorsal band and between setae II shift upward and backward to join border of dorsal band at end of segment, forming faint herringbone pattern with thin branches. Stigmal band black with light-colored spots, fairly broad, insignificantly broadening around stigmata. Stigmata of segments 1 to 6 surrounded by band up to middle. Substigmal band broad, yellow. Ventral side grayish-brown with violet tinge. In green-colored specimens pattern seen as dark green or grayish-green pigment. Body length 25 to 40 mm and width of head 3.0 mm.

In Belorussia larval development in July and August. Food plants: lettuce, dandelion, plantain, and burdock.

According to Döring, eggs straw-yellow, 0.65 to 0.75 mm in diameter, and 0.40 mm in height. Ribs 38 to 42, of which 18 or 19 reach micropylar zone. Micropylar rosette consists of 12 or 13 lobes.

10. **Mamestra oleracea** L. (tomato moth)

Mature larva: Spinneret somewhat pinched toward end, 2.0 times longer than first segment of labial palpus, with short thin fringe on dorsal edge of opening (Figure 79, *4*). Mandibles with tetragonal inner tooth. Distance between setae I–II on thoracic shield slightly less than between I–X. Distance between setae II–III on anal shield 1.5 times greater than between II–II. Hooks of abdominal legs: 20–27, 22–30, 27–32, 34–38, and 37–39.

Body green or yellowish-brown. Head dull yellow or brownish, with brown pattern of second type (Figure 49, *1*). Setae brownish, acuminate, set on large (0.12 mm) black spots that are distinct even on dark-colored background. Shields not prominent. Setae X and IX on thoracic shield set on black spots and I and II on white spots. Stigmata white, oval, with thin black edge. Thoracic legs yellowish, abdominal legs green. Pattern: dorsal and subdorsal bands consist of large white spots (up to 0.22 mm) of various size. Each spot surrounded by dark green pigment (Figure 75, *2*). Dorsal and subdorsal fields densely covered with white dots. In lower part of subdorsal field dots large (up to 0.18 mm), surrounded by dark green pigment, sometimes with admixture of brown. Stigmal band in form of two black smears located anterior and posterior to stigmata (Figure 55, *1* and 75, *2*). Substigmal band yellow or orange, its ventral border distinct only on thoracic segments and abdominal segments 1 and 2, but toward end of instar only on thoracic segments. Ventral side green; brownish pigment accumulates in basal field in dark-colored specimens. Body length 28 to 41 mm and width of head 2.8 to 3.0 mm.

Development: I-instar. Just hatched larva greenish-yellow, with colorless pinacula. Sclerotization of pinacula proceeds for 1.5 to 2.0 hrs. Head brownish. Thoracic shield yellowish, anal shield light-colored. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Feeding larva green, with black pinacula. Body length of just hatched larva 2.0 to 2.3 mm, before molt 4.5 mm, and width of head 0.31 to 0.38 mm.

II-instar. Body green. Head rust-colored, with very dark pattern of first type and black spots around setae. Setae brownish, acuminate, set on large black pinacula. Pinacula on shields somewhat smaller. Shields not prominent. Stigmata round, white, with black edge. Legs green or light-colored; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands in form of chain of large white dots. Substigmal band fairly broad, yellowish. Body length 4.5 to 8.0 mm and width of head 0.56 to 0.57 mm.

III-instar. Larvae differ from the II-instar only in dorsal and subdorsal bands in some specimens slightly fringed with dark-colored pigment. White dots sparse and scattered on dorsal field. Substigmal band broad, yellow. Body length 8.5 to 14.0 mm and width of head 0.76 to 0.85 mm.

IV-instar. Body green or yellowish-brown. Head pale yellow, with faint brownish pattern of first type. Setae brownish, acuminate, set on trunk on large black spots. Thoracic shield yellowish; setae I and II on it set on light-colored spots, and IX and X on black spots. Stigmata light-colored, oval, with black edge. Thoracic legs light-colored; abdominal legs green and all five pairs developed. Pattern almost same as in the III-instar. Scattered white dots denser on body; however, grouped in particular around black spots at base of setae, encircling them, and in lower part of subdorsal field. Body length 15 to 21 mm and width of head 1.26 to 1.38 mm.

V-instar. Color and pattern of head and body same as in the VI-instar. Sometimes stigmal band fainter, i.e., black smears present only posterior to stigmata and absent anteriorly. Body length 22 to 29 mm and width of head 2.0 to 2.2 mm.

In Belorussia, larval development in July and August and sometimes in June when incomplete second generation develops. Polyphagous species feeding on many weed grasses. Damages beet, carrot, cabbage, Swedish turnip, lettuce, tomato, pea, flax, tobacco, sorrel, and raspberry.

Eggs laid in compact clusters, in one to four layers of regular rows. They are bright green, 0.65 to 0.74 mm in length, and 0.53 to 0.56 mm in height. Ribs 43 to 47, of which 19 to 21 reach micropylar zone. Micropylar rosette consists of 14 or 15 lobes, with a single rim. On second day rusty-brown spot at apex and girdle at equator visible. Green color pales and eggs become pale yellowish-green. Before larva hatches egg ash-gray.

11. **Mamestra aliena** Hbn. (eastern moth)

Mature larva: Spinneret somewhat pinched toward end, over 1.5 times longer than first segment of labial palpus; dorsal edge of opening with minute dents (Figure 79, *4*). First seta of labial palpus equal to second segment; second seta shorter than first segment. Distances between setae I–II and I–X on thoracic shield almost equal. Distance between setae II–III on anal shield somewhat greater than between II–II. Mandibles with single tetragonal inner tooth. Hooks of abdominal legs: 19–20, 22–23, 22–24, 26–28, and 29–30.

Body reddish-gray, with admixture of brown. Head reddish-yellow with reddish-brown pattern of second type (Figure 49, *1*). Setae light brown, slender, acuminate, long (1.11 mm); pinacula and spots absent at base of setae on trunk and shields. Shields not prominent; narrow dorsal

bands extend along thoracic shield. Stigmata oval, light-colored, with thin brown edge. Legs light-colored. Pattern: dorsal band consists of light yellow dots, readily distinguishable from other dots only in posterior part of segment. Borders of band reddish-brown, not sharp. Chain of dots on subdorsal band distinct, its borders same color but less vivid. Dorsal and subdorsal fields with dense scattered yellowish dots, many of which surrounded by dark-colored pigment. Stigmal band absent. Substigmal band light yellow, narrow, its upper border distinct and lower fuses with yellowish-green color of ventral side. Light-colored dots on abdomen few. Body length 31 to 45 mm and width of head 3.3 to 3.5 mm.

Development: I-instar. Body pale bluish-green. Head dull yellow, with black spots around setae. Shields light-colored. Setae black, acuminate, long (0.12 mm), set on broad flat pinacula. Legs light-colored. Feeding larva green only in region of filled intestine. Head with pattern of first type. Pinacula black. Larva appears variegated. Abdominal legs wide set and underdeveloped on segments 3 and 4. Stigmata round, green, with brown edge. Length of just hatched larva 2.2 mm, before molt 4.0 to 5.0 mm, and width of head 0.34 mm.

II-instar. Body green. Head brownish-yellow, with very dark pattern of first type and black spots around setae. Setae black, strong, 0.157 mm, set on black round (0.039 mm) pinacula on both trunk and shields. Stigmata light-colored, round, with brown edge. Legs green; four pairs of abdominal developed. Pattern: dorsal, subdorsal, and suprastigmal bands whitish and continuous. Substigmal band whitish, narrow. Body length 5.0 to 7.5 mm and width of head 0.50 to 0.55 mm.

III-instar. Larvae differ from the II-instar in setae set not on pinacula but on minute black spots. All five pairs of abdominal legs developed. Body length 8.0 to 13.0 mm and width of head 0.83 to 0.85 mm.

IV-instar. Body green. On second and third day after molt light yellow dots seen on body. Head yellowish-green, without pattern and spots around setae. Setae slender, distinctly acuminate, 0.31 mm, and set on small, round, light yellow spots in some specimens, and on general background in others. Shields not prominent and spots absent at base of setae. Stigmata light-colored, somewhat oval, with thin black edge. Legs light-colored or greenish. Pattern: dorsal and subdorsal bands yellowish, fairly broad, almost continuous. In some specimens subdorsal band consists of dots at commencement of instar. Substigmal band light yellow, narrow, with indistinct lower border. Dorsal and subdorsal fields densely, ventral side sparsely, covered with groups of minute light-colored dots. Lower part of subdorsal field dark green. Body length 14 to 20 mm and width of head 1.28 to 1.37 mm.

V-instar. Larva differs from the VI-instar only in pattern on trunk. Dorsal and subdorsal bands consist not of dots as in the VI-instar but of oblong spots, and thus bands almost continuous. Light-colored dots scattered throughout body denser than in the IV-instar but fewer than in the VI. Hooks of abdominal legs reddish-yellow. Body length 20 to 29 mm and width of head 2.1 to 2.3 mm.

In Belorussia larval development in July and August. Food plants: broom, rest harrow, sweet clover, acacia, spurge, wormwood, celandine, cinquefoil, burdock, hops, and mountain ash.

Eggs laid in single layer of almost regular rows, with 10 to 250 in each layer. They are pale green, 0.70 to 0.74 mm in diameter, and 0.58 to 0.60 mm in height. Ribs 30 to 32, of which 13 to 15 reach micropylar zone. Micropylar rosette consists of 12 to 14 lobes. During embryonal growth color of eggs changes little. Initially they lose green color and turn pale yellow with dark-colored dot at apex. Before larva hatches egg light ash in color.

10. Genus *Barathra* Hbn.

Barathra brassicae L. (cabbage moth)

Mature larva: Length of spinneret 2.5 times greater than its width and 4.0 times greater than first segment of labial palpus. Ventral region of spinneret opening even, dorsal finely dentate (Figure 79, *1*). Second seta of labial palpus equal to first segment and first seta equal to second segment. Dorsal teeth of mandible reduced. Distance between setae M_1 and M_2 equal to distance between M_2 and *Mi.* Inner tooth of mandibles large, tetragonal. On anal shield distance between setae II–III greater than between II–II by 2.0 to 2.5 times. Hooks of abdominal legs arranged in one tier: 22–23, 23–25, 24–26, 26–28, and 29–32.

Body somewhat pinched anteriorly. Color varies from grayish-green to dark brown. Head yellow, with pattern of second type (Figure 49, *1*). Shields brown, with narrow light-colored dorsal and subdorsal bands. In dark-colored specimens bands more distinct. Setae rusty-brown, acuminate, surrounded by thin black line, and set on minute light-colored spots. Large irregular brown or black spot located on dorsal side of light-colored spot of setae I and II. Stigmata oval, white or yellowish, with thin black edge. Thoracic legs yellowish; abdominal legs light green, with large brown spot on outer side. Pattern: dorsal band on thoracic segments yellowish, narrow, and continuous; on abdominal segments in form of chain of minute greenish-yellow spots, masked by borders at many places. Borders of band uneven and consist of greenish-brown or dark green striae. Subdorsal band also in form of chain of light-colored dots which are more distinct. Lower border of band brown, not broad, even; upper border dark

brown, often almost black, and broad on thoracic segments; on abdominal segments broad only in anterior half of each segment, and at center of segment interrupted and fused with spot joining seta II. In many specimens upper border of subdorsal band at end of segment notably shifted upward and fuses with border of dorsal band to form herringbone pattern. On segments 7 and 8 border forms cuneiform spots; latter on segment 8 not proximate. Dorsal and subdorsal fields grayish-green, with large number of greenish-yellow dots and thin dark brown or black striae. Suprastigmal band not seen. Stigmal band dark brown or black, narrow outside stigmata, broadens notably in region of stigmata, and surrounds them above and from the sides (Figure 55, *7*). Substigmal band greenish, with mass of yellow dots; upper border distinct but uneven, and lower distinct only at commencement of instar. Ventral side yellowish-green or grayish-green, with sparse scattered yellow dots. In zone of basal band fine brown striae encircles dots. Body length 40 to 45 mm and width of head 3.0 to 3.1 mm.

Development: I-instar. Body of just hatched larva colorless, translucent with visible yellowish-red intestine. Head dark brown, almost black, lustrous. Thoracic shield brownish, its anterior edge uneven (Figure 59). Sclerotization of shield proceeds for 20 to 30 min. Anal shield almost not separate. Pinacula quite raised, colorless. Sclerotization of pinacula proceeds for 2.0 to 3.0 hrs after which they turn brown. Skin coarsely grained. Feeding larva takes on green color. Thoracic and abdominal legs green: abdominal legs underdeveloped on segments 3 and 4. Body length of just hatched larva 2.0 to 2.2 mm, before molt 4.4 to 4.5 mm, and width of head 0.34 to 0.36 mm.

II-instar. Body green. Head green, with light brown pattern of first type and brown spots around setae. Thoracic shield slightly fringed with brown pigment. Pinacula on body, including those on shields, brown, fairly large. Setae brown, acuminate. Stigmata light-colored, round, with brown edge. Thoracic legs yellowish; abdominal legs light-colored and two anterior pairs underdeveloped. Skin finely grained. Pattern: dorsal and subdorsal bands white, not broad, continuous, with uneven edges. Substigmal band broad, white. Stigmata disposed above bands. Body length 4.5 to 6.5 mm and width of head 0.50 to 0.53 mm.

III-instar. Body green, with weak dilatation on segment 8. Head green, with light brown pattern of first type and fairly large spots around setae. Shields almost invisible. Dorsal and subdorsal bands extend onto thoracic shield. Setae brown, slightly acuminate, set on minute pinacula, and surrounded by large brown spots. Stigmata round, light-colored, with brown edge. Legs green, abdominal legs on segment 3 underdeveloped. Pattern: dorsal and subdorsal bands white, interrupted at places. In some specimens bands fringed with brownish-green pigment. Dorsal field with scattered

white dots. Substigmal band white, fairly broad. Stigmata of segments 1 to 7 disposed on upper part of band and stigmata of segments I and 8 above band. Body length 7.0 to 12.0 mm and width of head 0.82 to 0.86 mm.

IV-instar. Body green. Segment 8 somewhat dilated. Head yellowish-green, with faintly visible light brown pattern of second type and black spots around setae. Shields not prominent. Setae set not on pinacula but on black spots. Stigmata light-colored, somewhat oval, with black rim. Legs light-colored; all five abdominal pairs developed. Pattern: dorsal and subdorsal bands in form of chain of white dots. Both bands edged with dark green pigment, sometimes with admixture of brown. Substigmal band light yellow, with distinct borders above and below. Dorsal and subdorsal fields with mass of scattered white and yellowish dots; ventral side with fewer dots. Body length 13.5 to 20.0 mm and width of head 1.30 to 1.33 mm.

V-instar. Body color variable: dark brown, light brown, or dark green. Abdominal side considerably lighter in color, more often green. Head greenish-yellow, with brown pattern of second type (Figure 49, *1*). Shields not prominent; dorsal and subdorsal bands on them consist of dots. Setae light brown, slender, distinctly acuminate, set on small black spots faintly visible against dark background. Legs light-colored. Pattern: dorsal and subdorsal bands in form of chain of white dots, fringed with striae of dark green or brown pigment. Dorsal field densely covered with white dots, fringed to some extent with dark green or brown pigment, depending on color intensity of back. Subdorsal field invariably more vividly colored than dorsal. Substigmal band yellow, densely covered in upper part with yellow dots; row of dots in lower part forms border of band. At center of band main color of skin visible. At end of instar orange pigment evident in substigmal band. Ventral side greenish-yellow with mass of yellow dots, around which dark pigment accumulates toward end of instar. Body length 20 to 30 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development in June and July, and in August–September. Two generations. Highly polyphagous species feeding on various weeds and wild flora. Serious pest of cultivated plants, damaging farm and vegetable crops, in particular cabbage.

Eggs laid in clusters in single layer of regular rows, and not contiguous. They are light yellow, 0.57 to 0.62 mm in diameter, and 0.42 to 0.47 mm in height. Sometimes, eggs highly flattened and hemispherical; diameter then ranges from 0.68 to 0.74 mm and height 0.40 to 0.45 mm. Ribs 35 to 38, of which 13 to 15 reach micropylar zone. Micropylar rosette consists of 12 or 13 lobes. Egg takes on pinkish tone after one day and brownish girdle and spot at apex visible. Chorion darkens gradually and before larva hatches acquires violet shade.

11. Genus *Polia* Ochs.

Rather large species (up to 52 mm) with fairly distinct rhombic spots on dorsal field. Setae I, II, and X on trunk set on light-colored spots or on general background color of back. Spinneret somewhat pinched toward end, 2.0 or 3.0 times longer than first segment of labial palpus; dorsal edge of opening convoluted (Figure 79, *7,* and *8*). Second seta of palpus shorter or equal to first segment, and first seta equal to second segment. Mandibles with single inner tooth. Metathoracic coxae not close to each other. Setae III and IIIa on segment III set on dark-colored spots (Figure 28, *1*). Larvae molt six times; last instar seventh.

Key to Species

1 (2). Dark spot absent on thoracic shield between setae II and IX. On head, setae A_1, A_2, and A_3 form right angle. Rhombic pattern on dorsal field dark brown, monochromatic (Figure 75, *5*)..... ..... 3. **P. nebulosa** Hufn.

2 (1). Small oblong spot present on thoracic shield between setae II and IX (Figure 76). On head, setae A_1, A_2, and A_3 form obtuse angle (Figure 32, *2*). Rhombic pattern on dorsal field darker around median line.

3 (4). Rhombic pattern along median line on back dark brown, later seen as fine brown striae. Distance between setae I–I on anal shield 1.5 times greater than between II–II..... 1. **P. bombycina** Hufn.

4 (3). Rhombic pattern along median line on back black, later seen as fine black striae. Distance between setae I–I on anal shield 2.5 times greater than between II–II..... 2. **P. hepatica** Cl.

1. **Polia bombycina** Hufn. (syn. *advena* Schiff.) (rest harrow owlet moth)

Mature larva: Seta A_2 shifted ventrally and forms obtuse angle with setae A_1 and A_3 (Figure 32, *2*). Distance between setae Frl_2–P_1 more than between P_1–P_2. Small oblong spot occurs between setae II and IX on thoracic shield (Figure 76). Distance between setae I–I on anal shield 1.5 times greater than between II–II. Hooks of abdominal legs: 32–34, 35–36, 36–37, 38–40, and 40–43.

Body brown, with admixture of red. Head yellow, with reddish-brown pattern of second type (Figure 49, *1*). Setae brown, acuminate, short (0.60 mm), and set on white spots. Shields not prominent. Stigmata oval, yellowish-red, with black edge. Legs brownish-red. Pattern: dorsal and subdorsal bands seen as large white dots fringed with dark brown pigment. Much larger dots seen along margins of segments. Dorsal field densely covered with white dots and fine brown striae. Latter denser around dorsal band and later extend to subdorsal band, forming rhom-

bic spot on dorsal field of abdominal segments. Dots adjoining subdorsal band less fringed. Subdorsal field darker than dorsal, densely covered with yellow dots, and fine brown striae forming borders. Substigmal band bordered above and below by yellow dots, with reddish-brown pigment at center. Ventral side greenish-brown. Body length 38 to 52 mm and width of head 3.60 to 3.80 mm.

Development: I-instar. Body of just hatched larva yellowish, translucent with visible lilac-gray intestine. Pinacula light-colored, 0.04 mm; sclerotization continues for 2.0 to 2.5 hrs, after which they turn black. Head yellow, with brown spots around setae. Thoracic shield yellow. Pinacula on shields minute. Setae strong, slightly pointed, brown. Stigmata light-colored, round, with thin light brown edge. Skin finely grained. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. On third day body takes on reddish tone. Pattern: dorsal and subdorsal bands white, narrow, continuous; suprastigmal band consists of dots; substigmal band broad, white. Body length of just hatched larva 2.8 to 3.0 mm, before molt 5.5 to 6.0 mm, and width of head 0.43 to 0.45 mm.

II-instar. Body light brown. Head light brown, with minute dark brown spots around setae. Setae brown, acuminate, set on black pinacula (0.40 mm). Shields not prominent, with minute brown spots around setae. Pattern: dorsal, subdorsal, and suprastigmal bands fairly broad, pale yellow. Dorsal field light reddish-brown, subdorsal dark brown. Substigmal band yellow, broad, extends onto anal leg. Subbasal field light reddish-brown, ventral side greenish. Body length 6.0 to 10.0 mm and width of head 0.60 to 0.62 mm.

III-instar. Larva differs from II-instar in smaller pinacula, suprastigmal band faint, dorsal and subdorsal bands in some specimens somewhat fringed with brown pigment, and dorsal field with reddish-yellow dots. Body length 10 to 15 mm and width of head 0.88 to 0.94 mm.

IV-instar. Body brownish-red, dark brown, or brown, with light-colored dorsal bands. Head light reddish-brown, with very dark-colored pattern of second type (Figure 49, *1*). Setae brown, slender, acuminate, and set on light-colored spots. Ridges surrounded by thin black line. Shields not prominent. Stigmata oval, light-colored, with black edge. Legs light-colored; all five abdominal pairs developed. Pattern: dorsal band consists of white dots, fused at many places. Band fringed with brown pigment that surrounds dots on band and dots adjacent to band. Subdorsal band consists of very fine dots; upper border narrow, lower merges with dark background of subdorsal field. Substigmal band yellow, at center with reddish-brown striae. Ventral side brownish-red, with mass of yellow dots. Body length 16 to 22 mm and width of head 1.37 to 1.42 mm.

V-instar. Larva differs from the IV-instar in pattern, which varies even during this instar. Dorsal and subdorsal bands consist of white dots fringed

with dark brown pigment. At commencement of instar dorsal field with herringbone pattern. Toward end of instar herringbone pattern obliterated since scattered light-colored spots along dorsal field disposed mainly at center of segment and adjoin subdorsal band to form rhombic pattern (Figure 75, *5*). Substigmal band yellow, fairly broad, with distinct upper and lower borders. Stigmata of segments 4 to 6 disposed on band. Body length 20 to 29 mm and width of head 1.80 to 1.90 mm.

VI-instar. Larva almost indistinguishable from the VII-instar but rhombic pattern in the VI-instar more distinct and borders of substigmal band more prominent. Body length 27 to 38 mm and width of head 2.60 to 2.80 mm.

In Belorussia larval development in July and August and, after hibernation, up to May 20. Food plants: whortleberry, melilot, rest harrow, St. John's wort, raspberry, dewberry, lady's mantle, dead nettle, cinquefoil, heath, hop, willow, and maple.

Eggs laid in clusters, in single layer, and not contiguous. They are light yellow, 0.80 to 0.90 mm in diameter, and 0.60 to 0.70 mm in height. Ribs 32 to 36, of which 17 or 18 reach micropylar zone. Micropylar rosette consists of 15 or 16 lobes, surrounded by 3 rims. Eggs turn yellowish-brown within 24 hrs and then light brown with very dark spot at apex and girdle at equator. Before larva hatches egg reddish-violet.

2. **Polia hepatica** Cl. (syn. *tincta* Brahm.) (whortleberry owlet moth)

Mature larva: Setae A_1, A_2, and A_3 form an obtuse angle (Figure 32, *2*). Distance between setae Frl_2–P_1 and P_1–P_2 equal. Small oblong spot on thoracic shield between setae II and IX (Figure 76). Distance between setae I–I on anal shield 2.5 times greater than between II–II. Hooks of abdominal legs: 35–37, 38–39, 40–42, 44–45, and 47–49.

Larva grayish-yellow. Head light or dark reddish-yellow, with brown pattern of second type (Figure 49, *1*). Sometimes pattern faint, especially at end of instar. Setae rusty-brown; I and II set on minute light-colored spots. Shields not prominent; setae set on minute light-colored spots. Stigmata dark yellowish-red, oval, with black edge. Thoracic legs grayish-yellow, abdominal legs gray with admixture of red. Pattern: dorsal band consists of oblong dull white spots, fused at many places, almost continuous, narrow. Borders of band black, fairly broad. Dorsal field densely covered with dull white dots and to some extent with fine black striae. Latter concentrate more at center of segment and reach subdorsal band to form rhombic spot. Toward end of instar borders of dorsal band become blackish-brown or brown, while rhombic pattern faint. Subdorsal band consists of light gray dots and oblong spots, faintly fringed with brownish pigment. Subdorsal field in light-colored specimens light reddish-brown and in dark-colored ones dark reddish-brown. Lower margin of subdor-

sal field dark brown. Substigmal band prominent, with dense scattered yellow dots. Ventral side greenish-brown. Body length 38 to 51 mm and width of head 3.70 to 3.90 mm.

Development: I-instar. Just hatched larva brownish-red. Head light brown, without spots around setae. Pinacula large (0.045 mm), same color as body, becoming dark brown after 2.0 or 3.0 hrs; pinacula on shields smaller and lighter in color; minute brown spots visible on head. Setae strong, brownish, and acuminate. Stigmata round, light-colored, with narrow dark-colored edge. Legs dark-colored; abdominal legs on segments 3 and 4 underdeveloped. Feeding larva reddish-yellow, with admixture of brown. Toward end of instar hazy yellow, continuous dorsal, subdorsal, and suprastigmal bands distinct. Ventral side greenish. Skin finely grained. Length of just hatched larva 2.7 to 3.0 mm, before molt 4.8 to 6.0 mm, and width of head 0.43 to 0.45 mm.

II-instar. Body yellowish-brown. Head yellow, with minute dark brown spots around setae. Pinacula black, small (0.033 mm), and small spot seen on ventral side of pinacula I and II lighter in color than body background. Brown spots visible on shields at base of setae. Thoracic shield light yellow, anal shield not prominent. Stigmata light-colored, round. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands white, continuous, fairly broad. Suprastigmal band dull white, narrower than subdorsal. Lower part of subdorsal field reddish-brown. Substigmal band broad, white. Basal field yellowish-brown. Ventral side greenish. Skin finely grained. Body length 6.0 to 10.0 mm and width of head 0.65 to 0.67 mm.

III-instar. Body well proportioned, reddish-yellow, in some specimens with admixture of brown. Head yellowish-pink, with brown spots around setae. Setae rust-colored, short (0.17 mm), distinctly acuminate, set on minute brown spots, and surrounded by ring of light-colored pigment. Shields not prominent. Stigmata round, yellowish-pink, with thin black edge. Legs light-colored; abdominal legs on segment 3 underdeveloped. Pattern same as in the II-instar. Skin smooth. Body length 10 to 15 mm and width of head 0.89 to 0.93 mm.

IV-instar. Body reddish-yellow, with admixture of violet and brown. Larvae lighter or darker in color. Head yellowish-red, with dark brown spots around setae, and reddish-brown, faint pattern of second type. Setae rust-colored, short, acuminate, set on round minute white spots; on shields set on dark brown spots. Shields not prominent. Stigmata oval, yellowish-red, with thin black edge. Legs light-colored; all five abdominal pairs developed. Pattern: dorsal, subdorsal, and suprastigmal bands consist of white dots. Dorsal and subdorsal fields with dense scattered white and yellow dots. Dots on dorsal band and those adjacent to it fringed with

dark brown pigment, which forms border of band; border darkest and broadest at margins of segments. Subdorsal band slightly fringed. Substigmal band bordered above and below by yellowish dots, pinkish-yellow at center. Basal field yellowish-pink, with yellow dots. Ventral side greenish. Body length 16 to 22 mm and width of head 1.36 to 1.42 mm.

V-instar. Unlike the IV-instar in these larvae pattern on head distinct and borders of dorsal band blackish-brown. Center of dorsal field with accumulation of striae of brown pigment forming faint rhombic pattern. Body length 21 to 29 mm and width of head 1.86 to 1.91 mm.

VI-instar. Larva differs little from the VII-instar. However, pattern on head more distinct in the VI-instar (Figure 49, *1*). Borders of dorsal band not broad; in some specimens dark brown and in others black. Rhombic pattern on dorsal field distinct, consists of dark brown or brownish-black striae. Upper part of substigmal band consists of fairly distinct yellow dots. Body length 28 to 38 mm and width of head 2.61 to 2.81 mm.

In Belorussia larval development from first few days of July to autumn and, after hibernation, to mid-May. Food plants; whortleberry, raspberry, dewberry, dead nettle, rest harrow, and birch.

Eggs are laid in clusters of 45 to 300 each, in single layer, and not contiguous. They are light yellow, 0.92 to 0.94 mm in diameter, and 0.71 to 0.72 mm in height. Ribs 34 or 35, of which 12 to 14 reach micropylar zone. Micropylar rosette consists of 12 to 16 lobes. Eggs acquire reddish-yellow coloration within 24 hrs, turn brownish-violet later, and become ash-gray before larva hatches.

3. **Polia nebulosa** Hufn. (hazy gray owlet moth)

Mature larva: Setae A_1, A_2, and A_3 form right angle (Figure 32, *3*). Second seta of labial palpus equal to first segment. Dark-colored spot absent between setae II and IX on thoracic shield. Hooks of abdominal legs: 34–35, 36–37, 38–40, 41–43, and 44–46.

Body slightly pinched toward anterior end, brownish-gray, sometimes with reddish tinge. Head gray or yellow, with brownish pattern of second type (Figure 49, *1*). Setae light brown, distinctly acuminate, and spots absent at base; setae on abdominal legs sometimes set on black spots. Shields not prominent. Stigmata brownish-reddish-yellow, oval, with thin black edge. Legs greenish-gray. Pattern: dorsal band consists of yellow dots, fused at many places. Band fringed with dark brown, sometimes almost black pigment. At margins of segments borders narrow, at center highly enlarged, forming rhombic spot on dorsal field of each abdominal segment. Dorsal field covered with yellow dots and patterned with fine striae; area free of rhombi, yellowish, with faint reddish tinge. Subdorsal band consists of grayish-yellow dots, slightly fringed at places with fine dark brown striae. [Upper] border absent in region of seta II. Subdorsal field covered with yellow and reddish dots and fine gray striae. Dark brown

to black oblique spot occurs between setae II and III (Figure 75, *5*). Lower part of subdorsal field highly darkened, especially around stigmata. Substigmal band very faint but differs from basal field in that dark-colored scattered dots denser. Basal field yellowish-gray. Body length 37 to 50 mm and width of head 3.70 to 3.90 mm.

Development: I-instar. Just hatched larva grayish-yellow. Head black. Pinacula light-colored. Setae rust-colored, acuminate. Thoracic shield dark brown, not fully sclerotized (Figure 59). Sclerotization of shield ceases after 30 to 40 min and of pinacula after 2.0 to 2.5 hrs. Thoracic legs dark-colored; abdominal legs light-colored and two anterior pairs underdeveloped. Large brownish spot visible toward end of instar on ventral side of abdominal legs, while dorsal and subdorsal fields turn yellowish-brown. Dorsal and subdorsal bands yellowish-gray. Skin finely grained. Length of just hatched larva 2.7 to 3.0 mm, before molt 5.5 mm, and width of head 0.43 to 0.44 mm.

II-instar. Larva quite well proportioned, with very prominent segments: body yellowish but green in region of filled intestine. Disturbed larva rolls into a coil. Head light yellow, with dark-colored spots around setae. Setae rust-colored, slender, acuminate, and set on minute brown pinacula. Shields weakly fringed with brownish striae; large brownish spots visible at base of setae. Stigmata round, light-colored, with very thin brown edge. Legs light-colored; three abdominal pairs developed. Pattern: dorsal and subdorsal bands consist of minute white oblong spots. Substigmal band broad, white. Subdorsal field yellowish-brown. Body length 6.0 to 9.0 mm and width of head 0.60 to 0.67 mm.

III-instar. Body green. Head yellow. Setae light brown, acuminate, set on minute black spots on trunk and shields. Shields yellowish. Stigmata round, light-colored. Thoracic legs yellowish; abdominal legs light-colored and underdeveloped on segment 3. Pattern: dorsal and subdorsal bands consist of white dots. Dorsal band fringed with dark green pigment. At center of segments, especially abdominal, borders enlarge to form rhombic pattern. Suprastigmal band consists of faint white dots. Subdorsal field brownish-green. Seta III set on very light-colored background. Substigmal band broad, bordered by white dots, and same shade of green at center as ventral side. Body length 10 to 14 mm and width of head 0.90 to 1.00 mm.

IV-instar. Body yellowish, with brownish-green rhombic pattern on dorsal field. Head yellow, with faint reddish pattern of first type (Figure 48, *1*). Setae brown, strong, acuminate, set on minute light-colored spots on trunk; on shields setae set on minute brown spots. Stigmata light-colored, oval. Legs light-colored; all five pairs of abdominal legs developed. Pattern same as in the III-instar. Body length 14 to 21 mm and width of head 1.32 to 1.46 mm.

V-instar. Larva differs from the IV-instar in that head acquires dark brown pattern of second type (Figure 49, *1*); setae on shields set not on spots but on general background color of shield; setae on trunk set on very minute, almost imperceptible, white spots. White dots scattered along body significantly larger; dots scattered on substigmal band yellowish-pink. Rhombic pattern on dorsal field same as in the III- and IV-instars. Body length 20 to 28 mm and width of head 1.75 to 1.88 mm.

VI-instar. Larva almost indistinguishable from the VII-instar. However, head invariably yellow, with brown pattern of second type (Figure 49, *1*). Brown spot visible on thoracic shield, at base of seta IX. Setae I and II often set on trunk or very minute white spots; sometimes setae absent. Setae on abdominal legs set on brown spots. Stigmata reddish-yellow. Dots scattered throughout body with reddish tinge. Body length 27 to 37 mm and width of head 2.70 to 2.80 mm.

In Belorussia larval development from latter half of June to autumn and, after hibernation, until May 20. Food plants: dewberry, dandelion, whortleberry, heath, Plantaginaceae, lady's mantle, clover, *Galium,* nightshade, birch, hop, rest harrow, alder, ash, and oak.

Eggs laid in clusters of 7 to 350 each, in regular rows, and not contiguous. They are bright green, 0.75 to 0.81 mm in diameter, and 0.61 to 0.62 mm in height. Ribs 32 to 34, of which 12 to 14 reach micropylar zone. Micropylar rosette consists of 10 to 12 lobes. During embryonal growth eggs hardly change color; before larvae hatch they turn pale yellow and head of larva visible.

12. Genus *Sideridis* Hbn.

(one species in Belorussian fauna)

Sideridis albicolor Hbn. (orache owlet moth)

Spinneret 1.5 times longer than first segment of labial palpus; second seta of palpus almost equal to first segment, and first seta shorter than second segment. Postgenal sclerites contiguous (*Pi* = 1/7, 1/8). Distances between setae Frl_2–P_1 and P_1–P_2 equal. Thoracic shield chitinous, lustrous. Distance between setae II–III on prothorax 1.5 times greater than between III–IX. Metathoracic coxae contiguous. Distance between setae II–III on anal shield 1.5 times more than between II–II. Skin thin and transparent. Abdominal legs long and hooks arranged in one tier: 22–25, 25–28, 27–30, 32–34, and 36–38.

Body slightly pinched toward anterior end, grayish-green or dark green. Head green, without pattern. Thoracic shield brown, with narrow yellowish dorsal band; subdorsal band not seen on shield. Anal shield not prominent. Setae rusty-brown, acuminate, without spots at base on trunk and shields. Stigmata white, oval, with black edge. Legs yellowish-green.

Pattern: dorsal band narrow, greenish-yellow; subdorsal band slightly broader. Bands consist of minute yellowish dots; very similar but dense dots scattered on dorsal field. Borders of band grayish, very faint, sometimes totally absent. Substigmal band whitish, with admixture of orange at center. Ventral side yellowish-green, lighter in color than dorsal. Body length 22 to 42 mm and width of head 3.0 mm.

In Belorussia larval development from early July to mid-September. Food plants: Plantaginaceae, orache, wormwood, and other herbaceous plants.

According to Döring (1955), eggs light yellow, with broad red girdle and spot at apex. Diameter 0.70 to 0.73 mm and height 0.45 to 0.50 mm. Ribs at apex 20 and at equator 35.

13. Genus *Heliophobus* Bsd.

(one species in Belorussian fauna)

Heliophobus reticulata Goeze (syn. *calcatrippae* View.) (reticulate owlet moth)

Spinneret somewhat pinched toward end, 2.0 times longer than first segment of labial palpus, with minute dents on dorsal side of opening (Figure 79, *9*); first seta of palpus equal to or shorter than second segment, and second seta equal to first segment. Extreme dorsal tooth of mandibles separated (Figure 15, IV); inner tooth present. Thoracic shield chitinous, lighter in color than overall body background. Distance between setae II–III on segment I somewhat more than between III–IX; distances between setae II–III and III–IV almost equal. Metathoracic coxae contiguous. Skin smooth. Hooks of abdominal legs set in single tier: 23–25, 25–27, 27–29, 28–32, and 35–40.

Body green, with violet-red shade, slightly pinched toward anterior end. Head yellow, with brownish pattern of second type (Figure 49, *1*). Setae rust-colored, acuminate, spots absent at base on trunk. Shields lighter in color than body background, with narrow dorsal bands and very small light-colored spots at base of setae. Stigmata large, white, oval, with black edge. Thoracic legs light yellow, abdominal legs greenish. Pattern: dorsal band consists of very minute yellowish dots that do not differ in color and size from dots scattered en masse on dorsal field. These dots and those of bands fringed with fine striae of pale violet-red, more rarely with brownish pigment. Hence band almost not delineated. Subdorsal band more distinct since dots forming it larger and their outlines darker. Dorsal and subdorsal fields yellowish-gray, with reddish-violet tinge. Substigmal band yellowish due to dense scattered yellow dots on green background, but its borders indistinct. Ventral side light green. Body length 33 to 45 mm and width of head 3.7 to 3.9 mm.

Development: I-instar. Just hatched larva light-colored, almost white, translucent with visible violet-red intestine, quite broad, with segment I almost equal to width of head. Head yellow, with brown spots around setae. Pinacula large, light-colored, turning black in 2.0 to 2.5 hrs. Thoracic shield yellowish-brown. Setae brownish, piliform, short (0.087 mm). Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Feeding larva yellowish; filled intestine green. Skin coarsely grained. Body length of just hatched larva 2.1 and 2.2 mm, before molt 4.0 to 4.5 mm, and width of head 0.347 mm.

II-instar. Body green. Head light green, with brown spots around setae and greenish-brown pattern of first type. Setae black, piliform, short (0.097 mm), and set on brown pinacula. Shields not prominent. Stigmata light-colored, round, with black edge. Legs green, with brown spots around setae. Pattern: dorsal and subdorsal bands white, narrow, consists of fused dots. Substigmal band not broad, white. Body length 4.5 to 8.5 mm, and width of head 0.52 to 0.54 mm.

III-instar. Body green. Head green, with yellowish-brown spots around setae and brownish-green pattern of first type. Setae piliform, black, set on very minute black pinacula on trunk and minute brown spots on shields. Stigmata light-colored, round. Legs green, with brown spots around setae; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands white, continuous, even, and narrow. Substigmal band yellowish. Ventral part of subdorsal field dark green. Body length 7.5 to 13.5 mm and width of head 0.83 to 0.84 mm.

IV-instar. Body green. Head light green, with greenish-brown pattern of first type. Setae brownish, slightly pointed, short (0.25 mm), and encircled by thin black line. Shields green, with narrow dorsal bands. Stigmata oval, yellow, broad, with black edge; stigmata on segments 2 to 7 disposed on substigmal band. Thoracic legs yellowish; abdominal legs green and all five pairs developed. Pattern: dorsal and subdorsal bands consist of very minute yellowish dots, which are not distinguishable from fairly large number of dots scattered in dorsal and subdorsal fields. Narrow dark green borders extend along sides of bands. Ventral region of subdorsal field dark green. Substigmal band yellow, broad, with distinct borders. Ventral side light green. Body length 14 to 22 mm and width of head 1.35 to 1.36 mm.

V-instar. Larva differs from the VI-instar in absence of reddish-violet tinge in first few days (tinge seen later). Shields brownish-green and borders of substigmal band distinct. Body length 22 to 32 mm and width of head 2.3 to 2.4 mm.

In Belorussia larval development from mid-June to mid-August. Pupae hibernate. Food plants: catchfly, *Saponaria, Melandrium,* and clove.

Eggs laid in chains of 5 to 20 each. They are greenish-yellow, 0.72 to 0.73 mm in diameter, and 0.52 to 0.53 mm in height. Ribs 34 to 36, of which 15 to 16 reach micropylar zone. Micropylar rosette consists of 14 to 16 lobes, with single rim. On second day reddish-yellow spot at apex and girdle at equator visible. Chorion gradually lightens in color while girdle and spot darken.

Subfamily Zenobiinae

Spinneret invariably longer than first segment of labial palpus (often 3.0 to 6.0 times), pinched to some extent toward end, more often round; opening of spinneret even, without fringes or dents. First and second setae of labial palpus rather well developed; first seta almost invariably exceeds length of second segment. Teeth of mandible normally developed in most species, sometimes dorsal ones reduced. In *Thalpophila matura* Hufn. first main tooth reduced. In *Luperina, Mesapamea,* and *Apamea* broad thoracic shield reaches setae III and IIIa, which constitutes a characteristic feature; in species of the latter genus seta III set on edge of thoracic shield (Figure 36, *2*). Seta III on segment 9 piliform. Skin smooth or finely grained; in *Meristis trigrammica* Hufn. coarsely grained (Figure 27, *3*). Abdominal legs invariably five pairs, long, rarely short, usually with uniordinal hooks; very rarely hooks indistinctly biordinal. Pattern on head of second type (Figure 49, *5*), more rarely of first type (Figure 48, *2*), or absent altogether. Pattern on trunk generally distinct, not complex; sometimes body color monochromatic, which is characteristic of species feeding inside stalks of plants. Molts, five; in species of the genus *Apamea*, seven molts. Many species inhabit forests, while some inhabit fields and meadows. Based on structural features of the larvae, we have included the following genera in this subfamily: *Blepharita, Eupsilia, Conistra, Lithophane, Cirrhia,* and *Xylena*. Many authors place these genera in the subfamily Cuculliinae.

Key to Genera

1 (2). Skin coarsely grained, in form of tubercles. Setae piliform, rather thick (Figure 27, *3*). Head rugulose, brown, with faint reticulate structure. Dorsal field with faint herringbone pattern. Larvae on herbaceous plants..... 15. **Meristis.**

2 (1). Skin smooth or finely grained. Setae acuminate. Head smooth. Pattern distinct.

3 (12). Thoracic shield broad, highly contiguous to setae III and IIIa, or seta III even set at edge of shield (Figure 36, *2, 3*).

4 (11). Setae III on prothorax set close to thoracic shield but significantly ventral to longitudinal line of disposition of setae IX (Figure 36, *3*).

5 (8). Anal shield rugulose, with crenate projections (Figure 84, *3*).

6 (7). Body fusiform. Segments 9 and 10 not darker than other body segments. Ungual base of thoracic legs with fairly broad projection (Figure 22, *2*). Larvae in stalks of rye and other cereals. ..... 18. **Mesapamea.**

7 (6). Body not fusiform. Segments 9 and 10 darker than other body segments. Ungual base of thoracic legs without projection (Figure 22, *3*). Larvae on herbaceous plants..... ..... 19. **Luperina.**

8 (5). Anal shield not rugulose, crenate projections absent.

9 (10). Body dull yellow with violet tinge. Dorsal and subdorsal bands on trunk grayish-white, broad, even. Larvae in stalks and roots of cereal plants..... 20. **Amphipoea.**

10 (9). Body light yellow, with admixture of red. Dorsal band on trunk narrow, subdorsal not visible. Larvae in stalks of potatoes, hops, cereals, and other plants..... 21. **Hydraecia.**

11 (4). Seta III on prothorax set at edge of thoracic shield and aligned with seta IX (Figure 36, *2*). Dorsal and subdorsal bands light-colored, fairly broad, and extend onto thoracic shield, or body monochromatic, with pink or gray pigment; in latter case, dorsal band visible only on thoracic shield, with subdorsal band altogether absent. Larvae in stalks or on roots of cereals or feed on their seeds..... 17. **Apamea.**

12 (3). Thoracic shield not broad; setae III and IIIa set slightly away from it (Figure 36, *1*).

13 (16). Small oblong dark-colored spot occurs on thoracic shield between setae II and IX (Figure 84, *1, 2*). Stigmata dark-colored. Mandibles without inner tooth.

14 (15). Hooks of abdominal legs indistinctly biordinal (Figure 24, *3*); if uniordinal, dark-colored cuneiform spots seen on segment 8. Stigmata on segment 8 larger than on segment 7 by 1.5 times. ..... 13. **Caradrina.**

15 (14). Hooks of abdominal legs uniordinal. Dark-colored cuneiform spots absent on segment 8. Stigmata on segment 8 larger than on segment 7 by 2.5 times. ..... 14. **Hoplodrina.**

16 (13). Dark-colored spot absent on thoracic shield between setae II and IX. Stigmata light- or dark-colored. Mandible with or without inner tooth.

17 (34). Dorsal band consists of chain of minute light-colored dots.

18 (21). Pattern on head of first type (Figure 48, *2*).

19 (20). Dorsal and subdorsal bands continuous and narrow on thoracic shield. Herringbone pattern absent on dorsal field. Stigmata

dark-colored. Spinneret 6.0 times longer than first segment of labial palpus. Mandibles without inner tooth... 16. **Rusina.**

20 (19). Subdorsal band on thoracic shield in form of large white dot in anterior part. Herringbone pattern absent on dorsal field. Stigmata light-colored. Spinneret 1.5 times longer than first segment of labial palpus. Mandibles with two inner teeth..... ..... 4. **Hyppa.**

21 (18). Pattern on head of second type (Figure 49, *5*).

22 (25). Dots forming chain in dorsal band minute and indistinguishable from those scattered on dorsal field.

23 (24). Light-colored spots distinctly visible at base of setae I, II, and X on abdominal segments. Setae set on light-colored spots on thoracic shield. Stigmata reddish-yellow. Mandibles with one or two inner teeth..... 1. **Blepharita.**

24 (23). Spots at base of setae on trunk minute, barely visible. Setae without spots at base on thoracic shield. Stigmata black. Mandibles without inner tooth..... 11. **Conistra.**

25 (22). Dots forming chainlet in dorsal band larger than those scattered on dorsal field.

26 (27). Large yellow spot occurs on segment 8 above stigmata (Figure 83, *4*). Body brownish-green. Stigmata white. Mandibles with inner tooth. Larvae on herbaceous plants, primarily buckwheat. ..... 5. **Trachea.**

27 (26). Large light-colored spot absent on segment 8.

28 (31). Dorsal band on thoracic shield narrow, subdorsal band significantly broader.

29 (30). Thoracic shield black, velvety. Body reddish-brown, with violet tinge and characteristic pattern (Figure 83, *3*). Stigmata light-colored. Mandibles with inner tooth..... ..... 8. **Lithophane** (in part).

30 (29). Thoraic shield brownish. Dorsal band fringed mainly along margins of segments, or large shaded rhombic or arrow-shaped spots on dorsal field. Stigmata dark-colored. Mandibles without inner tooth. Larvae on deciduous trees and herbaceous plants. ..... 12. **Cirrhia.**

31 (28). Dorsal and subdorsal bands on thoracic shield narrow, identical, or totally absent.

32 (33). Thoracic shield brown, dorsal bands distinct on it. Body yellowish-brown, dorsal band with shaded dark borders (Figure 83, *8*). Light-colored spots at base of setae I, II, and III with semicircle of black pigment.

33 (32). Thoracic shield green, dorsal bands not seen on it. Body green, dorsal field with faint herringbone pattern. Light-colored spots at base of setae without semicircle of dark pigment. Substigmal band at center green, pale yellow along margins. Extreme dorsal tooth of mandibles divided (Figure 15, IV)..... .....6. **Euplexia.**

34 (17). Dorsal band continuous, not interrupted.

35 (38). Setae on trunk set on pinacula. Body light green. Dorsal band without borders.

36 (37). Setae set on black pinacula. Dorsal bands yellowish. Head green, without pattern. Larvae on deciduous trees..... 9. **Cosmia.**

37 (36). Setae set on white pinacula. Dorsal bands white. Head green, with white pattern of first type (Figure 48, *2*)..... ..... 8. **Lithophane** (in part).

38 (35). Setae on dark- or light-colored spots. Body dark green or with admixture of brown. Dorsal band with dark-colored borders.

39 (40). Setae on minute black spots. First main tooth of mandibles reduced. Dorsal band on thoracic shield broad, on trunk narrow, with [distinct] borders in anterior part of segment (Figure 83, *1*). Larvae on roots of cereals..... 7. **Thalpophila.**

40 (39). Setae on light-colored spots. All main teeth of mandibles normal.

41 (42). Light-colored spots at base of setae I, II, and X large, round. Dorsal and subdorsal bands broad, yellow; dorsal field dark green, velvety. Larvae large (up to 65 mm)..... 3. **Xylena.**

42 (41). Light-colored spots at base of setae small. Dorsal bands narrow, bluish-white; dorsal field not velvety. Thoracic shield black, with bluish tinge. Substigmal band white, uneven, broad only between segments I–II and II–III. Body dark brown..... ..... 10. **Eupsilia.**

1. Genus *Blepharita* Hmps.

Spinneret 2.5 to 3.0 times longer than first segment of labial palpus; spinneret opening even, without fringes, dents, or convolutions. First seta of labial palpus equal to second segment or slightly longer; second seta almost equal to first segment. Mandibles with one or two inner teeth. Setigerous tubercles IIIa and V on prothorax, IIIa on meso- and metathorax, and III on segment 9 dark-colored, large (Figure 28). Hooks of abdominal legs uniordinal.

Key to Species

1 (2). Mandibles with single large inner tooth. Setigerous tubercles IIIa and V on prothorax, IIIa on meso- and metathorax, and III on

segment 9 black and much larger than for other setae.....
..... 2. **B. adusta** Esp.

2 (1). Mandibles with two inner teeth. Setigerous tubercles IIIa and V on prothorax, IIIa on meso- and metathorax, and III on segment 9 not larger than on other setae..... 1. **B. satura** Schiff.

1. **Blepharita satura** Schiff. (porphyritic owlet moth)

Mature larva: Spinneret almost 3.0 times longer than first segment of labial palpus. First seta of palpus slightly longer than second segment, second seta shorter than first segment. Mandibles with two inner teeth. Distances between setae P_1–Frl_2 and P_1–P_2 equal. Setigerous tubercles IIIa and V on segment I, IIIa on segments II and III, and III on segment 9 not larger than on other setae. Hooks of abdominal legs: 20–22, 22–24, 26–28, 29–30, and 34–36.

Body yellowish-gray, with admixture of red and brown. Head dull yellow or yellowish-gray, with faint but much darker pattern of second type (Figure 49, *5*). Setae rusty-brown, acuminate, set on white spots; spot at base of seta X smaller. Shields yellowish-brown, thoracic with narrow light-colored dorsal band; bands not visible on anal shield. Stigmata reddish-yellow, broad, with black margin. Thoracic legs grayish-yellow, abdominal legs yellowish-green. Pattern: dorsal band consists of very minute white dots indistinguishable from those scattered along dorsal field; band fringed with fine brown striae, which are denser in anterior part of segment. Subdorsal consists of minute dots and prominent only on thoracic segments; on abdominal segments seen only along brownish borders, which mask band almost completely. Substigmal band indistinguishable from dark gray basal field, along which yellowish dots and brownish striae are scattered. Ventral side yellowish-green. Body length 22 to 47 mm and width of head 3.20 to 3.30 mm.

In Belorussia larval development in May and June. Food plants: honeysuckle, whortleberry, heath, dandelion, *Galium,* linden, black thorn, raspberry, dewberry, and others.

According to Döring (1955), eggs straw-yellow with light brownish girdle and spot at apex. Diameter 0.80 to 0.85 mm and height 0.55 to 0.60 mm. Ribs 28 to 32, of which 13 to 16 reach micropylar zone. Micropylar rosette consists of 16 lobes.

2. **Blepharita adusta** Esp. (singed field owlet moth)

Mature larva: Spinneret 2.5 times longer than first segment of labial palpus. First seta of palpus equal to second segment, second seta longer than first segment. Mandibles with single large inner tooth. Distance between setae P_1–Frl_2 less than between P_1–P_2. Setigerous tubercles IIIa and V on segment I, IIIa on segments II and III, and III on segment 9

black, larger than for other setae (Figure 28). Hooks of abdominal legs: 19–21, 23–25, 24–27, 26–29, and 32–35.

Body green, grayish-green, or brownish-red. Head hazy green or brownish, with grayish-brown pattern of second type (Figure 49, *5*). In specimens with green head, pattern sometimes barely visible. Setae rust-colored, short, acuminate, set on light-colored spots; spot at base of seta X much smaller. Shields light brown, highly sclerotized; setae set on them on white spots. Dorsal band on thoracic shield narrow, continuous; subdorsal band faint. Stigmata reddish-yellow, broad, with black edge. Thoracic legs grayish-yellow; abdominal legs green, with reddish-brown hooks. Pattern: dorsal band consists of white dots that do not differ in size and color from dots scattered on dorsal field. In green specimens band fringed with striae of yellowish-brown pigment and in dark-colored specimens with dark brown pigment. Borders not broad, fairly even, somewhat enlarged and dark along margins of segments (Figure 83, *7*). Subdorsal band also consists of white dots. Borders of band insignificant. Subdorsal field, like dorsal, covered with white dots. Ventral edge of subdorsal field uneven since stigmata surrounded by yellowish-pink pigment. Substigmal band, like ventral side, green with yellowish dots. In green specimens boundary between subdorsal field and substigmal band almost absent. Body length 31 to 46 mm and width of head 3.20 to 3.30 mm.

Development: I-instar. Body of just hatched larva colorless, with reddish intestine. Head light yellow, with minute dark-colored spots around setae. Shields colorless, thoracic surrounded by faint dark-colored pigment. Pinacula on trunk and shields colorless, turning brown after 2.0 hrs. Setae dark-colored and slightly pointed. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Skin finely grained. Stigmata round, light-colored, with black edge. Feeding larva yellowish, but green in zone of filled intestine. Body length of just hatched larva 2.10 to 2.20 mm, before molt 4.50 mm, and width of head 0.325 to 0.327 mm.

II-instar. Body color same as in the I-instar. Head yellowish-green. Shields yellowish-green, with minute brown pinacula and light-colored dorsal bands. Pinacula on trunk small, green; brown spots at base of setae. Setae brown, weakly pointed. Legs light-colored. Pattern: dorsal and subdorsal bands whitish, narrow, interrupted at places. Substigmal band white, not broad. Body length 4.5 to 9.0 mm and width of head 0.55 to 0.57 mm.

III-instar. Body slender, green. Head yellowish-green. Setae brown, slightly pointed, set on minute brown spots surrounded by light green pigment. Shields green; spots absent at base of setae. Thoracic legs light-colored; abdominal legs green and two anterior pairs underdeveloped. Pattern: dorsal and subdorsal bands consist of minute white dots. Substigmal

band not broad, white, and extends onto anal leg. In some specimens dark green pigment accumulates in lower part of subdorsal field. Body length 9.0 to 15.0 mm and width of head 0.84 to 0.90 mm.

IV-instar. Body green, even. Head yellowish-green. Setae brown, slightly pointed, set on minute round white spots, including also seta X. Shields green; on thoracic shields setae I and II set on white spots, IX and X on general background. Stigmata white, slightly oval, with black edge. Legs light green; all five abdominal pairs developed. Pattern same as in the III-instar. White dots scattered throughout body. Body length 15 to 22 mm and width of head 1.36 to 1.38 mm.

V-instar. Body green, reddish-yellow, with lilac or flesh-colored tinge. Head green, with faint yellowish-red pattern of second type (Figure 49, *5*). Setae rust-colored, set on minute white spots, including seta X, on trunk as well as thoracic shield. Stigmata light green or pink, broad, oval, with black edge surrounded by light-colored girdle. Thoracic legs light-colored; abdominal legs green, with reddish hooks. Pattern as in the VI-instar except that substigmal band fairly distinct, white, uneven. Stigmata of segments 3 to 6 disposed on band, which enlarges around them, encompassing stigmata from all sides. In dark-colored specimens ventral side green and differs sharply from dorsal side. Body length 21 to 31 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development from July through September and, after hibernation, until May. Food plants: whortleberry, raspberry, *Galium,* golden rod, sheep's sorrel, burdock, dead nettle, dandelion, and tansy.

Eggs laid singly, yellow, 0.70 to 0.71 mm in diameter, and 0.52 to 0.54 mm in height. Ribs 42 to 44, of which 18 to 20 reach micropylar zone. Micropylar rosette consists of 15 or 16 lobes. Color of eggs lightens within 24 hrs and pinkish-yellow spot at apex and girdle at equator visible, which gradually turn brownish. Before larva hatches egg dark gray.

2. Genus *Dypterygia* Steph.
(one species in Belorussian fauna)

Dypterygia scabriuscula L. (herbaceous brown owlet moth)

Mature larva: Postgenal sclerites not fused (*Pi* = 1/8, 1/10). Spinneret considerably pinched toward end, 2.0 times longer than first segment of labial palpus. First segment of palpus long, slender, 3.0 or 4.0 times longer than wide. Second seta of palpus slightly shorter than first segment and 3.5 times longer than first seta. Distance between setae Frl_1–Frl_2 somewhat greater than between Frl_1–F_1. Seta P_1 slightly shifted posterior to line of Frl_2–Frl_2. Mandibles with developed teeth and inner tooth visible. Setae IIIa and V on segment I, IIIa on II and III, and III

on segment 9 set on dark-colored spots. Hooks of abdominal legs: 25–27, 28–30, 32–34, 34–36, and 37–39.

Body yellowish-brown, abdominal side brownish-green. Head muddy yellow, with brown pattern of second type (Figure 49, *5*). Shields brown, with narrow, muddy yellow dorsal and subdorsal bands and small muddy yellow spots around setae. Setae brownish, slender, acuminate; setae I, II, and III set on minute muddy yellow spots, surrounded from dorsal side by semicircle of dark-colored pigment; spots absent at base of rest of setae. Stigmata oval, reddish-yellow, with thin black edge. Thoracic legs brown, with dark-colored ringlets; abdominal legs with large brown spot on outer side. Pattern: dorsal and subdorsal bands consist of muddy yellow dots. Dorsal field covered with muddy yellow dots and brown striae. Striae denser around bands, forming diffuse borders; striae not adjacent to bands lighter in color. Borders of subdorsal band around seta II interrupted and in some specimens upper border displaced dorsally, forming short branches of herringbone pattern. On subdorsal field striae darker and denser. Among them and between scattered muddy yellow dots chain of very large dots of suprastigmal band intrude distinctly; dark striae grouped more densely around this band. Lower margin of subdorsal field light brown. Substigmal band yellow, with even borders, along which lie scattered muddy yellow dots fringed with brownish-red-yellowish pigment. Upper border of band yellow Basal field greenish-brown, darker than ventral side. Body length 30 to 45 mm and width of head 3.0 to 3.2 mm.

Development: I-instar. Body of just hatched larva yellowish, even, very slender compared to head (width of body 0.18 mm and head 0.38 mm). Larvae highly mobile. Shields, pinacula, and legs light-colored. Thoracic and abdominal legs wide-set; two anterior pairs of abdominal legs underdeveloped. Skin coarsely grained. Feeding larva yellowish, with translucent green intestine and black pinacula. After two or three days reddish-brown striae seen along setae II–II and III–III. Body length of just hatched larva 2.3 mm, before molt 5.0 mm, and width of head 0.38 mm.

II-instar. Body yellowish, with translucent green intestine. Head yellowish, with light brown pattern of first type (Figure 48, *2*). Shields same color as head. Pinacula dark brown. Legs light-colored. Pattern: dorsal and subdorsal bands not broad, even, with narrow light brown borders. Substigmal band somewhat broader than dorsal, whitish. Body length varies from 5.0 to 8.5 mm and width of head 0.60 to 0.65 mm.

III-instar. Body light-colored, reddish-brown. Head light yellow, with faint pattern of first type. Setae light brown, setaceous, set on minute brown pinacula, and surrounded by whitish pigment. Shields not prominent; minute white spots around setae. Skin finely grained. Stigmata round,

light-colored, with thin black edge. Legs reddish-yellow; five abdominal pairs developed. Pattern: dorsal band whitish, continuous, fairly broad, fringed with brownish-yellow pigment. Subdorsal band narrow, with very broad reddish-brown borders. Suprastigmal band narrow, interrupted, almost without [distinct] borders. Substigmal band broad, bright yellow. Lower margin of subdorsal field and basal field brownish. Body length 9.0 to 15.0 mm and width of head 0.87 to 0.89 mm.

IV-instar. Body rusty-brownish. Head pinkish, with rusty-brownish pattern of second type. Pinacula absent; setae set on fairly large white spots. Shields brownish, with narrow light-colored dorsal bands and large light-colored spots around setae. Stigmata light-colored, oval with thin brownish edge. Legs greenish-rust. Pattern: dorsal and subdorsal bands in form of chain of light yellow dots. Only traces of suprastigmal band seen. Lower margin of subdorsal field brown. Substigmal band broad, bright yellow. Body length 14 to 21 mm and width of head 1.20 to 1.30 mm.

V-instar. Larvae almost indistinguishable from the VI-instar. All setae set on light-colored, very large spots compared to the VI-instar. Body length 20 to 30 mm and width of head 2.0 to 2.2 mm.

In Belorussia larval development from July through September. Food plants: orache, dandelion, and buckwheat.

Female scatters eggs without attaching them to plants or soil. Eggs pale pink, almost spherical, 0.65 to 0.67 mm in diameter, and 0.50 to 0.55 mm in height. Ribs very sharp, 23 to 25 at equator, of which 12 to 14 reach micropylar zone. Micropylar rosette consists of 14 or 15 lobes.

3. Genus *Xylena* Ochs.
(one species examined)

Xylena vestusta Hbn.

Mature larva: Spinneret 2.0 times longer than first segment of labial palpus. First seta of palpus equal to second segment, second seta half length of first segment. Mandible with inner tooth. Distance between setae II–III on anal shield 1.5 times greater than between II–II. Distance between setae I–I and II–II on segment 8 equal. Metathoracic coxae contiguous. Skin smooth. Hooks of abdominal legs: 21–23, 23–25, 25–27, 26–28, and 29–32.

Larva cylindrical, almost even, somewhat broadened at center. Body color gangrenous green, dark green, or blackish-green. Head brownish-red, with faint pattern of first type (Figure 48, *1*); frons brown in lower half. Setae rusty-brown, short (0.89 mm), acuminate. Setae I, II, and X set on large, round, white spots; all other setae set on minute round, whitish spots. Shields hazy green. Narrow dorsal band and subdorsal band on shields same width as on body and distinct. Only seta X on thoracic shield

set on light-colored spot. Stigmata yellowish-red, fairly broad, with narrow black edge. Thoracic legs reddish, anal legs green. Pattern: dorsal band yellow, fairly broad, narrow on thoracic segments. Subdorsal band slightly narrower than dorsal, white, and yellow at end of instar. Dorsal field dark green or almost black, velvety. Color of subdorsal field gangrenous green. Stigmal band dark green or black; at margins of segments narrow, enlarging gradually toward stigmata, and encompassing them from above and sides. Lower border of band even. Substigmal band not broad, white in lower part, and yellow in upper. Ventral side light green. Toward end of instar gangrenous-green pigment accumulates on basal field. Body length 47 to 65 mm and width of head 4.8 to 5.0 mm.

Development: I-instar. Body of just hatched larva yellowish-gray. Head yellow with grayish-brown pattern of first type (Figure 48, *1*). Pinacula small (0.03 mm) gray. Legs gray; abdominal legs on segments 3 and 4 underdeveloped. Skin coarsely grained. Feeding larva yellowish-green, with black pinacula. Length of just hatched larva 2.20 to 2.30 mm, before molt 5.40 to 5.45 mm, and width of head 0.42 to 0.43 mm.

II-instar. Body well proportioned, dark green, velvety. Head pinkish-yellow, with rusty-brown pattern of first type. Setae black, strong, set on minute black pinacula, surrounded by ring of yellowish-green pigment. Thoracic shield same color as head. Stigmata round, light-colored. Thoracic legs yellowish; abdominal legs light-colored and two anterior pairs underdeveloped. Pattern: dorsal and subdorsal bands light-colored, yellowish-green, uneven. Substigmal band white, broad. Body length 6.0 to 10.0 mm and width of head 0.70 to 0.88 mm.

III-instar. Color and pattern same as in the I-instar. Stigmata somewhat oval. On second or third day sparse white dots seen on back and, toward end of instar also on abdominal side. Skin finely grained. Body length 11 to 18 mm and width of head 1.10 to 1.20 mm.

IV-instar. Body well proportioned, dark green or blackish-green. Head pinkish-green, with brownish pattern of first type. Setae black, acuminate, set on large, round, white spots; spots absent at base of setae on shields. Shields green, lighter in color than general background color of body, slightly bordered by brownish pigment. Stigmata oval, light-colored, with black edge. Thoracic legs yellowish; abdominal legs green and all five pairs developed. Pattern: dorsal and subdorsal bands yellowish-green, light-colored; dorsal band somewhat broader than subdorsal. Dorsal field and lower part of subdorsal field dark green or blackish-green. Substigmal band quite narrow, white in anterior part of body, transiting gradually thereafter into orange. Abdominal side light green. Body length 17 to 29 mm and width of head 1.78 to 1.90 mm.

V-instar. Dorsal side of body dark green or blackish-green, ventral side light green. Head yellowish-green, with light brownish pattern of first type (Figure 48, *1*). Pattern on body same as in the VI-instar except stigmal band not seen because entire ventral half of subdorsal field dark, brownish-green. Body length 30 to 46 mm and width of head 3.0 to 3.1 mm.

In Belorussia larval development from mid-June to late July. Food plants: *Galium,* delphinium, bistort, iris, willow herb, beet, maple, linden, and poplar.

Eggs laid in clusters, in one or two layers of regular compact rows. They are milk-white, 0.74 to 0.77 mm in diameter, and 0.55 to 0.56 mm in height. Ribs 40 to 46, of which 28 to 30 reach micropylar zone. Micropylar rosette consists of 13 or 14 lobes, with single rim. Eggs gradually turn yellow, then brownish-yellow before larvae hatch.

4. Genus *Hyppa* Dup.
(one species in genus)

Hyppa rectilinea Esp. (rectilinear owlet moth)

Mature larva: Postgenal sclerites almost fused (*Pi* = 1/10). Spinneret slightly pinched toward end, 1.5 times longer than first segment of labial palpus. Second seta of palpus 3.0 times longer than first. Dorsal teeth of mandibles reduced; two inner teeth visible. Seta P_1 on same line as setae Frl_2–Frl_2. Distance between Frl_2–P_1 less than between P_1–P_2. On prothorax distance between setae II—III greater than between III–IX by 1.5 times. On anal shield distance between II–III greater than between II–II by 2.0 times. Metathoracic coxae contiguous. Hooks of abdominal legs uniordinal: 20–20, 20–21, 23–24, 24–25, and 24–26.

Larvae yellowish-brown, light brown, or dark brown. Head reddish-brown, with very dark pattern of first type (Figure 48, *2*). Shields not prominent; throacic shield with narrow dorsal band, subdorsal in form of dots, with dots in anterior part very large. Setae light brown, highly acuminate. All except III set on white spots; III set on small black spot. On segment III setae Xa and Xb set on large round spot, and on segment II on somewhat smaller spot (Figure 83, *5*). Stigmata oval, hazy yellow, with black edge. Legs yellowish-red. Pattern: dorsal band in form of chain of white dots, larger on abdominal segments along margins; band narrow and continuous on segment I, and almost totally marked with dark-colored borders on II and III; on abdominal segments borders dark brown, extremely dark and broad along margins of segments. Subdorsal band also consists of white dots and fringed with brown pigment. Upper border in anterior part of segment darker and broad; around seta II shifted upward and backward and adjoins border of dorsal band to form herringbone pattern. In dark-colored specimens herringbone pattern faint. In light-

colored specimens dorsal field lighter in color than subdorsal; two fields almost similar in dark-colored specimens; lower margin of subdorsal field invariably darker. Substigmal band on segments I and 8 to 10 white and brownish-red or brownish-yellow on other segments. Ventral side light or dark brown. Body length 27 to 42 mm and width of head 3.10 to 3.20 mm.

Development: I-instar. Body of just hatched larva colorless, translucent with visible yellowish-red intestine, reddish-brown head, light brown thoracic shield, colorless pinacula, black, slightly pointed setae, and light-colored legs. Abdominal legs on segments 3 and 4 underdeveloped. Skin smooth. Feeding larva yellowish-pink; region of filled intestine green, with black pinacula, dark brown shields, and black thoracic legs. Mid-instar yellowish-red pigment begins to accumulate in lower part of subdorsal field and along sides of dorsal field. Body length of just hatched larva 1.9 to 2.0 mm, before molt 4.5 to 4.7 mm, and width of head 0.39 mm.

II-instar. Body dull green, with admixture of red; all segments very prominent and segment 8 slightly dilated. Head brownish-yellowish-red. Pinacula small and brown. Shields not prominent; light-colored dorsal bands extend along them. Stigmata light-colored; round, with brown edge. Pattern: dorsal and subdorsal bands white, uneven, often interrupted. Lower part of subdorsal field brownish-red. Substigmal band white, continuous only on thoracic segments and segments 8 and 9; on other segments white only at margins. Ventral side hazy green with reddish shade. Body length 4.5 to 8.0 mm and width of head 0.60 to 0.63 mm.

III-instar. Body green, with dark brown or reddish-brown pattern. Head dull green, with brownish-green pattern of first type (Figure 48, *2*). Setae rust-colored, slightly pointed, set on minute white spots. Dorsal and subdorsal bands on thoracic shield significantly larger in anterior part. Stigmata light-colored, on segments I and 8 somewhat oval. Legs light-colored; all five pairs of abdominal legs developed. Pattern: dorsal and subdorsal bands in form of chain of white dots, fused at many places. Dorsal band at margins of segments fringed with dark green or brown pigment; subdorsal fringed with brown pigment in anterior part of abdominal segments. Border later shifted upward and back and merges with borders of dorsal band to form branches of herringbone pattern. At commencement of instar this pattern brown, turning brownish-red at end. Dorsal field greenish-white, turning reddish-yellow at end of instar. Subdorsal field brown, turning brownish-red at end of instar. Substigmal band light yellow, broad, extends onto anal leg. On thoracic and abdominal segments 7 to 9, continuous and visible as white pigment above and below, but brownish-red or yellowish-red at center. Ventral side green or brownish. Body length 7.0 to 12.0 mm and width of head 0.964 to 1.0 mm.

IV-instar. Body yellowish-brown, with reddish-brown pattern. Head reddish-yellow, with brown pattern of first type (Figure 48, *2*). Setae I, II, Xa and b set on round white spots. Largest spots around setae Xa and b on metathorax. Abdominal legs with reddish plantae. Pattern corresponds totally to the III-instar. Body length 12 to 19 mm and width of head 1.398 to 1.410 mm.

V-instar. Body yellowish-brown. Head reddish-yellow, with brownish pattern of first type. Dorsal and subdorsal bands in anterior part of thoracic shield highly enlarged. In rest of characters larva does not differ from the VI-instar. Body length 18 to 29 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development from July to autumn. Larvae of last instar hibernate. Food plants: whortleberry, columbine, mountain cranberry, raspberry, dewberry, mountain ash, and willow.

Eggs laid in clusters of 8 to 250 each, in single layer. They are yellow, 0.737 to 0.780 mm in diameter, and 0.60 to 0.64 mm in height. Ribs 34 to 36, of which 9 or 10 reach micropylar zone. Micropylar rosette consists of 14 to 16 lobes.

5. Genus *Trachea* Ochs.

(one species in Belorussian fauna)

Trachea atriplicis L. (buckwheat owlet moth)

Mature larva: Spinneret 2.5 times longer than first segment of labial palpus. Second seta of palpus 4.0 times longer than first. Seta P_1 shifted caudal to line of setae Frl_2–Frl_2. Distance between setae Frl_2–P_1 greater than between P_1–P_2 by 1.5 times. Postgenal sclerites not contiguous. Teeth of mandibles developed, inner tooth present. On prothorax distance between setae II–III almost 1.5 times greater than distance between setae III–IX. Metathoracic coxae contiguous. Large yellow spot occurs above stigmata on segment 8 (Figure 83, *4*). Hooks of abdominal legs: 21–22, 23–24, 26–27, 27–28, and 29–30.

Body brownish-green, with slightly dilated segment 8. Head yellow, with reddish-brown pattern of second type (Figure 49, *5*). Shields brownish-green, with very narrow, slightly prominent dorsal band and 2 or 3 prominent dots of subdorsal band. Setae rust-colored, acuminate, short (0.65 mm). Setae I and II on white spots, with black spots located dorsal to them. All other setae set on white dots, similar to those scattered throughout body. Stigmata whitish, oval, with black edge. Thoracic legs yellowish, abdominal legs green. Pattern: dorsal and subdorsal bands consist of white or yellowish dots fringed with dark-colored, almost black pigment; large dots surrounded by dark-colored pigment, minute ones almost masked by it, creating impression that band is dark-colored; five

or six large light-colored dots present on band on each segment. Subdorsal band similar, only its borders less dark in color. Dorsal field dark green, with dense minute white dots. Subdorsal field somewhat darker and dots smaller. On segment 8 dots of subdorsal band shifted dorsally and under them, above stigmata, occurs large yellow spot—a characteristic feature of this species. Substigmal band broad, yellowish, with violet tinge, and dense yellow dots. Ventral side green, with white or yellowish dots. Body length 28 to 44 mm and width of head 3.70 to 3.80 mm.

Development: I-instar. Body of just hatched larva colorless, translucent with visible yellowish-pink intestine, and extremely slender compared to head. Head yellow, with very dark but faintly visible pattern of first type. Thoracic shield yellowish. Pinacula colorless, in form of light-colored tubercles that turn brown after 1.5 to 2.0 hrs. Setae long (0.13 mm), slightly pointed. Legs light-colored, widely set; abdominal legs on segments 3 and 4 underdeveloped. Skin finely grained. Feeding larva yellowish, with translucent green intestine. Body length of just hatched larva 1.70 to 1.80 mm, before molt 4.50 mm, and width of head 0.377 mm.

II-instar. Larva differs from the I-instar in setae rather acuminate and pattern present on body: dorsal and subdorsal bands in form of chain of white dots, substigmal band broad, white. Body length 4.0 to 7.0 mm and width of head 0.56 to 0.58 mm.

III-instar. Body green. Head yellow. Shields yellowish; dorsal and subdorsal bands seen as white dots on thoracic shield. Setae light brown, acuminate, set on minute brown spots, surrounded by light green pigment. Stigmata of segments I and 8 somewhat oval, rest round, greenish, with thin black edge. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands in form of chain of minute white dots. Sparse dull white dots scattered on green dorsal and subdorsal fields. Substigmal band white. Ventral side light green. Body length 7.0 to 12.0 mm and width of head 0.91 to 0.93 mm.

IV-instar. Color of body, head, and shields same as in the III-instar. Stigmata whitish, oval, with thin black edge. Setae set on minute white spots, with small dark brown spot located dorsal to them. Legs light-colored and all five abdominal pairs developed. Pattern: dorsal and subdorsal bands in form of chain of large and small dots surrounded by green pigment that is darker than body background. Dense white dots on dorsal and subdorsal fields, fewer dots on light green ventral side. On segment 8 subdorsal field with fairly large yellow spot above stigmata. Substigmal band white, broad. Body length 12 to 20 mm and width of head 1.60 to 1.70 mm.

V-instar. Larva differs from the VI-instar in very light green body background. Borders of dorsal and subdorsal bands not so dark. Dots

of bands and dots scattered on body white, not yellowish. Body length 19 to 28 mm and width of head 2.50 to 2.65 mm.

In Belorussia larval development in June and July and August and September. Two generations. Feed on plants of buckwheat family and often damage buckwheat crops. Younger instars feed mainly on various species of knotweed. From the data available in literature larvae also feed on nettles, dead nettle, bindweed, and orache.

Female scatters eggs without attaching them to leaves. Eggs light yellow, 0.61 to 0.63 mm in diameter, and 0.50 to 0.55 mm in height. Ribs 30 to 32, of which 14 to 15 reach micropylar zone; latter bulges somewhat. Micropylar rosette consists of 10 to 12 lobes. Eggs gradually darken and before emergence of larva turn ash-gray with violet tinge.

6. Genus *Euplexia* Steph.

(one species in Belorussian fauna)

Euplexia lucipara L. (raspberry owlet moth)

Mature larva: Postgenal sclerites not contiguous (*Pi* = 1/6). Spinneret 2.0 times longer than first segment of labial palpus. Second seta of palpus 4.0 times longer than first. Dorsal teeth of mandibles divided (Figure 15, *4*); inner tooth present. Seta P_1 disposed on same line as setae Frl_2–Frl_2. Distance between setae Frl_2–P_1 greater than between P_1–P_2. Metathoracic coxae contiguous. On anal shield distances between setae III–III and II–III equal. Seta II on segment 8 set on large white pinaculum. Hooks of abdominal legs: 17–18, 17–18, 19–22, 21–24, and 24–26.

Body green, sometimes with admixture of yellow; segment 8 slightly dilated. Head green, with very dark pattern of second type (Figure 49, *5*). Shields green; dorsal bands and spots at base of setae absent. Setae light brown; slender, acuminate, set on minute white spots on trunk. Largest spot, slightly raised in form of pinaculum, seen around seta II on segment 8. Stigmata white, oval, with thin black edge. Thoracic legs light-colored, abdominal legs green. Pattern: dorsal and subdorsal bands consist of minute yellowish dots, well separated on thoracic segments, but on abdominal segments only in posterior part. Dots of band fringed with dark green pigment. Whitish dots very dense on dorsal field. Dots dorsal to seta II and between II and I vividly fringed with dark green pigment, as a result of which herringbone pattern formed. Pattern more distinctly seen in yellow-colored specimens since dots in them fringed with brownish-green pigment. Subdorsal field lighter in color than dorsal. Substigmal band broad, green at center, and yellowish-white along margins. Ventral side green, with white dots. Body length 25 to 38 mm and width of head 2.80 to 2.90 mm.

Development: I-instar. Body of just hatched larva grayish, with very similar pinacula and light brown thoracic shield. After 25 to 30 min pinacula turn black. Head black. Thoracic legs dark-colored; abdominal legs light-colored and underdeveloped on segments 3 and 4. Feeding larva yellowish, in region of filled intestine green, with black pinacula and long (0.165 mm) setae. Body length of just hatched larva 1.70 mm, before molt 3.50 to 3.80 mm, and width of head 0.34 mm.

II-instar. Body color same as in the I-instar. Head yellow, with very dark pattern of first type and black minute spots around setae. Shields yellowish. Setae reddish-brown, short (0.137 mm), set on black pinacula (0.04 mm). Stigmata round, light-colored, with black edge. Legs light-colored. Pattern: dorsal and subdorsal bands consist of white dots that are denser around margins of segments. Substigmal band whitish, not broad. Sometimes in lower part of subdorsal field an accumulation of dark green pigment visible. Body length 3.5 to 6.0 mm and width of head 0.53 to 0.57 mm.

III-instar. Body green, with slightly enlarged segment 8. Head yellow, with black dots around setae and faint pattern of first type. Setae rusty-brown. Pinacula minute, black, surrounded by ring of white pigment. Shields not prominent; setae set on black spots. Pattern: dorsal and subdorsal bands in form of row of white dots, fused at many places. Dorsal field green, subdorsal field dark green or brown along ventral margin. Sometimes subdorsal band fringed with brownish pigment. Substigmal band white, not broad. Ventral side green. Body length 6.0 to 10.0 mm and width of head 0.78 to 0.83 mm.

IV-instar. Body color and pattern same. Stigmata light-colored, oval, with black edge. All five pairs of abdominal legs developed. Body length 11 to 17 mm and width of head 1.23 to 1.33 mm.

V-instar. Larvae totally correspond to the VI-instar in color, spots around setae, and often in pattern. Pattern on head not invariably of second type. In some specimens faint pattern of first type visible, in other specimens pattern totally absent. Herringbone pattern on dorsal field differs somewhat. Herringbone branches extend from upper border of subdorsal band, which is shifted dorsally and joins with border of dorsal band around posterior margins of segments. Body length 18 to 26 mm and width of head 1.82 to 1.83 mm.

In Belorussia larval development in June and July, and August and September. Two generations. Food plants: raspberry, dewberry, lupine, dead nettle, willow herb, ragweed, golden rod, lady's mantle, dandelion, and hops.

Eggs laid singly, pale yellow, 0.62 to 0.70 mm in diameter, and 0.58 to 0.59 mm in height. Ribs 24 to 26, of which 16 to 20 reach micropylar

zone. Micropylar rosette consists of 11 or 12 lobes. Within 24 hrs broad brownish-pink girdle at equator and spot on apex visible, which gradually darken and become almost black, while rest of chorion turns ashen. At end of embryonal growth chorion ash-gray, with body of larva translucent.

7. Genus *Thalpophila* Hbn.
(one species in Belorussian fauna)

Thalpophila matura Hufn. (mature owlet moth)

Mature larva: Postgenal sclerites almost contiguous (*Pi* = 1/10). Spinneret 2.5 times longer than first segment of labial palpus. Second seta of palpus 2.5 times longer than first seta. Seta P_1 on same line as Frl_2–Frl_2. Distance between setae Frl_2–P_1 less than between P_1–P_2. On thoracic shield distance between setae II–III, 1.5 times more than between III–IX. On anal shield distances between setae II–II and II–III almost equal. First main tooth of mandibles reduced, inner tooth present; seta M_1 slightly dorsal to seta M_2. Skin smooth. Abdominal legs short; hooks uniordinal: 13–14, 14–14, 18–19, 22–23, and 24–25.

Body light gray with dark brown and black pattern. Head light gray, with brownish-black pattern of second type (Figure 49, *5*). Shields blackish-brown, with light-colored dorsal and subdorsal bands of same width as on body. Setae very short, brownish-rusty, slightly pointed, and set on extremely small black spots; insertions of setae surrounded by black line [ring]. Stigmata dull white, oval, broad, with black edge. Legs yellowish-gray. Pattern: dorsal and subdorsal bands dull white, even, not broad; dorsal band in anterior half of segments 1 to 9 rather broadly fringed with black pigment (Figure 83, *1*), in posterior half and on thoracic segments with dark brown, violet-tinged borders. Borders of subdorsal band narrow, even, nearly black above and dark brown below. Dorsal field covered with dull white, often fused dots, and fine brownish longitudinal striae. On subdorsal field whitish dots fringed with brown pigment and hence, this field significantly darker than dorsal. Stigmata disposed on ventral margin of subdorsal field. Substigmal band broad, yellow along margins, with reddish-brown striae at center. Ventral side light gray, with dull white dots and brownish striae. Body length 28 to 43 mm and width of head 3.50 to 3.60 mm.

Development: I-instar. Body of just hatched larva yellowish, translucent with visible violet-colored intestine, and extremely slender compared to large head. Head yellow. Shields and pinacula same color as body; pinacula fairly large on all segments, smaller on shields. Pinacula not darkened. Setae brownish, acuminate, and long. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. After 6 to 12 hrs pattern visible:

white, rather broad dorsal band with uneven reddish-yellow borders; subdorsal and suprastigmal bands very narrow; substigmal band broad and white. Body of larva from second to third day green, with yellowish shields and pinacula. Stigmata round, light-colored, with dark yellow edge. Pattern on back gradually becomes more distinct. Substigmal band white, extends onto anal leg and head; seen in form of spots in region of eyes [ocelli]; antennae also white. Body length of just hatched larva 2.30 mm, before molt 5.50 mm, and width of head 0.542 mm.

II-instar. Body grayish-green, slender, and well proportioned. Head yellowish-gray, with brownish spots around setae and dark gray pattern of second type. Shields not prominent; light-colored dorsal and subdorsal bands extend onto them. Pinacula small, brownish-gray, and on shields very minute. Setae light-colored, acuminate, shorter than in the I-instar (0.17 mm). Pattern: dorsal band narrow, white with yellowish-green borders. Subdorsal and suprastigmal bands somewhat broader, with light brown narrow borders. Lower part of subdorsal field brownish. Substigmal band bright white, broad. Basal field brownish; ventral side brownish-yellow. Body length 5.5 to 9.0 mm and width of head 0.87 to 0.88 mm.

III-instar. Body light brown. Head dull yellow, with reddish pattern of second type. Pinacula somewhat darker than in the II-instar, flat. Dorsal and subdorsal bands narrow, white, with even brown borders. Suprastigmal band faint, substigmal band broad, yellowish. Lower margin of subdorsal field brownish, upper part, like dorsal field, light brown. Basal field brownish-yellow; ventral side light brown with narrow light-colored band along median line. Body length 10 to 15 mm and width of head 1.31 to 1.33 mm.

IV-instar. Body yellowish-brown. Head light gray, with light brown pattern of second type. Shields light brown, with grayish-yellow dorsal and subdorsal bands, which are broader on shields than on trunk. Setae brownish-yellow, short, set on very minute black spots in form of dots. Stigmata light-colored, oval, with black edge. Legs light brown; all five abdominal pairs developed. Pattern: dorsal band narrow, grayish-yellow, even, with rather narrow, even borders, black at center of segment and reddish-brown near intersegmental lines. Subdorsal and suprastigmal bands same as dorsal in width and color, with very narrow light brown borders. Dorsal field brownish-gray with brownish-red striae. Lower part of subdorsal field dark gray. Substigmal band broad, at center brownish-reddish-yellow, light yellow near intersegmental lines. Body length 14 to 20 mm and width of head 1.80 to 1.90 mm.

V-instar. Larva almost indistinguishable from the VI-instar. Body length 20 to 29 mm and width of head 2.60 to 2.70 mm.

In Belorussia larval development from July to autumn and, after hiber-

nation, to early May. Food plants: cereals—meadow grass, ryegrass, and others.

Eggs laid on soil but not firmly attached. They are spherical, with almost no flat surface at base, light yellow, 0.825 mm in diameter, and 0.845 mm in height. Ribs sharp, 26 to 28, of which 17 to 19 reach micropylar zone. Micropylar rosette consists of 10 to 12 lobes. Eggs initially turn pink, then acquire yellowish-brown specks that gradually darken. Before larva hatches egg light brown with lilac tinge.

8. Genus *Lithophane* Hbn.

Spinneret 2.0 to 3.0 times longer than first segment of labial palpus. Second seta of palpus 1.5 to 2.0 times shorter than first segment and 2.0 to 3.0 times longer than first seta. Dorsal teeth of mandibles reduced, inner tooth present. Postgenal sclerites straight, diverge somewhat in dorsal region. First and second segments of antennae yellowish. Setae Frl_2–Frl_2 and P_1 almost on same line. Metathoracic coxae highly contiguous; distance between them much less than half that between setae VIII–VIII. Skin smooth. Hooks of abdominal legs uniordinal.

Key to Species

1 (2). Head light-colored, with dark-colored pattern of second type (Figure 49, *5*). Body reddish-brown. Dorsal band with dark-colored borders forming characteristic pattern (Figure 83, *3*)..... ..... 3. **L. furcifera** Hufn.

2 (1). Head green, with white pattern of first type (Figure 48, *2*). Body green: dorsal band white, without border.

3 (4). Dorsal band broad, subdorsal narrow ..... 1. **L. socia** Hufn.

4 (3). Dorsal and subdorsal bands narrow, identical..... ..... 2. **L. ornithopus** Hufn.

1. **Lithophane socia** Hufn. (yellowish-brown bovine owlet moth)

Mature larva: Distance between setae I–I on thoracic shield slightly less than between X–X; distance between setae I–II on same shield 1.5 times less than between II–X. Hooks of abdominal legs: 23–24, 23–24, 24–25, 24–26, and 26–27.

Body slightly pinched toward anterior end, green, with faint bluish tinge. Head green, with distinct white pattern of first type (Figure 48, *2*). Setae rusty-brown, highly acuminate, set on white pinacula on trunk and on white spots on shields. Shields not prominent. Stigmata white, oval, with thin black edge. Legs green; plantae of abdominal legs quite broad. Pattern: dorsal band white, broad, even; subdorsal and suprastigmal bands

same color and form but narrow. Substigmal band golden-white, broader on prothorax and segment 8 than on rest of segments. Ventral side green. Entire body covered with white dots, fused at places and forming striae. Body length 23 to 40 mm and width of head 3.10 to 3.30 mm.

In Belorussia larval development from May through mid-July. Food plants: oak, linden, black thorn, elm, apple, and pear.

Eggs laid singly on underside of plant leaves, white 0.60 to 0.70 mm in diameter, and 0.40 to 0.45 mm in height. Ribs 35 to 37, of which 8 to 10 reach micropylar zone. Micropylar rosette consists of 11 or 12 lobes. Within 24 hrs minute reddish specks seen on rosette. Specks later appear at equator of egg also, while those on rosette fuse into spot. Before larva hatches egg light gray.

2. **Lithophane ornithopus** Hufn. (light gray bovine owlet moth)

Mature larva: Setae I–I and X–X on thoracic shield equidistant; distance between setae I–II slightly less than between II–IX. Hooks of abdominal legs: 22–23, 24–25, 24–26, 27–28, and 28–29.

Body just barely pinched toward anterior end, light green. Head light green, with faint white pattern of first type (Figure 48, *2*). Setae rusty-brown, highly acuminate, set on white spots on shields and on white pinacula on trunk. Shields not prominent. Stigmata white, oval, with thin black edge. Legs green. Pattern: dorsal and subdorsal band white, narrow, continuous. Suprastigmal band consists of white dots and indistinct. All bands without contrasting borders. Substigmal band white or yellowish, not broad. Ventral side green, does not differ from dorsal side. Entire body uniformly covered with white dots. Body length 22 to 38 mm and width of head 3.0 to 3.1 mm.

In Belorussia larvae seen in May and June. Food plants: oak, willow, black thorn, and poplar.

Eggs laid singly or in small clusters of three to six each. They are pale yellow, 0.65 to 0.70 mm in diameter, and 0.50 to 0.55 mm in height. Ribs sinuous, 36 to 38, of which 10 to 12 reach micropylar zone. Micropylar rosette consists of 12 or 13 lobes, with single rim. Within 24 hrs eggs acquire faint violet coloration and white specks visible on rosette.

3. **Lithophane furcifera** Hufn. (dark gray bovine owlet moth)

Mature larva: Distance between setae I–I on thoracic shield somewhat less than between X–X; between I–II distance 1.5 to 2.0 times less than between II–IX. Hooks of abdominal legs: 27–29, 28–29, 29–31, 30–33, and 33–35.

Body reddish-brown or grayish-green. Head dull white, with black or gray pattern of second type (Figure 49, *5*). Setae very slender, acuminate, set on white or yellowish spots, surrounded by ring of black pigment only

at setae I, III, and IV. Shields black, velvety; on thoracic shield dorsal band narrow and subdorsal broader. Setae on shields set on minute light-colored spots. Stigmata light-colored, oval, with black edge. Thoracic legs yellowish, abdominal legs green. Pattern: dorsal and subdorsal bands consist of white or yellowish dots. Dorsal band unevenly fringed with minute shaded black spots. Subdorsal band in anterior part of segment fringed with fairly broad black pigment, which at center of segment shifted dorsally and surrounded by semicircular light-colored spot of seta II (Figure 83, *3*). Lower border of subdorsal band in form of two oblong black spots at center of segment. Dorsal field reddish-brown, dull green, or grayish-green, and oblong black spots much more vivid. Subdorsal field same color as dorsal, and row of dots of suprastigmal band rather prominent. Yellowish, not very dense dots scattered on both dorsal and subdorsal fields. Substigmal band differs from general background only in dense yellow dots. Ventral side gray or green, with yellow dots. Body length 26 to 40 mm and width of head 3.10 to 3.20 mm.

V-instar. Larvae differ notably from the VI-instar. Body bright green, with golden-yellow bands. Head whitish-green, without pattern. Shields green, not prominent; golden-yellow dorsal bands of back extend onto shields without narrowing. Setae on shields set on round spots same color as dorsal bands. Spots around setae on trunk golden-white, round, fairly large; smaller around seta X. Stigmata light gray, oval, with thin black edge. Legs green. Pattern: dorsal and subdorsal bands golden-yellow, rather broad, continuous, even. Suprastigmal and substigmal bands in form of row of dots of same golden color. Body length 16 to 26 mm and width of head 2.25 to 2.30 mm.

Body pattern of larva changes within first few days of fifth molt. Immediately after molt body color and pattern same as in the V-instar. Later, black pigment appears around setae I and II, and black borders on subdorsal band. Subsequently, black pigment of border extends up to seta II. Shields turn blackish.

In Belorussia larval development in May and June. Food plants: alder, willow, birch, poplar, and oak.

According to Doring (1955), eggs yellowish-white, with two reddish spots at apex, 0.65 to 0.70 mm in diameter, and 0.40 to 0.45 mm in height. Ribs 38 to 40, of which 24 reach micropylar zone. Micropylar rosette consists of 14 lobes.

9. Genus *Cosmia* Ochs.
(one species examined)

Cosmia trapezina L. (elm owlet moth)

Mature larva: Spinneret 1.5 times longer than first segment of labial palpus. Second seta of palpus 2.0 times longer than first seta. Seta P_1 on

same line as setae Frl_2–Frl_2. Postgenal sclerites not contiguous (*Pi* = 1/4). Distance between setae II–II on prothorax 1.5 times greater than between III–IX. On metathorax seta IIIa set on dark-colored spot. Mandibular teeth developed; inner tooth present. Metathoracic coxae not contiguous; distance between them half distance between setae VIII–VIII. Skin slightly rugulose. Hooks of abdominal legs broad and strong: 15–17, 16–17, 16–17, 18–20, and 21–22.

Body yellowish or whitish-green. Head green or grayish-green, without pattern. Pinacula large, light-colored at base and black at apex. Pinacula I and II identical in size; pinaculum III somewhat larger. Setae pale rust, acuminate. Shields not prominent. Dorsal and subdorsal bands extend onto shields. Stigmata white, oval, with thin black edge. Thoracic legs light yellow, abdominal legs greenish. Pattern: dorsal band fairly broad, even, bright yellowish; subdorsal band same width and color but not bright. Dorsal field yellowish-green, subdorsal green. Substigmal band broad, yellow, but white close to stigmata. Ventral side green. Body length 20 to 32 mm and width of head 2.50 to 2.70 mm.

In Belorussia larval development in May and June. Food plants: hornbeam, oak, linden, willow, and elm.

According to Döring (1955), eggs pearly white, with thin red girdle, 0.65 to 0.70 mm in diameter, and 0.40 to 0.45 mm in height. Ribs 40 to 45, of which 20 to 25 reach micropylar zone. Micropylar rosette consists of 15 or 16 lobes, with single rim.

10. Genus *Eupsilia* Hbn.

(one species in Belorussian fauna)

Eupsilia transversa Hufn. (syn. *satellitia* L.) (trooping owlet moth)

Mature larva: Spinneret 2.5 to 3.0 times longer than first segment of labial palpus. Second seta of palpus almost equal to first segment and 2.0 times longer than first seta. Seta P_1 shifted caudal to line of setae Frl_2–Frl_2. Distance between setae Frl_1–Frl_2 and Frl_1–F_1 equal. On meso- and metathorax setae III and IIIa on dark spot. Mandibles with inner tooth. Skin smooth. Hooks of abdominal legs uniordinal: 14–15, 15–17, 16–18, 19–23, and 24–26.

Body somewhat pinched toward anterior end, dark-colored, sometimes almost black, with bluish-violet tinge. Head dark yellow, with brown, and in anterior part black, pattern of second type (Figure 49, *5*). Shields black, with bluish tinge; dorsal band narrow and subdorsal bands broad. Setae long, acuminate, set on white spots. Stigmata black, oval, with black margin. Thoracic legs black, abdominal legs same color as abdomen, with large black spot on outer side; plantae light-colored, with dark-colored hooks. Pattern: dorsal and subdorsal bands very narrow, bluish. Dorsal

field dark-colored, with bluish-violet tinge, subdorsal black. Substigmal band white, uneven, often interrupted, broad only in anterior part of body between segments I–II and II–III. All stigmata disposed above bands. Ventral side yellowish-pink. Body length 28 to 43 mm and width of head 3.20 to 3.25 mm.

I-instar. Body yellowish-brown, slender. Head black, lustrous. Shields dark brown. Setae short (0.065 mm), slightly pointed. Shields small, poorly sclerotized. Skin coarsely grained. Stigmata light-colored, round, with black edge. Thoracic legs dark-colored, abdominal legs yellowish-brown; legs underdeveloped on segments 3 and 4. Pattern: dorsal, subdorsal, and substigmal bands whitish, identical in width, continuous, and fairly broad. Body length 2.0 to 4.0 mm and width of head 0.30 to 0.31 mm.

II-instar. Larva differs very little from the I-instar. Dorsal band somewhat wider than subdorsal. Substigmal band in anterior part of body broader, in posterior part, commencing from segment 4, considerably narrower. Body length 3.5 to 7.0 mm and width of head 0.55 to 0.60 mm.

III-instar. Body yellowish-brown, as in the I- and II-instars. Head black, lustrous. Setae brown, acuminate. Pinacula small (0.065 mm), black, distinctly sclerotized, surrounded by ring of light-colored pigment. Shields brown; pinacula on shields barely visible. Skin finely grained. Stigmata round, light brown, with broad black edge. Thoracic legs black; abdominal legs yellowish-brown, with large, very dark spot on ventral side, and all five pairs developed. Pattern: dorsal band white, continuous, not broad; subdorsal same color but narrower than dorsal. Substigmal band white, uneven, continuous on segments 1 and 2, considerably narrower or interrupted on other segments along margins; between segments I–II and II–III band in form of round spots and at center of segments absent. Ventral side greenish-brown. Body length 7.0 to 12.0 mm and width of head 0.85 to 0.91 mm.

In Belorussia, larval development in May and June. Food plants: linden, oak, maple, willow, elm, hornbeam, and plum.

Eggs grayish-brown, with reddish tinge, 0.70 to 0.75 mm in diameter, and 0.40 to 0.45 mm in height. Ribs 40 to 42, of which 10 to 12 reach micropylar zone. Micropylar rosette consists of 15 to 18 lobes. Within 24 hrs light-colored spots form girdle. Lower part of egg lighter in color.

11. Genus *Conistra* Hbn.

Postgenal sclerites not contiguous (*Pi* = 1/4, 1/6). Spinneret 2.0 to 2.5 times longer than first segment of labial palpus. Second seta of palpus 1.5 to 2.0 times longer than first seta.

Seta Frl_1 far closer to F_1 than to Frl_2. Seta P_1 on same line as Frl_2–Frl_2. Distance between setae II–III on thoracic shield 2.0 times

greater than between III–IX. Mandibular teeth normally developed; inner tooth absent. Distance between metathoracic coxae legs equal to or less than distance between setae VIII–VIII. Abdominal legs short and hooks uniordinal. Larvae with only primary or primary and secondary setae.

Key to Species

1 (2). Trunk and head almost uniformly covered with rather short secondary setae. On dorsal field of abdominal segments two small black spots occur on each segment (Figure 83, *2*)..... ..... 2. **C. rubiginea** Schiff.

2 (1). Secondary setae on trunk and head absent. Black spots on dorsal field absent. On thoracic shield dorsal band narrow, hazy white, and subdorsal bands broad, white. Anal shield black, with white subdorsal bands; dorsal band absent (Figure 83, *9*)..... ..... 1. **C. vaccinii** L.

Subgenus *Conistra* Hbn.
(one species investigated)

1. **Conistra (Con.) vaccinii** L. (flat-bodied whortleberry owlet moth)

Mature larva: Distance between setae I–II on thoracic shield less than between setae II–IX. Distances between setae III–IIIa on prothorax and IV–V equal. Hooks of abdominal legs: 17–19, 19–21, 22–25, 24–27, and 29–31.

Body somewhat pinched toward anterior end, brownish-gray, with violet tinge. Head reddish-brown, with dark brown pattern of second type (Figure 49, *5*). Thoracic shield brown, with narrow, dull white dorsal band and broad white subdorsal bands. Posterior edge of shield green, bounded by thin brown line. Anal shield black at center; dorsal band on it totally masked by black pigment and not prominent; subdorsal bands rather broad, white. Lateral sides of shield brownish-gray so that central part prominent, with oblong-rectangular black spot (Figure 83, *9*). Setae reddish-rusty, acuminate, set on very minute whitish spots; on shields setae on general background color. Stigmata oval, broad, black, with black margin. Thoracic legs yellowish, abdominal legs green. Pattern: dorsal and subdorsal bands in form of chain of fused yellowish dots, faintly visible, since very similar dots densely scattered on dorsal and subdorsal fields. Suprastigmal and stigmal bands not seen. Substigmal band bounded above by row of yellow dots, but spots absent below and band not distinguishable on brownish-gray basal field. All stigmata disposed above band. Ventral side gangrenous green. Body length 25 to 37 mm and width of head 2.9 to 3.0 mm.

Development: III-instar. Body quite thick, short, reddish-yellow. Head yellow, with extremely dark, faint pattern of first type. Thoracic shield somewhat darker than body color; anal shield not prominent; dorsal and subdorsal bands on shields same width as on body. Setae rust-colored, somewhat pointed. On prothorax setae III and IIIa set on white round spots; IV, V, VIIa, and VIIb set on black spots, each pair sharing common spot. On mesothorax setae III and IIIa, and on metathorax seta IIIa set on black spots. On shields setae set on minute white spots. Stigmata dark brown, almost black, broad, with broad black edge, and encircled by white pigment. On prothorax and segment 8 stigmata somewhat oval, rest round. Legs light-colored; all five pairs of abdominal legs developed. Pattern: dorsal and subdorsal bands white, fairly broad, continuous, without [contrasting] borders. White dots sparse on dorsal and subdorsal fields. Substigmal band white, slightly broader than dorsal, uneven. Ventral side whitish. Body length 7.0 to 11.0 mm and width of head 0.78 mm.

IV-instar. Body greenish-reddish-brown. Head yellow, with very dark pattern of second type. Some changes evident in pattern also. Dorsal and subdorsal bands yellowish, quite broad, but not continuous. Bands consist of individual, close-set spots. Entire body covered with dense yellowish dots. Other characteristics same as in the III-instar. Body length 11 to 18 mm and width of head 1.10 to 1.20 mm.

V-instar. Larva dark brown or yellowish-brown. Pattern and other characters differ little from the VI-instar. Pattern on head lighter in color. Dorsal and subdorsal bands more distinct, but dots constituting them smaller than those scattered all over body. Substigmal band narrow, distinctly seen only on thoracic segments. Body length 17 to 26 mm and width of head 1.76 to 1.85 mm.

In Belorussia larval development in May and June. Food plants: linden, hornbeam, oak, maple, plum, poplar, willow, dewberry, raspberry, currants, and whortleberry.

According to Döring (1955), eggs yellowish-white with reddish girdle, 0.65 to 0.75 mm in diameter, and 0.45 to 0.50 mm in height. Ribs 40 to 50. Micropylar rosette consists of 12 to 15 lobes, with single rim.

Subgenus *Dasycampa* Gn.

2. **Conistra (Dasyc.) rubiginea** Schiff. (flat-bodied yellow owlet moth)

Mature larva: Body densely covered with secondary setae. Spinneret 2.0 times longer than first segment of labial palpus. Second seta of palpus slightly shorter than first segment and 2.5 times longer than first seta. Distance between metathoracic coxae slightly less than between setae VIII–VIII. Abdominal legs short and hooks uniordinal: 20–23, 21–24, 23–26, 25–27, and 29–33.

Body piliform, highly pinched toward anterior end, with distinct segments, and greenish-brown with admixture of yellow. Head black, with somewhat lighter colored epicranial suture. In addition to primary setae, fine rust-colored, rather short setae also present on head. First segment of antennae white, second yellowish-brown. Thoracic shield black or blackish-brown, velvety; anal shield light-colored. Narrow light-colored dorsal band distinct on thoracic shield, but negligible on anal shield. Setae on both shields, both primary and secondary, set on white specks, rust-colored, and slightly pointed. Stigmata broad, black, with black edge. Thoracic legs brown, abdominal legs yellowish-brown. Pattern: dorsal band somewhat lighter in color than body, narrow. Borders of band brownish-black; at center of each segment, especially abdominal, notably enlarged and form rectangular spots. Since band extremely narrow, spots form single black square on each segment (Figure 83, *2*). In anterior and posterior parts of segment, band and borders barely discernible. However, dorsal band and its borders, as well as broader substigmal band, so distinct at commencement of instar, almost absent in middle and at end of instar. Body length 25 to 37 mm and width of head 2.50 to 2.60 mm.

In Belorussia larval development in May and June. Food plants: hawthorn, willow, oak, plum, dog rose, raspberry, dewberry, strawberry, and dandelion.

According to Döring (1955), eggs pinkish-yellow with broad reddish girdle and spot at apex, 0.80 mm in diameter, and 0.60 mm in height. Ribs 32 to 34, of which 14 reach micropylar zone. Micropylar rosette consists of 16 to 17 lobes.

12. Genus *Cirrhia* Hbn.

Spinneret 2.5 to 3.0 times longer than first segment of labial palpus. Second seta of palpus 2.0 to 2.5 times longer than first seta. Postgenal sclerites either widely set or contiguous (*Pi* = 1/4, 1/8). Distance between setae M_1–M_2 either equal or greater than distance between M_2–M_i. Abdominal legs short. In early spring larvae live on catkins of willow, poplar, and others; subsequently they transfer to herbaceous plants.

Key to Species

1 (2). Postgenal sclerites widely set (*Pi*= 1/4). Dorsal field of abdominal segments with large dark-colored arrow-shaped spots (Figure 54, *8*). ..... 3. **C. circellaris** Hufn.

2 (1). Postgenal sclerites contiguous (*Pi* = 1/7, 1/8). Pattern on dorsal field of abdominal segments different.

3 (4). Dorsal field of abdominal segments with large dark-colored rhom-

bic spots (Figure 54, *1*). Subdorsal field considerably darker than basal..... 2. **C. icteritia** Hufn.

4 (3). Dorsal field of abdominal segments without large rhombic spots. Subdorsal field not darker than basal..... 1. **C. togata** Esp.

1. **Cirrhia togata** Esp. (syn. *lutea* Ström.) (golden owlet moth)

Mature larva: Spinneret 3.0 times longer than first segment of labial palpus. Distance between setae II–III on prothorax 2.5 to 3.0 times greater than between setae III–IX. Hooks of abdominal legs: 14–16, 14–17, 18–19, 20–21, and 22–23.

Body considerably pinched toward anterior end, brownish-gray with violet tinge. Head grayish-yellow, with brownish pattern of second type (Figure 49, *5*); submedian band in region of epicranial suture darker in color than reticulate structure. Thoracic shield dark brown, with narrow dorsal band and broader subdorsal bands. Bands also extend onto anal shield. Setae light brown, acuminate, set on white spots on trunk and on general background color on shields. Stigmata oval, dark brownish, with black edge. Thoracic legs yellowish-gray, abdominal legs greenish-gray. Pattern: dorsal and subdorsal bands consist of white dots, which are more distinct on thoracic segments and abdominal segments 7, 8, and 9. Dark-colored striae of borders grouped more around dorsal band along margins of segments. Subdorsal band almost entirely covered with dark-colored striae. Dorsal and subdorsal fields with scattered whitish dots. Dark-colored striae few on subdorsal fields and field itself lighter in color than dorsal. Substigmal band reddish-yellow, with innumerable reddish-violet striae; lower margin indistinct. Ventral side greenish-gray. Body length 20 to 30 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development in April and May. In early spring larvae feed on willow catkins, and subsequently on herbaceous vegetation.

Eggs pale yellow. Ribs large, 13 to 16, and all reach micropylar zone, but extend only to equator (Figure 7, *5*); depressions between ribs dark-colored. Micropylar rosette consists of 12 to 14 lobes. During embryonal development eggs initially acquire reddish-flesh coloration, then turn dark blue with light red ribs. Diameter of eggs 0.95 to 1.0 mm and height 0.90 to 0.95 mm.

2. **Cirrhia icteritia** Hufn. (syn. *fulvago* L.) (raspberry golden owlet moth)

Mature larva: Spinneret 2.5 times longer than first segment of labial palpus. Distance between setae II–III on prothorax 2.0 times greater than between setae III–IX. Hooks of abdominal legs: 17–19, 18–19, 21–23, 22–25, and 27–30.

Body considerably pinched toward anterior end, grayish-brown. Head yellowish-gray, with dark brown pattern of second type (Figure 49, *5*);

submedian band broad; reticulate structure with large cells. Setae brownish, with narrow light yellow dorsal band and very broad subdorsal bands; spots absent at base of setae on shields. Stigmata oval, black, with black edge. Thoracic legs dark-colored, abdominal legs light gray. Pattern: dorsal band consists of white dots, which are more distinct around margins of segments. Subdorsal band also in form of dots but faint. Dorsal field covered with yellowish dots and fine brownish striae; much darker striae grouped around dorsal band and extend farther toward subdorsal band, forming dark-colored rhombic figure on dorsal field (Figure 54, *1*). Subdorsal field dark gray, with violet tinge. Substigmal band in form of large whitish spots in region of stigmata, and at other places not different from basal field, which is light gray with violet tinge. Ventral side lighter in color than basal field. Body length 18 to 33 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development in April and May. In early spring larvae feed on willow buds and catkins, and subsequently on various herbaceous plants.

According to Döring (1955), eggs light yellow, 0.65 to 0.70 mm in diameter, and 0.40 to 0.45 mm in height. Ribs 32, of which 23 reach micropylar zone. Micropylar rosette consists of 12 lobes.

3. **Cirrhia circellaris** Hufn. (rust-colored, fluffy-legged owlet moth)

Mature larva: Spinneret 2.5 to 3.0 times longer than first segment of labial palpus. Second seta of palpus 2.5 times longer than first seta. Postgenal sclerites wide set (*Pi* = 1/4). Dorsal teeth of mandibles somewhat reduced, inner tooth absent. Distance between setae M_1–M_2 more than between M_2–M_i. Distance between setae I–II on thoracic shield less than between II–IX, but 2.0 times greater between II–III than between setae III–IX. Abdominal legs short, hooks uniordinal: 14–16, 14–17, 16–17, 19–20, and 20–23.

Body slightly pinched toward posterior end, light reddish-brown, with violet tinge. Head dull yellow, with reddish tinge and light brown pattern of second type (Figure 49, *5*). Setae rusty-brown, acuminate. Setae I and II set on small white spots, all others on general background color of body. Shields dark brown, with narrow white dorsal band, and much broader yellowish subdorsal bands. Stigmata dark-colored, oval, with black edge. Thoracic legs yellow, abdominal legs yellowish-green. Pattern: dorsal band white, not broad, almost continuous, fringed with brownish striae. Striae denser at center of segment and extend farther forward and upward to form at center of each segement a heart- or arrow-shaped spot (Figure 54, *8*). Subdorsal band yellowish, continuous, not broad, slightly fringed with light brownish striae. Dorsal field between arrow-shaped spots greenish-gray with white dots; subdorsal field same but additionally with

scattered light brownish striae; lower margin of field dark brown. Substigmal band differs little from dull greenish-yellow ventral side; lower border not prominent, and in region of stigmata band in form of rather large whitish and yellowish spots. Body length 22 to 34 mm and width of head 2.9 to 3.0 mm.

In Belorussia larval development in April and May. Larvae feed in spring on flowers of elm and poplar, more rarely oak, birch, black thorn, and plum, and subsequently on herbaceous vegetation.

According to Döring (1955), eggs pale yellow, 0.45 to 0.55 mm in diameter, and 0.25 to 0.30 mm in height. Ribs 30 to 32, of which 12 to 14 reach micropylar zone. Micropylar rosette consists of 11 to 13 lobes.

13. Genus *Caradrina* Ochs.

Larvae up to 3.0 cm, grayish-brown or muddy yellow, with yellowish dots and dark-colored striae. Head with pattern of second type or dark without pattern. Spinneret 3.0 to 5.0 times longer than first segment of labial palpus. Second seta of palpus 1.5 times longer than first seta, or setae equal. Between setae II–IX on thoracic shield small dark-colored spot occurs (Figure 84, *1, 2*). Mandibles without inner tooth. Setae set on pinacula. Hooks of abdominal legs uniordinal or indistinctly biordinal (Figure 24). Stigmata dark-colored. Skin finely grained.

Key to Species

1 (2). Oblong dark-colored spot between setae II–IX on prothorax situated along edge of thoracic shield (Figure 84, *2*). Hooks of abdominal legs uniordinal. Herringbone pattern distinctly visible on dorsal field (Figure 54, *3*). Upper border of subdorsal band on segment 8 in form of cuneate spots (Figure 54, *6*)..... ..... 1. **C. morpheus** Hufn.

2 (1). Oblong dark-colored spot between setae II–IX on prothorax situated on thoracic shield somewhat away from edge (Figure 84, *1*). Hooks of abdominal legs indistinctly biordinal. Herringbone pattern on dorsal field and cuneate spots on segment 8 absent.

3 (4). Frons with dark-colored spot in center. Second and first setae on labial palpus equal in length. Seta M_2 on mandible set on dark-colored spot ..... 2. **C. selini** Bsd.

4 (3). Frons darkly shaded in lower part. Second seta on labial palpus 1.5 times longer than first. Dark-colored spot absent at base of seta M_2 on mandible; anterior part of mandible brownish-yellow. ..... 3. **C. clavipalpis** Scop.

Subgenus *Caradrina* Ochs.

1. **Caradrina (Carad.) morpheus** Hufn. (lettuce owlet moth)

Mature larva: Spinneret 5.0 times longer than first segment of labial palpus. Second seta of palpus 1.5 times longer than first. Dark-colored spot visible at edge of thoracic shield (Figure 84, *2*). Distance between setae I–I on prothorax less than between X–X. Distance between II–III on anal shield 1.5 times greater than between II–II. Hooks of abdominal legs uniordinal: 15–17, 16–18, 20–21, 20–23, and 24–28.

Body slightly pinched toward anterior end, muddy yellow or yellowish-brown. Head dull yellow, with dark brown pattern of second type (Figure 49, *5*). Shields not prominent; thoracic shield somewhat covered in dark-colored striae and dorsal band distinct; subdorsal bands faint. Pinacula flat, slightly sclerotized, almost not visible. Setae muddy yellow, short, somewhat pinched toward end but terminate bluntly. Skin finely grained. Stigmata oval, brownish, with black edge. Thoracic legs muddy yellow, abdominal legs greenish-yellow. Pattern: dorsal and subdorsal bands narrow, whitish, and faint; dorsal band fringed with light brown pigment, more vivid around margins of segments. Dorsal field covered with whitish dots and brown oblong striae, more densely disposed around borders of dorsal band along posterior margin of segment; striae then extend forward aslant of seta I to form herringbone pattern. Borders of subdorsal band faint. Suprastigmal band narrow, whitish, fringed with light brown pigment, which is more vivid than on subdorsal band. Substigmal band grayish-yellow, differs little from ventral side. Body length 22 to 30 mm and width of head 2.40 to 2.60 mm.

Development: I-instar. Just hatched larva pale yellow, with rather large light-colored pinacula that turn brown after 1.5 to 2.0 hrs. Head black. Thoracic shield brown, anal shield light-colored. Skin coarsely grained. Setae slender, long (0.15 mm), clavate, flexed. Stigmata round, light-colored, with dark-colored margin. Thoracic legs dark-colored; abdominal legs light-colored and underdeveloped on segments 3 and 4. Body length of just hatched larva 2.0 mm, before molt 3.5 mm, and width of head 0.31 mm.

II-instar. Body pinkish-yellow, short, thick. Head brownish. Shields brown; anal shield lighter in color than thoracic. Pinacula large, light brown. Setae long (0.222 mm), slender, clavate, brown. Stigmata round, light-colored, with brown margin. Pattern: dorsal, subdorsal, and suprastigmal bands light- colored, lighter than general body background, not broad, continuous. Substigmal band light-colored, narrow, differing slightly from light-colored ventral side. Body length 3.5 to 5.0 mm and width of head 0.444 to 0.448 mm.

III-instar. Body and head same color as in the II-instar, or greenish. Shields brown, but light-colored dorsal and subdorsal bands extend onto them. Pinacula large, brown, weakly sclerotized. Setae long, flexed, slightly thickened at end but not clavate. Stigmata light brown, round, with black edge. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands narrow, pale yellow, without [contrasting] borders. Dorsal and subdorsal fields yellowish or green. Substigmal band yellow, with uniformly scattered brown striae; lower border not distinct. Ventral side green, with whitish dots and five brown striae. Body length 4.5 to 7.5 mm and width of head 0.60 to 0.61 mm.

In Belorussia larval development from July to autumn and, after hibernation, to mid-May. Food plants: dead nettle, almost all species of buckwheat, nettle, bindweed, and wormwood.

Female lays eggs singly or in small groups. Eggs pale yellow, 0.61 to 0.62 mm in diameter, and 0.45 to 0.48 mm in height. Ribs 32 or 33, of which 11 or 12 reach micropylar zone. Micropylar rosette consists of 13 or 14 lobes.

Subgenus *Paradrina* Brsn.

2. **Caradrina (Parad.) selini** Boisd. (small gray owlet moth)

Mature larva: Spinneret pinched toward anterior end, 3.0 times longer than first segment of labial palpus. Second seta of palpus somewhat longer than first. Oblong dark-colored spot between setae II–IX on thoracic shield located not on edge but somewhat away from it (Figure 84, *1*). Seta M_2 of mandibles set on dark-colored spot. Abdominal legs short; hooks indistinctly biordinal: 16–17, 16–18, 19–22, 24–26, and 29–31.

Body yellowish-gray, with violet tinge. Head dark brown, almost black on bulges of hemispheres, and dull white around epicranial suture, adfrontal sclerites, and in orbital region. Frons with dark-colored spot above setae F_1 and F_2. Setae brownish, slightly pointed, set on large brown pinacula. Pinacula I–II at beginning of instar brown, but pigmentation gradually disappears later until only apex of pinaculum remains brown. Shields grayish-brown, somewhat covered by dark-colored striae; light-colored dorsal and subdorsal bands quite distinct. Stigmata black, oval, with black edge. Thoracic legs dark-colored, abdominal legs light-colored. Pattern: dorsal band light-colored, dull white, continuous only on thoracic shield; interrupted on meso- and metathorax, and on abdominal segments in form of fused dots around margins of segments, which are very distinct along posterior margin. Dorsal field gray, with faint violet hue, covered by whitish dots and fine dark gray and dark brown striae. Striae grouped more around dorsal band, form its shaded borders, and mask band at

center of segment. Subdorsal band almost entirely covered by striae and only borders prominent. Subdorsal field lighter in lower part than dorsal field. Substigmal band not prominent, identical to ventral side, i.e., gray with dull white dots. Body length 18 to 25 mm and width of head 1.8 to 1.9 mm.

In Belorussia larval development in August and September. Larvae of last instar hibernate. Food plants: dead nettle, Plantaginaceae, dandelion, orache, sorrel, and lady's mantle.

According to Doring (1955), eggs white, with light brown girdle and spot at apex, 0.73 to 0.75 mm in diameter, and 0.40 to 0.45 mm in height. Ribs 25 to 29, of which 12 to 14 reach micropylar zone. Micropylar rosette consists of 10 or 11 lobes.

3. **Caradrina (Parad.) clavipalpis** Scop. (syn. *quadripunctata* F.)
(quadripunctate owlet moth)

Mature larva: Spinneret 2.5 times longer than first segment of labial palpus. Second seta of palpus 1.5 times longer than first. Dark spot between setae II–IX on thoracic shield somewhat farther away from edge (Figure 84, *1*). Dark spot absent at base of seta M_2 on mandible. Abdominal legs short; hooks indistinctly biordinal: 15–16, 16–17, 19–20, 22–24, and 25–27.

Body brownish-green or grayish-green, cylindrical. Head dark brown, with very dark pattern of second type (Figure 49, *5*), or almost black and without pattern, sometimes only bulges of hemispheres dark. Frons light-colored above and dark below. Shields brown, with light-colored dorsal and subdorsal bands and minute brown spots around setae. Setae brownish, slightly pointed. Pinacula not large, brown; III and IV notably larger than I and II. Stigmata dark brown, oval, with black edge. Thoracic legs dark-colored, abdominal legs light-colored. Pattern: dorsal band greenish-white, with faint brown borders that masks band at places. Borders along subdorsal band darker in color and masks band so that it is distinguishable only here and there. Dorsal field gray, with faint violet hue, covered with whitish dots and more rarely fine dark brown striae. Subdorsal field somewhat lighter in color than dorsal; lower margin, especially around stigmata, with accumulation of dark-colored pigment. Substigmal band altogether indistinguishable on basal field, covered by dull white or grayish dots and dark-colored striae. Ventral side grayish-green with yellow dots. Body length 20 to 29 mm and width of head 1.90 to 2.10 mm.

I-instar. Body of just hatched larva yellowish, translucent with visible violet intestine. Head black. Shields dark brown, with minute brown pinacula. Pinacula on body colorless, turning dark brown after 1.5 to 2.0 hrs. Skin finely grained. Setae slender, long (0.11 mm), clavate, flexed.

Thoracic legs dark-colored; abdominal legs light-colored, and underdeveloped on segments 3 and 4. Feeding larva with brown pinacula, green in region of filled intestine. Body length of just hatched larva 1.80 mm, before molt 3.20 mm, and width of head 0.29 mm.

In Belorussia larval development from July to autumn and, after hibernation, up to May. Food plants: Plantaginaceae, dandelion, Campanulaceae, and dead nettle.

Eggs laid singly or in groups of 5 to 10 each. They are pale yellow, 0.61 to 0.66 mm in diameter, and 0.44 to 0.48 mm in height. Ribs 35 to 38, of which 12 to 14 reach micropylar zone. Micropylar rosette consists of 12 or 13 lobes.

14. Genus *Hoplodrina* Brsn.
(one species investigated)

Hoplodrina ambigua Schiff. (brownish-gray owlet moth)

Spinneret highly pinched toward end, 3.0 to 3.5 times longer than first segment of labial palpus. Second seta of palpus 2.0 times longer than first. Oblong dark-colored spot between setae II–IX on prothorax located at edge of thoracic shield (Figure 84, *2*). Mandibles without inner tooth. Skin granulated. Abdominal legs short; hooks uniordinal: 15–18, 18–19, 18–21, 21–23, and 26–29.

Body highly pinched toward anterior end, short, thick; color of body yellowish-brown or yellowish-gray with admixture of brown. Head dull yellow, with dark brown pattern of second type, or entire upper part of hemisphere dark-colored. In the V-instar pattern on head of first type (Figure 48, *2*). Shields not prominent; on thoracic shield narrow, dull yellow dorsal band and notably fainter subdorsal band visible. Bands absent on anal shield. Setae rusty-brown, set on small dull yellow flat pinacula. Stigmata dark-colored, oval, broad. On segment 8 stigmata 2.5 times larger than on segment 7. Thoracic legs yellowish-brown, abdominal legs yellowish-gray. Pattern: dorsal band narrow, dull yellow, distinctly visible only on thoracic segments; on abdominal segments noticeable only around margins, where it is broader and deeply fringed with dark brown pigment; at center of each segment borders faint but masks band at several places. Subdorsal band noticeable only in form of isolated narrow striae; fringe brown or dark brown. Upper border of subdorsal band not broad, interrupted around seta II, and extends upward and backward as fine striae, but does not form herringbone pattern. Lower border broader, shaded, and fuses with dark background of subdorsal field. Dorsal field considerably lighter in color than subdorsal, covered with dull yellow dots and fine dark-colored striae. Latter, at midinstar or immediately after molt, fuse into thin oblique lines. Dark-colored shaded line extends along lower

margin of subdorsal field. Substigmal band almost indistinguishable from grayish-yellow ventral side; remnants of band seen in form of yellowish spots around stigmata. These spots are absent at end of instar. Body length 24 to 33 mm and width of head 2.0 to 2.1 mm.

Larvae of the V-instar found mid-September, and those of the VI-instar hibernate. Evidently in Belorussia this species produces two generations since moths encountered in June and August. Food plants: dandelion, thistle, lettuce, Plantaginaceae, groundsel, and Campanulaceae. Under laboratory conditions larvae also fed on cereal plants.

15. Genus *Meristis* Hbn.

(one species in Belorussian fauna)

Meristis trigrammica Hufn. (blunt-winged owlet moth)

Mature larva: Spinneret 4.5 times longer than first segment of labial palpus. Second seta of palpus 3.0 times shorter than first segment and 1.5 times longer than first seta. Seta M_1 absent on mandible (Figure 15, IX); inner tooth likewise absent. Metathoracic coxae not contiguous; distance between them equal to distance between setae VIII–VIII. Setae short, not acuminate (Figure 27, *3*). Microscopic setae IIIa and V on prothorax, IIIa on meta- and mesothorax, and III on segment 9 set on large, black, round spots. Skin highly granulated; granules in form of tubercles (Figure 27, *3*). Head rugulose. Species undergoes six molts, terminating in VII-instar. Abdominal legs short; hooks uniordinal: 12–14, 14–18, 14–19, 18–22, and 22–23.

Body flat, very broad, highly pinched toward anterior end (width of segment 8—7.0 mm, of thorax—3.7 mm), and light brown or yellowish-gray. Head brown, with indistinct reticulate structure along sides of hemispheres; submedian bands not prominent on dark-colored background of head. Pinacula not large, same color as body, black only at apex. Shields dark brown, with faint light-colored dorsal and subdorsal bands. Stigmata oval, dark brown, with rather broad black border. Thoracic legs light colored, with dark-colored ringlets; abdominal legs greenish-red. Pattern: dorsal band same as base color, narrow, fringed along margins of segments with dark brown pigment. Subdorsal band same width and color, its brown borders visible only in anterior half of segment; farther along, [upper] border shifts upward and backward and in posterior part of segment joins border of dorsal band, to form faint herringbone pattern. Lower border of subdorsal band continuous, somewhat shaded. Subdorsal field at center light brown, along lower margin dark brown. Substigmal band altogether indistinguishable from yellowish-gray ventral side since lower border absent. Body length 28 to 40 mm and width of head 2.9 to 3.0 mm.

Development: I-instar. Body of just hatched larva short, thick, yellowish. Head light brown and pinacula light-colored; both head and pinacula turn dark brown after 2.0 or 3.0 hrs. Setae light-colored, long (0.18 mm), thick, clavate; setae I arch forward and II backward and hence larva appears pilose. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Skin finely grained. Feeding larva yellowish-green. Body length of just hatched larva 2.0 mm, before molt 3.5 mm, and width of head 0.325 to 0.336 mm.

II-instar. Body somewhat pinched toward anterior end, greenish-pink. Head dull yellow, with minute brown spots around setae. Pinacula dark brown, 0.089 mm. Setae thick, slightly enlarged at end. Skin coarsely and unevenly granulated. Stigmata round, light-colored, with dark-colored frill. Legs light-colored; abdominal legs on segment 3 underdeveloped. Pattern: dorsal and subdorsal bands narrow, light-colored; substigmal band broad; all bands faint. Body length 3.0 to 7.0 mm and width of head 0.448 to 0.577 mm.

III-instar. Body reddish-brown, thick, short. Head reddish, with admixture of brown, with extremely dark-colored submedian bands and extremely faint reticulate structure. Shields dark brown, with narrow light-colored dorsal and subdorsal bands and minute brown pinacula. Pinacula on trunk large (0.10 mm), brown, corrugated. Setae rust-colored, slightly enlarged at end. Skin coarsely and unevenly granulated. Stigmata faintly oval, brown, with black edge. Thoracic legs light brown; abdominal legs light-colored, with large brown spot on ventral side, and all five pairs developed. Pattern: dorsal and subdorsal bands narrow, light yellow, with faint brown borders. Substigmal band light yellow, with distinct borders, covered in center at some places with reddish-brown pigment. Ventral side reddish-gray. Body length 6.5 to 10.0 mm and width of head 0.821 to 0.884 mm.

IV- and V-instars. Larvae differ from those of the III-instar mainly in formation of herringbone pattern on dorsal field. In the IV-instar borders on dorsal band uniform, reddish-brown; border on subdorsal band insignificantly shifted upward around pinaculum II, but does not join border of dorsal band. In the V-instar, dorsal band fringed with reddish-brown pigment only around margins of segments; pigment almost absent at center of borders. Herringbone pattern on dorsal field distinct. Head in IV- and V-instar brownish-yellow, with fairly distinct pattern of second type (Figure 49, *5*). In the IV-instar body length 9.0 to 15.0 mm and width of head 1.15 to 1.22 mm; in the V-instar length 13 to 21 mm and width of head 1.65 to 1.70 mm.

VI-instar. Larvae differ very little from the VII-instar. Herringbone pattern more distinct in dorsal field. Significant admixture of red pigment in body color; dorsal and subdorsal bands yellowish-red; substigmal band

reddish and more distinct than in the VII-instar. Ventral side reddish-green. Body length 20 to 29 mm and width of head 2.10 to 2.20 mm.

In Belorussia larval development from end of June to autumn and, after hibernation, to early May. Larvae of the VI-instar hibernate. Food plants: Plantaginaceae, dandelion, burdock, orache, sorrel, thistle, spurge, lady's mantle, and raspberry. Under laboratory conditions larvae fed avidly on leaves of beet, black currant, and sunflower.

Eggs laid in small clusters of 5 to 20 each, in single layer. They are light yellow, 0.669 to 0.687 mm in diameter, and 0.531 to 0.564 mm in height. Ribs 26 or 27, of which 14 or 15 reach micropylar zone. Micropylar rosette consists of 11 or 12 lobes, with single rim. On second day light brown girdle not far from apex and spot at apex visible. Later yellow coloration of egg darkens, while girdle and spot turn brownish. Before larva hatches egg grayish-brown.

16. Genus *Rusina* Steph.

(one species in genus)

Rusina tenebrosa Hbn. (syn. *umbratica* Goeze) (ground ivy owlet moth)

Mature larva: Spinneret 6.0 times longer than first segment of labial palpus, highly pinched toward end. Second seta of labial palpus slightly shorter than first segment and 3.0 times longer than first seta. Seta Frl_1 located slightly closer to F_1 than to Frl_2. Seta P_1 almost on same line as Frl_2–Frl_2. Distances between Frl_2–P_1 and P_1–P_2 equal. Distance between setae II–III on thoracic shield 1.5 times greater than between III–IX. Skin smooth. Abdominal legs short; hooks uniordinal: 18–19, 20–20, 21–22, 23–25, and 26–28.

Mobility of larvae poor. Body thick, pinched toward anterior end, with small head, and reddish-yellow with admixture of dark brown. Head brown, with dark pattern of first type (Figure 48, *2*). Shields brown, with narrow, dark yellow dorsal and subdorsal bands, and minute light-colored spots at base of setae. Seate brown, acuminate, set on small light-colored round spots, and surrounded by reddish-brown pigment. Stigmata dark-colored, oval, with black edge. Legs light-colored. Pattern: dorsal band on thoracic shield continuous, narrow; seen on segments II and III in form of chain of yellowish dots; chain on abdominal segments broken at center of each; border at center of segment almost absent, fairly broad along margins, reddish-brown. Subdorsal band consists of light yellow dots and fringed with dark brown pigment. Like subdorsal band, fringe also interrupted around seta II. Dorsal field reddish-yellow, with admixture of brown because covered with large number of reddish-yellow dots and fine brown striae. In some specimens faint herringbone pattern visible. Subdorsal field almost not different from dorsal, monochromatic due to dots

and striae. Lower margin of subdorsal field fringed with thin black line. Substigmal band with distinct border only on dorsal side and covered with dark yellow dots and brown striae. Ventral side somewhat lighter in color. Body length 20 to 36 mm and width of head 2.50 to 2.70 mm.

Development: I-instar. Body of just hatched larva thick, colorless, with long, slender, colorless setae exceeding body width. Setae terminate in minute clavate thickening. Head yellow. Thoracic shield yellow, anal shield colorless. Pinacula large, high, colorless, turning brown after 1.5 to 2.0 hrs. Skin coarsely grained. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Feeding larva green, with dark-colored thoracic legs. Body length of just hatched larva 2.0 mm, before molt 4.0 mm, and width of head 0.39 mm.

II-instar. Body thick, green, with reddish tinge. Head light brown, with very dark minute spots around setae, and faint pattern of first type. Pinacula large, light brown. Shields light brown. Setae rust-colored, piliform. Skin coarsely grained. Stigmata round, light-colored, with black edge. Thoracic legs dark-colored; abdominal legs light-colored, with brown spot on outer side, and anterior pair underdeveloped. Pattern: dorsal and subdorsal bands consist of rather large white dots. Substigmal band dull white, broad, and faint. Body length 4.0 to 7.0 mm and width of head 0.54 to 0.57 mm.

III-instar. Body greenish-brownish-red, thick, short. Head light brown, with admixture of red, with brown spots around setae, and pattern of first type. Setae rust-colored, piliform, set on flat light-colored pinacula. Shields light brown, with narrow dorsal bands; spots absent at base of setae. Skin finely grained. Stigmata light-colored, first and last slightly oval, rest round. Legs light-colored; all five pairs of abdominal legs developed. Pattern: dorsal band consists of large and minute white dots. Large dots disposed along margins of segments and insignificantly fringed with dark-colored pigment. Faint herringbone branches extend from borders forward and sideways. Suprastigmal band in form of chain of minute white dots, and insignificantly fringed with very dark pigment. Substigmal band quite broad, light red, and round white spots of setae IV and V very distinct along border of band. Body length 7.0 to 12.0 mm and width of head 0.72 to 0.74 mm.

IV-instar. Body brownish-yellowish-red. Head light brown, with dark brown pattern of first type (Figure 48, *2*). Setae piliform, short, rust-colored, and set on small yellowish spots. Shields reddish-brown, with light pink dorsal bands which, at center of thoracic shield, are highly enlarged. Setae I and II set on light-colored spots, and IX and X on dark-colored background. Skin smooth. Stigmata oval, dark in color, with black edge. Thoracic legs dark-colored; abdominal legs pinkish, with large dark-

colored spot on outer side. Pattern: dorsal and subdorsal bands consist of yellowish dots of varying size. At end of segment dorsal band includes one single large dot. In subdorsal band largest dots occur at center of segment. Dorsal field brownish-yellowish-red with yellow and red dots. Subdorsal field violet-red, with yellow dots. Substigmal band violet-red, with dense, scattered, muddy yellow spots; borders of band quite distinct. Ventral side violet-pink, with light yellow dots. Body length 12 to 18 mm and width of head 1.10 to 1.20 mm.

V-instar. Larvae differ little from the VI-instar. Violet tinge still preserved on subdorsal and abdominal sides. Borders of substigmal band distinct. Dorsal band visible through entire segment, at end of segment still includes one large dot. All remaining characters same as in the VI-instar. Body length 17 to 25 mm and width of head 1.77 to 1.80 mm.

In Belorussia larval development from July through September and, after hibernation, in May. Food plants: dandelion, lady's mantle, Plantaginaceae, strawberry, *Geum*, raspberry, currant, and sorrel.

Eggs laid singly and haphazardly. They are light green, 0.78 to 0.80 mm in diameter, and 0.70 to 0.75 mm in height. Ribs 30 to 32, of which 13 or 14 reach micropylar zone. Micropylar rosette consists of 11 to 15 lobes. At end of embryonal development eggs brownish and body of larva translucent.

17. Genus *Apamea* Ochs.

Larvae large (up to 50 mm) or moderate in size, with distinct dorsal and subdorsal bands that extend onto thoracic shield; more rarely bands on body totally absent and only narrow dorsal band visible on thoracic shield. Pinacula well developed, sclerotized or not sclerotized. On meso- and metathorax seta IIIa also set on pinaculum. A characteristic feature of this group is the broad thoracic shield, which extends to setae III and IIIa, so that seta III rests at edge of shield, almost on same longitudinal line as seta IX (Figure 36, *2*). Spinneret 2.0 to 3.0 times longer than first segment of labial palpus, and attenuates gradually toward end. Mandibles short, distal part equal to proximal; ribs on inner side of mandibles bulge somewhat, but inner tooth absent. Skin slightly granulated. Hooks of abdominal legs uniordinal. Species undergoes seven molts, terminating in the VIII-instar.

Beck (1960) divided this genus into two groups: A (''monoglypha'') and B (''sordens''). His division is wholly justified based on structural features as well as on pattern. Like him, we include the species *A. monoglypha* and *A. lateritia* in group A, and *A. crenata* and *A. sordens* in group B.

Key to Groups

1 (2). Oblong bands absent on body; narrow band present only on thoracic shield. First segment of labial palpus 2.0 times longer than its width. Distance between setae P_1–Frl_2 considerably less than between P_1–P_2..... Group A.

2 (1). Oblong bands present on body. First segment of labial palpus 2.5 to 3.0 times longer than its width. Distance between setae P_1–Frl_2 about 1.5 times greater than between P_1–P_2..... Group B.

Key to Species of Group A

1 (2). Body muddy yellow, with slight violet tinge. Middle of dorsal field reddish..... 1. **A. monoglypha** Hufn.

2 (1). Body dark gray, without violet tinge.... 2. **A. lateritia** Hufn.

1. **Apamea monoglypha** Hufn. (large field owlet moth)

Mature larva: Distances between setae Frl_1–Frl_2 and Frl_1–F_1 equal. Seta P_1 located on same line as Frl_2–Frl_2. On metathorax pinacula IV–V contiguous. Distance between metathoracic coxae 2.0 times less than between setae VIII–VIII. On segment 6 distance between pinacula IV–V, 2.0 times more than between III–IV. On segment 10 distance between pinacula IV–V less than between V–VI. Pinacula I and II on abdominal segments large, almost identical, insignificantly smaller than pinaculum III. Hooks of abdominal legs: 19–20, 20–20, 20–21, 20–21, and 21–22.

Body muddy yellow, with faint violet tinge and reddish shaded pigment on dorsal side. Head reddish-brown, darker on bulges of hemispheres, without pattern. Pinacula dark brown, almost black, round, sclerotized, and large (diameter of II on segment 2—0.51 mm). Setae brownish, highly acuminate, long. Shields dark brown, almost black, broad. Stigmata dark brown, oval, narrow. Legs yellowish. Pattern: dorsal band narrow, light-colored, prominent only on thoracic shield. All other bands totally absent. Center of dorsal field and partly subdorsal covered with transverse reddish spot. Reddish pigment gradually intensifies toward end of body. Ventral side dull yellow. Body length 32 to 50 mm and width of head 4.0 to 4.5 mm.

Development: I-instar. Just hatched larva somewhat pinched toward posterior end, with distinct segments and broad prothorax, which exceeds width of head. Body whitish, translucent with visible brown intestine. Head with deep parietal notch, light brown, lustrous. Shields broad, brown, thoracic not fully sclerotized (Figure 59). Pinacula small (0.007 mm), not sclerotized. After 1.5 to 2.0 hrs apices of pinacula turn brown. Sclerotization of thoracic shield continues for three or four days. Setae light-colored, slender, highly acuminate. Stigmata light-colored, round, with brown

margin. Thoracic legs dark-colored; abdominal legs light-colored, underdeveloped on segment 3, normal on segment 4. Body of feeding larva yellowish, with light-colored, almost nonsclerotized pinacula. Skin coarsely grained. Body length of just hatched larva 1.55 to 1.56 mm, before molt 2.5 to 3.0 mm, and width of head 0.266 mm.

II-instar. Body yellowish-pink. Head brown, with deep parietal notch. Shields brown, broad. Pinacula not sclerotized, in form of light-colored tubercles. Setae light-colored, acuminate, and long. Stigmata round, light-colored, with brown edge. Thoracic legs dark-colored; abdominal legs light-colored and anterior pair underdeveloped. Pattern absent. Body length 2.5 to 5.0 mm and width of head 0.43 to 0.45 mm.

III-instar. Larva differs from the II-instar in stigmata with slightly oval form and all five pairs of abdominal legs developed. Body length 3.5 to 8.0 mm and width of head 0.68 to 0.75 mm.

IV-instar. Body pale yellowish-pink. Head reddish-brown, darker on bulges of hemispheres. Shields brown. Pinacula large (0.137 mm), brown. Setae colorless, long (0.65 mm). Stigmata dark-colored, oval, with thin black edge. Thoracic legs yellow; abdominal legs light-colored, with large gray spot on inner side. Pattern: dorsal band light-colored, narrow, prominent on thoracic shield and in anterior part of some abdominal segments. Subdorsal band not prominent. Substigmal band narrow, light-colored, faint. Dorsal and subdorsal fields with rust-colored bloom that intensifies in posterior part of segment. Body length 6.0 to 12.0 mm and width of head 1.07 to 1.10 mm.

V-instar. Larva differs from the IV-instar in that rust-colored bloom in dorsal and subdorsal fields of abdominal segments takes on admixture of brown pigment. "Bloom" absent on thoracic segments. Ventral side straw-yellow. Body length 10 to 18 mm and width of head 1.40 to 1.45 mm.

VI-instar. Body yellowish-green. Head reddish-brown, with very dark but faint pattern of first type (Figure 48, *2*). Pinacula round, fairly well sclerotized, and large (0.294 mm); I and II almost equal in size. Setae brown, highly acuminate. Seta I almost 2.0 times shorter than II and III; seta III on segment 2 reaches 0.823 mm in length. Shields brown along edges, brownish-yellow at center. Stigmata and legs same as in the V-instar. Pattern: dorsal band narrow only on thoracic shield. Other bands absent. Dorsal and subdorsal fields of thoracic segments yellowish-green, of abdominal segments with brownish-red bloom that gradually intensifies toward posterior end of body. Body length 16 to 24 mm and width of head 2.10 to 2.20 mm.

VII-instar. Larva hardly differs from the VIII-instar. Pinacula slightly less sclerotized and lighter in color. Reddish pigment faintly visible on

thoracic segments. Sutures of adfrontal sclerites just perceptible. Body length 22 to 33 mm and width of head 2.7 to 3.0 mm.

Form found in Belorussia very close to that described by Beck (No. 258) and differs mainly in presence of large pinacula.

Commencing from the III-instar, the larvae builds a cocoon from plant residue before molting, or glues leaves into a light capsule. Larvae of V- and VI-instars hibernate. In Belorussia larval development from July until autumn and, after hibernation, in May. Food plants: ryegrass, reed grass, orchard grass, brome grass, and wheat. Larvae of younger instars live in plant stalks and those of older instars on roots.

Eggs laid behind leaf sheaths. They are pale yellow, 0.581 to 0.588 mm in diameter, and 0.265 to 0.282 mm in height. Ribs sinuous, 46 to 48, of which 28 to 32 reach micropylar zone. Micropylar rosette consists of 10 to 12 lobes.

2. **Apamea lateritia** Hufn. (reddish-brown field owlet moth)

Mature larva: Distances between setae Frl_1–Frl_2 and Frl_1–F_1 almost equal, and between Frl_2–P_1 somewhat less than between P_1–P_2. Distance between setae I–I on thoracic shield 1.5 times less than between X–X. Distance between metathoracic coxae and setae VIII–VIII equal. Pinacula IV and V contiguous on segment III. Hooks of abdominal legs: 14–15, 14–17, 16–17, 17–19, and 18–20.

Body dark gray, with admixture of brown. Pinacula dark brown, large; diameter of pinaculum II on segment 2—0.44 mm; pinaculum III larger than II and pinaculum I smaller. Head reddish-yellow, without pattern; few striae faintly visible on bulges of hemispheres, sometimes absent. Shields broad, brown. Setae dark brown, sharply acuminate. Stigmata oval, dark brown, with black edge. Legs light-colored. Pattern almost totally absent. Narrow dorsal band prominent only on thoracic shield. Ventral side light gray. Body length 23 to 29 mm and width of head 2.60 to 2.80 mm. Larva recorded on October 10, 1962. Presumably this represented the penultimate instar. Hibernating larvae were not successfully preserved [reared].

Development: I-instar. Just hatched larva short, thick, colorless, translucent with visible reddish intestine, somewhat pinched toward posterior end. Head brown, with faint but very dark pattern of first type. Pinacula large, colorless, turn brown apically within 60 to 90 min. Thoracic shield dark brown, anal shield light-colored. Setae rust-colored, acuminate, long. Skin coarsely grained. Stigmata round, light-colored, with thin brown edge. Throacic legs dark-colored; abdominal legs light-colored and underdeveloped on segments 3 and 4. Body of feeding larva pale yellow, with distinct segments. Head almost black. Body length of just hatched larva 1.53 to 1.55 mm, before molt 2.50 to 2.80 mm, and width of head 0.255 mm.

II-instar. Body yellowish. Head dark brown, without pattern. Shields brown, broad. Pinacula quite large, light-colored, around insertions of setae brownish. Setae light-colored, distinctly acuminate. Skin coarsely grained. Stigmata light-colored, round, with thin dark edge. Legs light-colored; abdominal legs on segment 3 underdeveloped. Pattern: dorsal band narrow, extends only along thoracic shield. Other bands absent. At center of dorsal field of abdominal segments accumulation of hazy yellow pigment in form of broad, shaded, transverse smear extends slightly onto subdorsal field. Body length 3.0 to 5.8 mm and width of head 0.48 to 0.54 mm.

III-instar. Body straw-yellow, thick, short. Head brownish-reddish-yellow, without pattern. Shields yellowish-brown, highly sclerotized, broad. Pinacula yellowish, not sclerotized, surrounded by pigment much lighter in color than body background. Setae rust-colored, slender, acuminate. Stigmata oval, dark-colored, with black edge. Thoracic legs grayish-yellow; abdominal legs colorless, all five pairs developed. Pattern: dorsal field, as in the II-instar, noticeable only on thoracic shield. At center of dorsal field, dull yellow transverse smears become somewhat broader and in some specimens take on faint pink tinge. In zone of subdorsal band on abdominal segments, smears often interrupted and create impression of presence of broken subdorsal band. Substigmal band not visible; only boundary between darker dorsal side and straw-yellow ventral side visible. Body length 5.0 to 10.0 mm and width of head 0.82 to 0.88 mm.

IV-instar. Body yellowish, with gray shade. Head pinkish-yellow, with brown spots at base of setae, and pinkish submedian and supraocular bands. Pattern on trunk differs from the III-instar in that transverse oblong smears on dorsal and subdorsal fields take on gray tinge and fainter on general, slightly grayish background. Smears almost not interrupted in region of subdorsal band. Body length 8.0 to 15.0 mm and width of head 1.10 to 1.20 mm.

V-instar. Body brownish, in some specimens dark brown with violet tinge. Head reddish-yellow, slightly darker on bulges of hemispheres. Shields brownish-yellow, highly sclerotized, large. Pinacula large and brown. Setae light brown, distinctly pointed. Stigmata dark-colored, with black narrow edge. Legs brownish-yellow. Pattern: narrow dorsal band visible only on thoracic shield. Subdorsal band altogether absent. Zone of substigmal band somewhat lighter in color than general body background. Transverse smears at center of dorsal and subdorsal fields not visible, but margins of segments slightly lighter in color than at center. Ventral side significantly lighter in color than dorsal. Body length 13 to 20 mm and width of head 1.59 to 1.70 mm.

VI-instar. Larva does not differ from preceding instar and there are no dark brown specimens in this instar. Body color more often grayish-

brown. Body length 17 to 25 mm and width of head 2.06 to 2.16 mm.

From the II-instar, before molting, larvae build light cocoon of plant residue and cobwebs in which they molt. In Belorussia larval development from July to autumn and, after hibernation, in May. Younger instars feed inside plant stalks and older instars on roots. Food plants: foxtail, timothy, orchard grass, brome grass, and reed grass.

Eggs laid on back of leaf sheaths. They are greenish-yellow, 0.614 to 0.630 mm in diameter, and 0.332 to 0.365 mm in height. Ribs 48 to 50, of which 28 to 32 reach micropylar zone. Micropylar rosette consists of 12 to 16 lobes.

Key to Species of Group B

1 (2). Dorsal band broad, white, even; subdorsal slightly narrower than dorsal, dull white. Dorsal field ash-gray, with brown striae.... ..... 2. **A. sordens** Hufn.

2 (1). Dorsal band narrow, white, even; subdorsal broad, brownish-yellow. Dorsal field light brown, with violet tinge..... ..... 1. **A. crenata** Hufn.

3. **Apamea crenata** Hufn. (syn. *rurea* F.) (field owlet moth)

Mature larva: Second seta of labial palpus slightly shorter than first segment and 2.5 times longer than first seta. Distances between setae Frl_1–Frl_2 and Frl_1–F_1 equal, but between Frl_2–P_1 greater than between P_1–P_2 by 1.5 times. Seta III on prothorax rests on edge of thoracic shield. On segment I pinacula III and IV contiguous. On segment 2 seta VIIb very close to longitudinal line of disposition of setae VIIa. Hooks of abdominal legs: 20–22, 24–25, 24–25, 30–31, and 35–37.

Body yellowish-grayish-brown, with violet tinge, somewhat pinched toward anterior end. Head light brown, with reddish tinge and darker brown pattern of second type (Figure 49, *5*). Shields brownish-black. Dorsal and subdorsal bands extend along shields. Anal shield brownish-black only between dorsal and subdorsal bands; significantly lighter colored along outer side of subdorsal band. Pinacula black; I and II smaller than III and V. Setae light brown, acuminate. Stigmata light brown, oval, with black margin. Thoracic legs yellowish, abdominal legs with admixture of gray. Pattern: dorsal band narrow, with fairly broad brownish borders with violet tinge which, at center of segment, enlarge to form faint rhombic spots at center of dorsal field. Subdorsal band considerably broader than dorsal, violet-yellow, with fine sparsely scattered, light brown striae. On subdorsal field striae considerably denser. Substigmal band broad, densely covered with whitish and yellowish dots and brownish striae. Ventral side gray, with whitish dots. Body length 25 to 37 mm and width of head 2.70 to 3.20 mm.

Development: I-instar. Body of just hatched larva colorless, translucent with visible reddish-yellow intestine, somewhat pinched toward posterior end. Segment 1 equal in width to head. Head blackish-brown, with deep parietal notch. Thoracic shield light brown, broad, reaches setae III and IIIa. Pinacula small and colorless. Setae light-colored, not pointed, almost piliform. Skin coarsely grained; granules in form of short papillae. Thoracic legs dark-colored; abdominal legs light-colored, almost normally developed on segments 3 and 4. Body of feeding larva pale yellow. Pinacula around setal insertions brownish. Body length of just hatched larva 1.4 mm, before molt 2.5 mm, and width of head 0.26 mm.

II-instar. Body yellowish-pink. Head dark brown. Shields dark brown, broad. Pinacula minute, apices dark-colored. Setae light-colored, short, not pointed. Stigmata light-colored, round, with light brownish margin. Thoracic legs dark-colored; abdominal legs light-colored and all five pairs developed. Pattern: dorsal and subdorsal bands quite broad, white, continuous, with even margins. Substigmal band white, not broad, faint. Body length 2.50 to 4.50 mm and width of head 0.37 to 0.38 mm.

III-instar. Body rust-colored, with light-colored bands. Head dark yellow, without pattern. Shields brown; width of dorsal and subdorsal bands extending along shields same width as on back. Pinacula small, dark brown, surrounded by ring of light-colored pigment, including also microscopic seta X. Stigmata round, light-colored, with black edge. Thoracic legs dark-colored, abdominal legs light-colored. Pattern: dorsal and subdorsal bands whitish, rather broad, identical, and even. Substigmal band broad, white. Ventral side yellowish. Body length 4.0 to 7.2 mm and width of head 0.52 to 0.53 mm.

IV-instar. Larva differs from the III-instar in dorsal band slightly narrower than subdorsal. Around dorsal band light brown borders faintly visible. Stigmata of segments I and 8 somewhat oval. Body length 7.0 to 12.0 mm and width of head 0.71 to 0.72 mm.

V-instar. Body yellowish-red, with violet tinge. Head reddish-yellow, with very dark but faint pattern of second type. Shields light brown, with white dorsal and subdorsal bands identical in width. Pinacula not large, brown. Setae light brown, acuminate. Stigmata oval, dark yellow, with black edge. Thoracic legs brownish-yellow, abdominal grayish-yellow. Pattern: dorsal band not broad, white, with even brownish borders. Dorsal field yellowish-red, with violet tinge. Subdorsal band broader than dorsal, dull white, slightly fringed with brownish pigment. Subdorsal field brownish-gray, with faint violet shade, darker along lower margin. Substigmal band broad, white, with distinct margins. Ventral side grayish-yellow. Body length 11 to 16 mm and width of head 1.05 to 1.10 mm.

VI-instar. Pattern of second type more distinct on head. Dorsal band quite narrow, white, with even brown borders, broad on shields. Subdorsal band considerably broader than dorsal, violet-yellow, with faint light brown borders. Substigmal band broad, yellowish. All other characters same as in the V-instar. Body length 15 to 20 mm and width of head 1.40 to 1.60 mm.

VII-instar. Larva almost indistinguishable from the VIII-instar, but rhombic spots on dorsal field formed by borders of dorsal band very faint. In some specimens spots altogether indistinguishable, and borders of dorsal band notably shaded. Body length 18 to 28 mm and width of head 2.0 to 2.2 mm.

In Belorussia larval development from July to autumn and, after hibernation, in April and May. Food plants: hair grass or tussock grass, ryegrass, and reed grass.

Eggs laid on back of leaf sheaths. They are light yellow, flat, 0.55 to 0.60 mm in diameter, and 0.30 to 0.33 mm in height. Ribs absent; only reticulate structure and longitudinal striae of grid pattern present almost at equator.

4. **Apamea sordens** Hufn. (syn. *basilinea* Schiff.) (rustic shoulder-knot moth)

Mature larva: Distance between setae Frl_2–Frl_1 and Frl_1–F_1 almost equal. Seta III on prothorax located at edge of thoracic shield almost on same longitudinal line as seta IX (Figure 36, *2*). Distance between setae II–III greater than between III–IX, and between I–I less than between X–X. Distance between setae II–III on segment III, 2.0 times greater than between I–II. On segments 1 to 6 pinaculum III larger than IV; setae I and II smaller than III, almost identical. Hooks of abdominal legs: 16–17, 17–18, 18–19, 19–20, and 24–25.

Body ash-gray, with brown pattern. Head dark yellow, with dark brown, almost black pattern of second type (Figure 49, *5*). Shields brown, velvety, with broad white dorsal and subdorsal bands. Pinacula I, II, and III dark brown or black, IV and V lighter in color. On ventral side pinacula faint. Setae brownish, long (up to 1.0 mm), slender. Stigmata gray, oval, with black edge. Thoracic legs yellowish, abdominal legs light-colored. Pattern: dorsal band pale yellow, fairly broad, even. Subdorsal band somewhat narrower than dorsal, dull white, faint. Dorsal field covered with fine brown striae which group more around dorsal band, forming its borders, and more densely scattered at center of segment, but do not form rhombic spot on dorsal field (Figure 83, *6*). Subdorsal field also covered with brown striae; here striae more dense along lower margin. Substigmal band broad, yellowish; lower border indistinct so that band differs little from yellowish ventral side. Skin covered with minute,

longitudinal, milk-white spots, which are particularly prominent on dorsal field. Dark-colored striae do not fringe these spots but are superimposed on them. Body length 24 to 36 mm and width of head 2.75 to 3.22 mm.

Development: I-instar. Just hatched larva colorless, slightly pinched toward posterior end; prothorax almost as wide as head. Head black, with deep parietal notch. Thoracic shield light brown, broad, reaches setae III and IIIa. Pinacula minute, colorless. Setae light-colored, slightly pointed. Skin coarsely grained. Thoracic legs dark-colored; abdominal legs light-colored and almost developed on segments 3 and 4. Body of feeding larva pale yellow, with light-colored unsclerotized pinacula. Body length of just hatched larva 1.46 mm, before molt 2.70 mm, and width of head 0.278 mm.

II-instar. Body pinkish-yellow, thick, short. Head brownish. Shields light brown, broad. Pinacula small and gray. Setae light-colored, slightly pointed. Stigmata light-colored, round, with a brown margin. Thoracic legs dark; abdominal legs light-colored, and all five pairs developed. Pattern: dorsal and subdorsal bands fairly broad, white, even. Substigmal band somewhat broader with indistinct borders, whitish. Ventral side yellowish. Body length 2.50 to 4.80 mm and width of head 0.368 to 0.391 mm.

III-instar. Larva differs from the IV-instar in distinct broad white substigmal band, which in the II-instar is faint. Body length 4.50 to 7.70 mm and width of head 0.520 to 0.585 mm.

IV-instar. Body pinkish-yellow. Head brownish-yellow, with faint, very dark pattern of first type (Figure 48, *2*). Shields light or dark brown, with broad light-colored dorsal and subdorsal bands. Pinacula dark brown, sometimes almost black. Skin finely grained. Setae rusty-red, acuminate. Stigmata on segments I and 8 somewhat oval, others circular, all light-colored, with black edge. Thoracic legs yellowish; abdominal legs light-colored, with large brown spots on outer side. Pattern: dorsal and subdorsal bands white or slightly yellowish, without [contrasting] borders; dorsal band somewhat broader than subdorsal. Dorsal and subdorsal fields reddish-yellow. Small accumulation of brown pigment seen along lower margin of subdorsal field. Substigmal band broad, light yellow, with distinct borders above and below. Ventral side lighter than dorsal. Body length 6.0 to 12.0 mm and width of head 0.766 to 0.784 mm.

V-instar. Body cylindrical, even, straw-yellow, with reddish tinge. Head yellow, somewhat darker than body, with extremely faint pattern of first type. Shields yellow, distinctly sclerotized. Pinacula fairly large, weakly sclerotized, light-colored. Setae light-colored, acuminate, short. Stigmata oval, dark-colored. Legs light-colored. Pattern: dorsal and sub-

dorsal bands pale yellow, rather broad; dorsal band slightly broader than subdorsal. Dorsal field somewhat darker than band. Accumulation of brownish pigment seen on subdorsal band in lower part. Substigmal band yellow, broad, not differing in color from ventral side, but borders quite distinct. Body length 10 to 17 mm and width of head 0.98 to 1.10 mm.

VI-instar. Body yellowish, with faint reddish tinge. Head light yellow, with distinct light brown pattern of second type (Figure 49, *5*); shields and pinacula light brownish. Dorsal field with fine brownish striae scattered here and there. On subdorsal field striae notably denser along lower margin. Pattern same as in the V-instar. Body length 16 to 21 mm and width of head 1.48 to 1.67 mm.

VII-instar. Larvae do not differ from the VIII-instar. Dark-colored striae on dorsal and subdorsal fields somewhat fewer. Body length 19 to 29 mm and width of head 2.20 to 2.30 mm.

In Belorussia larval development from June to autumn; pupation after hibernation. Food plants: cereals. Damage rye and wheat, more rarely barley and maize.

Eggs laid on back of scales of plant spikelets, close together, in irregular rows. They are light yellow, rather flat, 0.477 to 0.520 mm in diameter, and 0.347 to 0.370 mm in height. Ribs extremely flat, faint at equator, and all 34 to 36 reach micropylar zone. Micropylar rosette consists of 14 to 16 lobes.

18. Genus *Mesapamea* Hein.

Mesapamea secalis L. (common rustic moth)

Mature larva: Seta Frl_1 located closer to Frl_2 than to F_1. Seta III on prothorax closer to thoracic shield (Figure 36, *3*). Between setae II–III distance 2.0 times greater than between III–IX; between I–I distance less than between X–X. Seta V on prothorax microscopic, almost indistinguishable. Pinacula small, flat, unsclerotized. On abdominal segments pinacula I–II almost identical in size; pinaculum IV significantly larger than III. Hooks of abdominal legs: 12–13, 13–14, 15–16, 15–17, and 18–19.

Body slightly pinched toward ends, fusiform, dull green or grayish-green. Head brownish-yellow with very dark, slightly visible reticulate structure. Sometimes pattern totally absent. Pinacula almost unsclerotized, small, flat, and larger on thoracic segments. Setae rust-colored, acuminate. Shields broad, brownish-yellow, thoracic sometimes fringed with fine brown striae; anal shield rugulose. Stigmata yellow, oval, with thin black edge. Thoracic legs yellowish, abdominal legs light green. Pattern: dorsal and subdorsal bands narrow, continuous, greenish-white. Dorsal field rather narrowly fringed with light brown pigment; subdorsal faintly fringed

above and more intensely below. Dorsal field reddish, with slight violet tinge. Subdorsal field green, with insignificant admixture of yellowish-pink. Dorsally, setae III stand out slightly from greenish-white suprastigmal band. Substigmal band yellow, not broad. Ventral side green. Body length 18 to 30 mm and width of head 2.40 to 2.60 mm.

I-instar. Body of just hatched larva colorless, translucent with visible yellowish intestine. Head dark brown. Pinacula small, colorless. Shields yellowish. Thoracic legs dark; abdominal legs light-colored and underdeveloped on segments 3 and 4. Stigmata round, light-colored, with brownish edge. Body of feeding larva pale yellow, almost white, with colorless pinacula. Setae light-colored, piliform. Shields yellowish. Skin homogeneously coarsely grained. Body length of just hatched larva 1.138 mm and width of head 0.217 mm.

In Belorussia larval development in August and September and, after hibernation, in May. Larvae of the I-instar hibernate. Food plants: cereals. Damage rye, wheat, and also meadow grasses.

Eggs laid on back of leaf sheaths in two to four imbricate rows. They are light yellow, flat, 0.54 mm in diameter, and 0.225 mm in height. Ribs faint, 40 to 42, and all reach micropylar zone. Chorion gradually takes on brownish-red coloration. Before larvae hatch eggs gray, with head of larva dark, translucent.

19. Genus *Luperina* Bśd.

(one species in Belorussian fauna)

Luperina testacea Schiff. (yellowish-brown meadow owlet moth)

Mature larva: Spinneret 3.5 times longer than first segment of labial palpus, highly pinched toward end, with smooth opening. Second seta of palpus 2.0 times less length of first segment and 2.0 times longer than first seta. Setae P_1 on head on same line as setae Frl_2–Frl_2; seta P_2 shifted more toward epicranial suture than P_1; distance between setae Frl_1–Frl_2 less than between Frl_1–F_1. Mandibles large, with reduced dorsal teeth; inner tooth absent. Setae M_1 and M_2 contiguous; distance between M_1–M_2 about 0.33 distance between M_2–M_i. Seta V on prothorax microscopic, barely distinguishable. Thoracic shield broad, reaches seta III; latter right on edge of shield, but ventral to seta IX. Anal shield with carinate growths—along posterior edge and at center; setae II and III located at back of crest (Figure 84, *3*). Abdominal legs short, with faint hooks: 6–8, 9–10, 11–12, 11–13, and 15–18.

Body pinched toward posterior end, reddish-yellow, with admixture of gray. Head hazy yellow, with light brown pattern of first type (Figure 48, *2*). Thoracic shield yellowish-brown, its anterior part darker. Anal shield and almost all of segment 9 in dorsal part yellowish-brown. Setae

rusty-brown, short, very slender, acuminate; spots absent at their base. Stigmata reddish-yellow, oval, with thin black edge. Legs reddish-yellow. Pattern: dorsal band on thoracic shield whitish, narrow, on trunk brown, somewhat shaded. Subdorsal band whitish-gray, interrupted, almost totally covered with light brown striae on margin; upper border somewhat shaded, darker and broader than lower one. Dorsal and subdorsal fields reddish-yellow. Substigmal band grayish-yellow and almost indistinguishable from ventral side, which is similar in color. Basal field with sparse, fine light brown striae. Body length 24 to 35 mm and width of head 3.20 to 3.50 mm.

In Belorussia larval development in September and, after hibernation, until early July. Larvae of II- and III-instars hibernate. Food plants: cereals. Younger instars feed inside stalks of cereal plants, while older instars live on the soil and feed on roots and stalks. Evidently larvae also feed on dicotyledonous plants. In early July, 1954 we observed significant damage to tobacco crops in collective farms in Grodnensk. Larvae had riddled the stalks around the neck of the root.

Female lays eggs on back of leaf sheaths of cereal plants. Eggs pale yellow, with very tender shell, on which only reticulate structure discernible; ribs absent. Diameter of eggs 0.70 to 0.72 mm and height 0.40 to 0.43 mm. Micropylar rosette consists of 12 to 14 lobes.

20. Genus *Amphipoea* Billb.

(one species investigated)

Amphipoea fucosa Frr. (syn. *paludis* Tutt.) (spring owlet moth)

Mature larva: Setae IIIa and V on prothorax extremely minute, with extremely minute pinacula. Distance between setae I–I on thoracic shield 1.5 times less than between X–X, and between II–III almost 2.5 times more than between III–IX. Pinacula large; I and II on segments 1 to 6 identical; pinaculum III slightly larger, its diameter on segment 2—0.303 to 0.315 mm; pinaculum IV on segments 1 to 6—4.0 or 5.0 times more than pinaculum III; pinaculum IIIa—2.0 times less than stigmata. Distances between pinacula III–IIIa and III–IV equal. Hooks of abdominal legs: 14–15, 14–16, 16–17, 17–18, and 18–19.

Body grayish-yellow. Head reddish-yellow, with faint submedian band perceptible around apex of frons in form of oblong spot; reticulate structure faint. Setae rust-colored, acuminate, short. Pinacula cinnamon-brown, large; pinacula II on segments 8 and 9 highly stretched transversely. Shields greenish-yellow, with dark brown anterior rim or surrounded by dark-colored pigment from all sides. Thoracic shield with narrow dorsal band; bands absent on anal shield. Stigmata dark brown, with black edge. Thoracic legs light yellow, abdominal legs grayish. Pattern: dorsal and subdorsal bands broad, grayish-white, sometimes with faint bluish tinge.

Fringe of dorsal band quite broad, with reddish-brown pigment and lilac tinge. Subdorsal band with similar border on dorsal side. Borders of dorsal and subdorsal bands almost merge. Ventral border of subdorsal band narrow. Lower margin of subdorsal field same color as border of band. Substigmal band same color as dorsal and subdorsal bands; upper border distinct since it joins dark-colored subdorsal field, but lower border not distinct; band does not differ greatly in color from grayish ventral side. Body length 22 to 30 mm and width of head 2.9 to 3.0 mm.

Development: I-instar. Just hatched larva with broad thoracic segments (I equal to width of head), light-colored, pale yellow, translucent with visible pinkish intestine. Head and thoracic shield brownish; pinacula light-colored, small. Skin coarsely grained. Body color of feeding larva does not alter, except that pinacula sometimes take on grayish tinge. Length of just hatched larva 1.29 mm, before molt 1.70 to 1.80 mm, and width of head 0.13 to 0.15 mm.

II-instar. Body dull yellow, slightly pinched toward posterior end. Head dull yellow. Thoracic shield yellowish, distinctly sclerotized. Pinacula minute, grayish, extremely faint. Setae rust-colored, somewhat pointed. Stigmata dull yellow, round, with brownish margin. Skin coarsely grained. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal, subdorsal, and other bands of base color and hence not prominent; borders of bands partly visible as accumulation of light brown pigment along body between setae I–II, dorsal to pinaculum III, and along line of pinaculum IV. In basal field accumulation of brown pigment in form of scattered spots. Body length 1.70 to 3.70 mm and width of head 0.285 to 0.350 mm.

III-instar. Body pale yellow. Head brownish-yellow. Pinacula minute, light gray, light brown at end of instar. Setae rust-colored, slightly pointed. Shields surrounded by reddish-brown pigment. Stigmata light-colored, round, with black edge. Legs light-colored; abdominal legs on segment 3 underdeveloped. Pattern same as in the II-instar. Dark-colored pigment in lower region of subdorsal field above stigmata shifted upward to form light-colored cells for stigmata. Body length 3.40 to 6.20 mm and width of head 0.542 to 0.586 mm.

IV-instar. Body light green or greenish-yellow. Head yellowish, with faintly visible brownish-yellow spots around setae. Setae light-colored, short, somewhat pointed. Pinacula light-colored, brownish at apex; IX and X on prothorax and I on anal shield very large. Shields yellowish, fringed with brownish pigment. Stigmata oval, yellowish-brown, with black edge. Legs light-colored; all five abdominal pairs developed. Skin finely grained. Pattern: dorsal band broad, whitish, with bluish tinge, broadly fringed with brownish pigment. Subdorsal band slightly narrower than

dorsal; upper brownish border almost meets border of dorsal band. Against dark-colored background of borders light-colored pinacula with dark-colored apices quite distinct. Border of subdorsal band on lower side narrow. Lower part of subdorsal field brownish, with light-colored cells around stigmata. Substigmal band broad, pale yellow; upper part of basal field brownish. Ventral side yellowish-green. Body length 6.0 to 9.3 mm and width of head 0.715 to 0.758 mm.

V- and VI-instars. Larvae of these instars do not differ from the IV-instar in pattern. Head in the V- and VI-instars light yellow; in the V-instar minute brownish spots still preserved, which are totally absent in the VI-instar, and yellow pigment on bulges of hemispheres more vivid. In the V-instar pinaculum IV very prominent in size and in the VI-instar more than 2.0 times size of pinaculum III; pinaculum V smaller than IV but far larger than III. Pinacula of larvae of both instars not fully pigmented, slightly corrugated. Body length in the V-instar 8.0 to 13.0 mm and width of head 1.09 to 1.18 mm; in the VI-instar body length 12 to 18 mm and width of head 1.52 to 1.78 mm.

VII-instar. Body grayish-white, with lilac tinge. Head reddish-yellow; color more vivid on bulges of hemispheres. Pinacula entirely pigmented, large, their size ratios same as in the VIII-instar. Body pattern also same as in VIII-instar. Body length 17.0 to 24.5 mm and width of head 2.20 to 2.30 mm.

In Belorussia larval development in May and June. Eggs hibernate. Food plants: cereals. Often damage spring cereal crops.

Eggs laid on back of leaf sheath or on stubble, in two or three rows. They are pale yellow, almost white, 0.664 to 0.672 mm in diameter, and 0.464 to 0.498 mm in height. Ribs 54 to 56, of which 28 to 30 reach micropylar zone. Micropylar rosette consists of 14 to 16 lobes. Initially, chorion takes on hazy pink coloration, but later turns yellowish-brown.

21. Genus *Hydraecia* Gn.
(one species investigated)

Hydraecia micacea Esp. (potato stem borer)

Mature larva: Setae IIIa and V on prothorax not reduced; setae III and IIIa located below seta IX. Distance between setae I–I less than between X–X by 2.0 times; between II–III distance 1.5 times more than between III–IX. Metathoracic coxae not contiguous; distance between them equal to distance between setae VIII–VIII. Hooks of abdominal legs indistinctly biordinal (Figure 24, *3*), and occupy half circumference of planta: 17–19, 18–20, 18–22, 18–22, and 20–22.

Body slightly pinched toward anterior end, light yellow, with admixture of red. Head rust-colored or rusty-brown, and without pattern; often

bulges of hemispheres darker in color. Shields dark brown or brown, with slight admixture of red; thoracic shield darker in color along edges than at center. Pinacula dark brown or brown; on segments 1 to 6 pinaculum I much larger than pinaculum II. Setae rust-colored, short, slightly pointed. Stigmata oval, black, with blackish edge. Legs pinkish-yellow. Pattern: dorsal band very narrow, of base color, with narrow brownish-red borders, which extends onto thoracic shield, but absent on anal shield. Subdorsal band not visible. Substigmal band pinkish-yellow, not broad, almost indistinguishable from similar color of ventral side. Reddish pigment often accumulates at center of dorsal and partly subdorsal fields, especially on abdominal segments; pigment forms broad shaded smears stretched transversely. Body length 29 to 43 mm and width of head 3.10 to 3.30 mm.

In Belorussia larval development in May and June; eggs hibernate. Food plants: sedge, reeds, manna grass, pond dock, iris, and butter burr. Larve often damage potato and hops and are predaceous.

Eggs laid on back of leaf sheaths in two to four rows. They are hemispherical, pale yellow, 0.68 to 0.76 mm in diameter, and 0.40 to 0.42 mm in height. Ribs extremely small, 120 to 125; between 60 to 70 reach micropylar zone. Micropylar rosette consists of 15 to 17 lobes.

Subfamily Cuculliinae

Larvae moderate in size, often with variegated pattern on trunk. Characteristic feature of pattern—substigmal band extends not onto anal leg, as in species of other subfamilies, but toward anal shield and surrounds it (Figure 62, *2*). Pattern on head of first type (Figure 48); more rarely head without pattern. Setae on head in some species set on black spots, which are sometimes very large (Figure 48, *6*). Spinneret considerably pinched toward end, 1.5 to 5.0 times longer than first segment of labial palpus (Figure 17, *1*), round, and thin in species of *Cucullia*. Spinneret opening even, without fringe and dents. Seta III on segment 9 as strong as I and II or slightly weaker, but not piliform. Skin either smooth, granulated, rugulose, or covered with spines (some species of the genus *Amphipyra*). Abdominal legs five pairs, with hooks uniordinal or biordinal. Number of molts five (four in *Calophasia lunula* L.).

The genera *Lithophane, Eupsilia, Conistra, Blepharita, Xylena,* and *Cirrhia* have been placed by several researchers in the subfamily Cuculliinae; we included them in the subfamily Zenobiinae since they correspond more to this subfamily in structural features. On the same basis, the genus *Amphipyra* of the subfamily Zenobiinae has been included by us in the subfamily Cuculliinae.

Key to Genera

1 (2). Hooks of abdominal legs biordinal. Spinneret 3.0 to 5.0 times longer than first segment of labial palpus. Pinacula not sclerotized, sometimes very large, in form of projections [chalazae] (Figure 30) or highly sclerotized, and often surrounded by black pigment (Figure 80, *5–6*). Seta P_1 shifted posterior to line of Frl_2–Frl_2. Body light-colored, with admixture of bright shades, and often complex pattern (Figure 80, *1–3*), more rarely dark colored. Pattern on head of first type (Figure 48, *1, 3, 6*).... 2. **Cucullia.**

2 (1). Hooks of abdominal legs uniordinal. Spinneret 1.5 to 2.0 times longer than first segment of labial palpus. Seta P_1 located on same line as Frl_2–Frl_2. Pinacula and prominences absent on body.

3 (4). Spinneret 1.5 times longer than first segment of labial palpus. Light-colored background of body covered with black spots, stretched transversely on dorsal field (Figure 80, *4*). Pattern on head of first type (Figure 48, *6*)..... 3. **Calophasia.**

4 (3). Spinneret 2.0 times longer than first segment of labial palpus. Larvae green, with light-colored dorsal bands. Head without pattern or with white pattern of first type (Figure 48, *1*)..... ..... 1. **Amphipyra.**

1. Genus *Amphipyra* Ochs.

Body of larva green, slightly pinched toward anterior end, and in some species with highly enlarged segment 8. Head coarsely granulated or smooth, without pattern, or with white pattern of first type. Pattern on trunk consists of white or yellowish bands. Subdorsal band on segment 8 flexed above stigma in form of obtuse angle. Substigmal band extends not toward anal leg but envelops anal shield (Figure 62, *2*). Spinneret 1.8 to 2.0 times longer than first segment of labial palpus. Teeth of mandibles normally developed or second dorsal tooth divided; inner tooth present or absent. Seta P_1 almost on same line as Frl_2–Frl_2. Skin on trunk smooth or covered with minute spines. Hooks of abdominal legs uniordinal.

Key to Species

1 (4). Segment 8 highly enlarged. Skin on trunk smooth. Subdorsal band consists of large oblong spots. Second dorsal tooth of mandibles divided, inner tooth present.

2 (3). Segment 8 with large, pointed, reddish-brown dilatation on dorsal side. Head not granulated..... 1. **A. pyramidea** L.

3 (2). Segment 8 with rounded dilatation of different color on dorsal side. ..... 2. **A. perflua** F.

4 (1). Segment 8 not enlarged. Skin on trunk covered with minute spines. Subdorsal band continuous. Second dorsal tooth of mandibles not divided, inner tooth absent.

5 (6). Prominences of hemispheres of head coarsely granulated. Dorsal band absent on shields. Setae light brown..... ..... 3. **A. livida** Schiff.

6 (5). Head smooth. Dorsal band extends onto shield. Setae light-colored..... 4. **A. tragopoginis** Cl.

1. **Amphipyra pyramidea** L. (pyramidal owlet moth)

Mature larva: Segment 8 with large, pointed, reddish-brown dilatation on dorsal side. Skin on trunk and head smooth. Second dorsal tooth of mandibles divided, inner tooth present. Hooks of abdominal legs: 21–23, 23–24, 23–26, 25–27, and 27–29.

Body green, with white bloom. Head light green, with white pattern of first type (Figure 48, *1*). Shields not prominent and subdorsal bands extend onto them. Setae rust-colored, acuminate, set on large white spots on trunk. Stigmata white, with thin black edge. Legs green. Pattern: dorsal band quite broad, white, almost even. Subdorsal band consists of white, often oblong spots disposed obliquely; band narrow and continuous on segments 7 to 10 and flexed on segment 8 in form of obtuse angle (Figure 62, *2*). Substigmal band narrow, continuous, yellow, with narrow dark green border below. Ventral side green. Body length 38 to 50 mm and width of head 3.0 to 3.3 mm.

In Belorussia larval development in May and June. Eggs hibernate. Food plants: oak, linden, poplar, willow, elm, hazelnut, hawthorn, honeysuckle, lilac, and plum.

Eggs laid in crevices of bark of tree branches. They are 0.60 to 0.80 mm in diameter and 0.40 to 0.55 mm high. Ribs 32 to 34, of which 15 or 16 reach micropylar zone. Micropylar rosette consists of 11 lobes with single rim. Freshly laid eggs light violet, acquiring reddish tinge later. Before larvae hatch eggs gray, with violet hue.

2. **Amphipyra perflua** F. (brownish-gray smooth owlet moth)

Mature larva: Segment 8 with large round dilatation on dorsal side. Skin on trunk smooth, on head coarsely granulated. Second dorsal tooth of mandibles divided, inner tooth present. Hooks of abdominal legs: 23–26, 25–28, 28–29, 28–31, and 30–33.

Body green, with white bloom and scattered white and yellowish dots on dorsal side. Head pale yellow, with white pattern of first type (Figure 48, *1*). Shields green; dorsal band extends along thoracic shield and reaches

midlength of anal shield. Setae light-colored, acuminate, disposed on small yellowish spots. Stigmata white, with black edge. Legs green. Pattern: dorsal band light yellow, fairly broad, sometimes interrupted along margins of segments. Subdorsal band consists of oblong yellowish spots that form oblique smears; on segment 8 band forms steep flexures, after which notably pinched and extends along segment 9 toward anal shield; also seen on thoracic shield. Substigmal band bright yellow, not broad, and does not extend toward anal leg; instead it envelops anal shield (Figure 62, *2*). Ventral side somewhat lighter in color than dorsal. Body length 35 to 48 mm and width of head 3.0 to 3.2 mm.

In Belorussia larval development in May and June. Eggs hibernate. Food plants: willow, poplar, elm, hazelnut, hawthorn, plum, black thorn, apple, and pear.

Eggs laid in crevices in bark of branches. They are 1.10 to 1.20 mm in diameter, and 0.70 to 0.80 mm in height. Ribs 30 to 32, of which 15 to 17 reach micropylar zone. Micropylar rosette consists of 12 to 14 lobes and surrounded by three rims. Freshly laid eggs light yellow, later gradually turn dark gray.

3. **Amphipyra livida** Schiff. (black smooth owlet moth)

Mature larva: Head coarsely granulated on prominences of hemispheres. Dorsal teeth of mandibles normally developed, inner tooth absent. Skin covered with minute spines, distinctly visible in region of stigmata. Hooks of abdominal legs: 18–19, 18–20, 21–22, 23–24, and 26–27.

Body slightly pinched toward anterior end, green. Head green, without pattern. Shields not prominent; dorsal band does not extend onto thoracic shield. Setae short, acuminate, light brown, located on irregular white spots. Stigmata white, oval, with brownish edge. Legs green. Pattern: dorsal band rather broad, even, white, without [contrasting] borders; subdorsal band narrower than dorsal, almost continuous, even, extends onto shield. Dorsal and subdorsal fields green, lower margin of subdorsal field dark green. Substigmal band white, equal to dorsal in width, and envelops anal shield (Figure 62, *2*). Ventral side green. Body length 28 to 45 mm and width of head 2.8 to 3.0 mm.

In Belorussia larval development in May and June. Food plants: dandelion, hawkweed, and sorrel.

According to Doring (1955), eggs light blue, 0.60 to 0.75 mm in diameter, and 0.40 to 0.50 mm in height. Ribs 28 to 33, of which 11 or 12 reach micropylar zone. Micropylar rosette consists of 8 or 9 lobes, with single rim. During embryonal growth eggs, initially pinkish in color, turn brownish.

4. **Amphipyra tragopoginis** Cl. (tragopogon owlet moth)

Mature larva: Head smooth. Dorsal teeth of mandibles normally developed; inner tooth absent. Skin on trunk covered with minute spines. Hooks of abdominal legs: 14–16, 17–20, 18–20, 20–22, and 22–23.

Body slightly pinched toward anterior end, green. Head green, without pattern. Shields not prominent. Dorsal and subdorsal bands distinct on shields. Setae rust-colored, set on minute white spots on trunk and on general background on shields. Stigmata oval, white, with thin black edge; on prothorax and segment 8 located in lower part of subdorsal field; all other stigmata on substigmal band. Legs green. Pattern: dorsal band broad, white, fairly even. Subdorsal band slightly narrower than dorsal. Substigmal band white, as wide as dorsal. Ventral side green. Body length 24 to 38 mm and width of head 2.50 to 2.70 mm.

In Belorussia larval development in May and June. Food plants: *Galium, Tragopogon,* currants, sorrel, willow herb, *Crepis,* and chervil.

Eggs laid singly or in small clusters in a single layer, somewhat imbricated. They are yellow, 0.56 to 0.58 mm in diameter, and 0.413 to 0.430 mm in height. Ribs 61 to 63, of which 18 to 20 reach micropylar zone. Micropylar rosette consists of 10 or 11 lobes.

2. Genus *Cucullia* Schrk.

Spinneret long, 4.0 or 5.0 times longer than first segment of labial palpus, highly pinched toward end. First and second setae of labial palpus short, not pointed, in most cases identical in length, 7.0 to 10.0 times shorter than first segment, and equal to or 2.0 times longer than second segment. In *C. lychnitis* and *C. verbasci* setae long, acuminate, and not identical—first seta 4.0 times and second 2.0 times shorter than first segment. Mandibular teeth normally developed, inner tooth present or absent. Hooks of abdominal legs biordinal.

Key to Species

1 (8). Skin coarsely grained; granules often visible to naked eye.

2 (5). Skin granulated and rugulose. Setal bases sclerotized.

3 (4). Body cinnamon-brown. Head dark brown, with several reddish-brown spots. Abdominal legs black, with white plantae. Setal bases black, highly sclerotized..... 4. **C. umbratica** L.

4 (3). Body grayish-brown, with violet tinge. Head light violet, with black pattern of first type (Figures 48, *1*). Abdominal legs light-colored, with reddish plantae. Setal bases weakly sclerotized, brown. Subdorsal field with broad oblique brownish smears (Figure 80, *1*) ..... 1. **C. fraudatrix** Ev.

5 (2). Skin granulated but not rugulose. Setal bases not sclerotized.
6 (7). Setal bases III, IV, and especially I and II in form of large outgrowths [chalazae] (Figure 30). Body green, with admixture of pink..... 3. **C. artemisiae** Hufn.
7 (6). I and II large pinacula, but not in form of outgrowths; pinacula III and IV on common bulges (Figure 80, *2*). Body green, with admixture of white, red, and brown. Brownish-red and brownish-yellow pigment accumulates at center of dorsal and subdorsal fields. Dorsal band white, at center of segment narrow, and at margins notably enlarged.... 2. **C. absinthii** L.
8 (1). Skin finely grained or smooth.
9 (12). Skin finely grained. Dorsal and subdorsal bands distinct. Pinacula not sclerotized or absent.
10 (11). Pinacula minute, flat, not sclerotized. Body green, with reddish-violet dorsal surface. Black interrupted striae on dorsal field form figure of 8 (Figure 80, *3*)..... 6. **C. gnaphalii** Hbn.
11 (10). Pinacula absent. Dorsal side not reddish-violet. Black striae straight. Body green, with broad yellow dorsal band, its black borders straight. Subdorsal band narrower than dorsal (Figure 80, *7*)..... 5. **C. asteris** Schiff.
12 (9). Skin smooth. Dorsal and subdorsal bands not visible. Pinacula black, sclerotized, surrounded by black pigment. Body light-colored.
13 (14). Pattern on head of first type (Figure 48, *6*). Black spots surrounding pinaculum II separate. On abdominal segments ventral to pinaculum II, large black spot outside pinaculum present; spot sometimes fuses with spot of pinaculum II, and invariably isolated on segment 7 (Figure 80, *6*)..... 9. **C. verbasci** L.
14 (13). Pattern on head of first type (Figure 48, *3*). Black spots surrounding pinaculum II separate or fused. Large spot outside pinaculum absent on abdominal segments.
15 (16). Spots of pinacula II–II on segment I fused on dorsal line and extend farther onto dorsal and subdorsal field in form of narrow black band (Figure 80, *5*)..... 7. **C. lychnitis** Rmb.
16 (15). Black spots of pinacula II–II separate. Narrow transverse black lines extend into zone of dorsal and subdorsal bands and farther onto dorsal and subdorsal fields..... 8. **C. scrophulariae** Schiff.

1. **Cucullia fraudatrix** Ev. (eastern hooded owlet moth)

Mature larva: Front part of head flat. Spinneret 4.0 times longer than first segment of labial palpus. First seta of palpus longer than second segment; second seta longer than first seta, and 7.0 times shorter than first

segment. Mandibles without inner tooth. Distances between setae Frl_1–Frl_2 and Frl_1–P_1 and also between Frl_2–P_1 and P_1–P_2 equal. Setae VIII–VIII on segments 7 and 8 equidistant. Setae II–II and II–III on anal shield also equidistant. Hooks of abdominal legs: 16–17, 18–19, 18–19, 20–24, and 23–27. Skin coarsely grained and rugulose.

Body grayish-brown, with violet tinge. Head light violet-brown, with black pattern of first type (Figure 48, *1*). Shields lighter in color than general background of body. Dorsal bands extend onto shields. Setae brownish, highly acuminate, set on high, weakly sclerotized bases. Setal bases I and II black on ventral side and light-colored on dorsal. Setae on thoracic shield set on minute black spots. Stigmata oval, yellowish-red, with thin black edge and black aureole. Thoracic legs dark-colored; abdominal legs in anterior part light-colored, in posterior black; plantae reddish, hooks black. Pattern: dorsal band whitish-gray, with reddish-violet tinge, broad, uneven; covers up to half of setal bases I and II. At center of band shagreen granules surrounded by fine brown striae that form dark-colored background of median line of band. Subdorsal band considerably narrower than dorsal, but does not differ in color. Dorsal field brownish due to dense network of brown striae around reddish-violet granules of skin. Subdorsal field lighter in color than dorsal, with brownish, broad, obliquely set smear on each segment, which commences in forepart of segment of subdorsal band, runs aslant down to stigma, and encompasses it in form of black ring (Figure 80, *1*). Substigmal band yellow, and uneven due to displacement of dark-colored smear downward. Basal field dark brown, its dark pigment extending onto abdominal legs on proximal side. Main gray color of ventral side fringed along median line with dark-colored pigment, and in form of gray band with dark-colored border. Body length 25 to 38 mm and width of head 2.80 to 2.90 mm.

Development: I-instar. Body of just hatched larva thin, with all segments sharply demarcated, broad segment I (almost as wide as head), colorless, translucent with visible violet-red intestine. Head yellow, with brown spots around setae and rust-colored pattern of first type (Figure 48, *1*). Setal bases light-colored. Thoracic shield yellowish, anal shield not prominent. Feeding larva yellowish, with translucent green intestine. Spots on head around setae black, pattern brownish-yellow. Setal bases black, round; I and II equidistant from median line on back. Body length of just hatched larva 2.0 mm, before molt 4.0 mm, and width of head 0.303 mm.

II-instar. Body well proportioned, green. Head yellowish-green, with light brown pattern of first type. Setae black, slightly pointed, set on large black bases; setal bases on shields small. Shields green, slightly fringed

with brownish pigment. Stigmata light-colored, round, with thin black edge. Legs green; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands white, fairly broad, with even dark green borders. Main color of dorsal field between bands visible in form of bands. Suprastigmal band same as subdorsal, substigmal slightly broader. Stigmata located along ventral margin of subdorsal field. Ventral side green. Body length 4.0 to 7.0 mm and width of head 0.49 to 0.51 mm.

III-instar. Larvae differ from the II-instar only in pattern on trunk. Color of bands remains white but subdorsal band slightly narrower than dorsal. Bands extend onto shields. Substigmal band dull white. Three dull white bands extend along green background of ventral side. Body length 6.0 to 11.0 mm and width of head 0.71 to 0.72 mm.

IV-instar. Body yellowish-green, well proportioned, and slender. Head greenish-yellow, with dark green pattern of first type. Setae black, acuminate, set on light-colored unsclerotized bases. Base II somewhat farther away from median line on back than base I. Stigmata oval, light-colored, with black edge. Legs green; all five pairs of abdominal legs developed. Pattern: dorsal band broad, white, insignificantly fringed with dark green pigment. Subdorsal band yellowish, 2.0 times narrower than dorsal, highly fringed. Borders of dorsal and subdorsal bands almost fused. Fine brownish striae extend into subdorsal field from anterior part of segment toward seta III; accumulation of brownish-yellow pigment surrounds seta IV and stigmata. Three light-colored bands extend along ventral side; one median and two along line of legs. Bands fringed with greenish-brown pigment. Ventral side greenish-yellow. Body length 10 to 17 mm and width of head 1.10 to 1.20 mm.

V-instar. Body light green or brownish-green. Head light or dark brown, with darker pattern of first type. Setal bases light yellow. Dorsal band with violet tinge, more vivid in dark-colored specimens. Striae around skin granules on dorsal field reddish-brown-green, as in the VI-instar, and denser along median line on back. Borders of dorsal and subdorsal bands not broad, brownish-green, with slight admixture of brown in light-colored specimens. On subdorsal field striae extend from anterior part of segment toward stigmata, and form smears, as seen in the VI-instar. Basal field and hind side of abdominal legs dark brown. Ventral side dark green or light green, with three narrow white bands. Body length 17 to 26 mm and width of head 1.60 to 1.80 mm.

In Belorussia larval development from middle or late July to end of September. Feed on mugwort.

Eggs laid haphazardly or in small clusters, and glued to one another. These are light yellow, 0.80 mm in diameter, and 0.82 mm in height. Ribs

at equator 30 to 32. Chorion lightens within 24 hrs and dark yellow specks appear along sides. Color of egg gradually turns pink and specks yellowish-pink. Later, above equator of eggs, specks enlarge, fuse, and form irregular network. Egg dark gray before larva hatches.

2. **Cucullia absinthii** L. (brown hooded owlet moth)

Mature larva: Spinneret 4.5 times longer than first segment of labial palpus. First seta of labial palpus 2.0 times longer than second segment and equal to second seta. Mandibles without inner tooth. Seta P_1 considerably closer to P_2 than to Frl_2. Distance between setae VIII–VIII on prothorax 2.0 times greater than on mesothorax. Setae III and IV located on same prominence. Skin coarsely grained. Hooks of abdominal legs: 15–16, 15–18, 17–20, 19–23, and 24–27.

Body green, with admixture of white, red, and brown. Head yellowish-green or yellow with brownish-green or light brown pattern of first type (Figure 48, *1*). Shields yellow, covered with brown striae that extend onto yellow dorsal bands running along shields. Setal bases not sclerotized, soft. Bases I and II large, yellow or brownish-red; III and IV same color but considerably smaller. Rest of setal bases minute. Setae brownish, highly acuminate. Stigmata yellow, oval, with black edge. Thoracic legs yellowish-green; abdominal legs white, with brownish-red or brownish-yellow striae. Pattern: dorsal band white, narrow at center of segment, and notably enlarged along margins. Subdorsal band narrow, uneven, slightly flexed around seta II. Center of segment, especially on dorsal field, covered with rather dense (depending on whether at commencement or end of instar) brownish-yellow or brownish-red striae that extend also onto band. Sometimes, dorsal band at center of segment entirely covered by striae. Along margins of segments on dorsal field shagreen granules white, surrounded by green pigment. Pattern on dorsal field characteristic of given species: reddish-yellow or brownish-red at center of segment and white, pinching into acute angle, toward end of segment. At center of segment much darker borders in form of two broad oblong spots around dorsal band (Figure 80, *2*). At center of subdorsal field, brownish-yellow and brownish-red pigmentation faintly visible. Suprastigmal band white, narrow. Substigmal band white, broad, distinct only in anterior part of segment where it is situated somewhat more obliquely; at center of segment only lower part of band visible; upper part of band masks brownish-yellow and brownish-red pigmentation descending from dorsal field. In posterior part of segment pigment shifts onto band like a shadow. Main color of ventral side green, but appears white due to three broad white bands on it. Body length 25 to 38 mm and width of head 2.8 to 3.0 mm.

Development: I-instar. Body of just hatched larva light gray, colorless, thin, only segment I almost equal to width of head. Head light yellow,

with gray pattern of first type (Figure 48, *1*). Setal bases high, not sclerotized, visible as light-colored spots on gray background. Thoracic shield light yellow. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. After 2.0 to 4.0 hrs setal bases turn light brown and subdorsal band fringed on lower side with dark gray pigment. On second or third day light-colored dorsal band discernible. Body length of just hatched larva 1.9 mm, before molt 4.0 mm, and width of head 0.303 mm.

II-instar. Body green, well proportioned, with multiple bands. Head pinkish-yellow, with brownish pattern of first type. Setae black, set on brownish-green bases. Shields dull green with white dorsal bands. Stigmata light-colored, round, with dark-colored margin. Legs light-colored, thoracic legs with brown spots around setae. Pattern: dorsal, subdorsal, and suprastigmal bands white, with narrow brownish-green borders. Base green color between bands seen as bands and thus larva appears to have multiple bands. Substigmal band slightly broader than other bands, white, with brownish-green border on lower side. Ventral side brownish-green, with three white bands. Borders lighter than dorsal bands. Body length 3.5 to 6.0 mm and width of head 0.47 to 0.48 mm.

III-instar. Larva differs from the II-instar in dorsal band somewhat broader than subdorsal. At center of dorsal field reddish-violet tinge negligible. Body length 6.0 to 9.0 mm and width of head 0.72 to 0.74 mm.

IV-instar. Larva green, with admixture of brownish-yellow pigment. Site of setae III and IV bulges somewhat. Head light yellow, with brownish spots around setae, and much lighter pattern of first type. Setal bases yellow, not large; setae brownish, acuminate. Thoracic legs brownish-yellow; abdominal legs white, all five pairs developed. Pattern: dorsal band fairly broad, white, with lilac tinge, and brownish-lilac borders that enlarge at center of segment. Subdorsal band narrower. Strips of main color between bands faint. Brownish irregular spots surround stigmata and pinacula III and IV; spots descend to lower margin of substigmal band and ascend into suprastigmal band. Substigmal band white, not broad, and uneven because dark spots extend onto it. Ventral side green, with five smooth white bands. Unpaired band extends along median line; one of paired bands extends along base of legs, and the other along outer edge of base of legs. Body length 10 to 16 mm and width of head 1.0 to 1.2 mm.

V-instar. Larva similar to the VI-instar except that dorsal band extends less into posterior part of segment. Reddish-brown pigment extends onto subdorsal field less than in the VI-instar. Ventral side of some specimens with five white bands, in other specimens only three white bands. Body length 15 to 24 mm and width of head 1.70 to 1.90 mm.

In Belorussia larval development late July, August, and September. Feed on wormwood.

Eggs laid haphazardly, singly. They are light yellow, with broad base, 0.62 to 0.64 mm in diameter, and 0.65 to 0.67 mm in height. Ribs sharp, 25 to 27. Within 24 hrs eggs turn pink with very dark specks more densely disposed on ribs. Before larva hatches egg dark gray.

3. **Cucullia artemisiae** Hufn. (wormwood hooded owlet moth)

Mature larva: Spinneret considerably pinched toward end, 5.0 times longer than first segment of labial palpus. Both first and second setae of palpus 2.0 times longer than second segment. Mandibles without inner tooth. Distance between setae Frl_1–Frl_2 somewhat greater than between Frl_1–F_1; Frl_2–P_1 and P_1–P_2 equidistant. Setae VIII–VIII on prothorax 2.5 times closer to each other than on mesothorax. Setae VIII–VIII on segments 7 and 8 equidistant. Setae III and IV, and especially I and II, situated on large outgrowths (Figure 30). Head flat in front. Hooks of abdominal legs: 11–12, 13–14, 16–19, 18–19, and 18–20. Skin coarsely grained; granules in form of conical papillae.

Body green, with admixture of white and pink. Head yellowish-pinkish-green, with light brownish pattern of first type (Figure 48, *1*). Shields not prominent; setae on them set on prominent unsclerotized pinacula. Setal bases III, IV, and especially I and II on body very well developed and form outgrowths on skin. On meso- and metathorax outgrowths co-develop and I looks somewhat like an offshoot of II, shifted slightly toward caudal side. On abdominal segments bases I and II highly contiguous, and II notably larger than I. Two bases disposed on same line. Setae set somewhat to side of outgrowth (Figure 30). Outgrowths of bases III and IV also highly contiguous, but smaller than I and II. Outgrowth of V broad, flat. Setae brownish, firm, highly acuminate. Stigmata white, oval, with black edge. Thoracic legs yellowish; four pairs of abdominal legs white, anal legs green. Pattern: dorsal band greenish-white, on thoracic and abdominal segments 8 and 9 continuous, and on rest of segments highly pinched at center and quite broad near margins. Subdorsal band in form of individual, rather large white spots at margins of segments, and interrupted at center. Interruptions caused by extension of pinkish-red pigment from setal base (or growth) II to bases III and IV and toward stigmata. Suprastigmal band white, separated by pinkish-red spot, and visible only at margins of segments in form of two large spots; its lower margin often fuses with substigmal band. Latter white, quite broad, uneven, or even divided by pinkish-red spot surrounding stigmata. Spot descends obliquely onto basal field. Ventral side green, with three broad white bands. Body length 28 to 43 mm and width of head 2.9 to 3.0 mm.

In Belorussia larval development in July, August, and September. Food plants: mugwort, field wormwood, and daisy.

Eggs laid haphazardly, singly. They are somewhat lengthened, in form of truncated cone, light yellow, 0.65 to 0.66 mm in diameter, and 0.65 mm in height. Ribs at equator 24 to 26. On second day entire egg surface covered with yellowish-red specks, denser along ribs. Specks enlarge, fuse, and subsequently entire egg suffused with pink pigment. Before larva hatches egg turns brownish-gray.

4. **Cucullia umbratica** L. (gray hooded owlet moth)

Mature larva: Spinneret 3.8 times longer than first segment of labial palpus. First and second setae of palpus equal in size, almost rudimentary. Mandibles with inner tooth. Distance between Frl_2–P_1 greater than between P_1–P_2; distance between setae II–III on anal shield somewhat greater than between II–II. Skin on head and trunk coarsely grained and rugulose (Figure 26, *6*). Hooks of abdominal legs: 16–18, 18–20, 18–24, 26–28, and 30–32.

Body somewhat fusiform, brownish, with dark brown, almost black granules, and rugulose. Head dark brown, almost black, with reddish-yellow spots; spots large along line of setae P_1–P_2 and along epicranial suture. Epicranial suture white, frons and adfrontal sclerites brown. Thoracic shield reddish-yellow with dark striae and spots. Setal bases black. Setae brownish, somewhat pointed. Stigmata oval, dark, with black edge. Legs black; abdominal legs with white plantae. Pattern: dorsal band reddish-yellow, rather broad on thoracic segments and abdominal segments 9 and 10 (Figure 80, *8*), and visible only along margins of other segments. Subdorsal and suprastigmal bands narrow, interrupted, same color as dorsal. Substigmal band reddish-yellow, not broad, quite faint in middle part of body, but well delineated on thoracic segments; on abdominal segments 9 and 10 band expands considerably and extends toward anal shield. Ventral side gray, with much larger shagreen granules than on back. Body length 37 to 50 mm and width of head 3.6 to 4.0 mm.

Development: I-instar. Body of just hatched larva colorless, translucent with visible reddish-lilac intestine. Skin coarsely grained. Head yellowish-pink, with very dark spots around setae and pattern of first type (Figure 48, *1*). Setal bases large, light-colored. Setae black, strong, not pointed. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Feeding larva yellowish-green, well proportioned. Setal bases black. Shields yellow, with brown setal bases. Bases IX and X on thoracic shield larger than I and II. Pattern appears midinstar: broad white dorsal band and very narrow subdorsal and suprastigmal bands. Substigmal band white, broader than dorsal. Ventral side yellow, with white medial band. Length of just hatched larva 3.0 mm, before molt 6.0 mm, and width of head 0.41 mm.

II-instar. Body reddish-brown, well proportioned. Head brownish-red, with brown or black spots around setae and pattern of first type. Setae reddish-brown, not pointed, set on large dark brown bases. Shields with brown setal bases. Stigmata round, brownish-red, with black edge. Thoracic legs dark-colored; abdominal legs reddish-brown, with whitish plantae. Pattern: dorsal, subdorsal and suprastigmal bands brownish-red, not broad, with narrow brown borders. Main body color between bands also in form of bands. Substigmal band also brownish-red, slightly broader than other bands. Body length 5.0 to 10.0 mm and width of head 0.65 to 0.67 mm.

III-instar. Larva differs from the II-instar in that borders of bands broader, while strips of main color between dorsal and subdorsal bands narrow. Strip of base color not seen between subdorsal and suprastigmal bands. Body length 11 to 17 mm and width of head 0.9 to 1.0 mm.

IV-instar. Body brown. Skin highly sclerotized and coarsely grained. Head brown, with very dark but faint pattern of first type. Shields not prominent. Dorsal bands on shields brownish-yellow. Stigmata oval, light brown, with black edge. Thoracic legs black; abdominal legs brown, with white plantae, and all five pairs developed. Pattern: dorsal band brownish-yellow, fairly broad on thoracic segments and abdominal segments 9 and 10, narrow on all other segments, even interrupted at places. Subdorsal band of same color faintly discernible on middle abdominal segments. Ventral side light brown, with lighter band along median line. Body length 16 to 27 mm and width of head 1.70 to 1.80 mm.

V-instar. Larva almost the same as in the VI-instar. Head entirely dark brown or black, or with light-colored bands along frontal sutures. Body length 24 to 37 mm and width of head 2.50 to 2.70 mm.

In Belorussia larval development in July and August. Food plants: thistle, hawkweed, chicory, cat's ear, dandelion, groundsel, Campanulaceae, and hawkbit. Under laboratory conditions larvae of older instars allowed free food selection, avidly fed on leaves of lettuce, cabbage, clover, gourd, linden, and willow.

Eggs laid singly, lengthened in form of truncated cone, light yellow, 0.66 to 0.68 mm in diameter, and 0.64 to 0.65 mm in height. Ribs sharp, 27 to 30, of which 13 to 15 reach micropylar zone. Micropylar rosette consists of 12 or 13 lobes. Within 24 hrs yellowish specks appear on chorion. Subsequently shell takes on pink coloration, while specks turn reddish-yellow.

5. **Cucullia asteris** Schiff. (aster hooded owlet moth)

Mature larva: Spinneret 4.0 times longer than first segment of labial palpus. First and second setae of palpus extremely short, identical in length, with both equal to second segment. Mandibles with inner tooth. Seta P_1

closer to seta P_2 than to Frl_2. Setae Frl_1–Frl_2 and Frl_1–F_1 equidistant. Setae VIII-VIII on segments 7 and 8 also equidistant. Distance between VIII–VIII on prothorax 2.5 times less than on mesothorax. Skin finely grained. Hooks of abdominal legs: 16–17, 16–18, 17–18, 20–23, and 23–26.

Body green or flesh-colored, cylindrical, well proportioned. Head green or hazy pink, in some green specimens white; pattern black, of first type (Figure 48, *1*); black spots fuse and form separate groups. Setae black, acuminate, pinacula and spots at bases absent. Shields not prominent. Dorsal and subdorsal bands and their borders extend onto shields. Stigmata light-colored, oval, with thin black edge. Legs green or colorless. Pattern: dorsal band broad, yellow, and fringed with fairly broad black borders. Subdorsal band greenish-yellow, narrower than dorsal; border on lower side narrow, in form of black line, but on upper side in form of rather narrow black fringe. Between bands, base color of body itself in form of bands; in green-colored specimens bands of base color bluish, in flesh-colored specimens whitish-pink. Suprastigmal band same width as subdorsal; in green-colored specimens green or yellowish and in flesh-colored specimens crimson. Border of band black, in form of line (Figure 80, *7*). Subdorsal field in flesh-colored specimens light pink or crimson. Stigmal band narrow, black, extends only to upper part of stigmata; central and lower part of stigmata located on substigmal band. Substigmal band broad, with black line along lower border; upper half of band yellow, lower half white. Ventral side green, in flesh-colored specimens whitish, with oblong white spots; in green-colored specimens spots form three light-colored bands. Body length 28 to 45 mm and width of head 3.10 to 3.30 mm.

In Belorussia larval development in August and September. Food plants: golden rod and aster.

6. **Cucullia gnaphalii** Hbn. (golden rod hooded owlet moth)

Mature larva: Spinneret 4.5 times longer than first segment of labial palpus. First and second setae of palpus equal to second segment. Mandibles without inner tooth. Seta P_1 closer to P_2 than to Frl_2. Setae VIII–VIII on segments 7 and 8 equidistant, as are II–II and II–III on anal shield. Distance between VIII–VIII on prothorax 1.5 times less than on mesothorax. Skin finely grained. Hooks of abdominal legs: 20–22, 22–23, 22–26, 27–30, and 30–35.

Body bright green, with reddish-violet back. Head greenish-yellow, with black pattern of first type (Figure 48, *1*). Setae long (1.20 mm), brown, slender, and highly acuminate. Pinacula minute, flat, not sclerotized, and light-colored. Pinacula outlined with thin black line. Shields not prominent. Stigmata yellow, oval, with thin black edge. Legs green. Pattern: dorsal band narrow, pale violet, slightly fringed with brown pigment that

continues onto band at many places. Subdorsal band same color as body, green, with thin greenish-brown borders; band discernible only along borders. Central part of back reddish-violet, rather sharply delineated from base color. Reddish-violet background enlarges along margins of segments but pinched at center, encompasses seta I, and almost reaches seta II. Thin black line edges background color here. Median line of back surrounded by interrupted black striae, which approach dorsal band on each segment near margin of segment, and form figure of 8 at center of segment, with fairly sharp angles in anterior part, more rounded in posterior part (Figure 80, *3*). Reddish-violet section of dorsal field covered with violet dots and fine, sparse brown striae. Subdorsal field green. Zone of substigmal band yellowish-green with yellow dots. Setae III, IIIa, IV, and stigmata situated on large, common, triangular reddish-violet spot. Ventral side green with group of scattered yellow dots. Body length 25 to 38 mm and width of head 2.9 to 3.0 mm.

In Belorussia larval development in July and August. Food plant: golden rod.

7. **Cucullia lychnitis** Rbr. (brownish-gray hooded owlet moth)

Mature larva: Spinneret 5.0 times longer than first segment of labial palpus; first seta of palpus 2.0 times and second seta 3.0 times longer than second segment. Both the setae fairly long and acuminate. Mandibles with inner tooth. Seta P_1 closer to P_2 than to Frl_2. Setae Frl_1–Frl_2 and Frl_1–F_1 equidistant. Distance between setae II–III on anal shield slightly less than between II–II. Skin smooth. Hooks of abdominal legs: 18–19, 20–21, 20–22, 23–24, and 23–25.

Body dirty yellow or whitish, with black and yellow spots. Head yellow, with large, black, nearly round spots around setae and faint brownish-yellow pattern of first type (Figure 48, *3*). Shields yellow; setae located on large black spots. On thoracic shield, setae I and II set on round spots, X on rectangular or nearly square spot, and seta IX on transversely extended spot. At commencement of instar spots around setae I and II separate; later, black pigment of spots extends dorsally and spots fuse. Setae on trunk black, distinctly acuminate, set on small black pinacula that are faint because black pigment of pinacula greatly extends sideways and forms large spots. On pro- and mesothorax, pinacula I and II set on round black spots. Black spot of nearly same size adjacent to and caudad of pinacular spot [I]. Anterior to pinacula I and II on abdominal segments two separate transverse spots occur. Black pigment of pinaculum II greatly extends ventrally and dorsally and fuses on median line of back on segments 1 to 6 and 8 with spot of pinaculum II in second half of segment. Ventrally, black pigment of pinaculum II approaches spot of pinaculum III and often fuses with it. Black spot of pinaculum I also

somewhat transverse (Figure 80, *5*). Stigmata yellow, oval, with thin black edge. Legs yellow. Pattern: longitudinal bands absent on body. At center of segment, dorsal, subdorsal, and basal fields covered by bright yellow transverse band. Body length 29 to 43 mm and width of head 3.0 mm.

In Belorussia larval development in July and August. Food plant: panicled mullein.

8. **Cucullia scrophulariae** Schiff. (common hooded owlet moth)

Mature larva: Spinneret 4.5 times longer than first segment of labial palpus. Second seta of palpus 1.5 to 2.0 times longer than first seta. Mandibles with inner tooth. Distance between setae Frl_1 and Frl_2 somewhat less than between Frl_1 and F_1. Seta P_1 shifted caudally from line of disposition of setae Frl_2–Frl_2 and nearer to P_2 than to Frl_2. On anal shield distance between setae II–III slightly more than between II–II. Skin smooth. Hooks of abdominal legs: 17–19, 20–22, 22–23, 24–26, and 28–29.

Body slightly pinched toward anterior end, green, with faint bluish tinge. Head greenish-yellow, with faint pattern of first type (Figure 48, *3*), and rather larger black spots around setae; two black spots near epicranial suture and in parietal region. Frons with two pairs of large black spots and one pair of minute ones. Setae on trunk dark brownish, acuminate, strong; on segments II and III, setae I, II, III, and IIIa located on large round black spots, on abdominal segments setae I and II on similar spots, and III and IV on minute black spots. All segments with transverse black striae on dorsal and subdorsal fields, anterior and posterior to setae I, II, and III. Striae interrupted in region of dorsal and subdorsal bands. On segments II and III there are four or five striae, on anterior abdominal segments three or four, on last abdominal segments one to three. On each abdominal segment between setae I and II on dorsal field, two pairs of very short transverse striae seen; on segments 7 and 8 striae form spots and, additionally, on segment 8 two spots occur between setae I and II and two spots posterior to seta I. Shields not prominent; setae set on black spots. Yellow dorsal and subdorsal bands on thoracic shield visible as separate spots. Stigmata black, not large, rather broad, with black edge. Thoracic legs greenish, abdominal legs light-colored. Pattern: dorsal and subdorsal bands bright, yellow, with uneven margins; at places of black striae bands pinched, enlarging outside them. Substigmal band same width and color, only somewhat more uniform. Dorsal and subdorsal fields green, with bluish tinge. Ventral side whitish. Body length 32 to 55 mm and width of head 3.4 to 3.5 mm.

In Belorussia larval development from mid-June through August. Pupae hibernate. Food plants: figwort, mullein, and wormwood.

9. **Cucullia verbasci** L. (mullein hooded owlet moth)

Mature larva: Spinneret almost 5.0 times longer than first segment of labial palpus. First seta of palpus 2.0 times and second 4.0 times longer than second segment; both setae acuminate. Mandibles with inner tooth. Seta P_1 closer to P_2 than to Frl_2. Distance between setae Frl_1–Frl_2 slightly more than between Frl_1–F_1. Distance between seta II–III on anal shield slightly more than between II–II. Skin smooth. Hooks of abdominal legs: 17–18, 17–19, 20–22, 20–23, and 24–26.

Body grayish-white or with insignificant admixture of green, with black and yellow spots. Head yellowish, with very large black spots around setae and gray pattern of first type (Figure 48, *6*); black pigment on spot of seta P_2 extends notably toward parietal region. Shields grayish, with large black spots around setae. On thoracic shield seta I set on round spots. At base of setae II, IX, and X spots somewhat oval, irregularly shaped; longitudinal oblong yellow spot located between setae I–X and II–IX. Pinacula black, rather small, surrounded by black pigment. On meso- and metathorax two black spots occur anterior to pinacula I and II (Figure 80, *6*), and two more posterior to pinacula. In *C. lychnitis* these spots fuse with those of pinacula I and II; in *C. verbasci* they are separate. On abdominal segments pinaculum II set on transverse black spot that sometimes fuses with large black spot located ventrally. At commencement of instar pinacular spot II invariably separate. Pinaculum I located on slightly elongated but independent black spot (Figure 80, *6*). Pattern on trunk of *C. lychnitis* differs from *C. verbasci* in that spots of pinacula II–II separate and not fused along median line on dorsal surface in latter species. In *C. verbasci* spot of II may fuse with spot without seta located ventral to II, but never fuses with spot of pinaculum II. Large isolated spot without seta occurs on segment 7 (Figure 80, *5–6*). Pattern: oblong bands absent. Yellow spot extends transversely on abdominal segments between setae I and II. Stigmata and setae III, IV, and V fall on common yellow spot. Stigmata dark-colored. Body length 30 to 44 mm and width of head 3.0 mm.

In Belorussia larval development in June and July. Food plants: figwort and mullein.

3. Genus *Calophasia* Steph.
(one species in Belorussian fauna)

Calophasia lunula Hufn. (short-winged owlet moth)

Spinneret more than 1.5 times longer than first segment of labial palpus. Setae of palpus fairly long, acuminate; second seta somewhat shorter than first segment, first seta almost 2.0 times longer than second segment. Mandibles with divided dorsal teeth (Figure 15, IV), inner tooth

absent. Skin smooth. Metathoracic coxae contiguous. Species undergoes four molts, with the V-instar the last. Hooks of abdominal legs uniordinal: 18–20, 19–22, 23–25, 24–26, and 26–29.

Body slightly pinched toward anterior end, bluish-ash, with large black spots around setae and outside them. Head bluish-ash, with very large, slightly separated black spots at base of setae P_1 and P_2. Spots around setae A_2, L_1, and F_1 smaller. Faint pattern of first type visible between spots (Figure 48, *6*). Setae black, acuminate. Stigmata black, oval, with broad black edge. Legs light-colored. Pattern: dorsal band bright yellow, fairly broad, with even margins. Dorsal field intersected by slightly oblong black velvety spots (Figure 80, *4*). Main body background visible between spots. Subdorsal field bluish-ash with scattered large and small black spots of various shapes. Large number of spots around setae III and IV. Suprastigmal and stigmal bands not visible. Substigmal band bright yellow, same width as dorsal. Basal field covered with large and small black spots, the largest around setae V and VI. Ventral side ash-blue. Body length 24 to 35 mm and width of head 2.0 mm.

Development: I-instar. Body of just hatched larva gray, with rather small unsclerotized pinacula and yellowish thoracic shield. Head yellowish with large brown spots around setae and much lighter-colored pattern of first type. Legs light-colored. Skin coarsely grained. Feeding larva yellowish-green, with fairly large black pinacula; pinacula I and II on same longitudinal line. Pattern starts to appear midinstar. Initially, yellowish-red coloration seen along line of pinacula I and II, and then broad white, slightly bluish dorsal band. Borders of band evident even before yellowish-red pigment along line of pinacula I and II. Subdorsal band narrow, bluish, its borders narrower than those of dorsal band. Substigmal band broad, light-colored, faint. Body length of just hatched larva 2.4 mm, before molt 5.0 mm, and width of head 0.39 mm.

II-instar. Body cylindrical, lilac-brown. Head yellowish-gray, with very dark-colored pattern of first type and large brownish spots around setae. Setae black, somewhat acuminate. Pinacula large, black. Shields brownish. Stigmata round, light-colored, with fairly broad black edge. Legs dark-colored, abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal band yellow, rather broad; subdorsal bluish, very narrow. Dorsal and subdorsal fields lilac-brown. Substigmal band yellow, quite broad, with indistinct borders. All stigmata located on substigmal band. Ventral side brown. Body length 5.0 to 9.5 mm and width of head 0.65 to 0.70 mm.

III-instar. Body ash-gray, with lilac tinge and black and yellow pattern. Head whitish or light yellow, with very large black spots around setae P_1 and P_2, which almost fuse and form broad, oblong black band. Spots

smaller at base of setae L_1, A_2, and F_1. Pattern on head of first type, grayish, faint. Pinacula black, flat, located on black spots on trunk, and hence poorly distinguishable. Setae black, slightly pointed. Skin smooth. Stigmata round, light-colored, with black edge. Legs light-colored; all five abdominal pairs developed. Pattern: dorsal band yellow, broad; subdorsal base-colored, narrow. Dorsal field, between dorsal and subdorsal bands, with transverse, oblong, black velvety spots; subdorsal field with irregularly rounded black spots in addition to spots with pinacula on them. Substigmal band quite broad, at center of segment yellow, and along margins of segment base-colored. Basal field and ventral side ash-gray; former with large black spots and latter with small black spots. Body length 9.0 to 16.0 mm and width of head 0.90 to 0.91 mm.

IV-instar. In color and pattern almost identical to the V-instar, except that in the IV-instar pinacula still well preserved, although poorly visible on black spots. In the V-instar pinacula absent. Body length 17 to 25 mm and width of head 1.35 to 1.40 mm.

In Belorussia larval development in June, July, and August. Food plant: toadflax.

Eggs laid singly, light yellow, slightly enlarged, and 0.75 to 0.76 mm in both diameter and height. Ribs 20 to 24, of which 11 to 13 reach micropylar zone. Micropylar rosette consists of 9 to 11 lobes, with 2 rims. Within 24 hrs chorion takes on pink coloration and minute yellowish-pink circles seen, which then become dots. Before larva hatches egg dark gray.

Subfamily Melicleptriinae

Spinneret large, long, 4.0 or 5.0 times longer than first segment of labial palpus. Rim of spinneret opening without fringe and dents. Second seta of labial palpus 3.0 to 5.0 times shorter than first segment, slightly longer than first seta or equal to it. Mandibular teeth normally developed, or third main tooth reduced (Figure 86); inner tooth present or absent. Segment 1 with two sets of setae of group VII, and segment 2 with three setae of same group. Skin covered with spines (Figure 26, *5*), distinctly visible at microscopic magnification of 8 ×. Setal bases small or large, black, highly sclerotized. Stigmata dark-colored. Pattern on head of first type (Figure 48, *3–4*); in *P. umbra* pattern absent on head in last instar. Light-colored dorsal band in last instar distinct only on thoracic shield; on abdominal segments almost totally masked by dark-colored borders. Light-colored border distinct against dark-colored border (Figure 85, *1–3*). Five pairs of abdominal legs present, normal in length, with hooks biordinal (Figure 24, *2*).

Key to Genera

1 (2). Head light-colored, without pattern. Subdorsal bands on thoracic shield consist of individual spots (Figure 87, *2*)... 2. **Pyrrhia.**

2 (1). Head with pattern of first type (Figure 48, *3–4*). Subdorsal bands on thoracic shield continuous.

3 (4). Dorsal band on thoracic shield narrow, subdorsal broad (Figure 87, *3*), and continuous on abdominal segments (Figure 85, *1*). ..... 1. **Chloridea (viriplaca** Hufn.).

4 (3). Dorsal and subdorsal bands identical in width on thoracic shield (Figure 87, *1*); subdorsal consists of individual spots on abdominal segments (Figure 85, *2*)..... 1. **Chloridea (scutosa** Schiff.).

1. Genus *Chloridea* Dunc.

Postgenal sclerites not fused (*Pi* = 1/4, 1/5), narrow. Spinneret highly pinched toward end, 5.0 times longer than first segment of labial palpus. Second seta of palpus 3.0 to 5.0 times shorter than first segment and almost 2.0 times longer than first seta or equal to it. Mandibles with or without inner tooth. Skin covered with minute spines. Setal bases black.

1. **Chloridea viriplaca** Hufn. (syn. *dipsacea* L.) (alfalfa owlet moth)

Mature larva: Seta P_1 on same line as setae Frl_2–Frl_2. Distance between setae I–II on thoracic shield less than between II–IX. Mandibles with inner tooth. Hooks of abdominal legs: 13–14, 12–14, 14–16, 16–18, and 20–22.

Body grayish-green or dark brown. Head green or yellowish-green with black spots around setae and black pattern of first type (Figure 48, *4*). Shields yellowish or green; thoracic shield with very narrow dorsal band, rather broad subdorsal, and fine sinuous striae (Figure 87, *3*). Setal bases not large (I—0.098 mm, and II—0.137 mm), dark brown. Setae black, acuminate. Stigmata black, oval, with black, rather broad edge. Legs green. Pattern: dorsal band dull yellow, very narrow, with rather broad, even, dark gray, brown, or almost black borders; edges of latter fringed with uniform pale yellow pigment. Borders of dorsal band bicolored—dark and light. Subdorsal band considerably broader than dorsal, its dorsal border also bicolored—dark and light. Fine light-colored striae scattered on dark part of borders (Figure 85, *1*). Ventral border of subdorsal band considerably darker than dorsal, totally masked by dark color of subdorsal field, so that entire subdorsal field actually brown or black with sparse, light-colored dots. Substigmal band broad, with distinct borders; lower part white, upper border yellow, center yellowish-green. Stigmata and setal base IV disposed in upper part of band. Each stigma encircled by white ring. Stigmata of segments I and 8 disposed on dark-colored part

of subdorsal field and also encircled by white ring. Basal field brownish-green, ventral side green. Body length 21 to 37 mm and width of head 2.3 to 2.4 mm.

Development: I-instar. Body of just hatched larva yellowish-white. Prothorax broad, equal to width of head. Head black. Thoracic shield brownish, broad. Setal bases minute, light-colored, but turn brown in 20 to 30 min. Stigmata light-colored, round, with broad dark brown edge. Setae brownish, piliform, short. Thoracic legs dark-colored; abdominal legs light-colored and underdeveloped on segments 3 and 4. Skin coarsely grained. Feeding larva yellowish. Body length of just hatched larva 1.37 mm, before molt 2.8 to 3.0 mm, and width of head 0.255 mm.

II-instar. Body yellowish-green, with bluish tinge. Head black. Setal bases brown, poorly sclerotized. Shields brown, with faint setal bases. Setae black, piliform. Thoracic legs black; abdominal legs green, with large brown spots on outer side. Skin coarsely grained, granules in form of papillae. Pattern: dorsal and subdorsal bands of base color, not broad. Dorsal band fringed with two narrow light-colored lines; subdorsal band fringed with similar lines only on dorsal side. Substigmal band light-colored, narrow, barely visible. Body length 3.0 to 5.0 mm and width of head 0.41 to 0.43 mm.

III-instar. Body dark green. Head dull yellow, with black spots around setae and pattern of first type (Figure 48, *I*). Setal bases large, black. Shields lighter than head and surrounded by brown striae. Setae black, slightly pointed. Stigmata round, light-colored, with black edge. Abdominal legs underdeveloped only on segment 3. Skin coarsely grained; scattered black papillae with spines occur in-between minute green granules on back. Pattern same as in the II-instar, but dorsal band fairly broad, and fringed with two light-colored lines. Substigmal band whitish, broad, green at center. Ventral side green, lighter in color than dorsal. Body length 5.0 to 9.0 mm and width of head 0.61 to 0.67 mm.

IV-instar. Color of body, setal bases, and color and pattern of head same as in the III-instar. Shields green, bordered by black striae. Stigmata dark-colored, slightly oval, with broad black edge. Legs green; all five abdominal pairs developed. Pattern: chain of minute whitish or yellowish dots seen along median line of green dorsal band. Light-colored lines represent borders of dorsal band split into separate dots in the IV-instar. Hence, in this instar light-colored chain of dots extending along median line of back constitute dorsal band, while dark green background and light-colored dots alongside represent a double border. Subdorsal band also visible; consists of chain of yellowish dots ventral to setal base II. On dorsal side, border also doubled, i.e., in form of green border of band and row of light-colored dots extending between setal bases I and II. Substigmal band yellowish, broad, white along lower border, green at

center. Stigmata of segments 1 to 7 disposed on band. Ventral side green. Body length 8.5 to 15.0 mm and width of head 0.92 to 1.14 mm.

V-instar. Body greenish-gray, with admixture of brown. Color and pattern on head same as in the VI-instar. Shields brownish-green, with light-colored dorsal bands. Setae black, acuminate. Setal bases black, large. Pattern: dorsal band white, continuous, narrow, with double borders—broad brown and narrow continuous light yellow or white. Subdorsal band wider than dorsal, white, and continuous. Upper side of subdorsal band also with double border—broad brown and narrow continuous white. Subdorsal field somewhat darker than dorsal, with sparse scattered white dots. Substigmal band white, broad, at center whitish-green. On segments 1 to 7 stigmata and setal base IV disposed in upper part of band and encircled by white ring. Basal field brownish-green. Body length 14 to 22 mm and width of head 1.50 to 1.65 mm.

In Belorussia larval development from July through mid-September. Pupae hibernate. Species highly polyphagous and possibly feeds on more than 70 species of plants from 22 families. Damages alfalfa, flax, vetch, clover, sunflower, tobacco, vegetable, and other plants.

Eggs laid singly on leaves, buds, and flowers of plants. They are yellow, 0.50 to 0.58 mm in diameter, and 0.46 to 0.48 mm in height. Ribs 36 to 38, of which 15 or 16 reach micropylar zone. Micropylar rosette consists of 11 or 12 lobes. On second day fairly broad yellowish girdle visible not far from apex, which gradually takes on brownish-yellow coloration while chorion turns pale or hazy yellow. Sometimes yellow dot visible at apex. Before larvae hatch eggs gray and head of larva visible, black.

2. **Chloridea scutosa** Schiff. (wormwood owlet moth)

Mature larva: Spinneret 5.0 times longer than first segment of labial palpus. Second seta 5.0 times shorter than first segment and equal to first seta. Distance between setae I–II on thoracic shield 1.5 times less than between II–IX. Setae II–II and II–III equidistant on anal shield. Mandibles with reduced third main tooth (Figure 86); inner tooth absent. Hooks of abdominal legs: 13–14, 14–15, 14–16, 17–18, and 20–23.

Body yellowish-green, with pattern of black and yellow pigment. Head yellow, with black spots around setae, and black pattern of first type (Figure 46, *3*). Setae black, highly acuminate, set on large black setal bases; setal base I on abdominal segments larger than base II; setal base II larger than base I on meso- and metathorax. Thoracic shield black, with rather broad yellowish dorsal and subdorsal bands; spots absent at base of setae (Figure 87, *1*). Stigmata oval, black, with blackish edge. Thoracic legs black, abdominal legs yellow. Pattern: dorsal band on thoracic shield quite broad, yellow; on meso- and metathorax very nar-

row, faint; on abdominal segments totally masked by black borders and in form of broad, uniform black band, with quite broad greenish-yellow fringe. Subdorsal band greenish-yellow, fairly distinct on thoracic segments; on abdominal segments represented by scattered striae and spots. Upper side of subdorsal band with double border—one moderately broad and black, the other narrower and light-colored. Latter border contours setal bases I and II. Dorsal field with wide, scattered, oblique dark-colored striae. Black lower border of band merges and blends into black background of subdorsal field (Figure 85, *2*). Substigmal band yellow. Stigmata and setal base IV disposed on band. Lower border of band not visible since band merges with yellow background of ventral side. Brown pigment along line of legs represents border of broad median abdominal band. Body length 19 to 34 mm and width of head 2.50 to 2.70 mm.

Development: I-instar. Body with very prominent segments, grayish, with broad prothorax almost equal in width to head. Head brown; thoracic shield light brown. Setae yellowish-brown, piliform; setal bases light-colored, minute. Skin coarsely grained. Feeding larva yellowish-green, with black setal bases. Body length of just hatched larva 1.7 mm, before molt 3.5 to 4.0 mm, and width of head 0.303 mm.

II-instar. Body green. Head yellow, with black spots around setae. Setae black, strong, acuminate, and set on large, black, highly sclerotized bases. Setal base I larger than II. Stigmata light-colored, round, with brown edge. Thoracic legs black; abdominal legs green and anterior two pairs underdeveloped. Pattern: dorsal and subdorsal bands of base color. Borders of dorsal band light-colored, even; subdorsal band bordered with light-colored pigment only on upper side. Substigmal band not prominent but its site lighter in color than body background. Body length 3.5 to 5.7 mm and width of head 0.48 to 0.52 mm.

III-instar. Larva differs from preceding instar in more distinct pattern. Dorsal field with light yellow band along median line; on thoracic segments band narrow, continuous, but on abdominal segments in form of row of sparse dots. Borders of band quite broad, green, with narrow, light yellow edge. Subdorsal band narrow, continuous, light yellow, and fringed on upper side with dark green pigment edged with minute dots and fine striae. Border of band on lower side green, without distinct edge, and blends into dark green background of subdorsal field. Substigmal band broad, light yellow, with distinct borders. Ventral side light green. Body length 5.0 to 9.0 mm and width of head 0.737 to 0.758 mm.

IV-instar. Body dark green, slender, and well proportioned. Head yellow, with black spots around setae and pattern of first type: occipital region of hemisphere black. Setal bases black, highly sclerotized. Setal base I larger than II. Base III larger than II and smaller than I. Setae black, distinctly acuminate. Shields black, with setal bases smaller than on

body, and light yellow dorsal and subdorsal bands. Skin covered with larger papillae bearing minute spines at apex. Stigmata black, oval, with broad black edge. Thoracic legs black; abdominal legs green and all five pairs developed. Pattern: light-colored dorsal band distinct on thoracic shield, narrow on other thoracic segments, very narrow on abdominal segments and noticeable only at margins of segments; at center of segments blackish-green borders terminate and even, narrow yellowish borders follow after it. Subdorsal band narrow, light yellow, with double border—dark- and light-colored; latter visible as separate striae and dots. Subdorsal field dark green. Substigmal band broad, light yellow; its upper margin reaches setal base III while lower one reaches base V. Setal base IV and stigma disposed at center of band. Green ventral side with unpaired median yellow band and paired band below base VI. Body length 8.0 to 16.0 mm and width of head 1.20 to 1.30 mm.

V-instar. Body yellowish-green. Head yellow, with black spots around setae and large scattered spots which may fuse at several places; prominences of hemispheres and occipital region black. Shields black, with broad, yellow, uneven dorsal and subdorsal bands. Setal bases black, large; on abdominal segments base I larger than II. Pattern on trunk differs from the VI-instar in distinct yellow, even subdorsal band, and substigmal band with distinct borders. In all other features pattern wholly corresponds to the VI-instar. Body length 13 to 21 mm and width of head 1.58 to 1.62 mm.

In Belorussia larval development from July through September. Species highly polyphagous and feeds on many weeds, cultivated plants, and wild herbaceous vegetation. Damages clover, alfalfa, sunflower, and vegetable crops.

Eggs laid singly on upper and underside of leaves. They are yellow, 0.509 to 0.510 mm in diameter, and 0.47 mm in height. Ribs at equator 38 to 40. On second day brownish-yellow girdle visible close to apex and similar dot at apex. Girdle gradually enlarges and covers entire upper part of egg, while lower part turns hazy yellow.

2. Genus *Pyrrhia* Hbn.

(one species in Belorussian fauna)

Pyrrhia umbra Hufn. (rest harrow owlet moth)

Mature larva: Postgenal sclerites not contiguous (*Pi* = 1/5). Spinneret 4.0 times longer than first segment of labial palpus. Second seta of palpus slightly longer than first seta. Seta P_1 situated above seta Frl_2. Distance between setae I–I on thoracic shield one-half distance between X–X. Distance between II–II on anal shield 1.5 times less than between

II–III. Mandibles with inner tooth. Skin covered with minute spines. Hooks of abdominal legs biordinal: 14–15, 14–16, 16–17, 16–18, and 18–20.

Main body color green; pattern white and dark, either brownish or brownish-black. Head yellow, with minute brown spots around setae, without pattern. Setae black, highly acuminate. Setal bases large, raised, black, highly sclerotized. Setal base II on abdominal segments somewhat larger than I. Thoracic shield black, lustrous, with uneven white dorsal and subdorsal bands (Figure 87, *2*). Stigmata oval, black, with black edge, surrounded by ring of white pigment. Thoracic legs black; abdominal legs green on inner side and black on outer. Pattern: dorsal band white, on thoracic shield distinct, not broad, and interrupted; on thoracic segments band very narrow, on abdominal segments faint around margins. Borders of dorsal band broad, brown at commencement of instar and black at end of it. Narrow white band follows after darker border. Subdorsal band broad, white initially, yellowish at end of instar. Dorsally fringed with dark-colored pigment, followed by white pigment in form of dots and striae (Figure 85, *3*). Subdorsal field brown or black. Substigmal band yellow, broad, with distinct borders. Stigmata of segments 1 to 7 disposed in upper part of band. Basal field brownish or black. Center of ventral side green. Body length 26 to 40 mm and width of head 2.7 to 2.8 mm.

Development: I-instar. Body of just hatched larva colorless, with colorless large setal bases; sclerotization of bases proceeds for 3.0 to 4.0 hrs. Head black. Thoracic shield dark brown, not fully sclerotized (Figure 59). Skin coarsely grained. Setae black, piliform. Thoracic legs black; abdominal legs colorless and underdeveloped on segments 3 and 4. Feeding larva green, with black pinacula. Large black spot occurs on outer side of abdominal legs. Body length of just hatched larva 1.6 mm, before molt 3.0 mm, and width of head 0.326 mm.

II-instar. Body green. Head brown or yellowish-brown. Setal bases large, round, black. Shields brown, with large setal bases. Setae black, piliform. Stigmata light-colored, round, with black edge, and on tubercles. Pattern: dorsal band not visible; subdorsal and substigmal bands light-colored, very faint. Body length 3.0 to 5.0 mm and width of head 0.542 to 0.544 mm. Abdominal side slightly lighter in color than dorsal.

III-instar. Body green. Head green or light brown, with very dark-colored pattern of first type (Figure 48, *1*). Setae black, somewhat pointed, and set on large black setal bases. Bases III and IV larger than I and II. Shields green, slightly fringed with brown pigment, with black setal bases and white subdorsal bands. Skin covered with minute spines (Figure 26, *5*). Stigmata green, round; on segments 1 and 8 somewhat oval; located on tubercles. Thoracic legs black; abdominal legs black on outer side and

green on inner. Pattern: dorsal band dark green, quite broad, with narrow, uniform white borders. Subdorsal band white, broader than white borders of dorsal band, vivid, and uniform. Substigmal band white, not broad, with indistinct margin at base. Ventral side green. Body length 4.5 to 8.0 mm and width of head 0.715 to 0.780 mm.

IV-instar. Larva differs from the III-instar in that setal bases I and II sclerotized only at apex, and III and IV sclerotized more. Between borders of dorsal and subdorsal bands chain of white dots could be regarded as second border of subdorsal band. Substigmal band broad, with distinct borders, white, but green at center. Body length 7.0 to 15.0 mm and width of head 1.24 to 1.33 mm.

V-instar. Body green, with yellowish bands. Head yellow, with minute black spots around setae and reddish-yellow pattern of first type (Figure 48, *2*). Setae brown, strong, acuminate, and set on round, black, distinctly sclerotized bases. Bases III and IV significantly larger than I and II. Shields green, with flat black setal bases and fairly broad subdorsal bands. Pattern somewhat different from the VI-instar. Dorsal band white; on abdominal segments quite distinct, though narrow; on thoracic segments not prominent and does not extend onto shields. Borders of band doubled—one broad and dark green, and the other narrower with white edging. Subdorsal band quite broad, yellowish. Dorsally with dark green fringe with yellowish edging. Substigmal band broad, white or yellowish along margins, and green at center. All other characteristics same as in the VI-instar. Body length 14 to 26 mm and width of head 1.66 to 1.70 mm.

In Belorussia larval development in June, July, and August. Food plants: rest harrow, geranium, clover, beans, and sage.

Eggs laid singly on upper and underside of leaves. They are yellow, 0.607 to 0.628 mm in diameter, and 0.455 to 0.477 mm in height. Ribs 34 or 35, of which 15 to 17 reach micropylar zone. Micropylar rosette consists of 10 or 11 lobes. After two days narrow reddish girdle at equator and spot at apex visible. Before larva hatches egg yellowish-ash, with head of larva black, visible.

Subfamily Plusiinae

Spinneret round, without fringe and dents along margin of opening, and 1.5 to 2.0 times longer than first segment of labial palpus. Second seta of labial palpus equal to first segment or considerably longer. Two or three setae of group VII developed on segment 1, and three of same group on segment 2; setae VIIa and VIId set on single pinaculum on segment 2. In *Plusia* and *Abrostola* setae VIIa and VIId set on separate pinacula. On segment 9 seta III developed, and like I or II quite strong; in *Abrostola* seta III piliform.

Body of most species greatly pinched toward anterior end, light or dark green, sometimes with admixture of gray, with white and black pattern. Head green, yellowish-green with black spots, or black; in *Abrostola* with black pattern of second type (Figure 49, *4*) or only with dark-colored submedian bands, without reticulate structure. Pinacula present; sclerotized pinacula black and unsclerotized pinacula white or green. In *Abrostola* pinaculum II on segment 8 from 5.0 to 7.0 times larger than pinaculum I. In *Autographa, Chrysaspidia, Plusia,* and *Polychrysia* abdominal legs absent on segments 3 and 4; in *Abrostola* these legs are present but somewhat shortened. Hooks on abdominal legs biordinal. Skin covered with minute spines or granules. Species undergo four molts; V-instar the last.

Key to Genera

1 (2). Abdominal legs, five pairs. Pinaculum II on segment 8 from 5.0 to 7.0 times larger than pinaculum I. Setae III on segment 9 piliform. Seta P_1 shifted caudally from line of setae Frl_1–Frl_2. Characteristic pattern of dorsal field visible on segments 1 and 2 (Figure 93, *6–8*) ..... 1. **Abrostola.**

2 (1). Abdominal legs, three pairs. Pinacula I and II on segment 8 almost equal. Seta III on segment 9 normally developed, similar to I or II. Seta P_1 located on same line as setae Frl_2–Frl_2. Pattern of dorsal field on segments 1 and 2 consists of longitudinal bands (Figure 93, *1–5*).

3 (8). Ungual base of thoracic legs with broad growth (Figure 22, *1*). Setae A_1, A_2, and A_3 on head form obtuse angle. Segment 1, except for *A. confusa* Steph., with two setae of group VII.

4 (7). Head green, without pattern. Pinacula green.

5 (6). Dorsal band green, even, with broad white borders (Figure 93, *5*). White borders of subdorsal band visible only on thoracic segments. ..... 5. **Polychrysia.**

6 (5). Dorsal band uneven, 2.0 times broader at center of each abdominal segment (Figure 93, *2*)..... 2. **Plusia.**

7 (4). Head with pattern of first type, often black, or black only along sides of hemispheres. Pinacula black or light-colored, pinaculum III usually dark. Dorsal band green, with narrow light-colored borders (Figure 93, *3–4*)..... 3. **Autographa.**

8 (3). Ungual base of thoracic legs without growth (Figure 22, *3*). Setae A_1, A_2, and A_3 on head form right angle. Segment I with three setae of group VII. Dorsal band broad, insignificantly broader at center of abdominal segments (Figure 93, *1*). Head green, with light brown pattern of first type (Figure 48, *1*).... 4. **Chrysaspidia.**

1. Genus *Abrostola* Ochs.

Postgenal sclerites narrow, almost contiguous (*Pi* = 1/8, 1/9). Mandibles with inner tooth. Two setae of group VII developed on segment 1 and three of same group on segment 2; setae set on separate pinacula. Pinacula II on segment 8 from 5.0 to 7.0 times large than pinaculam I. Seta III on segment 9 piliform. Abdominal legs, five pairs; hooks biordinal. Skin finely grained, without spines.

Key to Species

1 (2). Segments 1 and 2 with large black, velvety, triangular spot, with adjacent large white spots on segment 1 (Figure 93, *8*)..... ..... 2. **A. trigemina** Wrnbg.

2 (1). Segments 1 and 2 (Figure 93, *6*) with large, dark green, velvety, semicircular spot or broad, oblique green spots between setae I and II (Figure 93, *7*)..... 1. **A. triplasia** L.

1. **Abrostola triplasia** L. (syn. *tripartita* Hufn.) (nettle gray owlet moth)

Mature larva: Spinneret highly pinched toward end, 2.0 times longer than first segment of labial palpus. Second seta of palpus somewhat longer than first segment and 2.0 times longer than first seta. Hooks of abdominal legs: 23–24, 25–27, 28–29, 28–30, and 31–32.

Body green, with mixture of white, dark green, and sometimes brownish pigment. Head dull green with mixture of dark green and brown forming submedian bands that are pinched downward; suborbital band remains same; reticulate structure faintly developed. Setae reddish-brown or light-colored, faint, highly acuminate. Pinacula white; I and II almost identical on thoracic segments; on segments 2 and 3 pinaculum II large, and on segment 8 very large. Shields not prominent; three light-colored bands extend along thoracic shield and two along anal. Stigmata oval, pinkish-white, with reddish-brown margin. Thoracic legs brown or brownish-gray; abdominal legs green and first two pairs shorter and thinner than the rest. Pattern varies. *Variation I*: Dorsal band on segments II and III rather broad, white; on abdominal segments covered with minute reddish-brown spots with white pigment perceptible only at center of segments; band almost absent on segments 1 and 2. Subdorsal band on thoracic segments in form of row of white dots; on segments 1 and 2 in first third of segment also in form of row of dots, later continuous, highly enlarged, shifts upward in region of pinaculum II, and fuses with branch of same band extending from other side of body, encompassing on caudal side large dark green, velvety, semicircular spot, and covering entire dorsal field at center of segment (Figure 93, *6*). On other abdominal segments subdorsal band shifts upward and on caudal side encloses broad dark green

oblique spot. At center of all abdominal segments subdorsal band joins broad white oblique line on substigmal band. Dorsal field, outside oblique dark-colored spots and semicircles, covered with large number of white and reddish-brown spots and smears. Subdorsal field in lower part dark green. Substigmal band white, not broad. Subdorsal field with broad dark green, oblique smears extending toward abdominal legs.

Variation 2: Dorsal band green; on segments II and III broad; on abdominal segments visible only on anterior half, uneven; on segments 7 and 8, narrow but extends along entire segment. Dorsal band fringed with white pigment; on thoracic segments borders at center of segment extend to pinacula II's; on abdominal segments (Figure 93, *7*) borders enlarge notably in anterior part of segment and gradually narrow toward region of pinaculum I to form large white, triangular spot with smear of dorsal band at center; in posterior part of segment borders narrow and often mask dorsal band. Subdorsal and suprastigmal bands in form of separate dark green spots in posterior part of segments; borders of band broad, white. Upper border of subdorsal band at beginning of segment shifts notably upward to encompass pinaculum II, and at end of segment approaches border of dorsal band to form broad, oblique white striae. Substigmal band white, not broad, even; on abdominal segments shifts notably upward so that all stigmata disposed below band. Ventral side green with white spots or dots. In basal field dots dense and form oblique light-colored smears. Body length 22 to 36 mm and width of head 2.10 to 2.15 mm.

In Belorussia larval development in June and July, and August and September. Food plant: common stinging nettle.

2. **Abrostola trigemina** Werneb. (syn. *triplasia* Hufn.) (brown nettle owlet moth)

Mature larva: Spinneret same as in *A. triplasia* L. Hooks of abdominal legs: 20–21, 20–23, 24–26, 24–28, and 28–30.

Body highly pinched toward anterior end. Main body color green. Head pale green, with black pattern of second type (Figure 49, *4*). Pinacula not large, white, surrounded by ring of dark green pigment. Setae light-colored, terminally brownish, highly acuminate. Thoracic shield darker than back, with broad white dorsal band and narrow white subdorsal bands. Stigmata white, oval, with black margin. Legs reddish-brown; abdominal legs dark brown on outer side, and first two pairs less developed than the rest. Pattern: dorsal bands white, continuous on thoracic shield, gradually enlarging on segments II and III, with fine green striae extending onto band; on segment 1 white background forms double band along outer side of pinacula I and II, then notably expands downward to form

large white spot along sides of dorsal field. Center of segment I with black, velvety, triangular spot (Figure 93, *8*), which on segment 2 is somewhat smaller; black background posteriorly and along sides of segment 2 with white margin. Dorsal band in posterior part of all abdominal segments, except 8, not broad, white, with green striae; in anterior part of segments narrow, appears pinched by dark triangular spots adjoining it. On segment 8 band interrupted by large dark-colored spot extending transversely in posterior part of segment; spot bordered by light-colored line. Subdorsal band narrow, faint. Substigmal band narrow, white, covered in region of stigmata by dark green pigment that shifts obliquely downward toward rear border of abdominal legs; on margins of segments III and 1 substigmal band broad, yellow. Basal field dark-colored. Ventral side green, with white dots and dark green striae; broad light-colored band extends along median line. Body length 23 to 37 mm and width of head 2.20 to 2.30 mm.

Development: I-instar. Body of just hatched larva colorless, with black head, light brown thoracic shield, and colorless pinacula that turn brown after 1.5 to 2.0 hrs. Skin finely grained. Thoracic legs black; abdominal legs colorless and on segments 3 and 4 extremely small, rudimentary. Feeding larva green. Body length of just hatched larva 2.0 mm, before molt 4.0 mm, and width of head 0.368 mm.

II-instar. Body pale green, with dilatation on segment 8. Head light green, with large spot in region of eyes and minute pinacula at base of setae. Setae weak, acuminate. Pinacula not large, black. Stigmata round, light-colored, with reddish-brown edge. Thoracic legs black; abdominal legs light-colored and first two pairs short, slender. Pattern: bands not visible. Row of rather large reddish-yellow spots located along line of pinaculum III. Similar spots border both sides of median line on ventral side. Body length 4.0 to 7.5 mm and width of head 0.564 to 0.585 mm.

III-instar. Body green, highly pinched toward anterior end. Head pale green, with black submedian band; reticulate structure not visible. Pinacula black, I and II almost identical, III significantly larger. Shields light-colored, with minute black pinacula. Setae brownish, acuminate. First and last stigmata slightly oval, rest circular, light-colored, with black margin. Pattern: dorsal band on thoracic segments broad, continuous, greenish-white; on segments 1 and 2 doubled and extends up to middle of segment in form of fork where it splits and forms at center of segment a cross-shaped spot, connected by thin white stria with broad section of band in posterior part of segment. On other abdominal segments dorsal band narrow, green, with thin white striae alongside. Subdorsal band green, its upper border narrow and white; on segments 1, 2, and 3 band interrupted around pinaculum II and forms an oblique branch upward and backward toward dorsal band; on segment 1 a large, longitudinal, vivid white spots

extending from pinaculum I fuses with subdorsal band; on segment 2 white line extends upward from subdorsal band toward pinaculum I. Substigmal band white, not broad; broad oblique lines extend from it toward abdominal legs. Body length 7.0 to 14.0 mm and width of head 0.867 to 0.909 mm.

IV-instar. Body green, highly pinched toward anterior end. Head light green, with black spots around setae, black submedian band, and without reticulate structure. Pinacula light green; I and II (in addition to those located on segments 1, 2, and 8) surrounded by broad ring of light green pigment. Shields, setae, legs, and pattern same as in the V-instar. Body length 13 to 24 mm and width of head 1.441 to 1.463 mm.

In Belorussia larval development in June and July, and in August and September. Food plant: common stinging nettle.

Eggs laid singly, pale green, 0.65 to 0.67 mm in diameter, and 0.586 mm in height. Ribs 32 to 34, of which 16 or 17 reach micropylar zone. Micropylar rosette consists of 10 or 11 lobes, with 2 or 3 rims. Before larvae hatch eggs turn yellowish.

2. Genus *Plusia* Ochs.

(one species in Belorussian fauna)

Plusia chrysitis L. (metallic golden moth)

Mature larva: Postgenal sclerites narrow, not contiguous ($Pi = 1/6$). Spinneret slightly pinched toward end, 1.5 times longer than first segment of labial palpus. Second seta of palpus slightly shorter than first segment and 5.0 times longer than first seta. Seta Frl_2 considerably above apex of frons; seta P_1 much closer to epicranial suture than P_2. Setae A_1, A_2, and A_3 form an obtuse angle. Distance between setae I–II on thoracic shield 2.0 times less than between III–IX. Distance between setae II–II on anal shield 1.5 times less than between II–III. Segment 1 with two setae of group VII developed, and segment 2 with three. On segment 2 setae VIIa and VIId share common pinaculum. Skin covered with extremely minute spines. Hooks of abdominal legs: 18–19, 19–20, and 19–20.

Body highly pinched toward anterior end, green, with white pattern. Head green, without pattern. Pinacula light-colored, on apex white, not large, and on shields minute. Setae rusty-brown, acuminate. Stigmata oval, broad, with thin rusty-brown edge. Legs green. Pattern: dorsal band of base color, uneven, narrow on thoracic segments, and twice as large on abdominal. Band fringed with white pigment. Subdorsal band also green with white borders, uneven. Lower border quite even, upper border in form of individual oblique bands that separate around seta II from lower border, later extend upward and backward and fuse around seta I with border of dorsal band (Figure 93, *2*). Borders of dorsal and subdorsal

bands extend onto shields. Substigmal band white above and below, green at center. All stigmata disposed on band. Ventral side green, lighter than dorsal. Sparse white dots scattered on subdorsal field and in region of abdomen. Body length 25 to 38 mm and width of head 2.20 to 2.40 mm.

Development: I-instar. Body of just hatched larva colorless, slender, with slightly enlarged segment 8. Head colorless; pinacula minute, colorless; sclerotization continues for 15 to 25 min. Setae dark brown, acuminate. Feeding larva light green, with lustrous black pinacula. Body length of just hatched larva 2.1 mm, before molt 4.5 mm, and width of head 0.355 mm.

II-instar. Body green, somewhat pinched toward anterior end. Head green. Setae long, dark-colored, acuminate. Pinacula minute, black. Shields green. Stigmata green, round, with yellowish edge. Legs green. Pattern absent. Body length 4.50 to 8.50 mm and width of head 0.542 to 0.600 mm.

III-instar. Body significantly pinched toward anterior end, green. Head green, with large brown spots at base of setae. Pinacula large, but sclerotized only at apex and hence appear small. Shields green, with minute black pinacula. Setae brownish, long, acuminate. Stigmata slightly oval, broad, greenish-white, with thin reddish-brown margin. Legs green; abdominal legs with light-colored plantae. Pattern: dorsal band not visible, subdorsal green, with white borders; lower thin border extends below pinaculum II, while upper in form of fine, individual, white, oblique striae, which commence from pinaculum II and extends backward to pinaculum I of successive segment. Borders of bands extend onto shields. Substigmal band white, narrow, with distinct upper and lower borders. Ventral side green, same color as dorsal. Body length 8.0 to 16.5 mm and width of head 0.77 to 0.87 mm.

IV-instar. Larva differs from the V-instar only in very large pinacula, but as in the V-instar, pinacula also white, not sclerotized. Body length 17 to 28 mm and width of head 1.42 to 1.55 mm.

In Belorussia larval development in June and July, and in August and September; evidently, larvae hibernate. Food plants: common stinging nettle, dead nettle, *Lycopus, Myosotis,* hemp nettle, hedge nettle, *Origanum, Ballota,* viper's bugloss, plantain, whorehound, burr marigold, and hollyhock.

Eggs laid singly, pale yellow, almost colorless, 0.732 to 0.755 mm in diameter, and 0.375 to 0.378 mm in height. Ribs 44, of which 14 to 16 reach micropylar zone. Micropylar rosette consists of 7 or 8 lobes, with 2 or 3 rims. During embryonal development color of egg does not change. Before larva hatches, dark mandibles and eyes visible.

3. Genus *Autographa* Hbn.

Postgenal sclerites not contiguous (*Pi* = 1/7, 1/6). Spinneret slender, slightly enlarged at center, 2.0 times longer than first segment of labial palpus. Second seta of palpus almost 2.0 times longer than first segment and 2.0 times longer than first seta. Seta P_1 on same line as Frl_2–Frl_2; seta P_2 separated from epicranial suture slightly more than P_1. Setae A_1, A_2, and A_3 form obtuse angle. Distance between setae I–II on thoracic shield half distance between II–IX. Segment 1 with two or three setae of group VII.

Key to Species

1 (2). Dorsal band broad, with thin light-colored connecting strip at center of each abdominal segment (Figure 93, *3*). Skin covered with equal-sized spines. Segment 1 with two setae of group VII.... ..... 1. **A. gamma** L.

2 (1). Dorsal band not broad, without light-colored connecting strip on abdominal segments (Figure 93, *4*). Skin covered with various-sized spines. Segment 1 with three setae of group VII..... ..... 2. **A. confusa** Steph.

1. **Autographa gamma** L. (silver Y-moth)

Mature larva: Segment 1 with two setae of group VII, and segment 2 with three. Setae VIIa and VIId on segment 2 share common pinaculum. Skin covered with minute, almost equal-sized spines. Hooks of abdominal legs: 17–18, 18–19, and 19–21.

Body highly pinched toward anterior end, light or dark green. Head green, with black pattern of first type (Figure 48, *1*). Sometimes pattern seen only in median part of head, while lateral sides of hemispheres covered with black pigment. In dark-colored specimens head black, only epicranial and adfrontal sutures green. Toward end of instar black pigment of head disappears gradually. Pinacula large, I and II on abdominal segments almost identical. At commencement of instar pinacula highly sclerotized, black; sclerotization gradually disappears later and only apices remain black. Before pupation, all pinacula green. Sclerotization of pinacula on segments 1 and 2 retained the longest. Shields black or green; light-colored borders of subdorsal band extend onto shields. Setae long, rust-colored. Stigmata green, oval, with thin black edge. Thoracic legs black in dark-colored specimens and green with black rings in light green specimens; abdominal legs green. Pattern: dorsal and subdorsal bands of base green, with white or yellowish borders. Dorsal band quite broad, uneven, somewhat expands at center and end of segment; hence its thin border sinuate. At center of abdominal segments, between borders, connecting

strips intersect band (Figure 93, *3*). Upper border of subdorsal band quite broad, lower narrow, and terminates on mesothorax and on segment 8. Border of subdorsal band encompasses pinaculum II, where it is usually flexed; subdorsal band extends along line of pinaculum II, i.e., shifts upward. Substigmal band yellow, not broad, with eroded lower border. Dorsal field, subdorsal field, and ventral side green; sparse yellowish dots dispersed along subdorsal field and region of abdomen. Body length 24 to 40 mm and width of head 2.0 to 2.2 mm.

Development: I-instar. Body of just hatched larva colorless, with large colorless pinacula, their sclerotization continuing for 2.0 to 3.0 hrs. Head almost black; thoracic shield brown. Legs light-colored; abdominal legs three pairs, the first two pairs not even perceptible as rudiments. Skin finely grained. Feeding larva green, with black pinacula; on meso- and metathorax pinacula II and IV large, oblong. Length of just hatched larva 2.0 to 2.1 mm, before molt 4.5 to 4.6 mm, and width of head 0.264 to 0.282 mm.

II-instar. Body with very prominent segments, slightly pinched toward anterior end. Head yellowish-green, with black spots around setae, and brownish-yellow pattern of first type (Figure 48, *1*). Setae black, acuminate. Pinacula black, round; pinacula I and II large on segments 1 to 5, smaller on other segments, and almost minute on shields. Shields not prominent. Stigmata round, light-colored, with thin black edge. Skin coarsely grained. Legs light-colored. Pattern absent. Body length 4.50 to 7.30 mm and width of head 0.40 to 0.57 mm.

III-instar. Color of body, head, and shields same as in the II-instar. Pinacula black, I and III larger than II. Toward end of instar sclerotization of pinacula gradually decreases, and retained longest on segments 1 and 2. Thoracic legs dark-colored; abdominal legs light-colored with dark-colored spots on outer side. Pattern: dorsal and ventral sides of pinaculum II with two thin whitish bands—borders of green subdorsal band. Dorsal band not prominent. Substigmal band white, narrow; stigmata disposed on it. Body length 7.5 to 15.0 mm and width of head 0.746 to 0.842 mm.

IV-instar. Body green, highly pinched toward anterior end. Head yellow, with dark brown spots around setae and pattern of first type. In genal region spots often fused into larger spot. Pinacula and shields same as in the III-instar, their sclerotization disappearing toward end of instar. Stigmata oval, light-colored, with black edge. Thoracic legs at commencement of instar green, gradually darken, and later become black. Abdominal legs green, with black spots on outer side or dark with light-colored plantae. Pattern same as in the V-instar. Body length 13 to 23 mm and width of head 1.182 to 1.274 mm.

In Belorussia larval development in June and July, and in August and September; in southern part of Republic three generations occur every year; in the central part a third generation has been recorded in some years. Both larvae and pupae hibernate. Species highly polyphagous, feeding on many cultivated plants, weeds, and wild flora; sporadically damages flax and other crops severely.

Eggs laid singly, light yellow, 0.55 to 0.60 mm in diameter, and 0.382 to 0.415 mm in height. Ribs 34 to 38, of which 24 or 25 reach micropylar zone. Micropylar rosette consists of 7 or 8 lobes, with 2 or 3 rims. During embryonal development color of eggs pales somewhat. Before larva hatches black head and setae visible.

2. **Autographa confusa** Steph. (syn. *gutta* Gn.) (drop owlet moth)

Mature larva: Three setae of group VII developed on segments 1 and 2. Setae VIIa and VIId on segments 1 and 2 set on common pinaculum. Skin covered with minute spines with large ones scattered in-between. Hooks of abdominal legs: 18–20, 20–21, and 18–21.

Body bright green, more rarely grayish-green or reddish-gray, highly pinched toward anterior end, with distinct segments. Head green, with minute black spots at base of setae and black region in lower part of hemispheres. Sometimes black spots present around epicranial suture; rarely, entire head black. Pinacula large but notably smaller than in *A. gamma,* unsclerotized, white. Pinaculum III brownish or black; light-colored at end of instar. Shields not prominent; light-colored borders of dorsal bands extend along them. Setae dark brown, slender, acuminate. Thoracic legs black, abdominal legs green. Pattern: dorsal band green, with narrow white borders, uneven, and somewhat enlarged at center of segment (Figure 93, *4*). Subdorsal band also green, highly shifted upward, and extends between pinacula I and II. Upper narrow white border of subdorsal band encircles pinaculum I on ventral side; lower border encircles pinaculum II on dorsal side. Substigmal band white, not broad, with eroded lower border. Stigmata disposed on band. Ventral side green, much brighter than back. White dots scattered along body. Body length 24 to 37 mm and width of head 2.0 to 2.2 mm.

Development: I-instar. Just hatched larva yellowish, with black head, gray thoracic shield, and large colorless pinacula that turn black within 2.0 hrs. Setae long, brownish, not pointed. Body of feeding larva colorless, green only in region of filled intestine. Shields and pinacula brown. Skin finely grained. Thoracic legs light brown, abdominal legs light-colored. Body length of just hatched larva 1.8 to 2.0 mm, before molt 3.9 to 4.0 mm, and width of head 0.282 mm.

II-instar. Body green, with very prominent segments. Head yellowish-green, with minute black spots around base of setae and around epicranial

suture. Setae long, black, acuminate. Pinacula large, black, unevenly roundish; pinaculum III on thoracic segments largest. At end of instar process of sclerotization of pinacula ceases. Thoracic shield yellowish, fringed with brownish striae. Skin coarsely grained. Stigmata round, broad, light-colored, with brown margin. Thoracic legs dark-colored, abdominal legs green. Pattern absent. Body length 4.0 to 7.0 mm and width of head 0.542 to 0.586 mm.

III-instar. Body notably pinched toward anterior end. Head green, with black spots at base of setae, around epicranial suture, and along sides of head. Pinacula large, green, black only at commencement of instar except pinaculum III, which remains black up to midinstar. Setae very long, black, acuminate. Stigmata slightly oval, light-colored. Pattern: row of minute white spots seen along line of pinaculum I and white line along line of pinaculum II, representing light-colored borders of green subdorsal band. Substigmal band white, not broad; stigmata disposed along its upper border. Body length 8.0 to 16.0 mm and width of head 0.845 to 0.889 mm.

IV-instar. Body green, highly pinched toward anterior end. Head green; minute black dots in orbital region almost fuse into black spot; black spots around epicranial suture quite large. Pinacula I and II light-colored, III and IV black. In other characteristics larvae do not differ from the V-instar.

In Belorussia larvae found in June and July, and in August and September. Food plants: dead nettle, yarrow, daisy, wormwood, camomile, dandelion, and plantain. Sometimes damage vegetable crops.

Eggs laid singly, light yellow, 0.606 to 0.617 mm in diameter, and 0.400 to 0.412 mm in height. Ribs 38 to 40, of which 15 or 16 reach micropylar zone. Micropylar rosette consists of 8 or 9 lobes, with 2 rims. During embryonal development eggs hardly change in color, but before larvae hatch turn light gray, with black head of larva visible.

4. Genus *Chrysaspidia* Hbn.
(one species investigated)

Chrysaspidia festucae L. (metallic cereal moth)

Mature larva: Postgenal sclerites broad, adjacent. Spinneret highly pinched toward end, 2.0 times longer than first segment of labial palpus. Second seta of palpus equal to first segment and almost 3.0 times longer than first seta. Seta Frl_2 considerably above apex of frons; seta P_1 on same line as Frl_2–Frl_2 and closer to epicranial suture than P_2. Second dorsal tooth of mandible split. Distance between setae I–II on thoracic shield 2.5 times less than between II–IX; distance between II–II on oval shield 2.5 times less than between II–III. Three setae of group VII developed

on segments 1 and 2. Setae VIIa and VIId on segments 2 and 3 share common pinaculum. Skin covered with minute spines. Hooks of abdominal legs: 15–17, 18–19, and 18–20.

Body bright green, slightly pinched toward anterior end. Head green, with faint light brown pattern of first type (Figure 48, *1*). Setae light brown, long, slender, acuminate, and set on light-colored pinacula. Shields not prominent; dorsal and subdorsal bands and their borders do not extend onto them; dorsal band barely perceptible on thoracic shield. Stigmata white, with broad yellowish margin. Legs green. Pattern: dorsal band green, slightly darker than general body background, with narrow, light yellow, even borders (Figure 93, *1*). Subdorsal band slightly shifted upward, lighter than dorsal band, with similar light yellow borders. Borders of dorsal and subdorsal bands form two flexures within segments. Lower part of subdorsal field dark green. Substigmal band golden-yellow, not broad, even, with distinct borders. Ventral side green, does not differ from dorsal. Body length 22 to 37 mm and width of head 2.70 to 2.80 mm.

Development: I-instar. Body of just hatched larva colorless. Head yellowish, with rusty-brown spots around setae. Pinacula rather large, colorless; sclerotization proceeds for 30 to 40 min. Setae long, black, acuminate. Skin finely grained. Legs colorless; abdominal legs three pairs, since even rudimentary [vestigial] ones absent on segments 3 and 4. Feeding larva green, with black large pinacula, and grayish shields edged with brown pigment. Stigmata round, light-colored, with thin yellowish edge. Body length of just hatched larva 1.7 mm, before molt 4.0 to 4.5 mm, and width of head 0.333 to 0.360 mm.

II and III-instars. These larvae differ little from the I-instar. Body green. Head yellowish or green, with brown spots around setae. Pinacula black; shields barely distinguishable. Pattern not seen in the IV-instar; two whitish lines encompass pinaculum II in the III-instar. Substigmal band whitish, faint. Body length in the II-instar 4.0 to 8.0 mm and width of head 0.510 to 0.549 mm; body length in the III-instar 7.0 to 14.0 mm and width of head 0.765 to 0.800 mm.

IV-instar. Larvae differ from the V-instar in that borders of dorsal and subdorsal bands not light yellow but white. Body length 12 to 23 mm and width of head 1.215 to 1.372 mm.

In Belorussia larval development in June–July, and August–September. Food plants: sedge, manna grass, reeds, fescue, *Alisma*, iris, broad-leaved cattail, and burr reed.

Eggs laid singly or in small clusters of 5 to 25 each. They are pale yellow, 0.737 to 0.758 mm in diameter, and 0.56 to 0.58 mm in height. Ribs 42 or 43, of which 25 or 26 reach micropylar zone. Micropylar rosette consists of 7 or 8 lobes, with 3 rims. After two days slightly yellowish-

brown dots appear at apex and color of eggs gradually pales. Before larva hatches egg ash-gray.

5. Genus *Polychrysia* Hbn.
(one species in Belorussian fauna)

Polychrysia moneta F. (golden metallic moth)

Mature larva: Postgenal sclerites almost contiguous (*Pi* = 1/9). Spinneret 2.5 times longer than first segment of labial palpus. Second seta of palpus almost equal to first segment and 2.0 times longer than first seta. Seta P_1 on same line as Frl_2–Frl_2; seta P_2 somewhat farther from epicranial suture than P_1. Distance between setae I–II on thoracic shield 2.0 times greater than between II–IX. Distance between II–II on anal shield 2.0 times less than distance between II–III. Two setae of group VII developed on segment I; setae VIIa, VIIb, and VIId share common pinaculum on segments 2 and 3. Skin covered with minute spines. Hooks of abdominal legs: 20–21, 22–23, and 21–22.

Body light green, pinched toward anterior end, with prominent segments. Head green, without pattern. Setae light-colored, acuminate. Pinacula not sclerotized, light green, white at apex; pinacula I and II almost identical. Shields not prominent; narrow borders of subdorsal band extends along thoracic shield. Stigmata oval, broad, white, with light brown edge. Legs green; abdominal legs with large brown spots on outer side. Pattern: dorsal band of base color, slightly darker than general green body background, almost uniform, with rather broad whitish borders (Figure 93, *5*). Between setae I and II subdorsal band very dark green and somewhat broader than dorsal. On thoracic segments subdorsal band fringed with white striae. On abdominal segments borders not present, only lighter green background visible on dorsal and ventral sides of band. Substigmal band not broad, white, in region of stigmata yellowish. Ventral side green, brighter than dorsal. Body length 25 to 37 mm and width of head 2.0 to 2.1 mm.

In Belorussia larvae seen at end of May. Food plants: delphinium, globe flower, and aconite.

Subfamily Jaspidiinae

1. Genus *Emmelia* Hbn.
(one species investigated)

Emmelia trabealis Scop. (bindweed owlet moth)

Mature larva: Postgenal sclerites not contiguous (*Pi* = 1/5). Spinneret broad, slightly pinched toward end, almost 2.0 times longer than

first segment of labial palpus. Second seta of palpus one-third shorter than first segment and 2.5 times longer than first seta. Seta P_1 above seta Frl_2; P_2 closer to epicranial suture than P_1. Apex of frons dilated, in form of tubercle. Anal shield with uneven edges (Figure 88) and seta II considerably larger and stronger than the rest; distance between setae II–II less than between II–III. Mandibular teeth normal; inner tooth large, broad, crenate. Abdominal legs, three pairs. Hooks arranged in one tier: 16–17, 17–18, and 17–19. Skin finely grained.

Body long and slender, with slightly enlarged segment 8. Main body color dark green or brownish; pattern white, yellow, and black. Head black, with white spot on prominences of hemispheres and around adfrontal sutures (Figure 89). Frons black in lower part, with black spot at apex of tubercle. Setae black, acuminate, strong. Pinacula quite large, light brown or black; pinacula I and II on segments 1 to 3 and 8 located on almost same longitudinal line (Figure 39, *2*). Thoracic shield black, with broad light-colored subdorsal bands, narrow dorsal bands, and light-colored striae. Stigmata somewhat oval, dark-colored, with black edge. Thoracic legs black, abdominal legs yellowish-brown. Pattern: dorsal band white; on thoracic segments narrow, continuous; on abdominal segments consists of minute dots surrounded by black pigment and other adjacent dots; two rows of large white dots occur along margins of black pigment. Subdorsal band consists of row of large white dots. Dorsal field green or brownish, with scattered white dots and black striae. Subdorsal field dark brown or black with sparse white dots. Substigmal band broad, bright yellow, at places white, and notably shifted upward so that all stigmata disposed on band. Ventral side black or brown, with large number of white dots, and two rows of much larger dots on either side of median line. Body length 17 to 25 mm and width of head 1.53 to 1.55 mm.

Development: I-instar. Just hatched larva grayish, with large light-colored pinacula. Body slender, segment 8 dilated, prothorax almost as wide as head. Head and thoracic shield black. Setae brown, piliform. Skin finely grained. Thoracic legs black; abdominal legs light-colored and consist of three pairs since even rudimentary legs absent on segments 3 and 4. Body of feeding larva greenish-yellow, with light brown pinacula. Abdominal segments 1 to 4 with broad brownish-yellow or brownish connecting strips. Body length of just hatched larva 1.40 mm, before molt 2.50 mm, and width of head 0.255 mm.

II-instar. Body greenish-yellow, with dark-colored pattern, and highly dilated segments, especially segments 1 to 4 and 8. Head brown to almost black. Pinacula large, brownish; pinacula I and II on same longitudinal line. Setae brown, piliform. Shields brown, with minute pinacula. Stigmata round, light-colored, with brown edge. Thoracic legs black; abdominal

legs yellowish, with large brown spots on outer side. Pattern: segments 1 to 4 with broad, brownish, transverse connecting strips between pinacula I and II. Broad, brownish dorsal band and white borders of same width in form of separate spots distinctly visible along margins of segments. Subdorsal band white, also consists of large spots because interrupted at places of brownish connecting strips. Substigmal band not present. Ventral side brownish-green. Body length 2.5 to 5.0 mm and width of head 0.34 to 0.37 mm.

In Belorussia larval development in June and August. Two generations. Feed mainly on bindweed.

Eggs laid singly and haphazardly. They are green, 0.313 to 0.350 mm in diameter, and 0.45 to 0.46 mm in height. Ribs 28 to 30, of which 10 or 12 reach micropylar zone. Micropylar rosette consists of 6 or 7 lobes, with single rim. On second day brownish spot visible at apex. Eggshell subsequently turns yellowish-gray, with an admixture of brown later. Before larva hatches egg grayish-brown.

Subfamily Catocalinae

Spinneret broad, slightly pinched toward end, and 1.5 to 2.0 times longer than first segment of labial palpus. Spinneret opening without fringe or dents. Second seta of labial palpus longer than first seta. Teeth of mandibles often reduced; in *Lygephila* and *Ectypa* dorsal teeth reduced; in some *Catocala* teeth totally reduced. In species of *Catocala* and *Ectypa* seta P_1 notably above Frl_2–Frl_2, while in *Lygephila* these setae aligned. Seta III developed, not pilose, on segment 9.

Body well proportioned or with significantly dilated segments 5 and 8. In *Catocala* dermal growths in form of fringe on each side of body below seta VI a characteristic feature. Pattern on head of second type (Figure 49, *9*) or third type (Figure 47, *3*). In *E. glyphica* L. head with light-colored longitudinal bands, which correspond to longitudinal bands on trunk. Abdominal legs, five pairs; two anterior pairs considerably shorter than rest; *E. glyphica* L. lacks legs on segment 3. Hooks uniordinal. Five molts, the VI-instar last.

Key to Genera

1 (4). Distinct tubercle or small dilatation surrounded by dark pigment present on dorsal side of segment 5. Dermal growths in form of fringe present on each side of body. Pattern on head of second type (Figure 49, *9*). Larvae large, up to 50 to 90 mm long.

2 (3). Segments 5 and 8 highly dilated. Distance between setae I–I on anal shield considerably more than between setae II–II..... ..... 1. **Mormonia.**

3 (2). Small dilatation present on dorsal side of segment 5; segment 8 not dilated. Setae I–I and II–II on anal shield equidistant.... ..... 2. **Catocala.**

4 (1). Body well proportioned, without tubercles or dilatations. Dermal growths absent below seta VI along sides of body. Pattern on head different. Larvae medium in size, up to 30 to 40 mm long.

5 (6). Seta P_1 on same line as setae Frl_2–Frl_2. Head light-colored, with dark pattern of third type (Figure 47, *3*). Abdominal legs, five pairs..... 4. **Lygephila.**

6 (5). Seta P_1 above line of setae Frl_2–Frl_2. Head dark-colored, with light-colored oblong bands. Abdominal legs, four pairs..... ..... 3. **Ectypa.**

1. Genus *Mormonia* Hbn.

(one species in Belorussian fauna)

Mormonia sponsa L. (crimson underwing)

Mature larva: Main teeth of mandibles quite well developed, ventral ones weak, dorsal ones reduced; inner tooth large. Setae Frl_1–Frl_2 and Frl_1–F_1 equidistant. Distance between seta I–I on anal shield considerably more than between II–II. Distance between metathoracic coxae equal to distance between setae VIII–VIII. Segment 5 highly dilated. Greatly enlarged setal base II forms dilatation on segment 8. Dermal growths hang below seta VI along sides of body. Hooks of abdominal legs: 36–42, 41–45, 45–49, 49–52, and 50–53.

Body not uniform in size; highly enlarged in region of segments 4 to 6. Main greenish-yellow color of body with faint violet tinge; body densely covered with brown and black dots. Head light gray, with brownish pattern of second type (Figure 49, *9*); frons light-colored, with black oblong line. Shields not prominent. Setal bases reddish, quite large; base II almost 3.0 times larger than base I. Setal base II on segment 8, 20 or more times larger than base I. Setae dark-colored, acuminate; I and II short, III, IV, and V between 2.0 to 3.0 times longer. Stigmata dark yellow, oval, with black edge. Abdominal legs dark-colored, on segments 3 and 4 somewhat shorter than on 5 and 6; plantae of legs broad. Pattern: dorsal band of main body color but more densely covered with black dots and hence seen as prominent dark line. All other bands absent. Dorsal and lateral sides of body almost uniformly covered with brown and black, more rarely dark yellow dots. Dilatation on segment 5 covered with black dots, at center with light yellow dots that form transverse smears. Ventral side light gray, with faint violet tinge; large black spots present along median line. Body length 50 to 70 mm and width of head 3.80 to 4.00 mm.

In Belorussia larval development in May and June. Feed on oak leaves. Eggs hibernate.

According to Döring (1955), eggs dark brown, with extremely light-colored girdle and spot at apex, 1.30 to 1.40 mm in diameter, and 0.60 to 0.70 mm in height. Micropylar rosette consists of 14 to 16 lobes, with 3 rims. Ribs absent.

2. Genus *Catocala* Schrk.

Seta P_1 considerably above Frl_2. All or only dorsal and ventral teeth of mandibles reduced; inner tooth present or absent. Distinct tubercle present on dorsal side of segment 5. Dermal growths hang below seta VI along body sides. Abdominal legs on segments 3 and 4 shorter than on segments 5 and 6.

Key to Species

1 (2). Body ash-gray. Sinuous black bands on hemispheres of head around epicranial suture do not curve downward (Figure 92, *1*). All teeth of mandibles reduced; inner tooth absent..... ..... 1. **C. fraxini** L.

2 (1). Body gray. Sinuous black bands on hemispheres of head around epicranial suture poorly down-curved (Figure 92, *2*). Main teeth of mandibles developed, dorsal and ventral reduced; inner tooth present..... 2. **C. nupta** L.

1. **Catocala fraxini** L. (blue underwing moth)

Mature larva: Teeth of mandibles reduced; inner tooth absent. Distance between setae Frl_1–Frl_2 greater than between Frl_1–F_1 by 1.5 times. Setae I–I and II–II on anal shield equidistant. Distance between metathoracic coxae half distance between setae VIII–VIII. Small tubercle present on dorsal side of segment 5. Hooks of abdominal legs: 52–53, 53–56, 55–57, 56–58, and 58–62.

Body ash-gray. Small tubercle on segment 5 broadly fringed with large black dots. Pinacula minute, flat, yellowish-gray, faint. On segment 5 pinaculum II larger than I; on segments 8 and 9 pinaculum II larger than pinaculum I by 10 times. Head grayish-yellow, with brown pattern of second type. Submedian bands on prominences of hemispheres yellowish-red but arc downward in form of three brown smears (Figure 49, *9*). Sinuous black bands around epicranial suture not down-curved (Figure 92, *1*). Shields not prominent. Setae slender, acuminate, light-colored; I and II short and set on almost same longitudinal line. Stigmata dark gray, oval, with black edge. Legs gray; plantae of abdominal legs broad, surrounded on outer side with black pigment. Pattern: light-colored dorsal

band noticeable only at margins of segments 5 and 6 where black dots surround small tubercle; dots absent in region of bands. Entire body, except ventral side, covered with varicolored dots: yellowish, light or dark brown, more rarely black; oblong bands eclipsed. Ventral side whitish, with large black spots. Skin on trunk smooth, on head coarse grained. Body length 60 to 90 mm and width of head 5.00 to 5.30 mm.

Development: Body of the I-instar slender, well proportioned, yellowish-green. Head flat, muddy yellow. Skin very finely grained. Two anterior pairs of abdominal legs very poorly developed, but with hooks. Pinacula minute, stigmata round. Body of the II-instar green, with black pinacula; pattern light-colored, dorsal and subdorsal bands narrow, and substigmal band yellowish. Body of the III-instar ash-gray; pattern on body faint, dorsal and subdorsal bands of base-colored, fringed with minute black dots. Pattern on head reddish-gray, of second type. After the third molt lateral sides of body below seta VI with velvety dermal growths and small dilatations on dorsal side of segment 5. Pattern on trunk faint since entire body covered with large black dots. Hemispheres of head with sinuous black bands around epicranial suture. Submedian band between setae P_1 and P_2 reddish-yellow but forms three black smears in genal region; it is also black in occipital region. Larvae of the V-instar differ from the VI-instar only in more prominent dilatation on segment 5, more distinctly fringed with black dots.

Body length and width of head in the I-instar 5 to 10 mm and 0.64 mm; II-instar 10 to 18 mm and 0.96 to 1.00 mm; III-instar 17 to 30 mm and 1.70 to 1.75 mm; IV-instar 30 to 47 mm and 2.2 to 2.5 mm; and V-instar 45 to 65 mm and 4.0 to 4.1 mm.

In Belorussia larval development in May and June. Food plants: poplar, aspen, ash, elm, oak, birch, willow, and maple. Allowed free food selection in gardens, larvae feed mainly on poplar.

Eggs laid singly or in small clusters in crevices of bark of tree branches. They are 1.20 to 1.30 mm in diameter, and 0.80 to 0.90 mm in height. Ribs 26 to 32, of which 12 to 16 reach micropylar zone. Micropylar rosette consists of 12 lobes, with 4 rims. Freshly laid egg light brown, turning dark brown later.

2. **Catocala nupta** L. (red underwing)

Mature larva: Main teeth of mandibles poorly developed, dorsal and ventral ones reduced; inner tooth large, set in deep pit. Setae Frl_1–Frl_2 and Frl_1–F_1 equidistant. Setae I–I and II–II on anal shield also equidistant. Small tubercle present on dorsal side of segment 5. Velvety dermal growths hang below seta VI along sides of body. Large black spots present on abdominal side. Hooks of abdominal legs: 37–45, 40–46, 47–48, 48–50, and 50–53.

Body gray, somewhat fusiform. Head yellowish-gray, with reddish-brown pattern of second type. Submedian bands in region of setae P_1 and P_2 yellowish-red, but descend to genal region in form of three reddish-brown smears; black bands framing head in form of rim (Figure 49, *9*), arch downward slightly from epicranial suture (Figure 92, *2*). Shields not prominent. Setae set on small pinacula; pinaculum II, 2.0 times larger than pinaculum I. Setae light-colored, acuminate; I and II short, III, IV, and V between 2.0 to 3.0 times longer. Stigmata pale yellow, oval, with black edge. Abdominal legs with broad plantae fringed with black pigment. Pattern: dorsal and subdorsal bands of base color and prominent only along borders formed by minute brown dots. Dorsal band quite broad, uneven, doubles in width on each abdominal segment. Subdorsal and suprastigmal bands narrow and even. Borders of bands narrow and very dark-colored, background of body visible between them. Substigmal band lighter than base color, narrow, even. Ventral side bluish-white, with large black spots. Body length 54 to 75 mm and width of head 4.00 to 4.20 mm.

Development: Body of the I-instar slender, well proportioned, yellowish-green, with minute brown pinacula. Skin finely grained. Head yellowish, with faint pattern of first type. Body of the II-instar becomes light brown. Small tubercle on dorsal side of segment 5. Pattern on trunk: dorsal band broad, dull yellow; subdorsal and suprastigmal bands narrow. Substigmal band brownish, merges with color of lower part of subdorsal field. Head with reddish-brown pattern of second type. In the III-instar pattern on head supplemented by two flexed black smears along sides of head, which in lower part do not reach oribital region but do reach epicranial suture in upper part. In the IV-instar, these smears transform into broad black, flexed bands (Figure 49, *9*). Velvety dermal growths hang along sides of body below seta VI. Body pattern visible as oblong bands of identical width; base color ash-gray, fringed with dark-colored dots. Larvae of the V-instar almost indistinguishable from the VI-instar. Body length and width of head in the I-instar 4.0 to 8.0 mm and 0.50 mm; II-instar 7 to 14 mm and 0.85 to 0.90 mm; III-instar 14 to 25 mm and 1.26 to 1.30 mm; IV-instar 24 to 38 mm and 2.0 to 2.3 mm; and V-instar 37 to 55 mm and 3.40 to 3.60 mm.

In Belorussia larval development in May and June. Food plants: willow and poplar.

Eggs laid singly or in clusters of 3 to 5 each in crevices of bark of tree branches. They are 1.0 to 1.2 mm in diameter and 0.60 to 0.70 mm in height. Ribs 37 to 40, of which 17 to 19 reach micropylar zone. Micropylar rosette consists of 10 to 12 lobes, surrounded by 4 rims. Freshly laid eggs light gray, turning brownish later.

3. Genus *Ectypa* Billbg.
(one species in Belorussian fauna)

Ectypa glyphica L. (brown clover owlet moth)

Mature larva: Spinneret broad; ventral margin of opening steplike. Second seta of labial palpus equal to first segment in length and 2.0 times longer than first seta. Seta P_1 higher than Frl_2. Distance between setae Frl_1–Frl_2 greater than between Frl_1–F_1 by 1.5 to 2.0 times. Metathoracic coxae contiguous. Abdominal legs absent on segment 3, considerably shorter on segment 4 than on segments 5 and 6. Skin smooth.

Body yellowish-gray. Head brownish. Light-colored dorsal and subdorsal bands extend onto head; dorsal band broad, extends along epicranial suture and adfrontal sclerites; subdorsal band narrow, reaches seta P_2. Broader suprastigmal band extends along line of seta L_1 with substigmal band of same width as on trunk below seta, encompassing orbital region and extending to antennae. Shields not prominent, but pattern of trunk extends onto them. Setae brownish, highly acuminate, with dark-colored pinacula; setae I and II on same longitudinal line (Figure 39, *2*). Pinacula and spots absent at base of setae. Stigmata somewhat oval, reddish-yellow, with brownish edge. Thoracic legs waxy yellow; abdominal legs same color as body, with black spots at base. Pattern: dorsal band pale yellow, broad, with narrow brownish-red borders; center of band brownish-red. Subdorsal band narrow, yellowish-gray, with narrow dark-colored borders. Suprastigmal band broader than subdorsal, with broad, uneven, yellowish-red borders. Lower part of subdorsal field brownish, with light yellow infiltration. Substigmal band broad, light yellow, with large yellowish-red spots at center. Ventral side lighter in color than dorsal, with three light-colored bands and yellowish-red borders. Large triangular black spot occurs anterior to first pair of abdominal legs. Body length 25 to 35 mm and width of head 2.50 to 2.70 mm.

In Belorussia larvae found from late June through mid-September. Food plants: clover, alfalfa, peavine, lotus, and vetch.

4. Genus *Lygephila* Billbg.

Spinneret broad, slightly pinched toward end, 1.5 times longer than first segment of labial palpus, with slight curve on dorsal side of opening. Second seta 2.0 times shorter than first segment and slightly longer than first seta. Dorsal teeth of mandibles reduced; two teeth on inner side. Seta P_1 on same line as setae Frl_2. Metathoracic coxae contiguous; distal part of tibia with minute sac on inner side. Hooks of abdominal legs uniordinal, vary from 15 to 32.

Key to Species

1 (2). Pattern on head not sharp, without black spots. Pinacula white, with black apex. Body dull yellow, with brownish and yellow pattern. Stigmata reddish-brown..... 2. **L. viciae** Hbn.

2 (1). Pattern on head sharp, with black spots around setae and along line of submedian band. Pinacula black, surrounded by light-colored pigment. Body gray, with black, dark brown, and orange pattern. Stigmata black..... 1. **L. pastinum** Tr.

1. **Lygephila pastinum** Tr. (gray vetch moth)

Mature larva: Body slightly fusiform. Head light gray, with faint pattern of third type (Figure 47, *3*). Setae dark brown, distinctly acuminate, located on flat black shields, surrounded by ring of light-colored pigment. Shields not prominent. Stigmata black, oval, with black edge. Thoracic legs yellowish-brown; abdominal legs brown and two anterior pairs slightly shorter than others. Pattern: dorsal band ash-gray, not broad, slightly enlarged on abdominal segments toward pinacula II, where light brown line with faint violet tinge formed by fine striae, more prominent at center. Borders of band broad, reach seta I, where they fuse with similar upper border of subdorsal band and form broad dark-colored edging (Figure 95). Subdorsal band white, rather broad, narrowly fringed with fine brown striae on lower side. Both dorsal and subdorsal bands with scattered orange spots, largest on margins of segments. Lower margin of subdorsal field black or dark brown. Substigmal band broad, uneven, white in upper part and yellow in lower part. Basal field brownish-yellow. Ventral side yellowish-gray with orange dots. Body length 28 to 43 mm and width of head 2.60 to 2.70 mm.

Development: I-instar. Body of larva just hatched light dull yellow, slender compared to large head. Head yellow. Pinacula and shields same color as body. Pinacula I and II set on same longitudinal line. Skin coarsely grained. Abdominal legs on segments 3 and 4 rudimentary. Feeding larva pale yellow, with brownish pinacula. Stigmata light-colored, round, with light brown edge. On second or third day pattern visible. Accumulation of brown pigment forms borders of dorsal band along line of setae I and II; accumulation of brownish pigment in form of narrow band below seta III. Substigmal band white, not broad. Basal field brownish. Body length of just hatched larva 2.2 mm, before molt 5.0 mm, and width of head 0.37 mm.

II-instar. Body light gray, with brownish dorsal field. Head pale yellow, with groups of minute brownish spots. Setae set on dark brown pinacula. Pinacula I and II on abdominal segments almost on same longitudinal line; pinaculum I on thoracic segments smaller than II and

III. Stigmata round, light-colored. Pattern: dorsal, subdorsal, and suprastigmal bands dull yellow, quite broad, with brownish borders. Upper border of subdorsal band fuses with border of dorsal band. Lower border of subdorsal and suprastigmal bands expands notably at center of segments. Substigmal band not broad, even, yellowish. Basal field brownish. Two pairs of light-colored bands extend along ventral side. Body length 5.0 to 8.5 mm and width of head 0.520 to 0.564 mm.

III-instar. Body yellowish-gray. Head yellowish-gray, with black submedian band consisting of individual transverse striae. Pinacula black, quite flat; stigmata yellow, oval. Legs brownish; abdominal legs on segment 4 poorly developed, on segment 3 rudimentary. Pattern: dorsal band pale yellow, with large orange-colored spot on margin of segments. Borders of band broad, consists of large black or brown striae and spots. Subdorsal band yellow, quite broad, at center and along margins of segments orange; lower border in form of separate dark-colored spots. Subdorsal field light-colored with small and large black spots. Substigmal band yellow. Basal field dark brown. Ventral side brownish-yellow, with two pairs of light-colored oblong bands. Body length 8.0 to 14.0 mm and width of head 0.737 to 0.758 mm.

IV- and V-instars. In the IV-instar first pair of abdominal legs somewhat more developed; subdorsal band light yellow with row of small and large orange spots along its upper margin; black reticulate structure visible at site of submedian band on head. All remaining features same as in the III-instar. In the V-instar larva almost indistinguishable from the VI-instar. Body length and width of head of IV-instar 13 to 21 mm and 1.051 to 1.073 mm; and of V-instar 18 to 29 mm and 1.507 to 1.529 mm.

In Belorussia larval development in July and August and, after hibernation, in May. Larvae of the IV-instar hibernate. Food plants: tufted vetch, wood vetch, and milk vetch.

Eggs laid haphazardly, not attached to leaves. They are pale yellow, 0.672 mm in diameter, and 0.65 mm in height. Ribs sharp, 23 to 25 at apex, and 31 or 32 at equator.

2. **Lygephila viciae** Hbn. (yellowish-gray vetch moth)

Mature larva: Body somewhat fusiform, dull yellow. Head light yellow, with brownish pattern of third type (Figure 47, *3*). Setae reddish-brown, slender, acuminate, and set on flat, white, quite large pinacula with black apex. Shields not prominent. Stigmata oval, broad, reddish-brown, with black edge. Thoracic legs light-colored; abdominal legs yellowish-brown, somewhat shorter on segments 3 and 4. Pattern: dorsal band reddish-yellow, uneven, quite broad; median line of band with fine brownish striae. Borders of band broad, reach seta I and almost fuse with

upper border of subdorsal band. Subdorsal band reddish-yellow, with white border, and quite broad. Lower border of band brownish, narrow. Lower part of subdorsal field with dense brownish striae. Substigmal band not broad, reddish-yellow, white along borders, uneven. Basal field densely covered with brownish striae. Ventral side reddish-yellow, with light yellow dots. Body length 28 to 45 mm and width of head 2.60 to 2.70 mm.

Development: I-instar. Body of just hatched larva yellowish, very slender compared to large head. Head greenish-yellow, with light brown pattern (Figure 58, *1*). Pinacula large, light-colored. Stigmata light-colored, round, with light brownish edge. Legs light-colored; abdominal legs on segments 3 and 4 rudimentary. Skin coarsely grained. Body of feeding larva yellowish-green, with black pinacula. Body length of just hatched larva 3.0 mm, before molt 5.0 mm, and width of head 0.40 mm.

II-instar. Body slender, green. Head greenish-yellow, with same pattern as in the I-instar. Pinacula large, black; pinacula I and II on abdominal segments on same longitudinal line. Pattern: dorsal band of base color, with light-colored borders, not broad. Subdorsal and suprastigmal bands whitish, of same width, more distinct. Substigmal band whitish, with indistinct borders. Body length 5.0 to 9.0 mm and width of head 0.583 to 0.586 mm.

III-instar. Body light green, with ashen bloom. Head pinkish-yellow, with brownish pattern (Figure 58, *2*). Setae brownish, acuminate, set on quite large black pinacula. Stigmata round, whitish, with brownish edge. Abdominal legs on segment 4 poorly developed, on segment 3 rudimentary. Pattern: dorsal band green, narrow, uneven, with whitish uneven borders. Subdorsal band whitish, broad, with reddish-brown broad border on upper side and narrow border on lower side. Suprastigmal band whitish, broad, adjoins lower border of subdorsal band, which is broad, reddish-brown. Substigmal band broad, white. Ventral side grayish-green. Body length 8.0 to 15.0 mm and width of head 0.758 to 0.780 mm.

IV-instar. Body yellowish-gray, well proportioned. Head light yellow, with ashen bloom, and brownish pattern (Figure 58, *3*). Pinacula quite large, light yellow, with black apices. Stigmata somewhat oval, with black edge. Legs same color as body. Pattern: dorsal band greenish-gray, uneven, with one narrow whitish and second brownish border; latter reaches pinaculum II. Subdorsal band ash-yellow, with brownish dorsal border reaching pinaculum II, and ventral border consisting of oblong spots. Stigmal band brownish. Substigmal band light yellow, quite broad. Ventral side light yellow, with ashen bloom. Body length 14 to 22 mm and width of head 1.073 to 1.095 mm.

V-instar. Body yellowish-brown. Stigmata reddish-yellow. Borders of dorsal band shaded more, with faint striae. All remaining features and

pattern correspond to those of the VI-instar. Body length 21 to 32 mm and width of head 1.62 to 1.84 mm.

In Belorussia larval development in July, August, and September. Pupa hibernates. Food plants: tufted vetch, wood vetch, milk vetch, and tuberous pea.

Eggs laid haphazardly, not attached to leaves. They are light blue, 0.737 mm in diameter, and 0.700 mm in height. Ribs at apex 27 or 28, and at equator 35 or 36. During embryonal development eggs initially pale, then turn yellowish-pink.

Subfamily Scoliopteryginae, subfam. nov.

The characteristics supporting the isolation of the genus *Scoliopteryx* in a separate subfamily are: 1) Seta Xa on prothorax notably shifted caudally and set on margin of segment (Figure 35); in all other species seta Xa situated at edge of thoracic shield (Figure 34). 2)On segments 1 to 6, between setae II and IV, single seta IVa (spuria post-stigmatalis) occurs (Figure 97); this seta is absent in all other species. Hooks of abdominal legs underdeveloped at ends of series of hooks.

Spinneret somewhat enlarged at center and slightly pinched toward end; opening of spinneret with smooth edge. Length of spinneret almost 2.5 times longer than first segment of labial palpus. Second seta of palpus considerably shorter than first segment and 4.0 times longer than first seta. Mandibular teeth normal; inner tooth large, with smooth edge. Seta VIII on abdominal segments short, conical. Abdominal legs, five pairs; first four pairs with 19 or 20 developed hooks and anal pair with 20 or 21. Skin finely grained. Larvae undergo five molts, the VI-instar last. The subfamily consists of a single species.

1. Genus *Scoliopteryx* Germ.

Scoliopteryx libatrix L. (dentate owlet moth)

Mature larva: Body green, somewhat fusiform. Head green, with very faint pattern of first type (Figure 48, *1*). Setae slender, light brown, highly acuminate, and without pinacula and spots at their base. Shields not prominent; dorsal bands faint on them. Stigmata oval, reddish-yellow, with thin yellowish-brown edge. Thoracic legs yellowish, abdominal legs green. Pattern: dorsal band dark green, without borders. Subdorsal band narrow, shaded, black, slightly shifted ventrally; upper border slightly broader than band, even, golden-yellow; border absent on lower side. Dorsal and subdorsal fields monochromatic, green. Substigmal band not present; sometimes perceptible as a fine line which, outside stigmata, shifts upward, descends to stigmata, and extends below them touching their lower

edge. Basal field and ventral side light green. Body length 28 to 45 mm and width of head 2.9 to 3.0 mm.

Development: I-instar. Body of just hatched larva slender, white. Head white, with black eyes. Pinacula extremely minute, white. Legs white; abdominal legs on segments 3 and 4 underdeveloped. Feeding larva light green, with white head, shields, and legs; pinacula somewhat lighter in color than general background. Skin finely grained. Body length of just hatched larva 2.1 to 2.2 mm, before molt 4.5 mm, and width of head 0.434 mm.

II-instar. Body and head light green. Shields not prominent. Setae rust-colored, slightly pointed, set on minute green pinacula. Stigmata round, light green, with green edge. Legs light-colored; abdominal legs on segments 3 and 4 underdeveloped. Pattern: dorsal and subdorsal bands green, slightly darker than general body background, and faint; dorsal somewhat broader than subdorsal. Substigmal band not present. Pattern visible a day or two after molt. Body length 4.5 to 7.5 mm and width of head 0.758 to 0.780 mm.

III-instar. Larva differs from the II-instar in distinctly manifested dorsal and subdorsal bands. Bands gray, almost equal in width. Body length 7.0 to 14.0 mm and width of head 0.986 to 1.029 mm.

IV-instar. Body green, slender. Head green. Shields green, with narrow dark dorsal and subdorsal bands. Pinacula absent. Stigmata oval, light yellow, with light brownish edge. Thoracic legs light-colored, abdominal legs green. Pattern: dorsal band green, darker than general body background; subdorsal dark green, with whitish or pale yellow narrow border on dorsal side. Substigmal band not present. Ventral side green, lighter in color than dorsal. Body length 13 to 22 mm and width of head 1.380 to 1.442 mm.

V-instar. Larva differs from the VI-instar in subdorsal band not black but dark green, with pale yellow or whitish borders. Body length 20 to 30 mm and width of head 1.90 to 2.00 mm.

In Belorussia larval development in May–June, and August–September. Food plants: willow and, more rarely, poplar.

Eggs laid singly, light green, highly flattened, almost hemispherical, 0.867 to 0.878 mm in diameter, and 0.480 to 0.510 mm in height. Ribs 48 to 50, of which 22 or 23 reach micropylar zone. Micropylar rosette consists of 10 to 12 lobes, surrounded by reticulate structure.

Subfamily Herminiinae

1. Genus *Herminia* Latr.
(one species investigated)

Herminia barbalis Cl. (bearded owlet moth)

Mature larva: Spinneret slightly pinched toward end, somewhat longer

than first segment of labial palpus. Second seta of palpus 2.0 times shorter than first segment and 1.5 times shorter than first seta. Postgenal sclerites not contiguous (*Pi* = 1). Seta P_1 considerably higher than seta Frl_2. Main teeth of mandibles round; inner tooth present. Thoracic shield broad; setae III and IIIa set on shield. Metathoracic coxae not contiguous; distance between them equal to distance between setae VIII–VIII. Tarsal setae enlarged (Figure 96). Abdominal legs short, five pairs. Hooks uniordinal. Skin on trunk and head coarsely grained.

Body flat, reddish-brown, with admixture of yellow. Head reddish-yellow, with dark brown pattern of second type (Figure 49, *1*); submedian band narrow, cells of reticulate structure large. Skin on head uniformly coarsely grained, on body coarsely grained here and there. Shields reddish to dull yellow; thoracic shield with light-colored dorsal band and dark brown borders. Setae colorless, piliform, somewhat pointed only on anal and thoracic shields. Setae I, II, III, IV, and V short; VI and VII long; setae I and II thick, very short (0.20 mm). Pinacula black, well sclerotized, round; pinaculum I larger than II and III. Stigmata oval, black, with black edge. Legs same color as abdominal side. Pattern: dorsal band on thoracic shield light-colored, with black borders; on all other segments black and broad. Subdorsal and substigmal bands absent. Dorsal and subdorsal fields covered with sinuous reddish-brown striae, forming reticulate pattern. Anterior to stigmata broad oblique line extends upward and forward to pinaculum II of successive segment. Ventral side matte reddish-yellow. Body length 18 to 30 mm and width of head 2.70 to 2.80 mm.

In Belorussia larval development in August–September and, after hibernation, until mid-May. Larvae of the V-instar hibernate. Food plants: alder, hornbeam, birch, and hazelnut. Feeds on dried and withered leaves.

Subfamily Beninae

Genus *Bena* Billbg.

(one species investigated)

Bena prasinana L. (beech silkworm)

Mature larva: Postgenal sclerites contiguous. Spinneret 3.0 times longer than first segment of labial palpus, somewhat pinched toward end. Second seta of palpus equal in length to first segment and 2.5 times longer than first seta. Seta P_1 notably caudal to line of setae Frl_2–Frl_2, and closer to epicranial suture than to P_2. Teeth of mandibles faint, outer edge almost even; inner tooth present. Distance between setae I–I on thoracic shield 2.0 times less than between X–X. Distance between setae II–II on anal shield 1.5 times less than between II–III. Metathoracic coxae not contiguous: distance between them equal to distance between setae VIII–VIII;

tarsal setae thick (Figure 90, *2*). Two setae of group VII developed on segment 1 and three of same group on segment 2. Skin on trunk smooth, on head unevenly coarsely grained and rugulose. Abdominal legs long, with broad plantae (Figure 90, *1*). Hooks uniordinal: 46–48, 50–52, 50–52, 51–52, and 52–53. Larvae undergo six molts, the VII-instar last.

Body green, slightly pinched toward posterior end. Head green, without pattern. Setae light-colored, slender, weak, and acuminate. Pinacula minute, golden-yellow. Shields green; thoracic shield with white edging anteriorly. Stigmata oval, narrow, reddish-yellow, with thin green edge. Legs green; abdominal legs with reddish spot on outer side; anal legs with broad golden-yellow oblong band, with crimson-red pigment at center. Pattern: dorsal band golden-yellow, consists of uneven oblong spots; borders of band also in form of spots. Green background visible between band and borders. Subdorsal band quite broad, even, continuous, golden-yellow. Suprastigmal band in form of sinuous striae adjacent to golden-yellow spots (Figure 91). Substigmal band green, faint, bordered by golden-yellow spots. Ventral side green, at places with whitish bloom. Body length 27 to 40 mm and width of head 3.7 to 4.0 mm.

Development: I-instar. Body of just hatched larva pale yellow, translucent with visible reddish intestine, and very slender compared to head. Head pale yellow. Pinacula minute, same color as body. Legs light-colored; all five pairs of abdominal legs developed. Feeding larva green, slightly pinched toward posterior end. Pinacula green, minute. Setae light brown, acuminate. Stigmata round, light-colored, with light-colored edge. Mid-instar broad, light-colored, diffuse subdorsal band visible. Body length of just hatched larva 2.0 mm, before molt 3.5 mm, and width of head 0.434 mm.

II- and III-instars. Larvae of the II-instar differ from the I-instar in pinacula green in upper part and whitish in lower. Subdorsal band distinctly visible, broad, whitish. In the III-instar pinacula totally white and quite large. Whitish spots visible in region of suprastigmal band. All remaining features same as in the I-instar. Body length in the II-instar 4.0 to 8.0 mm and width of head 0.638 to 0.671 mm; in the III-instar 9.0 to 14.0 mm and 0.867 to 0.909 mm respectively.

IV-instar. Body green, pinched toward posterior end. Head green, without pattern. Thoracic shield with white edging anteriorly. Pinacula, including pinaculum X, white. Skin coarsely grained. Setae light brown. Stigmata slightly oval, green, with green edge. Legs green. Pattern: along both sides of median dorsal line two white, irregular, round or oblong spots occur on each segment, which constitute the borders of green dorsal band. Subdorsal band quite broad, white, even. Suprastigmal and substigmal bands consist of white spots. Body length 13 to 17 mm and width of head 1.28

to 1.31 mm.

V-instar. Larva differs from the IV-instar in edging of thoracic shield, pinacula, bands, and borders of bands not white but golden-yellow. Body length 18 to 23 mm and width of head 1.888 to 1.900 mm.

VI-instar. Body highly pinched toward posterior end, considerably more than in the VII-instar; prothorax as wide or wider than head. All other features same as in the VII-instar. Body length 20 to 29 mm and width of head 2.50 to 2.80 mm.

In Belorussia larval development in July–August. Pupa hibernates. Food plants: beech, oak, birch, hornbeam, hazelnut, ash, and maple.

Eggs laid singly or in small imbricate clusters of 5 to 25 each. They are light yellow, hemispherical, resemble tablets, 1.176 mm in diameter, and 0.392 mm in height. Ribs 42 to 46, of which 16 to 18 reach micropylar zone. Micropylar rosette consists of 12 to 16 lobes. During embryonal development eggs initially pink with a few reddish dots at apex. Number of dots increases later and eventually form reddish-brown spot at apex.

BIBLIOGRAPHY

Barrett, Ch.G. 1897. *The Lepidoptera of the British Islands. Heterocera, Noctuidae.* London.

Batiashvili, I.D. 1949. K izucheniyu zernovoi sovki *Trachea* (*Hadena*) *basilinea* F. v usloviyakh Gruzii (Study of the grain moth *Trachea* (*Hadena*) *basilinea* F. under conditions in Georgia). *Tr. In-ta Zashch. Rast. AN GruzSSR,* no. 6.

Beck, H. 1960. *Die Larvalsystematik der Eulen* (*Noctuidae*). Berlin.

Bobinskaya, S.G. 1960. Kholodostoikost' gusenits seroi zernovoi sovki (Cold resistance of the larvae of the gray grain moth). *Zashch. Rast.,* no. 9, p. 47.

Bogush, P.P. 1964. Malaya nazemnaya sovka v Turkmenistane i drugikh mestakh ee obitaniya (Small land moth in Turkmenia and other sites of its habitation). Ashkhabad, 221 pp.

Boursin, Ch. and J. Aubert. 1953. Les Phalénides (Noctuelles) du Jura (Revision de la nomenclature et introduction à la fauna des macrolépidoptères du Jura). *Société Linéenne de Lyon* 22(5): 115–126.

Boursin, Ch. 1964. Les Noctuidae Trifinae de France et de Belgique (Contributions à l'Étude des Noctuidae Trifinae, 148). *Bull. Mens. Soc. Linnéene de Lyon,* vol. 6, pp. 204–240.

Brues, Ch. 1923. Choice of food and numerical abundance among insects. *Journ. Econ. Entom.,* vol. 16, pp. 46–51.

Byazdenka, T.T. 1952. Shkodniki i khvaroby tekhnichnykh kul'tur i mery barats'by zimi (Cutworms and borer moths of technical crop and their control). Minsk.

Chapman, T. 1896. The characters of the eggs of Lepidoptera as affording a basis for classification. *Ent. Rec.,* vol. 8, pp. 287–289.

Cholodkowsky, N. 1903. Ueber die gelben Flecke und die kolbenformigen Haare der Raupen von *Acronicta alni* L. *Zool. Jahrb., Syst.,* 19(5): 554–556.

Crumb, S.E. 1934. Classification of some Noctuid larvae of the subfamily Hypeninae. *Ent. Amer. Brooklyn,* vol. 14, pp. 133–197.

Crumb, S.E. 1956. The larvae of the Phalaenidae. *U.S. Dept. Agr. Tech. Bull.,* no. 1135.

Danilevskii, A.S. 1935. Rol' pitayushchikh rastenii v biologii lugovogo motyl'ka (Role of food plants in the biology of the meadow moth). *Entomol. Obozr.,* vol. 26, pp. 91–110.

Danilevskii, A.S. 1941. O pishchevoi spetsializatsii dubovogo shelkopryada

(*Anthereae pernyi* Guer.) i sistematicheskikh otnosheniyakh ego kormovykh rastenii [Food specialization of the oak bombyx moth (*Anthereae pernyi* Guer.) and systematic relations of its food plants]. *Tr. Leningr. Ob-va Estest.*, vol. 68, p. 4.

Danilevskii, A.S. 1948. Fotoperiodicheskaya reaktsiya nasekomykh v usloviyakh iskusstvennogo osveshcheniya (Photoperiodic reaction of insects under conditions of artificial lighting). *DAN SSSR* 60(3): 481–484.

Danilevskii, A.S. 1949. Zavisimost' geograficheskogo rasprostraneniya nasekomykh ot ekologicheskikh osobennostei ikh zhiznennykh tsiklov (Dependence of the geographic distribution of insects on the ecological characteristics of their life cycles). *Entomol. Obozr.* 30(3–4): 194–209.

Danilevskii, A.S. 1950. Temperaturnye usloviya reaktivatsii diapauziruyushchikh stadii nasekomykh (Temperature conditions for reactivation of diapausing stages of insects). *Tr. Leningr. Ob-va Estest.* 70(4): 90–107.

Danilevskii, A.S. 1951. Ob usloviyakh mnogoletnei diapauzy u cheshuekrylykh (Conditions for protracted diapause among Lepidoptera). *Entomol. Obozr.* 31(3–4): 386–392.

Danilevskii, A.S. 1957. Fotoperiodizm kak faktor obrazovaniya geograficheskikh ras u nasekomykh (Photoperiodicity as a factor in the evolution of geographic races among insects). *Entomol. Obozr.* 36(1): 6–27.

Danilevskii, A.S. 1957. Sezonnye ritmy i vnutrividovaya geograficheskaya differentsiatsiya u nasekomykh (Seasonal cycles and intraspecific geographic differentiation among insects). *Vestnik LGU,* vol. 21, pp. 93–105.

Danilevskii, A.S. 1961. Fotoperiodizm i sezonnoe razvitie nasekomykh (Photoperiodicity and seasonal growth of insects). Izd. LGU, 243 pp.

Daricheva, M.A. 1964. Materialy k izucheniyu ozimoi sovki (*Agrotis segetum* Schiff.) v Turkmenii [Data from a study of the turnip moth (*Agrotis segetum* Schiff.) in Turkmenia]. *Izv. AN TurkmenSSR, Ser. Biol.*, vol. 6, pp. 33–41.

Döring, E. 1936. Beitrage zur kenntnis der Noctuideneier. *Entom. Ztschr., Frankfurt,* vol. 49, pp. 445–448.

Doring, E. 1955. *Zur Morphologie der Schmetterlingseier.* Berlin.

Duclaux, M.E. 1869. De l'influence du froid de l'hiver sur le développement de l'embryon ou ver à soie, et sur l'éclosion de la graine. *C. R. Acad. Sci. Paris.*, vol. 69, pp. 1021–1022.

Dyar, H. 1894. A classification of Lepidopterous larvae. *Ann. Amer. Acad. Sci. New York,* vol. 8, pp. 194–232.

Dyar, H. 1895. Additional notes on the classification of Lepidopterous larvae. *Trans. Amer. Acad. Sci. New York,* vol. 14, pp. 49–62.

Dyar, H. 1899. Descriptions of the larvae of fifty North American Noctuidae. *Proc. Ent. Soc. Washington,* vol. 4, pp. 315–332.

Fiedler, H. 1937. Die wichtigsten schädlichen Erdraupen der Gattung *Agrotis* Hbn. (Lep., Noct.). *Dtsch. Ent. Z., Berlin,* pp. 113–172.

Filip'ev, I.N. 1932. Otryad Lepidoptera. Cheshuekrylye, ili babochki (Order Lepidoptera. Butterflies or moths). *Tr. Po Zashch. Rast.*, vol. 1, p. 5.

Forbes, W. 1910. A structural study of some caterpillars. *Ann. Ent. Soc. Amer.,* vol. 3, pp. 94–132.

Forbes, W. 1911. A structural study of the caterpillars. *Ann. Ent. Soc. Amer.,* vol. 4, pp. 261–279.

Forbes, W. 1916. On certain caterpillar homologies. *Journ. New York Ent. Soc.,* vol. 24, pp. 137–142.

Fracker, S.B. 1915. The classification of Lepidopterous larvae. *Illinois Biol. Monogr.,* vol. 2 [pp. omitted in original bibliography].

Garman, H. 1921. Some neglected setae of Lepidopterous larvae. *Ann. Ent. Soc. Amer.,* vol. 14, pp. 145–149.

Geispits, K.F. 1949. Svet kak faktor, reguliruyushchii tsikl razvitiya sosnovogo shelkopryada (Light as a factor controlling the growth cycle of the pine moth). *DAN SSSR, Novaya Ser.* 68(4): 781–784.

Geispits, K.F. 1953. Reaktsiya monovol'tinnykh chesuekrylykh na prodolzhitel' nost' dnya (Response of monovoltine lepidopterous insects to diurnal duration). *Entomol. Obozr.* 33(1): 17–31.

Geispits, K.F. 1957. O mekhanizme vospriyatiya svetovykh razdrazhenii pri fotoperiodicheskoi reaktsii u gusenits cheshuekrylykh (Mechanism of the perception of light stimuli during photoperiodic reaction among larvae of Lepidoptera). *Zool. Zh.* 36(4): 548–560.

Gerasimov, A.M. 1939. Diagnostika cheshuekrylykh, imeyushchikh khozyaistvennoe znachenie (Diagnosis of Lepidoptera of economic importance). *Izv. Vyssh. Kurs. Prikl. Zool. i Fitopatol.,* vol. 7, pp. 15–34.

Gerasimov, A.M. 1939a. Gusenitsy (obshchaya kharakteristika i opredelitel'naya tablitsa semeistv) [Larvae (general characteristics and keys to families)]. *Izv. Vyssh. Kurs. Prikl. Zool. i Fitopatol.,* vol. 9, pp. 31–67.

Gerasimov, A.M. 1952. Nasekomye cheshuekrylye, gusenitsy (Lepidoptera, larvae). *Fauna SSSR,* 1, 2: 1–336.

Gerasimow [Gerasimov], A. 1935. Zur Frage der Homodynamie der Borsten von Schmetterlingsraupen. *Zool. Anz.,* vol. 112, pp. 177–194.

Gerasimow [Gerasimov], A. 1937. Bestimmungstabelle der Familien von Schmetterlingsraupen (Lepid.). *Stetting ent. Ztg.,* vol. 98, pp. 281–300.

Gerasimow [Gerasimov], A. 1939. Die Chaetotaxie des analsegments der Raupen. *Zeitschr. Oesterr. Ent. Ver.,* vol. 24, pp. 50–59.

Goryshin, N.I. 1955. Sootnoshenie svetovogo i temperaturnogo faktorov v fotoperiodicheskoi reaktsii nasekomykh (Relation of light and temperature factors in the photoperiodic reaction of insects). *Entomol. Obozr.,* vol. 34, pp. 9–14.

Goryshin, N.I. 1958. Ekologicheskii analiz sezonnogo tsikla razvitiya khlopkovoi sovki (*Chloridea obsoleta* F.) v severnykh raionakh ee rasprostraneniya [Ecological analysis of the seasonal cycle of growth of cotton bollworm (*Chloridea obsoleta* F.) in the northern regions of its range]. *Uch. Zap. LGU,* vol. 240, pp. 3–20.

Hampson, G.F. 1903–1910. *Catalogue of Lepidoptera Phalaenae in the British Museum,* vols. 4–10.

Hinton, H. 1946. On the homology and nomenclature of the setae of Lepidopterous larvae, with some notes on the phylogeny of the Lepidoptera. *Trans. Roy. Ent. Soc. London* 97(1): 3–37.

Il'inskii, A.I. 1948. Opredelitel' yaitsekladok, lichinok i kukolok nasekomykh, vrednykh v lesnom khozyastve (Identification of clutches, molts, and pupae of insects damaging forests). Gos. Lesotekh. Izd-vo.

Janisch, E. 1932. Thē influence of temperature on the life history of insects. *Trans. Ent. Soc. London,* vol. 80 [pp. omitted in original bibliography].

Kal'bergenov, G.K. 1951. Biologicheskoe i ekologicheskoe obosnovanie mer bor'by s kapustnoi sovkoi v usloviyakh Moskovskoi oblasti (Biological and ecological basis of measures for controlling the cabbage moth under conditions of Moscow District). Avtoref. Kand. Diss., MGU.

Koch, M. 1958. *Eulen Deutschlands. Wir bestimmen Schmetterlinge,* vol. 3.

Komarova, O.S. 1949. Prichiny, vyzyvayushchie diapauzu grozdevoi listovertki (Factors causing diapause in the European grape moth). *DAN SSSR,* 68(4): 787–792.

Komarova, O.S. 1959. Formirovanie zimuyushchego zapasa i diapauza kukolok khlopkovoi sovki (Formation of winter reserves and diapause in pupae of scarce bordered strawworm). *Entomol. Obozr.* 38(2): 352–361.

Korschnelt, E. 1887. Zur Bildung der Eihüllen, der Mikropylen und Chorionanhänge bei den Insekten. *Nov. Act. Akad. Leop. Carol.,* vol. 51, pp. 181–252.

Kosobutskii, M.I. 1928. Ozimaya sovka (*Euxoa segetum* Schiff.) v Votskoi avtonomnoi oblasti [The Turnip Moth (*Euxoa segetum* Schiff.) in Votsk Autonomous Region]. Izhevsk.

Kozhanchikov, I.V. 1937. Sovki (podsem. Agrotinae) [Owlet moths (sub-

family Agrotinae)]. *Fauna SSSR, Nasekomye, Cheshuekrylye,* vol. 13, no. 3 [pp. omitted in original bibliography].

Kozhanchikov, I.V. 1937a. Nekotorye dannye po vliyaniyu temperatury i vlazhnosti na razvitie sovki gammy (Some data on the effect of temperature and humidity on growth of the silver y-moth). *Zashch. Rast.,* vol. 14, pp. 49–61.

Kozhanchikov, I.V. 1937b. Rost i fiziologicheskoe sostoyanie organizma nasekomykh v svyazi s vliyaniem ekologicheskikh faktorov (Physiological state of the organism of insects in relation to the effect of ecological factors). *Zool. Zhurn.,* vol. 16, no. 1 [pp. omitted in original bibliography].

Kozhanchikov, I.V. 1941. Ob usloviyakh smeny kormovykh rastenii u dendrofil'nykh nasekomykh (Conditions for change of food plants among dendrophilic insects). *Zool. Zhurn.* 20(3): 382–397.

Kozhanchikov, I.V. 1941a. Rasprostranenie i godichnye izmeneniya chislennosti ozimoi sovki i lugovogo motyl'ka v svyazi s usloviyami tepla i vlazhnosti (Range and annual changes in population of the turnip moth and beet webworm in relation to heat and moisture conditions). *Zool. Zhurn.* 20(1): 30–45.

Kozhanchikov, I.V. 1946. O fiziologicheskikh usloviyakh pishchevoi spetsializatsii vrednoi cherepashki (Physiological conditions of food specialization of harmful shield bugs). *Izv. AN SSSR, Ser. Biol.,* vol. 4, pp. 355–359.

Kozhanchikov, I.V. 1950. Osnovnye cherty pishchevoi spetsializatsii aziatskoi saranchi (Basic features of food specialization among Asian locusts). *Izv. AN SSSR, Ser. Biol.,* vol. 4, pp. 73–86.

Kozhanchikov, I.V. 1950. Volnyanki—Orgyidae [Tussock moths (Orgyidae)]. *Fauna SSSR, Nasekomye Cheshuekrylye* (Moscow-Leningrad), vol. 12 [pp. omitted in original bibliography].

Kozhanchikov, I.V. 1951. Pishchevaya spetsializatsiya i ee znachenie v zhizni nasekomykh (Food specialization and its importance in the life of insects). *Entomol. Obozr.* 31(3–4): 323–335.

Kozhanchikov, I.V. 1952. Mnogoyadnost' zhivotnykh i izmenchivost' sredy (Polyphagy of animals and environmental variations). *Zool. Zhurn.* 31(6): 793–801.

Kozhanchikov, I.V. 1956. Vidovoi sostav, osobennosti biologii i geograficheskoe rasprostranenie vrednykh podgryzayushchikh sovoi v SSSR (Species composition, characteristics of biology, and geographic range of harmful cutworms in the Soviet Union). *Sb. Rabot In-ta Prikl. Zool. i Fitopatol.,* vol. 4, pp. 5–57.

Kulagin, N.M. 1915. Nasekomye, vrednye dlya polevykh rastenii v Evropeiskoi Rossii v 1914 g. (Insects damaging cultivated plants in

European Russia in 1914). *Izv. Moskovsk. Entomol. Ob-va,* vol. 1 [pp. omitted in original bibliography].

Kuznetsov, N.Ya. 1915. Nasekomye cheshuekrylye (vvedenie). [Lepidoptera (an introduction)]. *Fauna Rossii,* vol. 1, no. 1.

Kuznetsov, N.Ya. 1930. Svyaz' geograficheskogo rasprostraneniya belyanok (Lepidoptera, Asciidae) s rasprostraneniem ikh kormovykh rastenii [Relation of the geographic range of white butterflies (Lepidoptera, Asciidae) to the range of their food plants]. *Ezhegodn. Zool. Muz. AN SSSR,* vol. 31, pp. 49–63.

Kuznetsova, I.A. 1955. Ob izmeneniyakh zhirovoi tkani v svyazi s fotoperiodicheskoi reaktsiei i diapauzoi nasekomykh (Changes in adipose tissue in relation to photoperiodic reaction and diapause of insects). *Zool. Zhurn.* 34(3): 532–541.

Larchenko, K.I. 1937. Tsikl razvitiya zhirovogo tela lugovogo motyl'ka i ozimoi sovki i ego svyaz' s sozrevaniem i plodovitost'yu (Growth cycle of the adipose body of beet webworm and turnip moth and its relation to maturation and fertility). *Entomol. Obozr.* 27(1–2): 29–75.

Larchenko, K.I. 1949. Zakonomernost' razvitiya i razmnozheniya ozimoi sovki (*Agrotis segetum* Schiff.) [Principles of growth and reproduction of the turnip moth (*Agrotis segetum* Schiff.)]. *Izv. AN SSSR, Ser. Biol.,* vol. 4, pp. 470–494.

Leuckart, R. 1855. Ueber die Mikropyle und den feinern Bau der Schalenhaut bei den Insecteneier. *Arch. Anat. Physiol.,* pp. 166–195.

Ludwig, D. 1932. The effect of temperature on the growth curves of the Japanese beetle *Popilia japonica. New. Physiol. Zool.,* vol. 5 [pp. omitted in original bibliography].

Markovets, A.F. 1951. Vrediteli polevykh kul'tur i mery bor'by s nimi (Pests of cultivated plantations and measures for controlling them). Izd-vo AN BSSR, Minsk.

Markov, F.I. 1958. Ozimaya sovka (*Agrotis segetum* Schiff.) v oroshaemykh raionakh svekloseyaniya Kirgizii i Kazakhstana i sistema mer bor'by s neyu [The turnip moth (*Agrotis segetum* Schiff.) in irrigated sections of beet plantations in Kirgizia and Kazakhstan and measures for its control]. Frunze, 133 pp.

Merzheevskaya, O.I. 1956. Azimaya sovka (*Agrotis segetum* Schiff.) va umovakh zakhodnyai chastki BSSR. *Vestsi AN BSSR, Ser. Biyal.,* vol. 1, pp. 87–96.

Merzheevskaya, O.I. 1961. O pishchevoi spetsializatsii sovok—ogorodnoi (*Polia oleracea* L.) i otlichnoi (*P. dissimilis* Knoch.) [Food specialization of moths—tomato (*Polia oleracea* L.) and dog's tooth (*P. dissimilis* Knoch.)]. *Zool. Zhurn.* 40(5): 707–714.

Merzheevskaya, O.I. 1963. Sovki (Noctuidae, Lepidoptera), snizhayu-

shchie urozhai sel'skokhozyaistvennykh kul'tur v Belorusskoi SSR [Owlet moths (Noctuidae, Lepidoptera) damaging agricultural crops in Belorussian Soviet Socialist Republic]. *Zool. Zhurn.* 42(3): 359–367.

Merzheevskaya, O.I. 1965. Novyi fiksator dlya gusenits (New fixer for larvae). *Zool. Zhurn.* 44(2): 299–300.

Merzheevskaya, O.I. and E.I. Khats'ko. 1960. Razvitstse sovak agarodnai i admennai va umovakh BSSR (Development of cabbage moth and dog's tooth in the territory of BSSR). *Vestsi AN BSSR, Ser. Biyal.,* vol. 4, pp. 125–136.

Merzheevskaya, O.I. and E.I. Khats'ko. 1961. Nekatoryya danyya ab zhyylenni sovak agarodnaya (*Polia oleracea* L.) i admennai (*P. dissimilis* Knoch.) [Some data on the cabbage moth (*Polia oleracea* L.) and dog's tooth (*P. dissimilis* Knoch.)]. *Vestsi AN BSSR, Ser. Biyal.,* vol. 2, pp. 106–115.

Merzheevskaya, O.I. and E.A. Gerastevich. 1962. Metod sbora na svet zhivykh nasekomykh (Method for collecting live insects on light). *Zool. Zhurn.* 41(11): 1741–1743.

Merzheevskaya, O.I., E.I. Khats'ko, S.V. Kundakova and R.U. Malchanava. 1964. Ab ezhavai spetsyyalizatsyi azimai i klichiikavai sovak (On the food specialization of turnip and rustic moths). *Vestsi AN BSSR, Ser. Biyal.,* vol. 4, pp. 121–129.

Meyrick, E. 1895. *A Handbook of the British Lepidoptera.* London.

Milyanovskii, E.S. 1957. Svetolovushka kak metod prognoza intensivnosti razmnozheniya nasekomykh (Insect trap as a method for predicting level of reproduction among insects). *Tr. Sukhumsk. Zonal'n. Opytn. St. Efirnomasl. Kul't.,* vol. 2, pp. 85–98.

Ostanets, A. 1926. Vliyanie nizkikh temperatur na gusenits ozimoi sovki (Effect of low temperatures on larvae of the turnip moth). *Byull. Voronezhsk. St. Zashch. Rast.,* no. 7, p. 3.

Plyushchevskii-Plyushchik, V.A. 1922. Vredonosnyi "cherv' " (Dangerous "worm"). *Izv. Vitebsk. Gubispolkoma,* July 21, no. 165.

Popov, P.V. 1929. O pshenichnoi sovke *Euxoa tritici* L. [The white-line dart moth (*Euxoa tritici* L.)]. *Zashch. Rast.* 6(1–2): 221–223.

Pospelov, S.M. 1958. Zernovaya sovka na kukuruze (The maize moth). *Zashch. Rast.,* vol. 4, p. 50.

Puzyrnyi, R.G. 1929. Iz nablyudenii nad pitaniem gusenits ozimoi sovki *Euxoa segetum* Schiff. v usloviyakh Khar'kovskogo i Poltavskogo okrugov [Observations on the feeding of larvae of the turnip moth (*Euxoa segetum* Schiff.) under conditions in Khar'kov and Poltav]. *Zashch. Rast.* 6(1–2): 53–62.

Puzyrnyi, R.G. 1931. Klevernaya sovka *Scotogramma trifolii* Rott. [The clover moth (*Scotogramma trifolii* Rott.)]. *Zashch. Rast.* 8(3): 267–274.

Ripley, L.B. 1932. The external morphology and postembryology of Noctuid larvae. *Illinois Biol. Monogr.*, vol. 8, pp. 243–344.

Rossikov, K.N. 1909. Ozimaya sovka (ozimyi cherv'—*Agrotis segetum* Schiff.), ee zhizn', svoistva is sposoby bor'by [The turnip moth (*Agrotis segetum* Schiff.)—Its life, properties, and methods of control]. Izd. Dep. Zemled.

Ryabov, M.A. 1951. Osnovnye morfologicheskie osobennosti zemlyanykh podgryzayushchikh sovok (Lepidoptera, Agrotidae) [Important morphological characteristics of cutworms (Lepidoptera, Agrotidae)]. *Entomol. Obozr.* 31(3–4): 474–484.

Ryabov, M.A. 1960. Gusenitsy sovok. Opredelitel' nasekomykh po povrezhdeniyam kul'turnykh rastenii (Larvae of owlet moths. Identification of insects based on damage caused to cultivated plants). Sel'khozgiz, pp. 531–564.

Sakharov, N. 1931. Ozimaya sovka (The turnip moth). Sel'khozgiz.

Sakharov, N. and V. Strukov. 1927. K voprosu izucheniya nochnoi entomofauny i, v chastnosti, babochek sem. Noctuidae (Study of nocturnal entomological fauna, especially butterflies of the family Noctuidae). *Opytnaya Agronomiya Vostoka* 4(2): 249–262.

Sanderson, R. 1910. The relation of temperature to the growth of insects. *Journ. Econ. Entom.*, vol. 3 [pp. omitted in original bibliography].

Seitz, A. 1889. Ueber Schmetterlingseier. *Zool. Jahrb. Syst.*, vol. 4, pp. 485–492.

Shel'deshova, G.G. 1956. Biologiya i ekologicheskie osobennosti grusheplodozhorki (*Carpocapsa pyrivora* Danil.) [Biology and ecological characteristics of the pear moth (*Carpocapsa pyrivora* Danil.)]. Avtoref. Kand. Diss. *In-ta Zool. AN SSSR.*

Shel'deshova, G.G. 1965. Geograficheskaya izmenchivost' fotoperiodicheskoi reaktsii i sezonnogo razvitiya yablonnoi plodozhorki—*Laspeyresia pomonella* L. [Geographic variability of photoperiodic reaction and seasonal growth of the apple moth (*Laspeyresia pomonella* L.)]. *Tr. In-ta Zool. AN SSSR,* vol. 36, pp. 5–25.

Sorauer, P. 1925. *Handbuch der Pflanzen Krankheiten.* Berlin, 4, 1.

Spuler, A. 1908–1910. *Die Schmetterlinge und Raupen Europas.* Stuttgart, vols. 1–4.

Staudinger, O. 1901. *Catalog der Lepidopteren des Palaearctischen Faunengebietes.* Berlin.

Tong[e], A. 1932. The ova of British Lepidoptera Noctuidae. *Proc. Lond. Entom. and Nat. Hist. Soc.*, pp. 3–15 [sic, 6–13].

Tsou, V. 1914. The body setae of Lepidopterous larvae. *Trans. Amer. Micr. Soc.*, vol. 33, pp. 233–260.

Tulashvili, N.D. 1952. Nekotorye dannye k biologii sovki ipsilon (*Agrotis*

ypsilon Rott.) v usloviyakh Gruzii [Some information on the biology of the dark sword grass moth (*Agrotis ypsilon* Rott.) under conditions in Georgia]. *Tr. In-ta Zashch. Rast. AN GruzSSR,* vol. 8 [pp. omitted in original bibliography].

Ushatinskaya, R.S. 1957. Osnovy kholodostoikosti nasekomykh (Principles of cold resistance in insects). Izd-vo AN SSSR, 314 pp.

Vasil'ev, E. 1912. Kormovye rasteniya nekotorykh nasekomykh i prichiny, obuslovlivayushchie ikh vybor (Food plants of some insects and reasons for their selection). *Vestn. Sakhar. Prom.* 13(41): 471–474.

Verschaffelt, E. 1910. The cause determining the selection of food in some herbivorous insects. *Proc. Roy. Soc. Acad. Weten. Sect. Sci. Amsterdam,* vol. 13 [pp. omitted in original bibliography].

Walsch, D. 1864. On phytophagic varieties and phytophagous species, *Proc. Entom. Soc. Philadel.* vol. 3 [pp. omitted in original bibliography].

Warren, W. 1914. Noctuidae. In: *Gross-Schmetterlinge der Erde.* Edited by A. Seitz. Stuttgart, vol. 3.

Znamenskii, A.V. 1926. Nasekomye, vredyashchie polevodstvu (Agricultural pests). Poltava.

Zorin, P.V. and L.M. Zorina. 1929. K biologii ogorodnoi sovki *Polia oleracea* L. [Biology of the tomato moth (*Polia oleracea* L.)]. *Zashch. Rast.* 5(5–6): 475–486.

Zweigelt, H. 1926. Gallenbildung und Spezialisation. *Verh. Deutsch. Ges. Ent.* München.

ILLUSTRATIONS

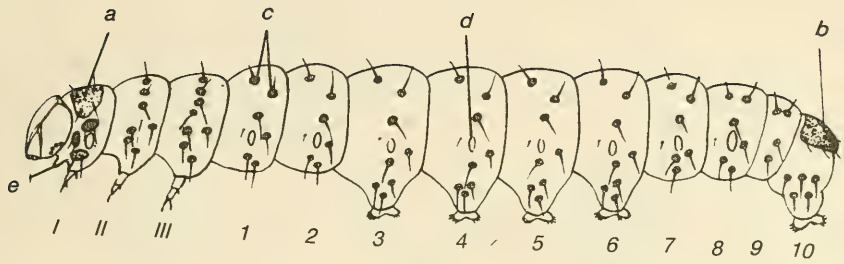
Figure 8. General view of larva:

a—thoracic shield; b—anal shield; c—pinacula; d—stigmata; e—neck gland; I to III—thoracic segments; 1 to 10—abdominal segments.

Figure 9. Head of larva:

a—frontal view; b—lateral view; 1—epicranial suture; 2—frontal suture; 3—adfrontal suture; 4—frons; 5—adfrontal sclerite; 6—parietal notch; 7—parietal apex; 8—frontoclypeal suture; 9—postclypeus; 10—anteclypeus; 11—labrum; 12—ocelli; 13—mandibles; 14—antenna.

Setae: A_{1-3}—anterior group; P_{1-2}—posterior group; L_1—lateral group; V_{1-3}—parietal group; O_{1-3}—orbital group; SO_{1-3}—suborbital group; F_1—frontal group; Frl_{1-2}—adfrontal group; *Cl*—clypeal setae.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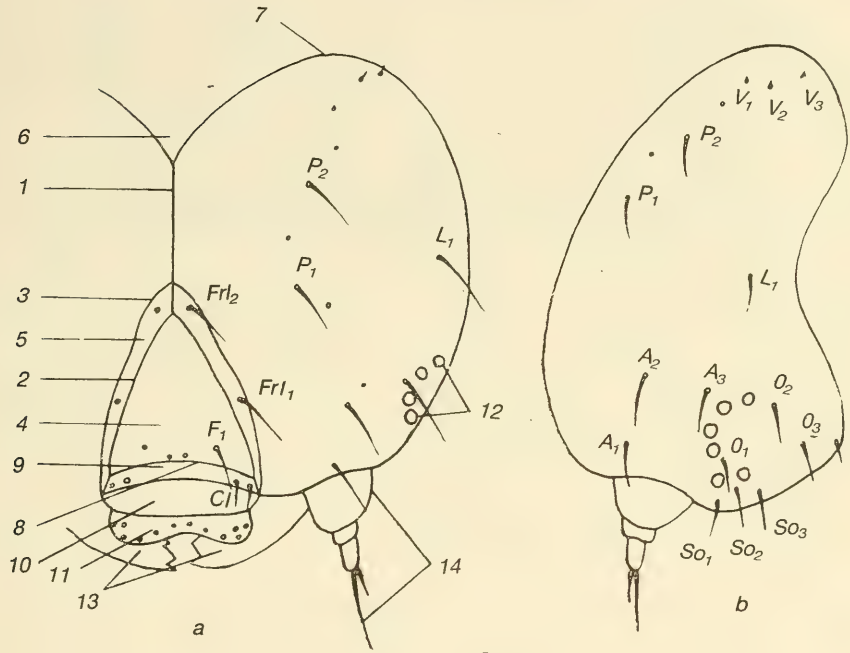
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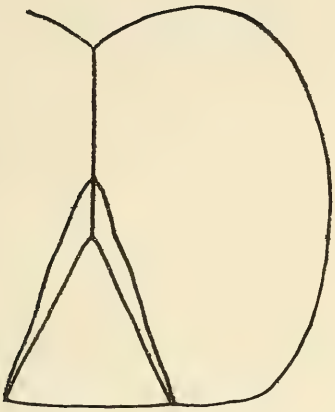
Figure 10. Head with long epicranial suture and weak parietal notch.

Figure 11. Head with highly reduced epicranial suture and very deep parietal notch.

Figure 12. Sketch depicting proportions of the height of frons to length of the epicranial suture (from Ripley, 1923).

Figure 13. Head of larva, lateral view (a) and Beck's postgenal index (b):

V—vertex; G—gena; S. Pg—postgenal suture; Pg—postgenal sclerites; 1, 2, 3, 4, 5, 6—ocelli; Pe—edge of postgenal sclerite.



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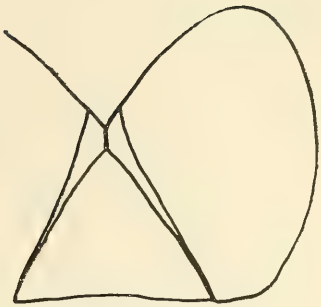

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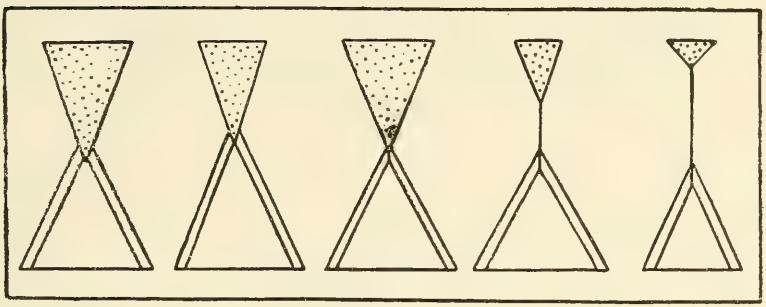

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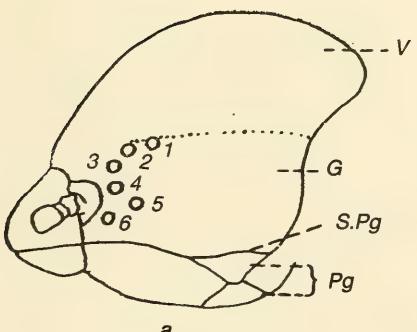
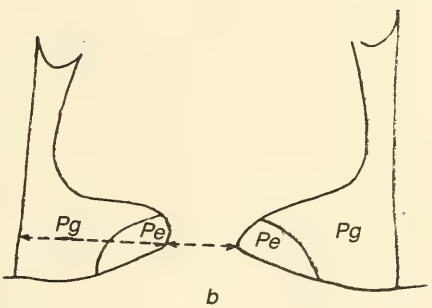


a

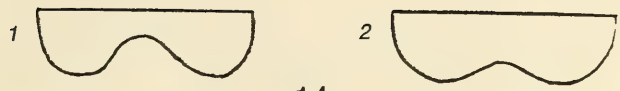


b

13

Figure 14. Labrum:
1—with deep notch; 2—with weak notch.

Figure 15. Mandibles:
I—sketch of mandible (from Beck) (2, 1—dorsal teeth; 3, 2, 1—main teeth; lower ventral tooth); II—*Agrotis corticea* Schiff.; III—*Orthosia gothica* L.; IV—*Calophasia lunula* Hufn.; V—*Mythimna pallens* L.; VI—*Rivula sericealis* Scop. (from Beck); VII—*Mamestra aliena* Hbn.; VIII—*Euclidimera mi* Cl. (from Beck) (dz—distal zone, pz—proximal zone, Mi—basal edge of mandible, M_1, M_2—setae); IX—*Panolis flammea* Schiff.; X—*Mamestra dysodea* Schiff.; XI—*Mythimna turca* L.; XII—*Hadena rivularis* F.; XIII—*Mamestra thalassina* Hufn. (I to IX—outer surface, X to XIII—inner surface of mandible).



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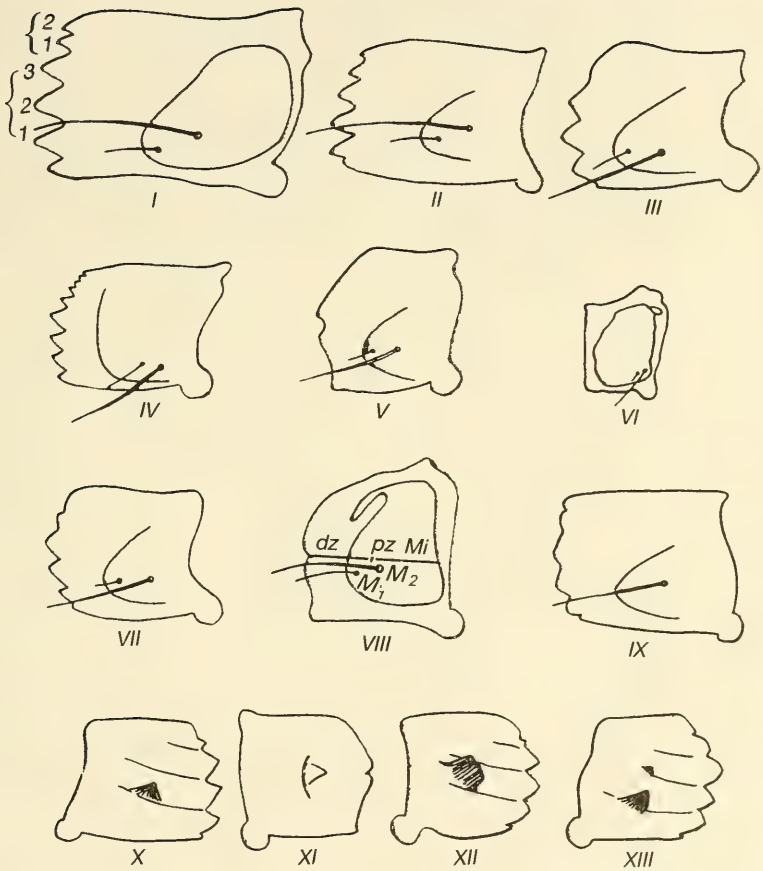

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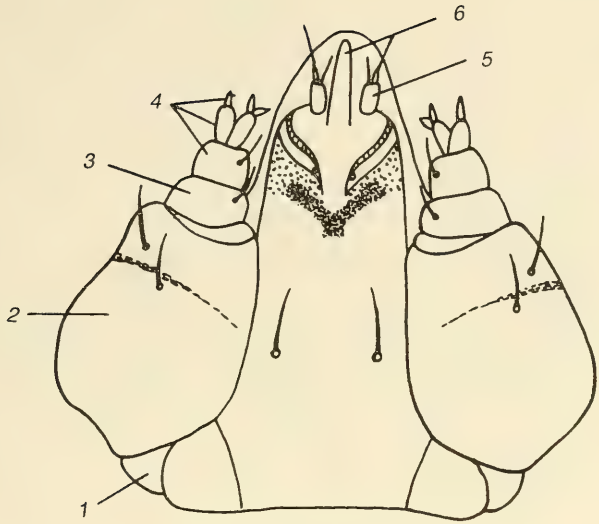
Figure 16. Maxillae and lower lip of *Mamestra pisi* L.:
1—cardo; 2—stipes; 3—palpus holder; 4—maxillary palpus; 5—labial palpus; 6—spinneret.

Figure 17. Spinneret and labial palpus:
1—*Cucullia absinthii* L.; 2—*Mamestra persicariae* L.; 3—*Panolis flammea* Schiff.; 4—*Mythimna pallens* L.; 5—*Graphiphora xanthographa* Schiff.; 6—*Agrotis corticea* Schiff.



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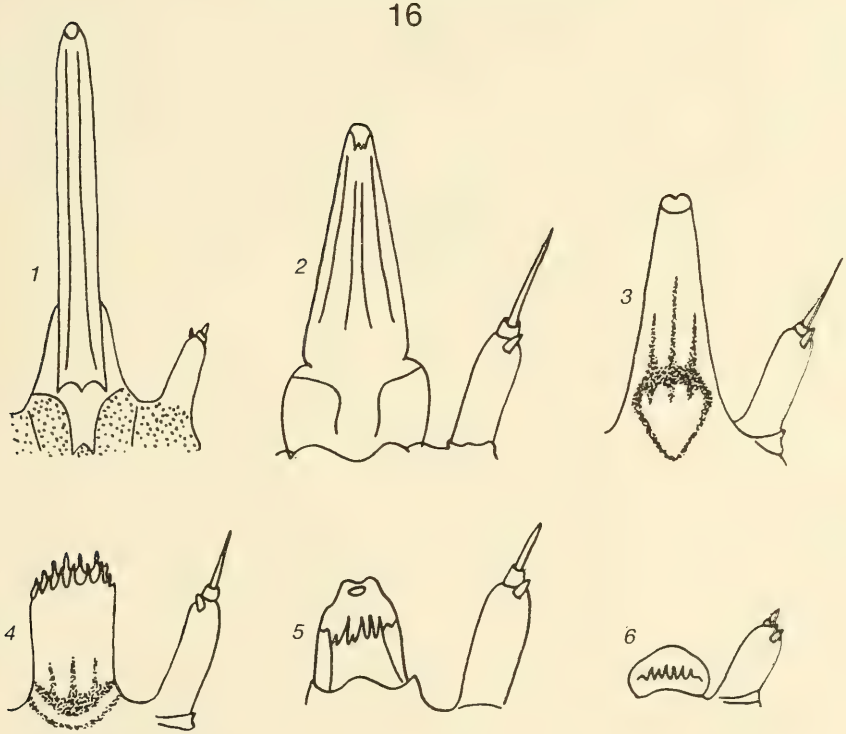

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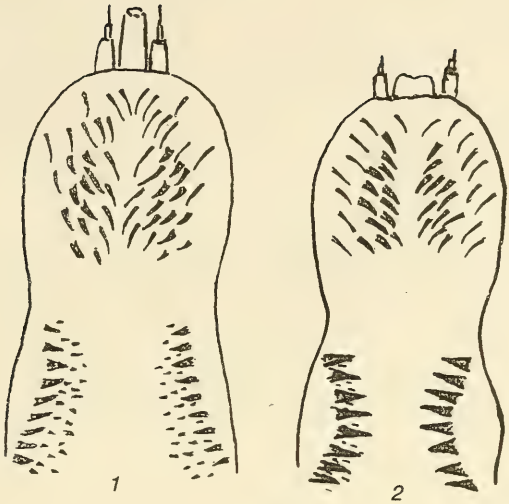
Figure 18. Hypopharynx:
1—*Mamestra suasa* Schiff.; 2—*Axylia putris* L.

Figure 19. Antenna of *Mamestra suasa* Schiff.:
I—first segment; II—second; III—third; IV—fourth; II_1—small seta; II_2—large seta; 1—antennal pore.



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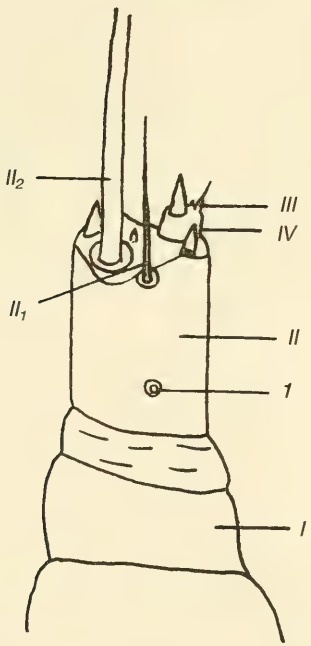

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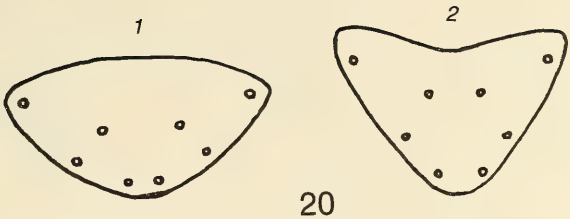
Figure 20. Anal shield:
1—*Aplecta prasina* Schiff.; 2—*Cucullia umbratica* L.

Figure 21. Structure and chaetotaxy of mesothoracic legs of *Barathra brassicae* L.:
cx—coxa; tch—trochanter; fm—femur; tb—tibia; ts—tarsus; ung—ungues; 1 to 8—setae of legs; VIIa and VIII—setae of body.



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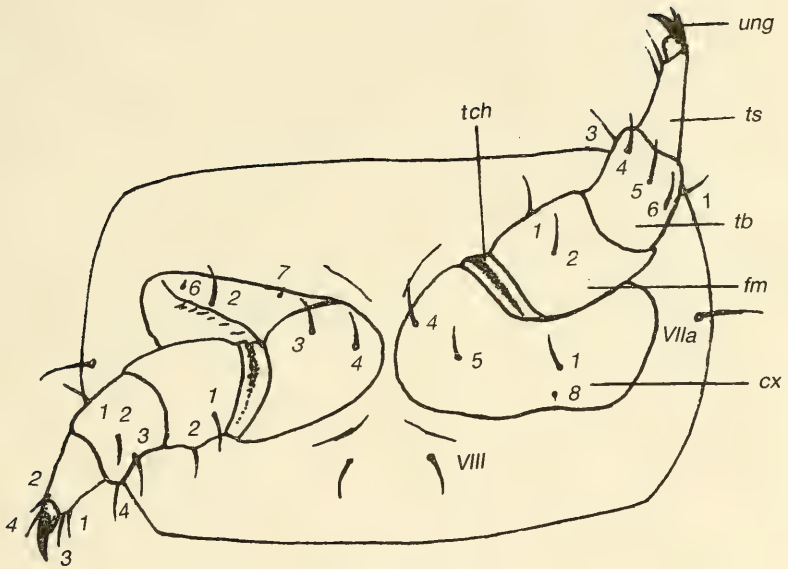
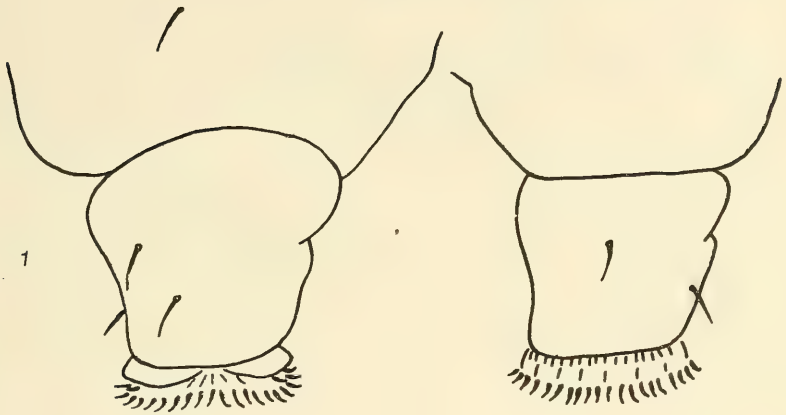


21

Figure 22. Ungues of thoracic legs of larvae:
1—with broad base; 2—with moderate base; 3—with narrow base.

Figure 23. Abdominal leg:
1—*Mamestra suasa* Schiff.; 2—*Acronicta rumicis* L. (a—outer side, b—inner side).

22



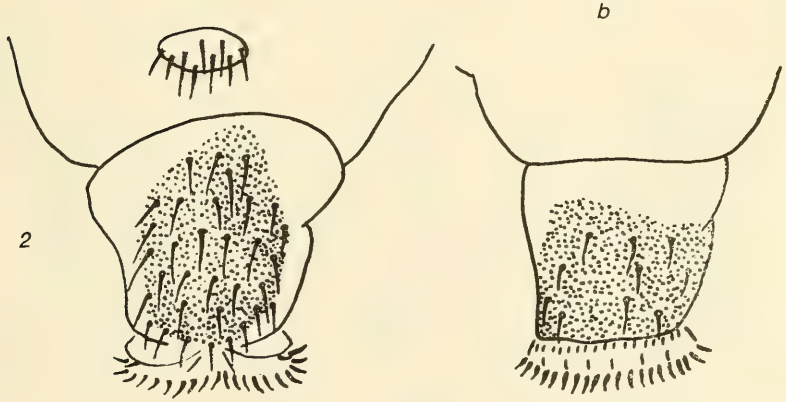


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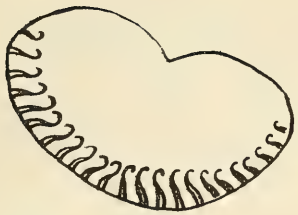
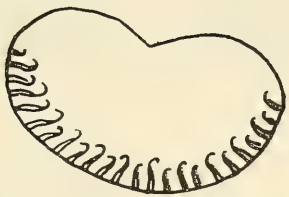
Figure 24. Arrangement of hooks on abdominal leg:
1—uniordinal; 2—biordinal; 3—indistinctly biordinal (sketches); 4—*Agrotis segetum* Schiff.; 5—*A. exclamationis* L.

Figure 25. Stigmata:
1—*Cucullia absinthii* L.; 2—*Orthosia populi* Strom.; 3—*Agrotis ipsilon* Hufn.



1

2



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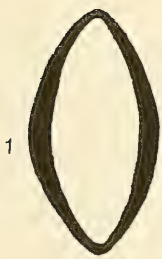

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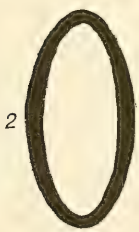

2

3

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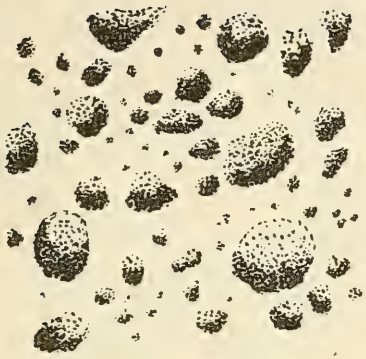
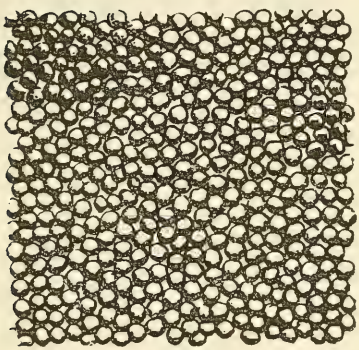
Figure 26. Dermal [granulation] patterns:
1—*Agrotis ipsilon* Hufn.; 2—*A. exclamationis* L.; 3—*A. segetum* Schiff.; 4—*Acronicta aceris* L.; 5—*Chloridea viriplaca* Hufn.; 6—*Cucullia umbratica* L.



1

2



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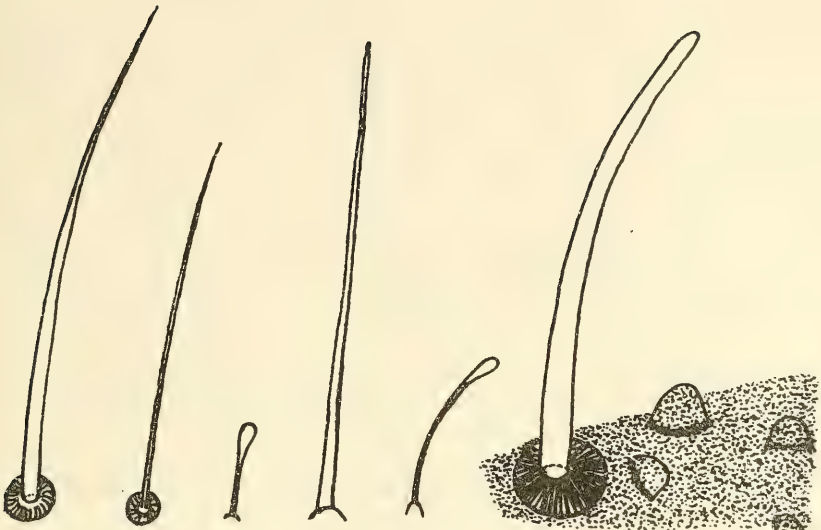
4

5

6

Figure 27. Setae and sections of dermal granular and spinelike structures:

1—setae III and IIIa of prothoracic segment in *Mamestra thalassina* Hufn.; 2—seta II of first [abdominal] segment in *Agrotis exclamationis* L. in instars I and VI; 3—seta II of first segment in *Meristis trigrammica* Hufn. in instars I and VI and dermal granules; 4—seta and dermal spines in *Acronicta aceris* L.; 5—seta in *Acronicta rumicis* L.; 6—seta II of first segment in *Acronicta alni* L.; 7—seta II of first segment and dermal granules in *Herminia barbalis* Cl.



1 2 3

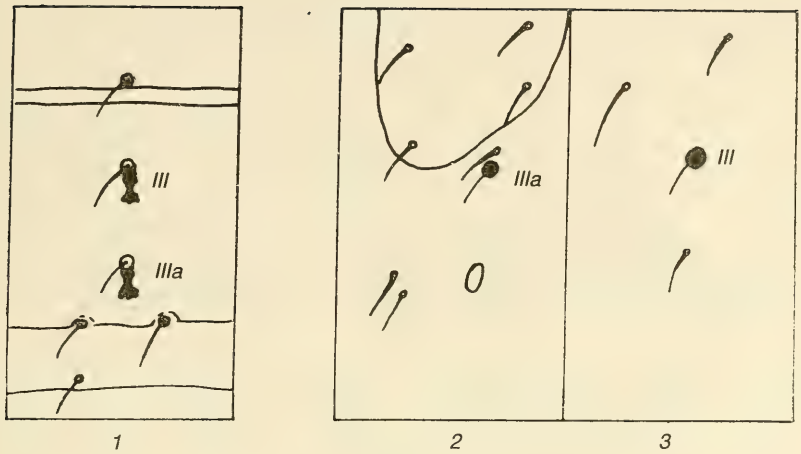
4 5 6 7

27

Figure 28. Dark spots at bases of setae:
1—III and IIIa on metathorax; 2—IIIa on prothorax; 3—III on segment 9.

Figure 29. Gradual increase and development of warts [pinacula to scoli]: I–I on first segment in *Acronicta psi* L. during larval development (instars I, III, IV, V, VII).

Figure 30. Enlarged setal bases [chalazae] of I and II in *Cucullia artemisiae* Hufn.



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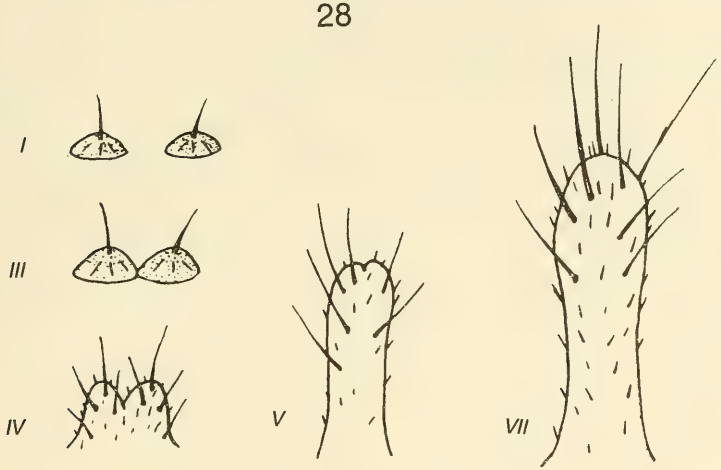

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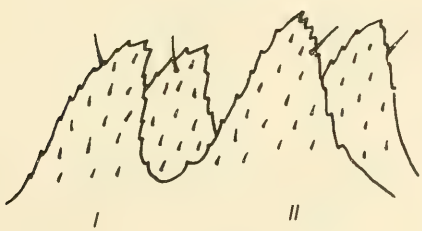

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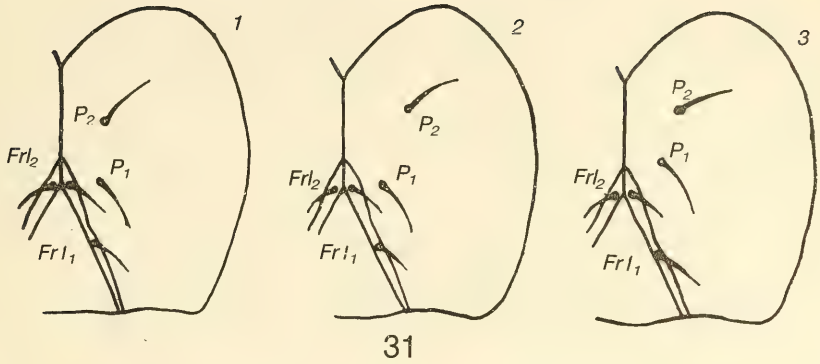
Figure 31. Displacement of setae P_1 and P_2:
1—P_1 on same horizontal line as Frl_2-Frl_2; 2—P_2 shifted ventral to epicranial suture; 3—P_1 shifted toward top of horizontal line of Frl_2-Frl_2.

Figure 32. Displacement of setae Frl_1, A_1, A_2, A_3:
1—Frl_1 toward apex of frons; 2—A_1, A_2, A_3 form an obtuse angle; 3—A_1, A_2, A_3 form a right angle.

Figure 33. Head of *Daseochaeta alpium* Osb. (from Beck, 1960).



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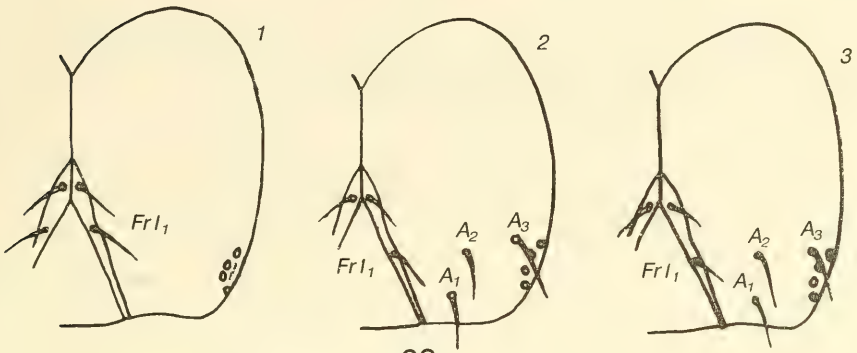

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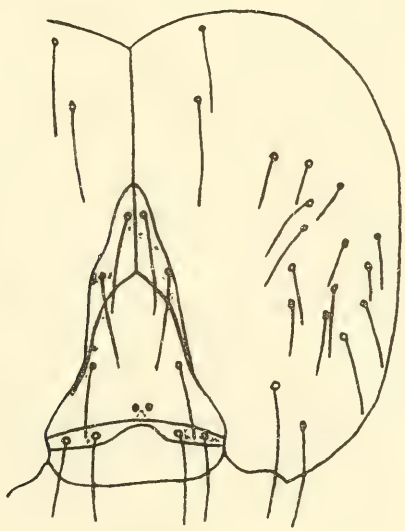

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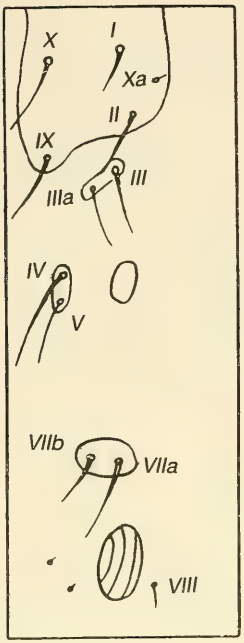
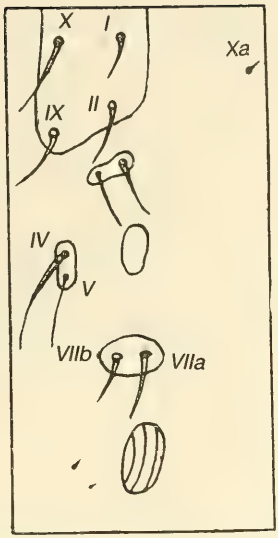
Figure 34. Chaetotaxy of prothoracic segment (sketch).

Figure 35. Chaetotaxy of prothoracic segment in *Scoliopteryx libatrix* L.

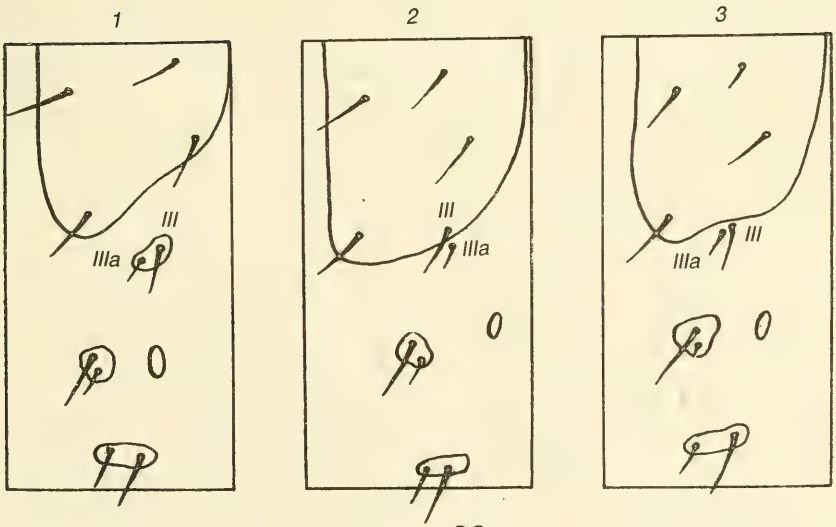
Figure 36. Displacement of setae III and IIIa on prothorax: 1—*Mamestra suasa* Schiff.; 2—*Apamea monoglypha* Hufn.; 3—*Mesapamea secalis* L.


X
I
Xa
II
IX
III
IIIa
IV
V
VIIb
VIIa
VIII

34


X
I
Xa
IX
II
IV
V
VIIb
VIIa

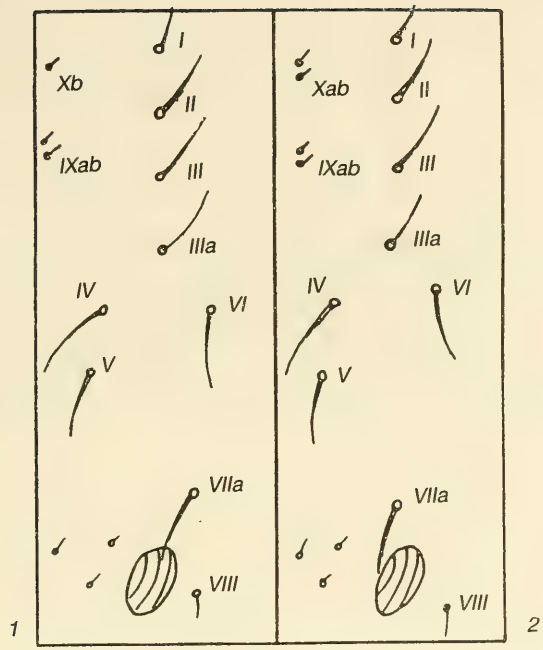
35


1
III
IIIa
2
III
IIIa
3
III
IIIa

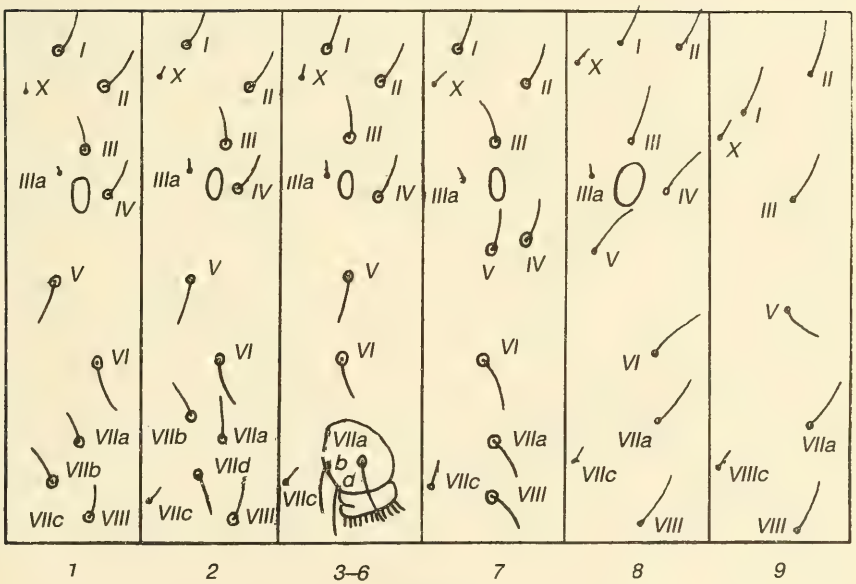
36

Figure 37. Chaetotaxy:
1—mesothorax; 2—metathorax.

Figure 38. Chaetotaxy of segments 1 to 9.


I
Xb
II
IXab
III
IIIa
IV
VI
V
VIIa
VIII
1
I
Xab
II
IXab
III
IIIa
IV
VI
V
VIIa
VIII
2

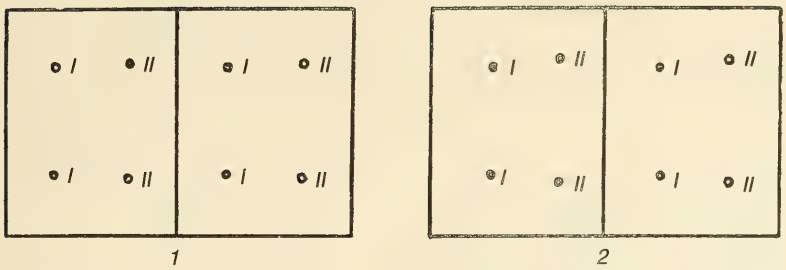
37


I
X
II
III
IIIa
IV
V
VI
VIIa
VIIb
VIIc
VIII
VIId
b
d
1
2
3–6
7
8
9

38

Figure 39. Arrangement of setae I and II on segments 5 and 6:
1 and 2—*Cucullia umbratica* L.; 3 and 4—*Agrotis segetum* Schiff. (instars I and VI).

Figure 40. Number of setae VI on trunk.
1—*Agrotis segetum* Schiff.; 2—*Episema caeruleocephala* L.



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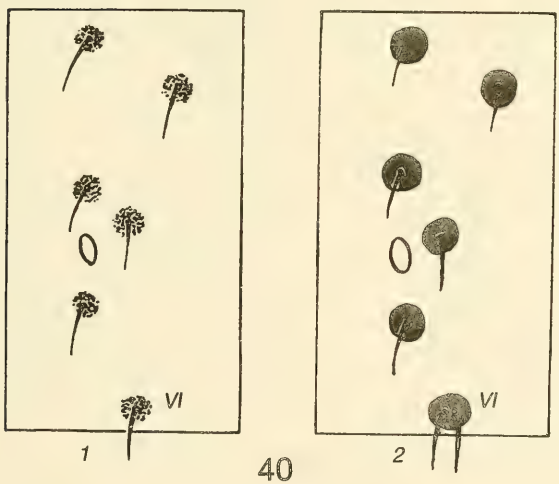

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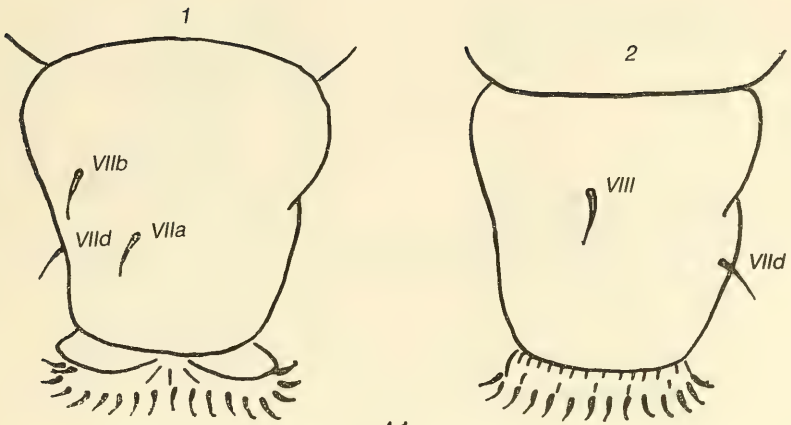
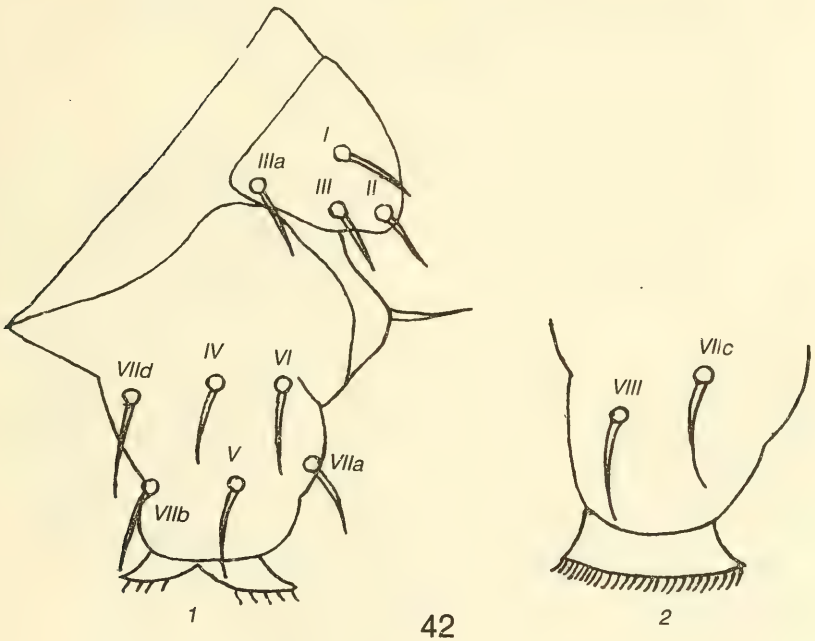
Figure 41. Chaetotaxy of abdominal leg.
1—outer side; 2—inner side.

Figure 42. Chaetotaxy of segment 10.
1—outer side; 2—inner side.


1
VIIb
VIId
VIIa
2
VIII
VIId

41


I
IIIa
III
II
VIId
IV
VI
V
VIIa
VIIb
1
VIIc
VIII
2

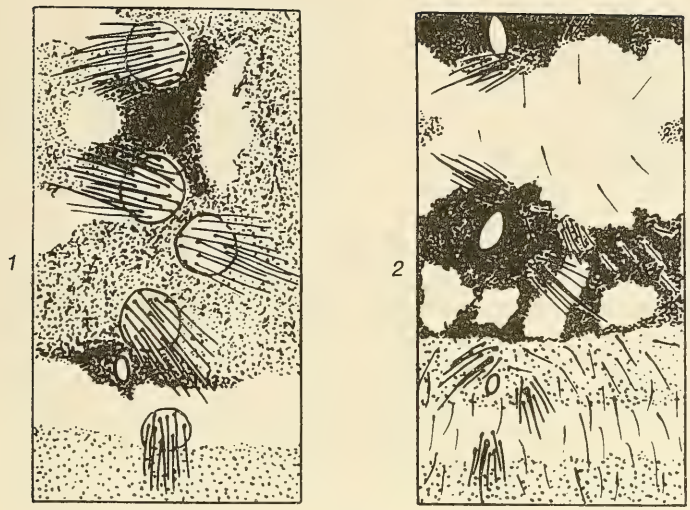
42

Figure 43. Pattern and disposition of secondary setae on trunk among species of Acronictinae:

1—*Acronicta rumicis* L.; 2—*A. tridens* Schiff.

Figure 44. Pattern on head of Noctuidae (from Gerasimov, 1952):

1—reticulate pattern on head of *Eurois occulta* L.; 2—punctate pattern on head and parts of prothorax in *Euxoa tritici* L.



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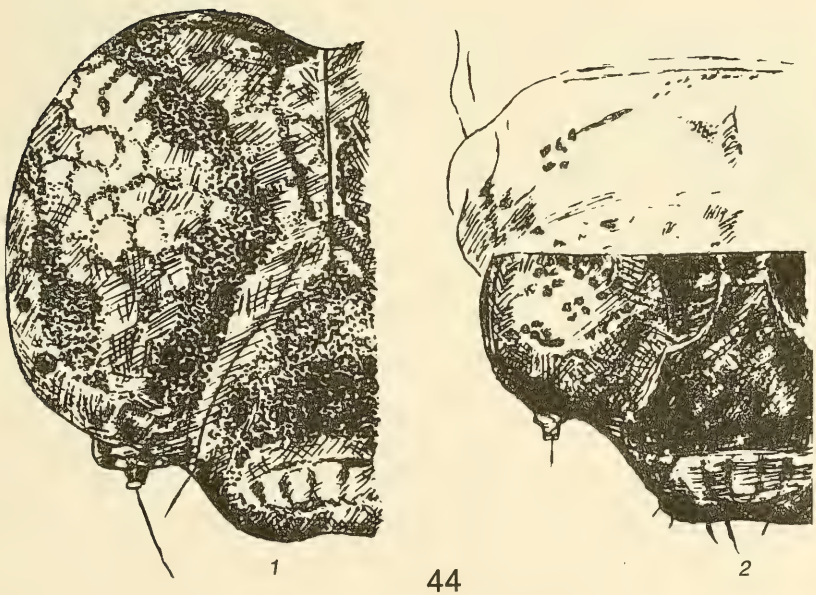


44

Figure 45. Types of pattern on head of Noctuidae (from Ryabov, 1960):

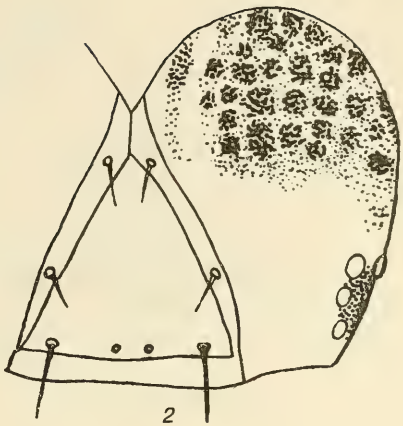
1—pattern formed by adfrontal bands and reticulate elements; 2—astral pattern.

Figure 46. Sketch of pattern on head of Noctuidae (from Beck, 1960):

1—pattern with dark-colored reticulate elements; 2—pattern with dark-colored reticulate fields.

1

45



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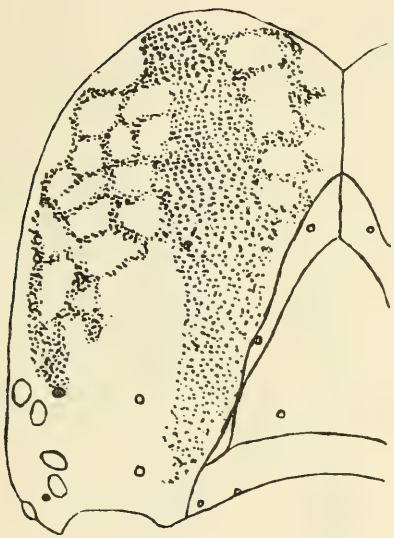

1

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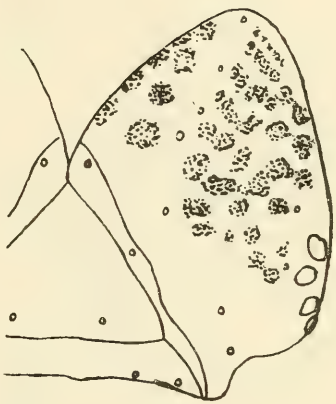
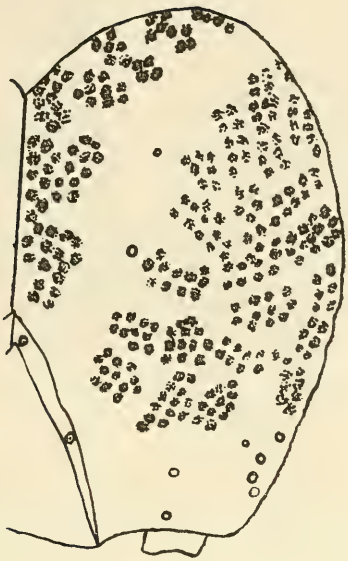


2

Figure 47. Sketch of pattern on head of Noctuidae:
1—1st type, *Cucullia gnaphalii* Hbn.; 2—2nd type, *Mamestra thalassina* Hufn.; 3—3rd type, *Lygephila viciae* Hbn.



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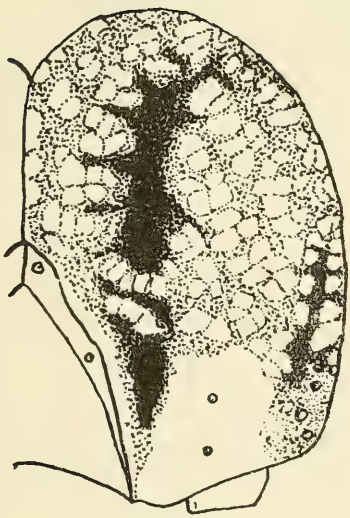

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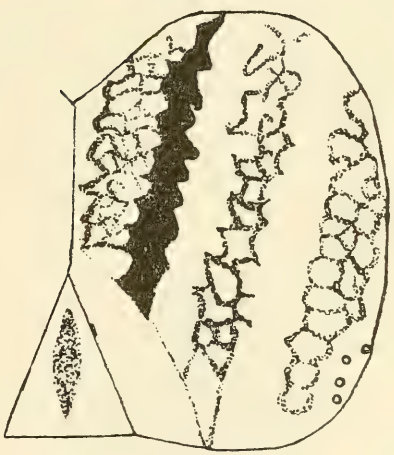

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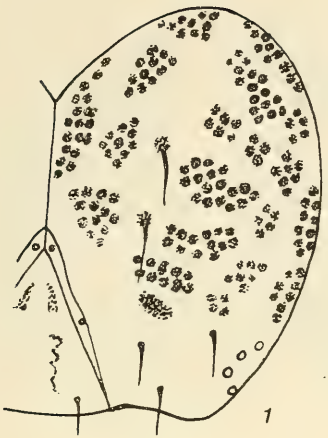
Figure 48. Variations in pattern of 1st type on head:
1—*Cucullia absinthii* L.; 2—*Rusina tenebrosa* Hbn.; 3—*Chloridea scutosa* Schiff.; 4—*Chloridea viriplaca* Hufn.; 5—*Euxoa tritici* L.; 6—*Calophasia lunula* Hufn.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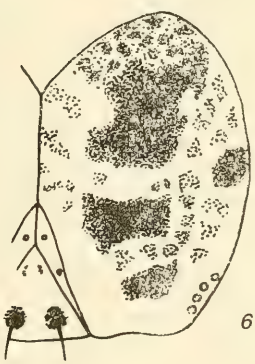
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Figure 49. Variations in pattern of 2nd type on head:
1—*Triphaena augur* F.; 2—*Mythimna comma* L.; 3—*Diarsia brunnea* Schiff.; 4—*Abrostola trigemina* Wern.; 5—*Apamea sordens* Hufn.; 6—*Panolis flammea* Schiff.; 7—*Graphiphora baja* Schiff.; 8—*Agrotis segetum* Schiff.; 9—*Catocala nupta* L.

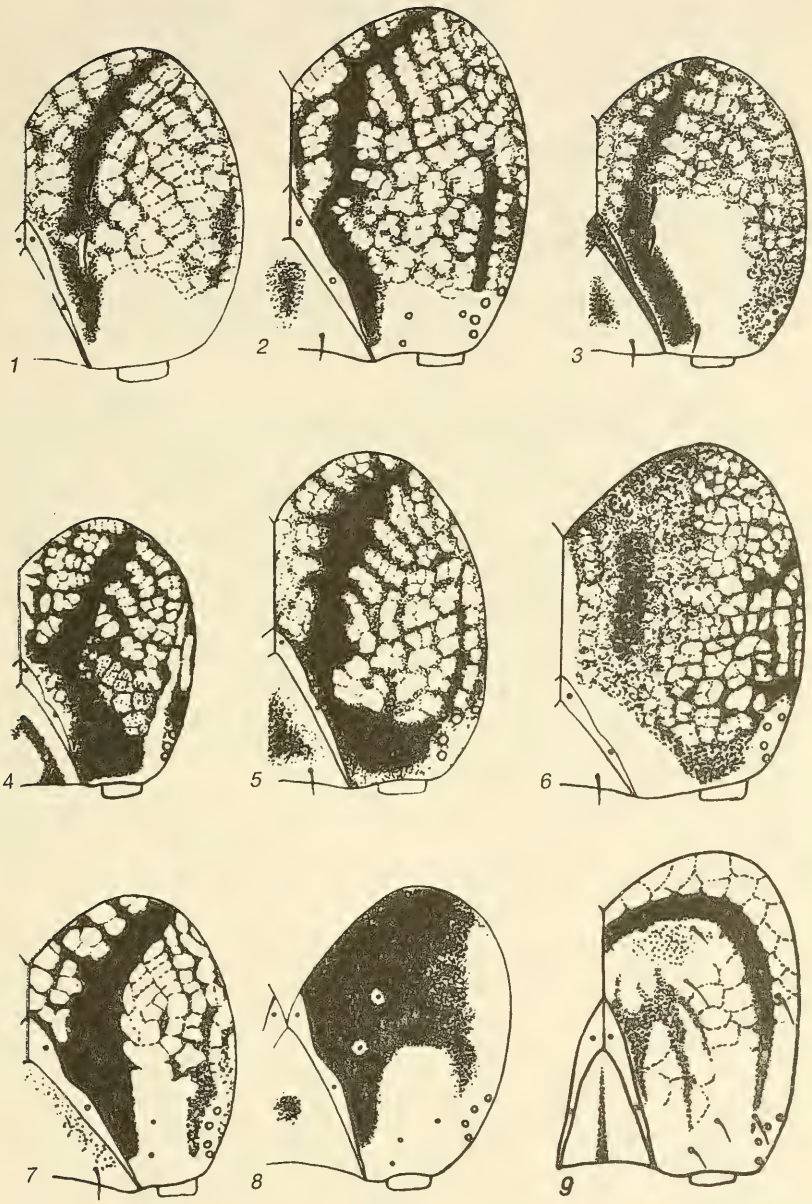

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Figure 50. Pattern of segments 6 and 7 of larva of *Ematurga atomaria* L. (instars I, III, IV):

1—dorsal band; 2—subdorsal; 3—suprastigmal; 4—stigmal; 5—substigmal; 6—basal; 7—subbasal; 8—supraventral; 9—ventral (semischematic, from Kuznetsov, 1915).

Figure 51. Sketch depicting division of trunk of larva into zones (from Beck, 1960):

1—dorsal; 2—subdorsal; 3—pleural; 4—ventral.

Figure 52. Sketch depicting division of zones of trunk of larva into subzones (from Beck, 1960):

1 and 3—lateral subzone of dorsal zone; 2—internal subzone of dorsal zone; 4—dorsal subzone of subdorsal zone; 5—ventral subzone of subdorsal zone; 6—pleural zone; 7—ventral zone.

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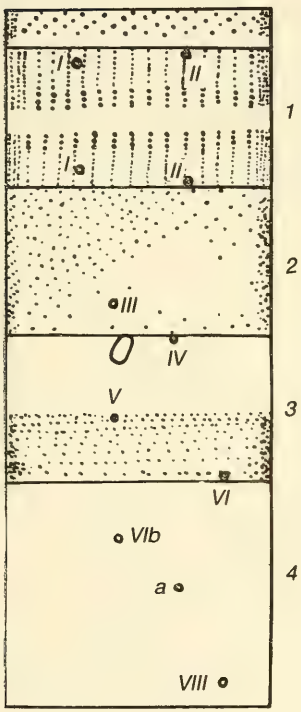

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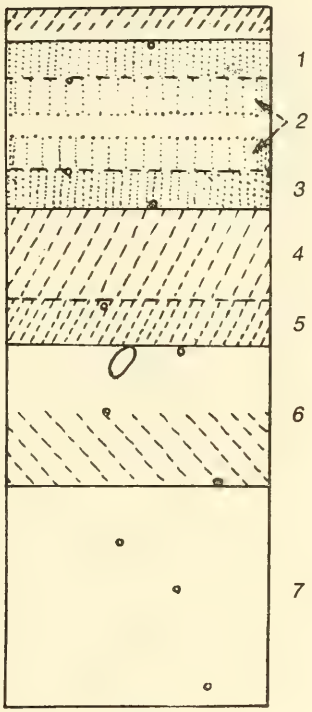

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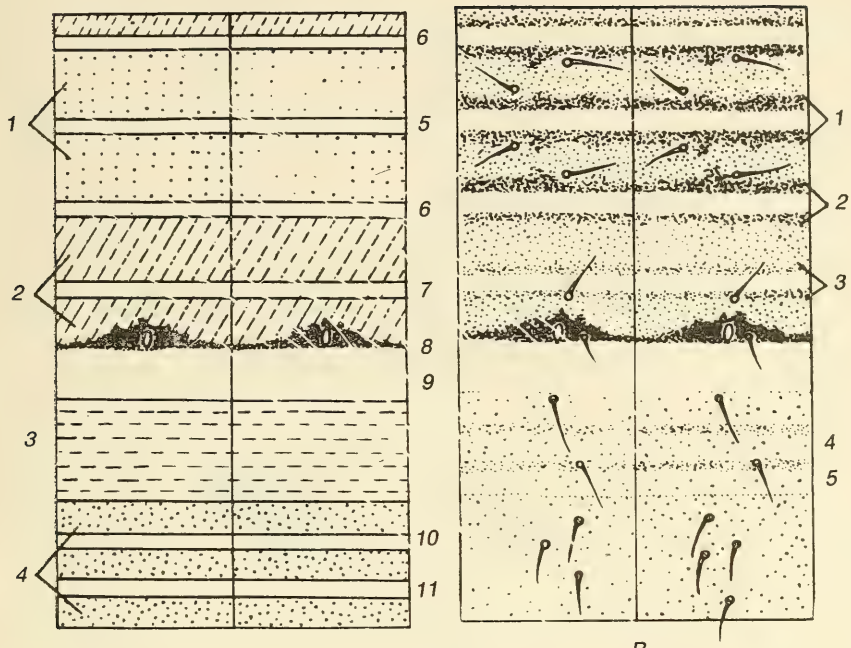
Figure 53. Sketch of pattern on trunk of larva:

A: 1—dorsal field; 2—subdorsal; 3—basal; 4—ventral; 5—dorsal band; 6—subdorsal; 7—suprastigmal; 8—stigmal; 9—substigmal; 10—supraventral; 11—ventral. B: 1—border of dorsal band; 2—subdorsal; 3—suprastigmal; 4—basal band; 5—subbasal band.

Figure 54. Sketch of pattern in dorsal field:

1—rhomboidal shading; 2—semicircular spot; 3—herringbone; 4—oblong spots of border of subdorsal band (segments 1 to 6); 5—fused cuneiform spots; 6—separated cuneiform spots; 7—light-colored transverse spot posterior to dark-colored cuneiform spots; 8—arrow-shaped spot (segment 8).



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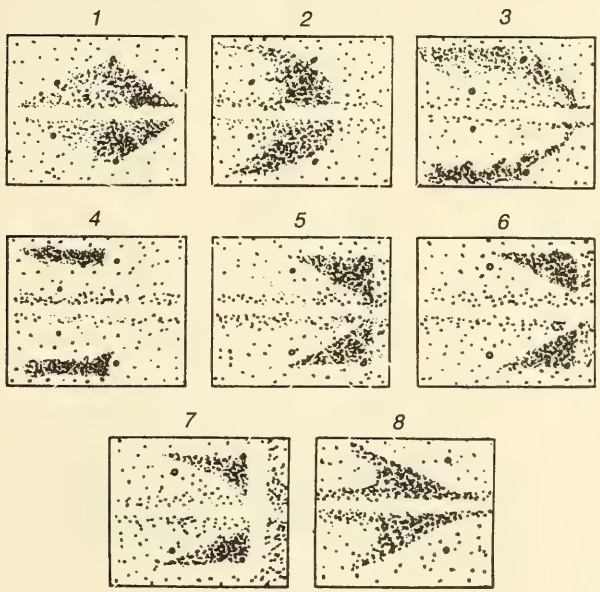

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Figure 55. Different forms of stigmal band:
1—*Mamestra oleracea* L.; 2—*Diarsia brunnea* Schiff.; 3—*Triphaena augur* F.; 4—*Mamestra persicariae* L.; 5—*Cucullia asteris* Schiff.; 6—*Mamestra suasa* Schiff.; 7—*Barathra brassicae* L.; 8—*Aplecta prasina* Schiff.; 9—*Abrostola trigemina* Wern.

55

Figure 56. Development of pattern of 1st type on head:
1—*Xylena vetusta* Hbn. (instars I, III, V); 2—*Calophasia lunula* Hufn. (instars II, III, V); 3—*Diphthera coenobita* Esp. (instars III, IV, VI).

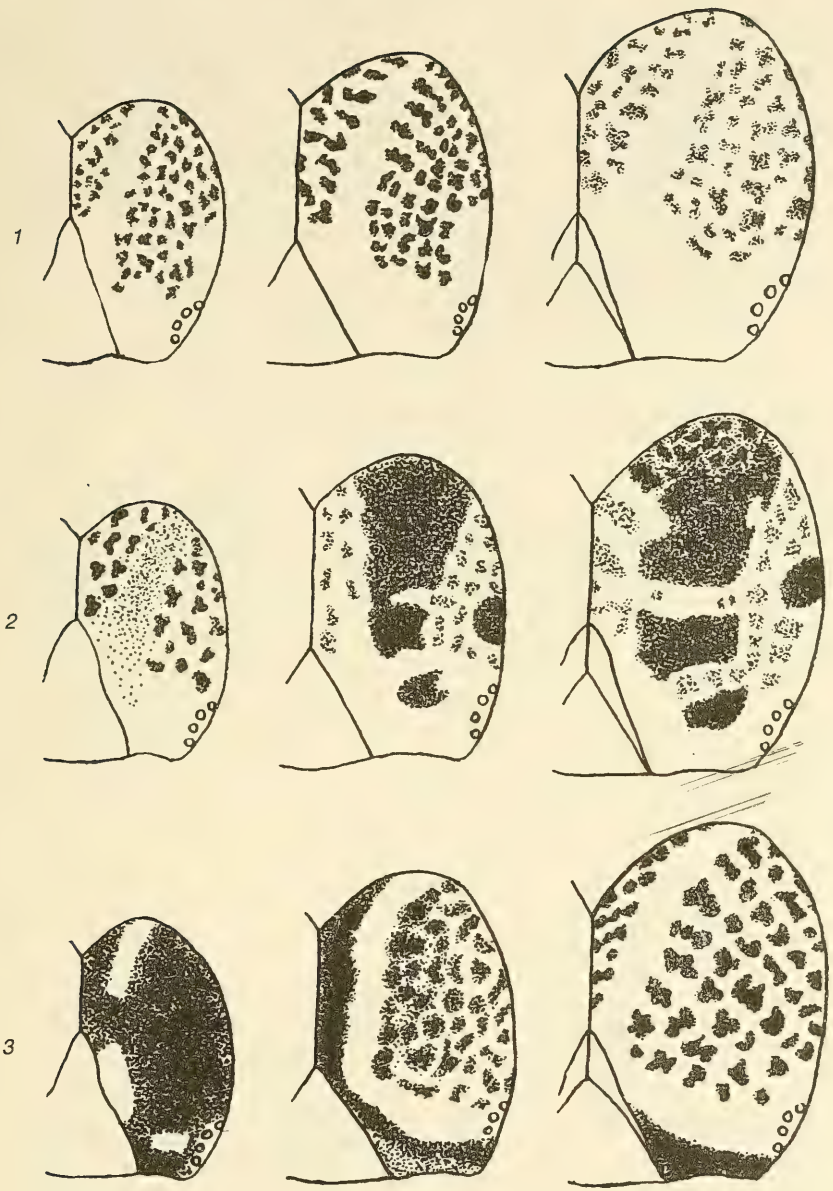

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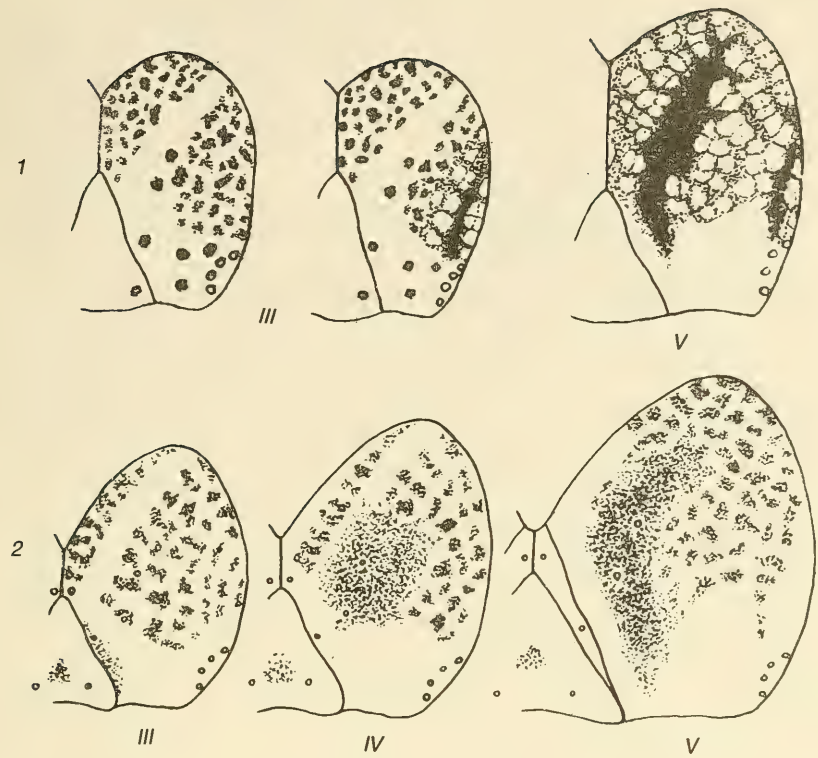
Figure 57. Development of pattern of 2nd type on head:
1—*Mamestra thalassina* Hufn. (instars III and V); 2—*Agrotis segetum* Schiff. (instars III, IV, and V).

Figure 58. Development of pattern of 3rd type on head of *Lygephila viciae* Hbn.:
1—I-instar; 2—III-instar; 3—VI-instar.



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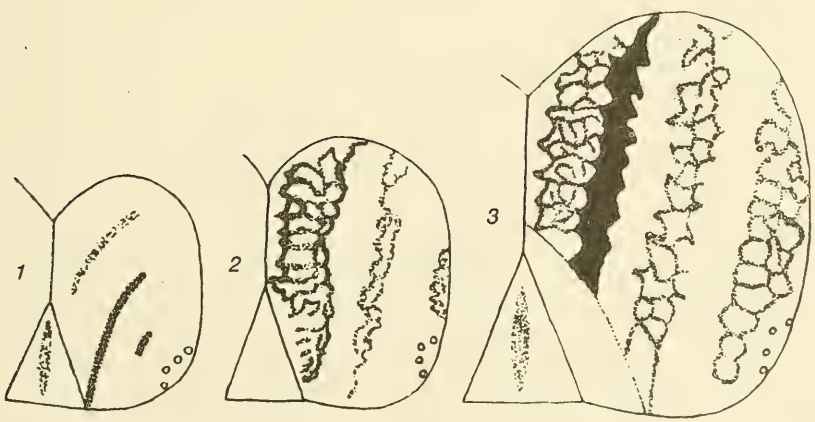

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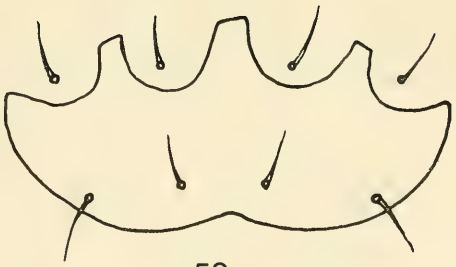
Figure 59. Thoracic shield of just hatched larva of *Barathra brassicae* L.

Figure 60. Development of pattern in dorsal field of *Agrotis exclamationis* L.:
1—I-instar; 2—II-instar; 3—III-instar.

Figure 61. Development of herringbone pattern in dorsal field of *Graphiphora baja* F.:
1—I-instar; 2—II-instar; 3—III-instar; 4—IV-instar.



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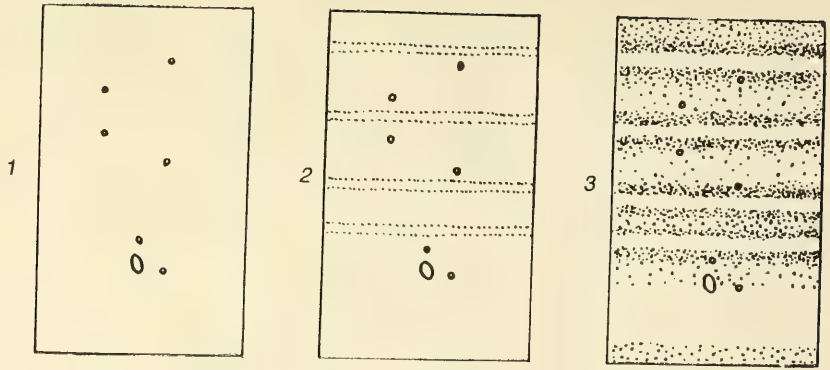

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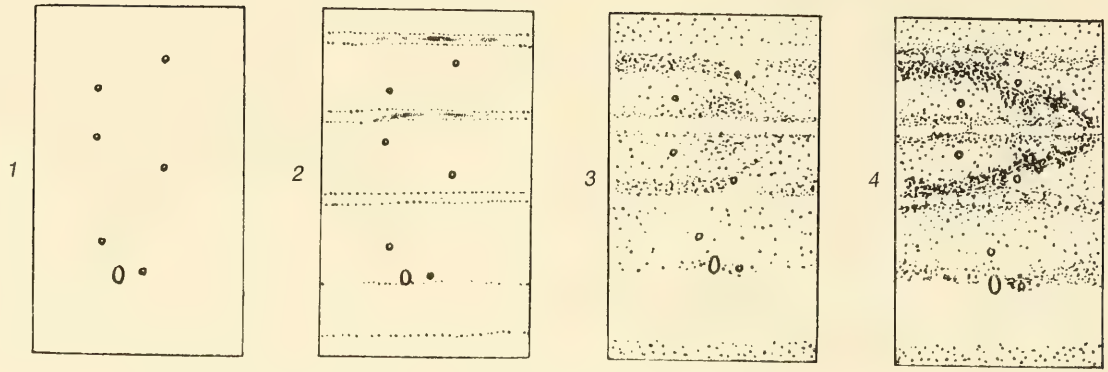

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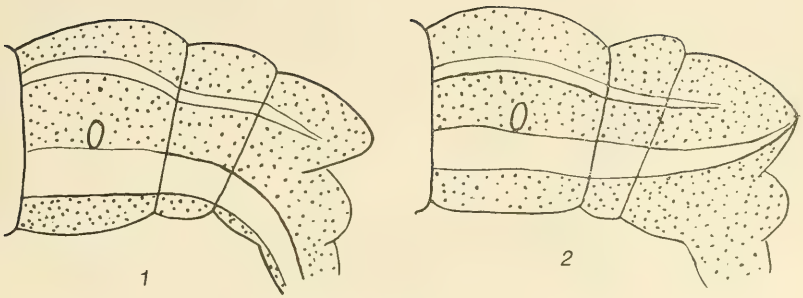
Figure 62. Arrangement of substigmal band on segment 10.
1—extends onto anal leg; 2—surrounds anal shield.

Figure 63. Chaetotaxy of *Episema caeruleocephala* L. (VI-instar):
I and III—thoracic segments; 1, 2, 6 and 8—abdominal segments.

Figure 64. Characteristics of thoracic leg:
1—tibia of *Acronicta alni* L. (from Beck, 1960); 2—tarsus of *Calocasia coryli* L.



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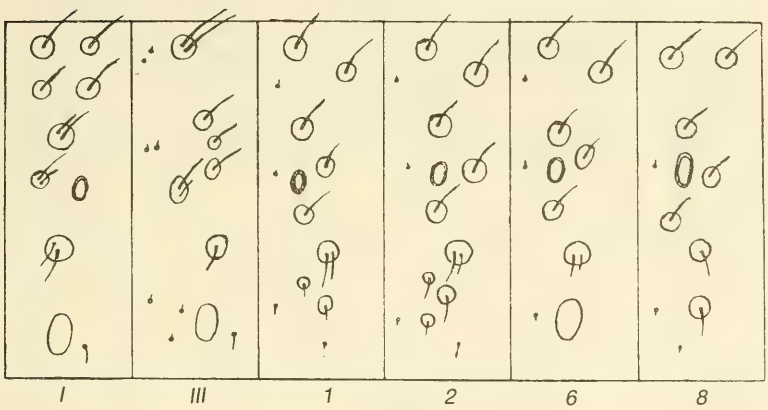

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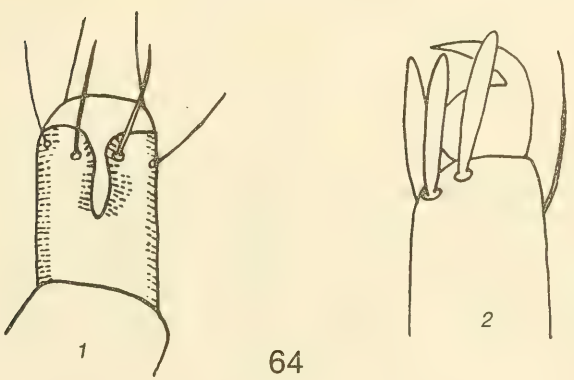

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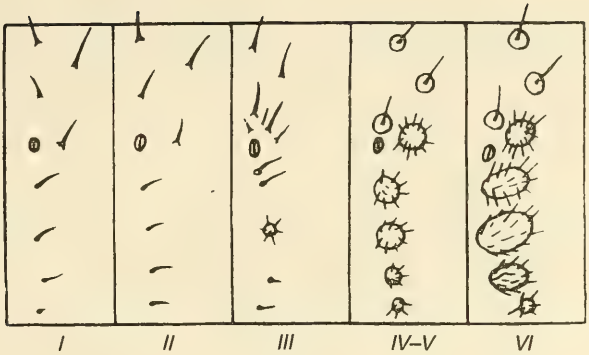
Figure 65. Characteristics of chaetotaxy of segment 1 in *Subacronicta megacephala* Schiff. in different instars (I to VI) (from Kozhanchikov, 1950).

Figure 66. Thoracic legs and labrum (from Beck, 1960):
Thoracic legs of segments I and III (1) and labrum (2) in *Diphthera coenobita* Esp.; labrum of *Calocasia coryli* L. (3).

Figure 67. Characteristics of chaetotaxy of segment 1 in different instars (I to VII) of *Acronicta aceris* L. (from Kozhanchikov, 1950).



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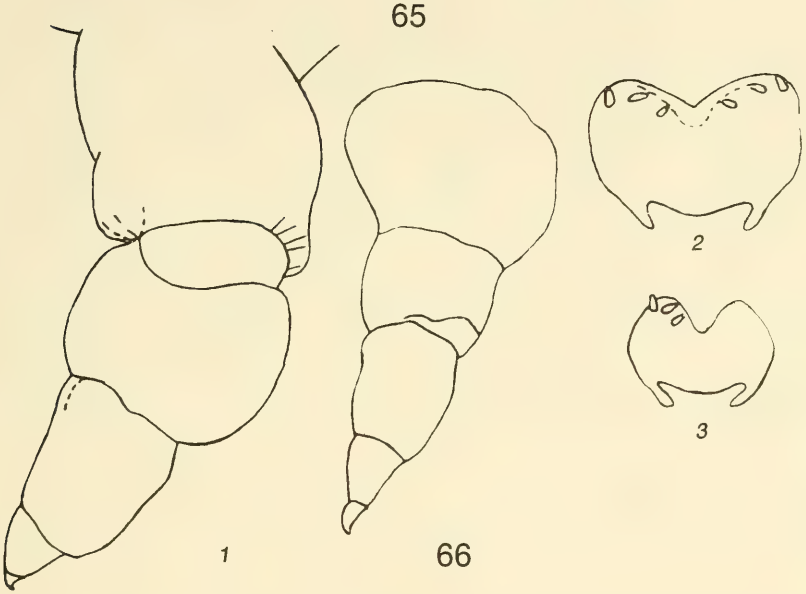

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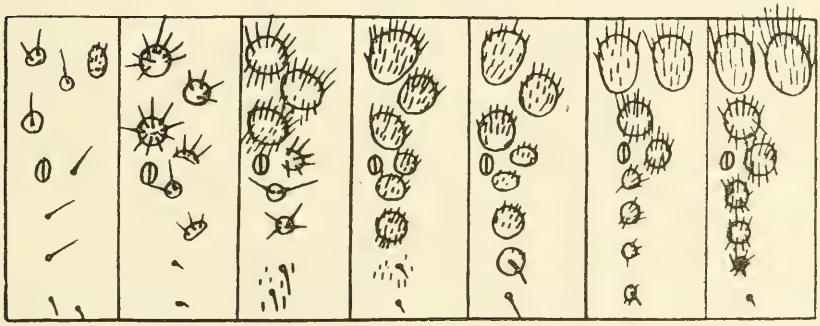

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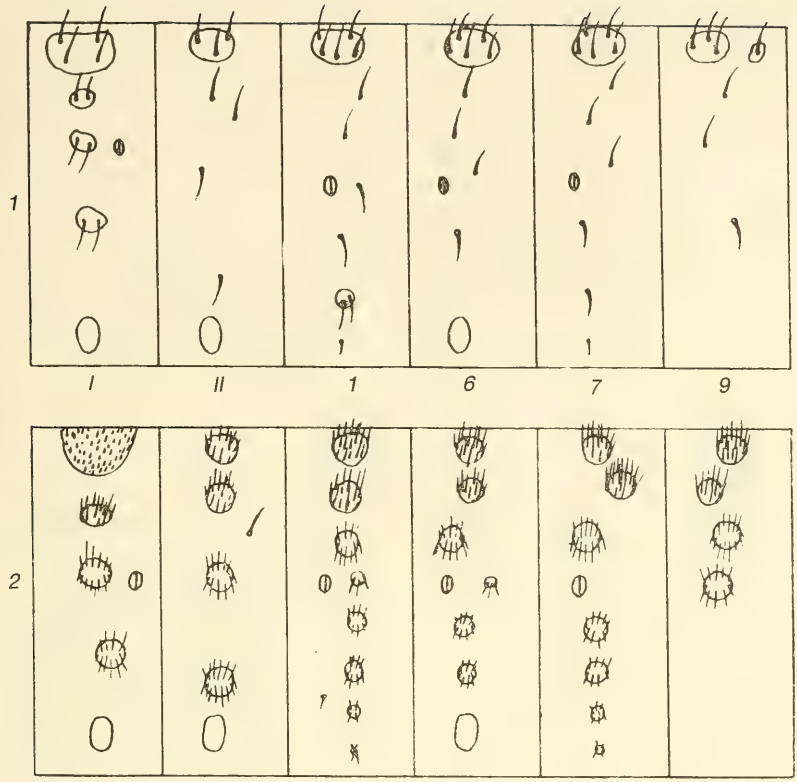
Figure 68. Chaetotaxy of pro- (I) and mesothorax (II) of segments (1, 6, 7, 9) in *Acronicta rumicis* L.:
1—I-instar; 2—VI-instar.

Figure 69. Arrangement of warts on body:
1—*Calocasia coryli* L. (segment 7); 2—*Daseochaeta alpium* Osb. (segment 9) (from Beck, 1960).



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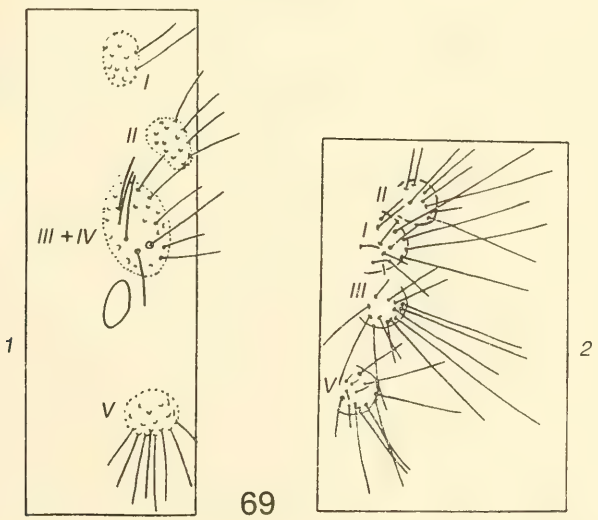

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Figure 70. Mandibles:
1—*Calocasia coryli* L.; 2—*Diphthera coenobita* Esp.

Figure 71. *Subacronicta megacephala* Schiff.:
1—pattern on head; 2—close-set warts I and II on meso- and metathorax.

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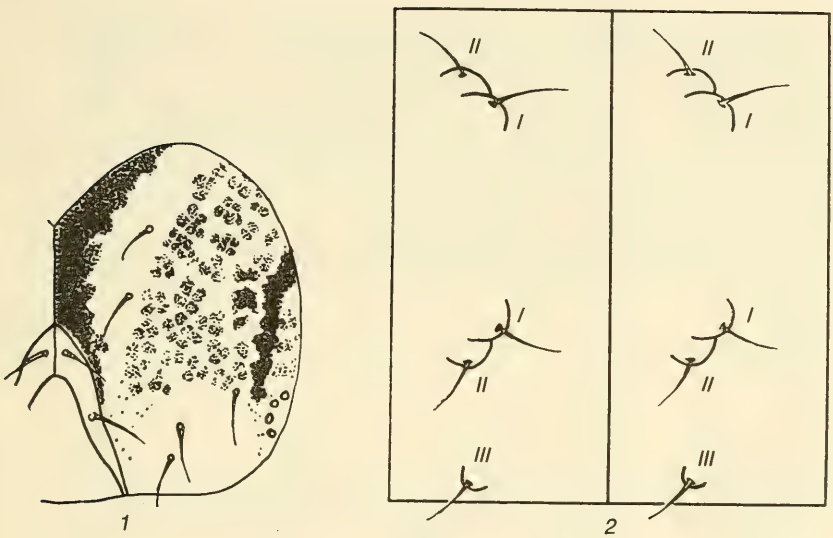

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Figure 72. Pattern on trunk in Agrotinae:
1—*Lycophotia signum* F.; 2—*Diarsia brunnea* Schiff.; 3—*Graphiphora baja* Schiff.

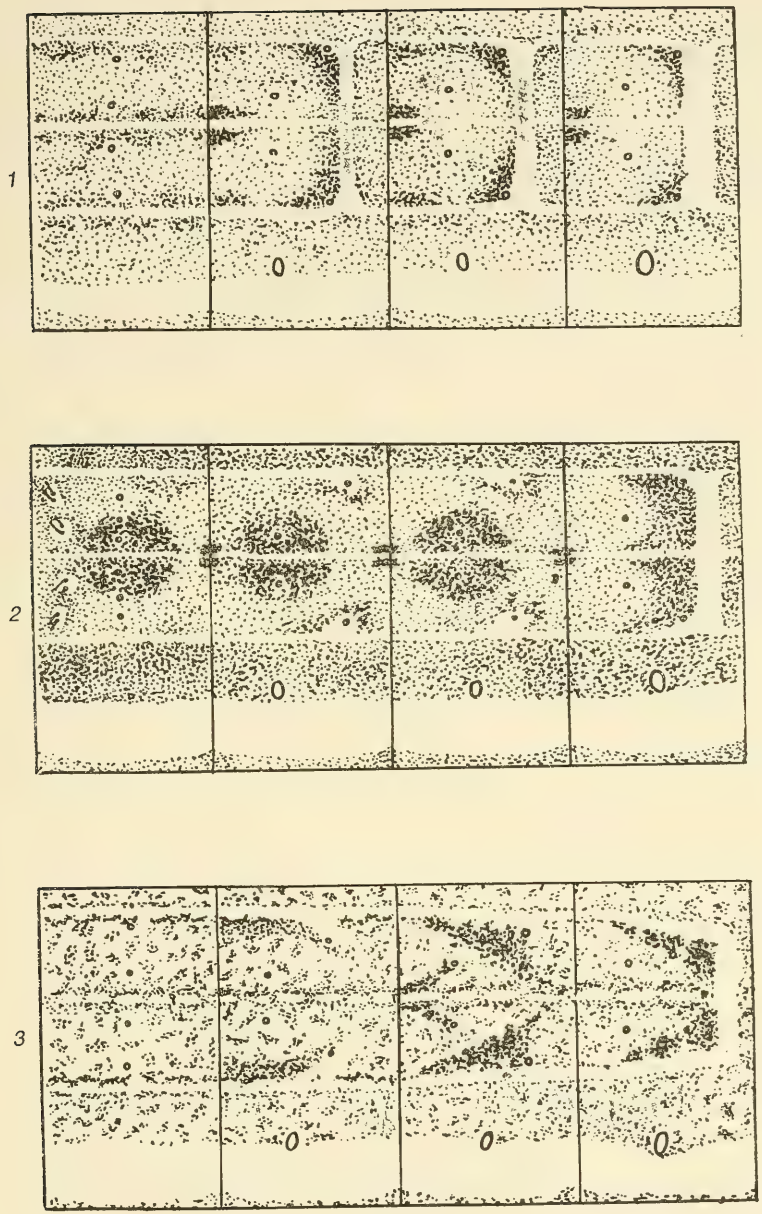
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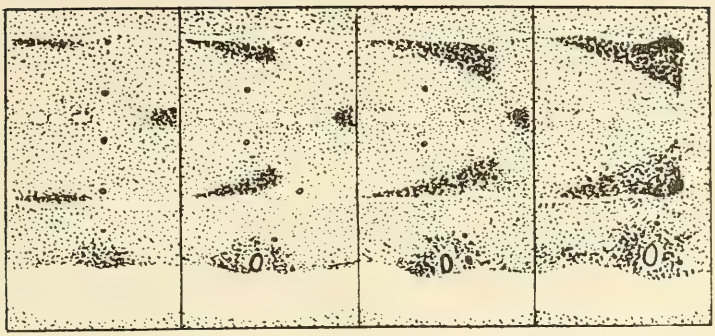
Figure 72 continued.

4—*Graphiphora c-nigrum;* 5—*G. ditrapezium* Schiff.; 6—*G. xanthographa* Schiff.



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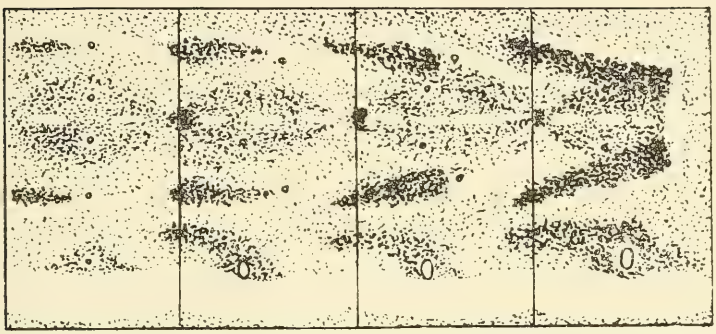

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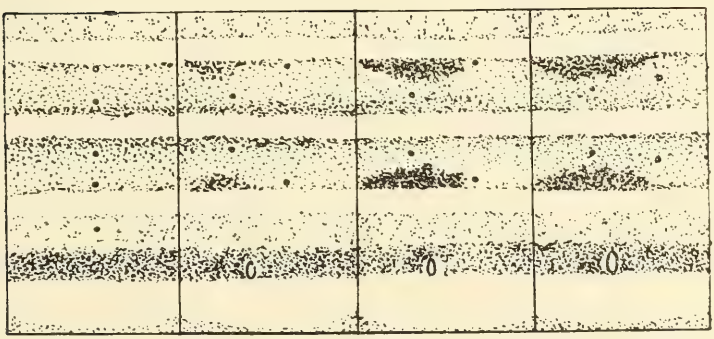

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Figure 72 continued.

7—*Lycophotia porphyrea* Schiff.; 8—*Agrotis segetum* Schiff.; 9—*Axylia putris* L.; 10—*Aplecta prasina* Schiff. (segments III, 1, 7, and 8).

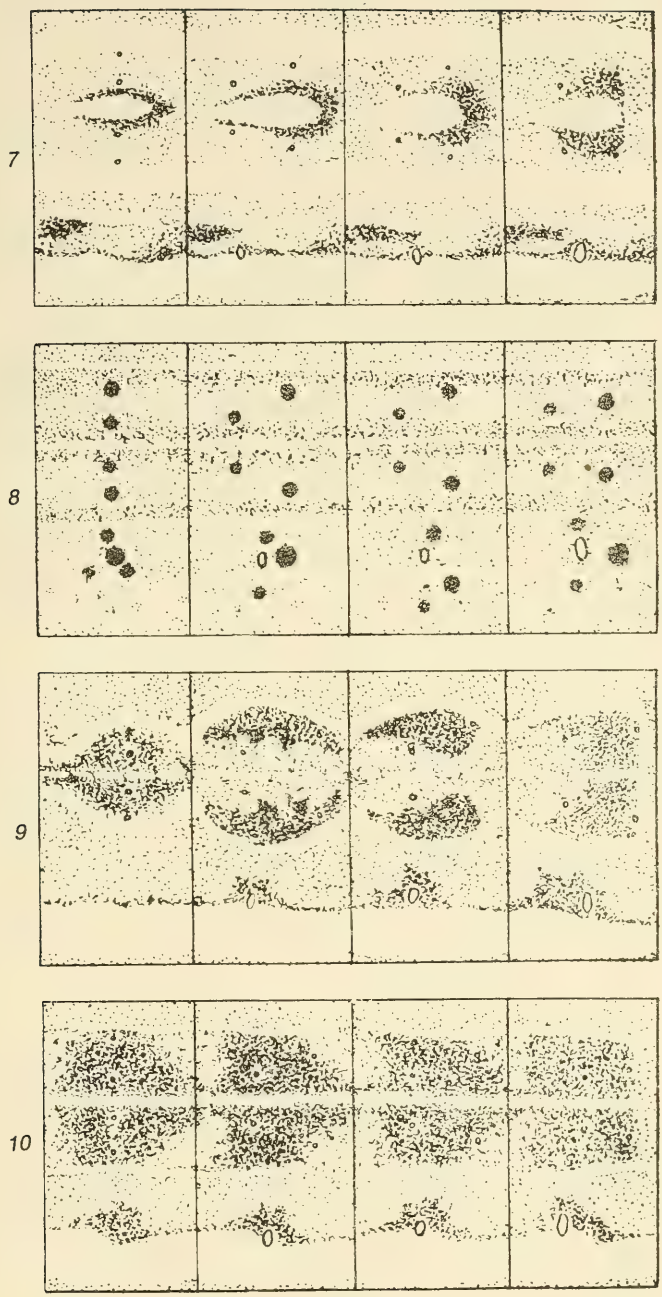

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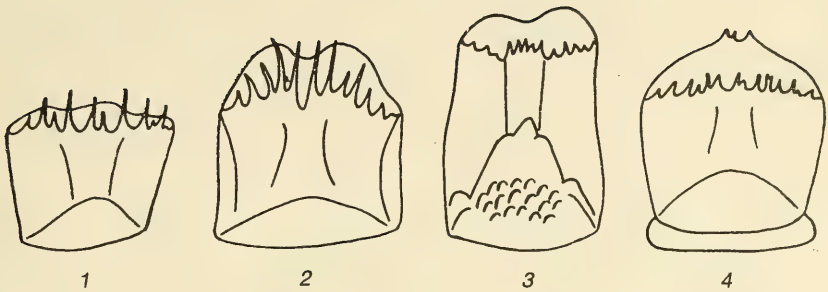
Figure 73. Shape of opening of spinneret in species of Agrotinae: 1—*Triphaena orbona* Hufn.; 2—*T. pronuba* L.; 3—*T. augur* F.; 4—*Graphiphora c-nigrum* L.; 5—*G. baja* F.; 6—*G. triangulum* Hufn.; 7—*G. ditrapezium* Schiff.; 8—*G. ashworthii* Doub.; 9—*Lycophotia signum* F.; 10—*Axylia putris* L.; 11—*Diarsia brunnea* Schiff.; 12—*Naenia typica* L.; 13—*Ochropleura plecta* L.; 14—*Agrotis ipsilon* Hufn.; 15—*A. segetum* Schiff.; 16—*Euxoa tritici* L.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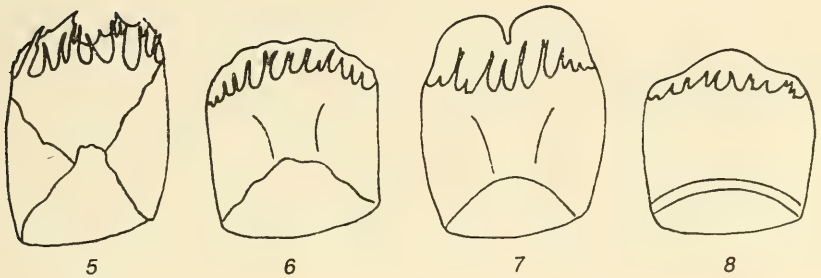
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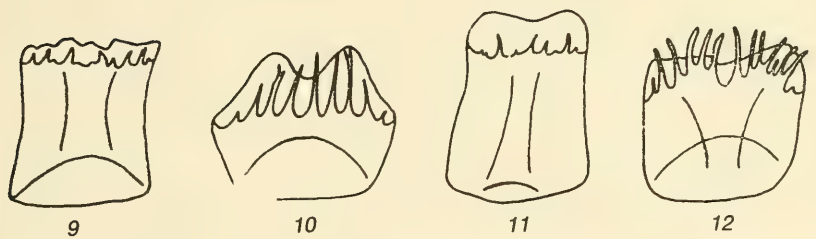
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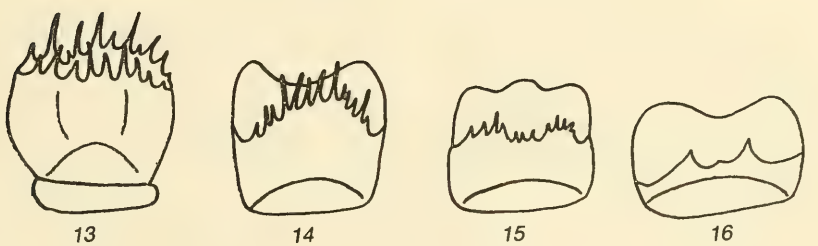
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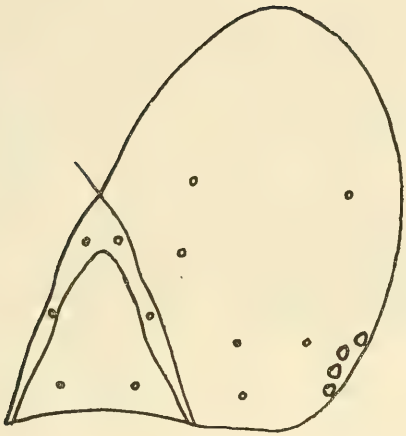
Figure 74. Shape of upper portion of adfrontal sclerites: *Agrotis ipsilon* Hufn. (1); *A. segetum* Schiff. (2, 3). Labrum: *A. corticea* Schiff. (4); *A. segetum* Schiff. (5).



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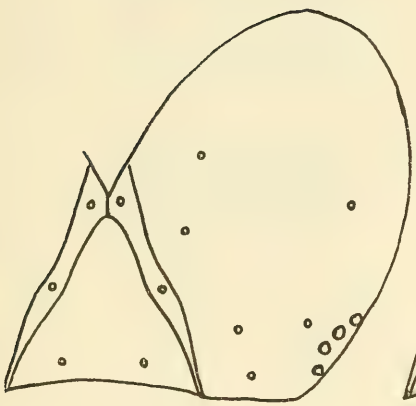

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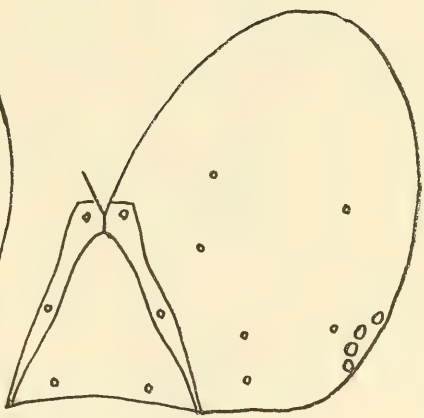

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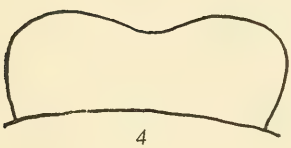

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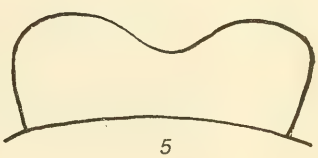

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74

Figure 75. Pattern on trunk in species of Hadeninae:
1—*Mamestra persicariae* L.; 2—*M. oleracea* L.; 3—*M. psi* L.; 4—*M. bicolorata* Hufn.; 5—*Polia nebulosa* Hufn.; 6—*Hadena lepida* Esp.

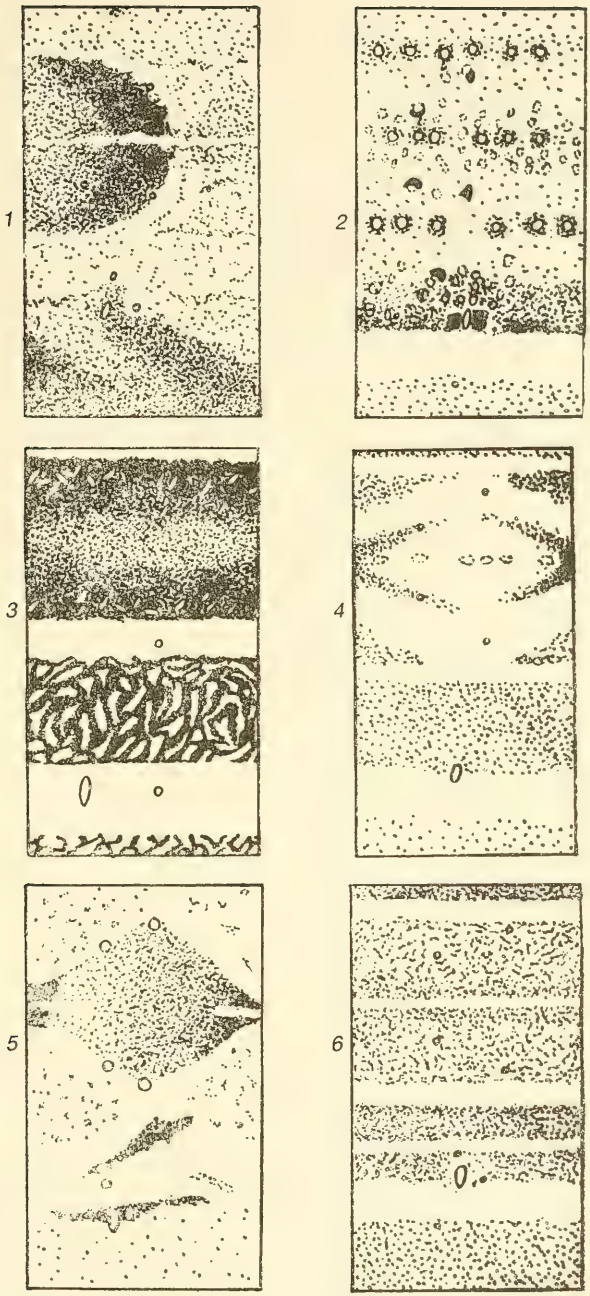

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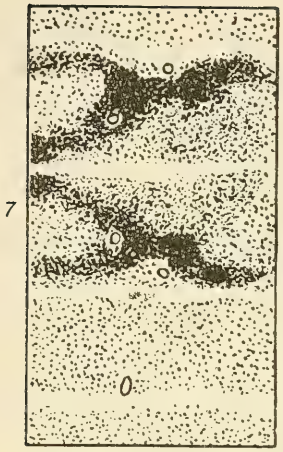
Figure 75 continued.

7—*Mythimna turca* L.; 8—*Barathra brassicae* L. (segment 1); 9—*Discestra trifolii* Hufn. (segments 2 and 8); 10—*Mamestra persicariae* L. (segments 7 to 10).



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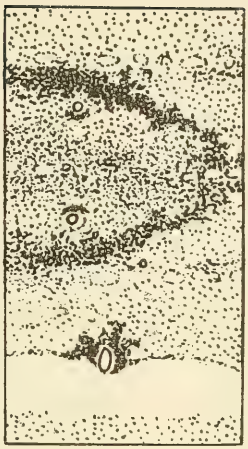

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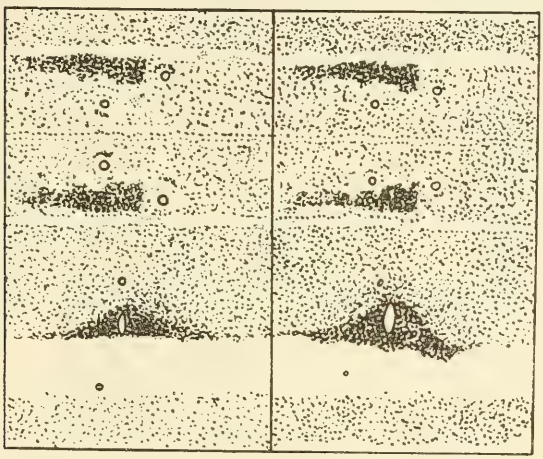

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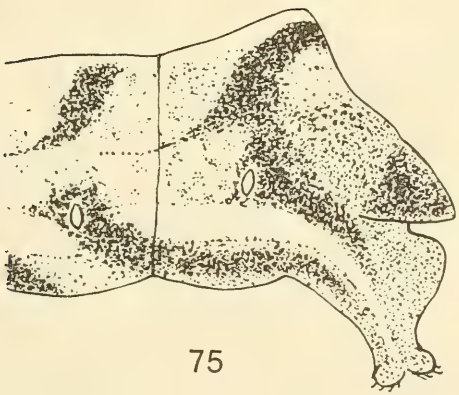

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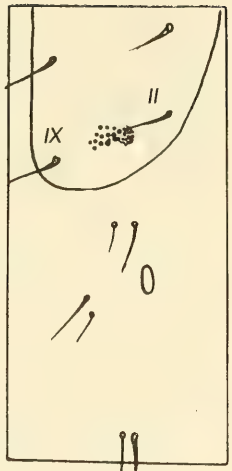
Figure 76. Prothorax in *Polia bombycina* Hufn.: Dark-colored spot between setae II and IX.

Figure 77. Development of pattern on head in *Orthosia populi* Ström. (instars IV, V, and VI).

Figure 78. Arcuate line in subdorsal field of segments 1 and 2 in *Hadena rivularis* F.



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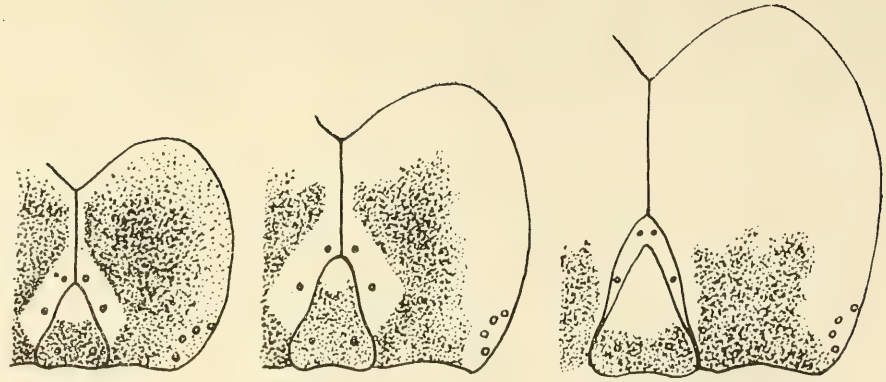

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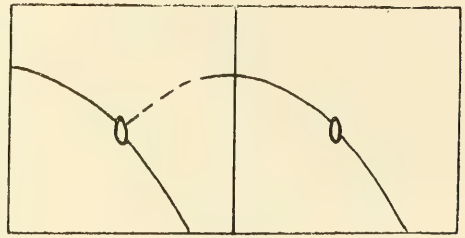

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Figure 79. Shape of opening of spinneret in species of Hadeninae: 1—*Barathra brassicae* L.; 2—*Discestra trifolii* Hufn.; 3—*Mamestra contigua* Schiff.; 4—*M. aliena* Hbn.; 5—*Hadena bicruris* Hufn.; 6—*H. lepida* Esp.; 7—*Polia bombycina* Hufn.; 8—*P. nebulosa* Hufn.; 9—*Heliophobus reticulata* Goeze; 10—*Orthosia gothica* L.; 11—*O. populi* Ström.; 12—*Mythimna turca* L.; 13—*M. albipuncta* Schiff.; 14—*M. comma* L.; 15—*Tholera decimalis* Poda; 16—*T. cespitis* Schiff.


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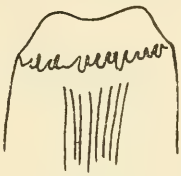
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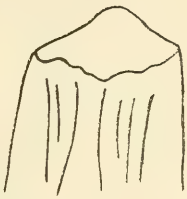
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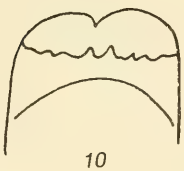
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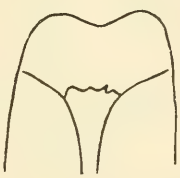
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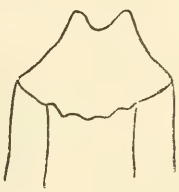
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Figure 80. Pattern on trunk in Cuculliinae:
1—*Cucullia fraudatrix* Ev.; 2—*C. absinthii* L.; 3—*C. gnaphalii* Hbn.;
4—*Calophasia lunula* Hufn. (segment 3); 5—*Cucullia lychnitis* Rbr.

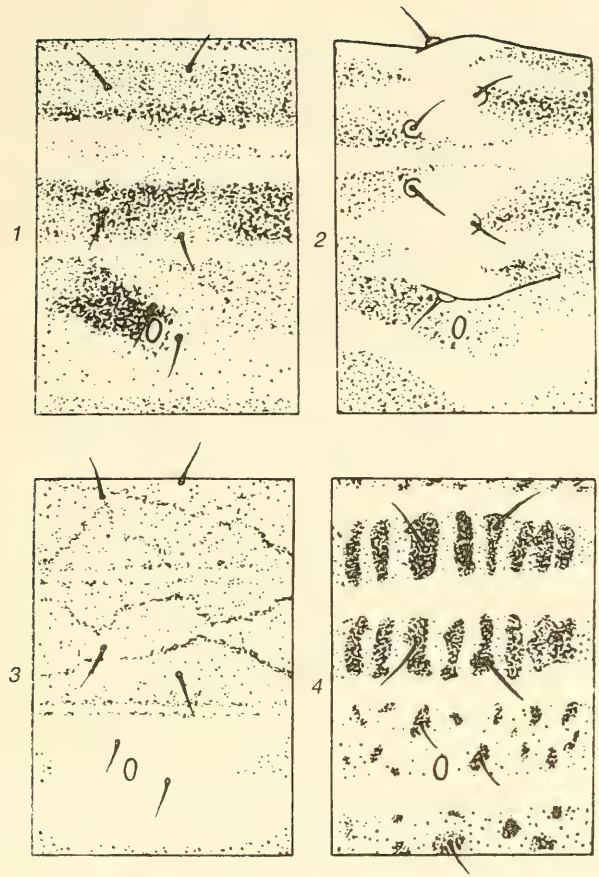
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Figure 80 continued.

6—*C. verbasci* L.; 7—*C. asteris* Schiff. (segments III, 1, 7); 8—*C. umbratica* L. (segments 8 to 10).

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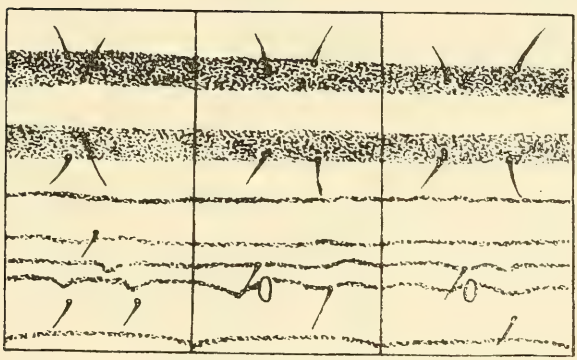

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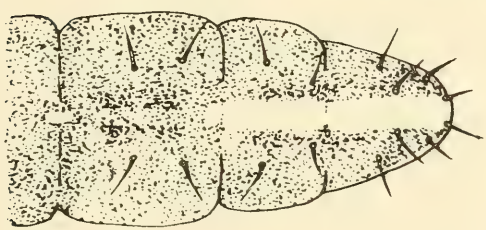

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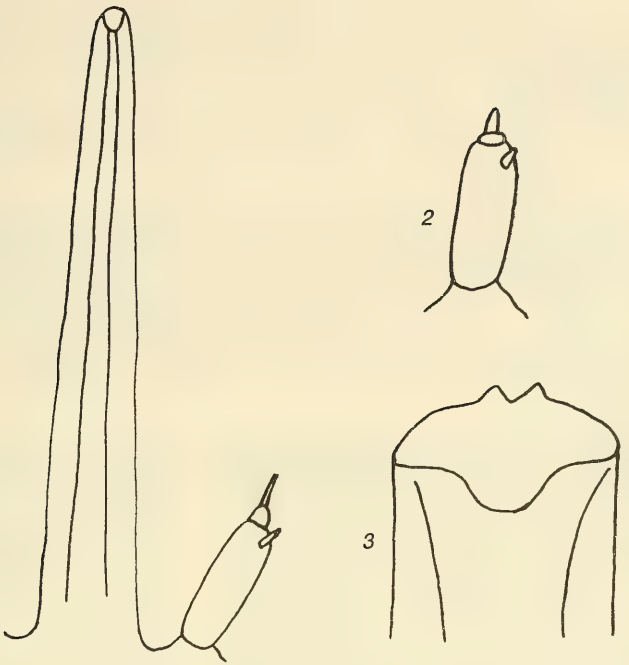
Figure 81. Spinneret and labial palpus in *Cucullia lychnitis* Rbr. (1); labial palpus in *Cucullia gnaphalii* Hbn. (2); opening of spinneret in *Calophasia lunula* Hufn. (3).

Figure 82. Spinneret and labial palpus in *Apamea monoglypha* Hufn. (1); *Euplexia lucipara* L. (2). Mandible of *Thalophila matura* Hufn. (3).



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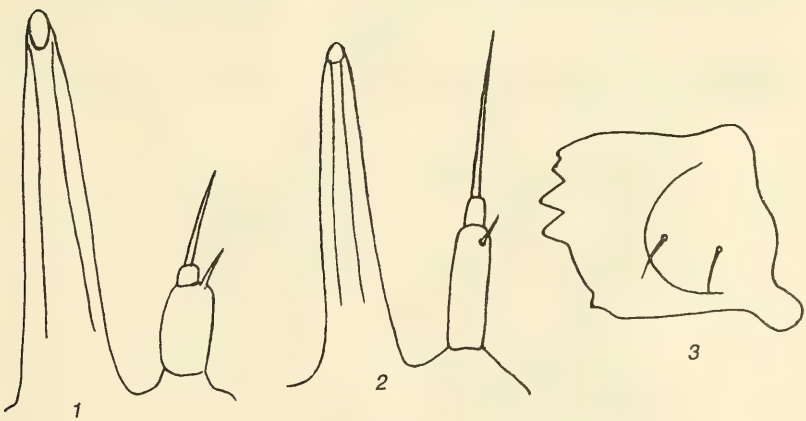

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Figure 83. Pattern on body in species of Zenobiinae:
1—*Thalpophila matura* Hufn.; 2—*Conistra rubiginea* Schiff.; 3—*Lithophane furcifera* Hufn. (segment 3); 4—*Trachea atriplicis* L. (segment 8); 5—*Hyppa rectilinea* Esp. (segments II and III); 6—*Apamea sordens* Hufn.; 7—*Rusina tenebrosa* Hbn.

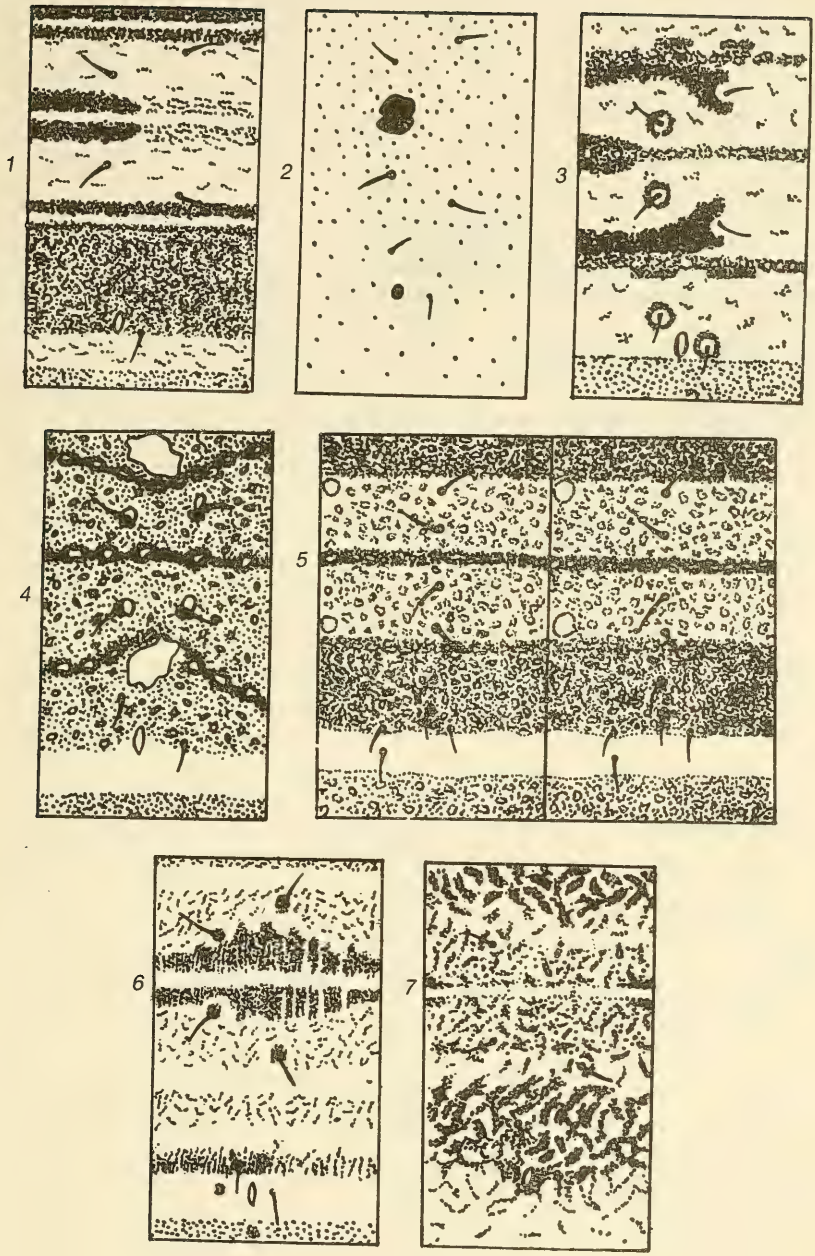

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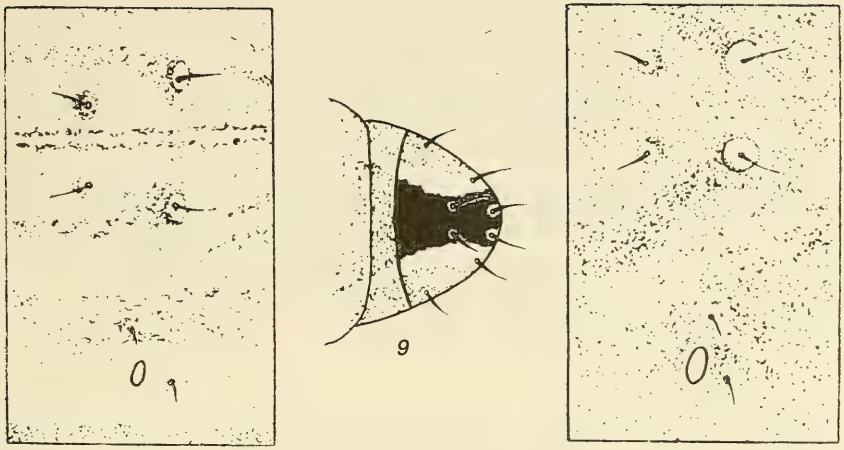
Figure 83 continued.

8—*Dypterygia scabriuscula* L. (segment 3); 9—*Conistra vaccinii* L. (segments 9 and 10); 10—*Euplexia lucipara* L. (segment 8).

Figure 84. Arrangement of dark-colored spot on thoracic shield between setae II and IX:

Caradrina selini Bsd. (1); *C. morpheus* Hufn. (2). Anal shield in *Luperina testacea* Schiff. (3).



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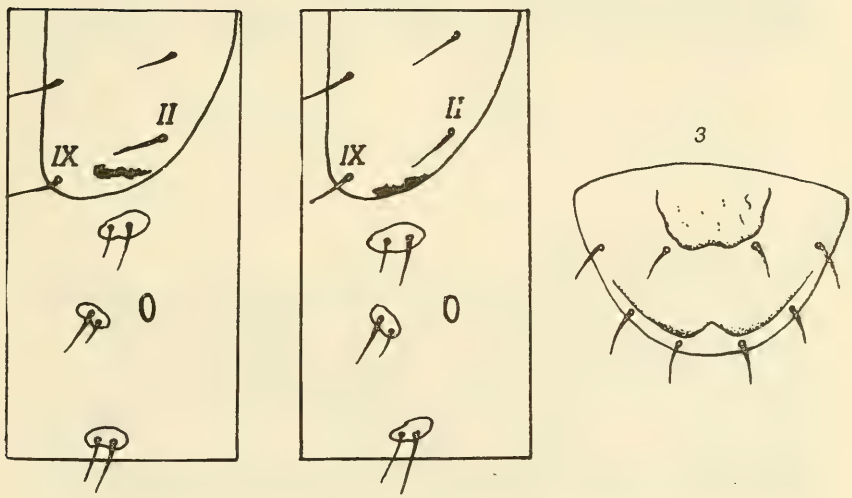

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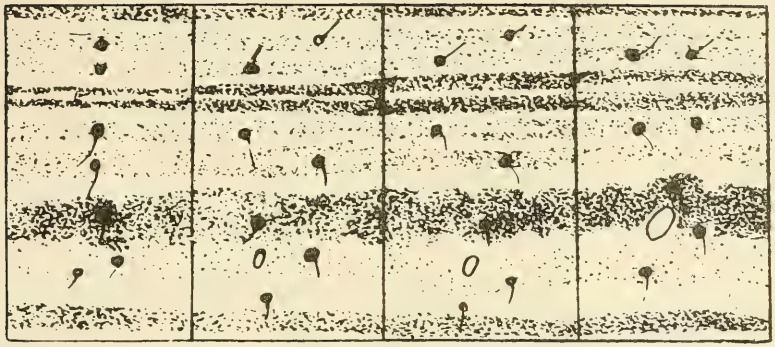
84

Figure 85. Pattern on trunk in species of Melicleptriinae: 1—*Chloridea viriplaca* Hufn.; 2—*C. scutosa* Schiff.; 3—*Pyrrhia umbra* Hufn. (segments III, 1, 7, 8).



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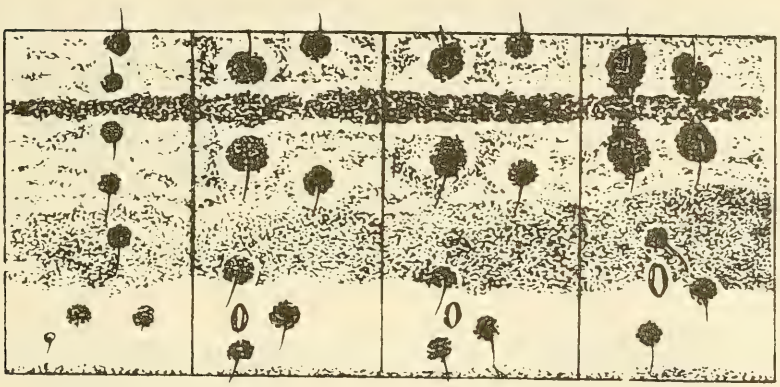

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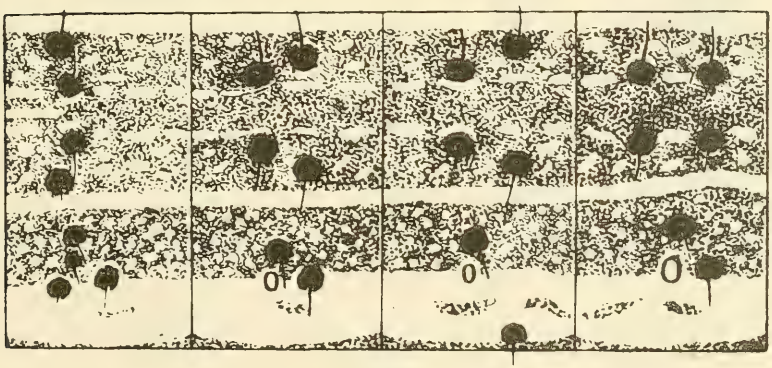

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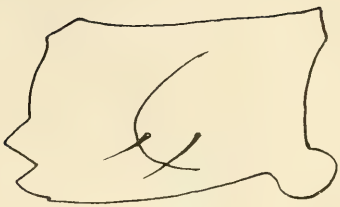
Figure 86. Mandible of *Chloridea scutosa* Schiff.

Figure 87. Pattern on thoracic shield:
1—*Chloridea scutosa* Schiff.; 2—*Pyrrhia umbra* Hufn.; 3—*Chloridea viriplaca* Hufn.

Figure 88. Anal shield in *Emmelia trabealis* Scop.

Figure 89. Pattern on head in *Emmelia trabealis* Scop.



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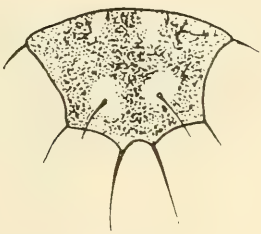

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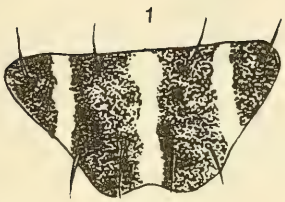

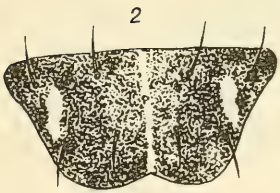

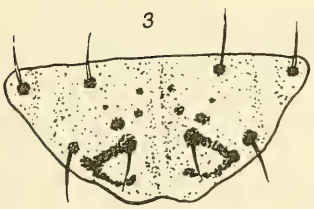

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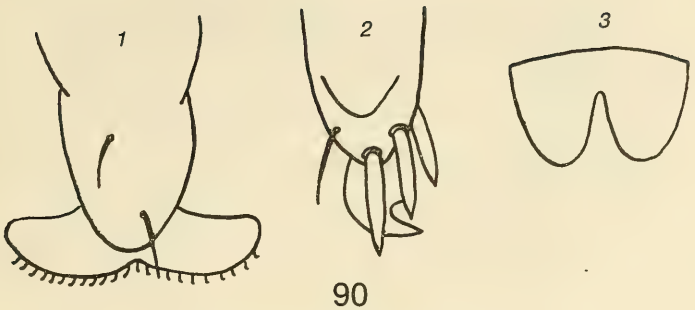
Figure 90. *Bena prasinana* L.:
1—planta of abdominal leg; 2—tarsus of thoracic leg; 3—labrum.

Figure 91. Pattern on body in *Bena prasinana* L. (segment 1).

Figure 92. Characteristics of fusion of black arcuate bands on head with line of epicranial suture in *Catocala*:
1—*Catocala fraxini* L.; 2—*C. nupta* L.



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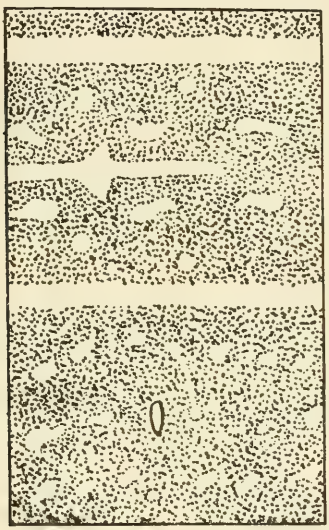

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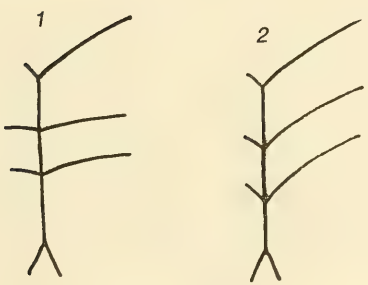

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Figure 93. Pattern on body in species of Plusiinae:
1—*Chrysaspidia festucae* L.; 2—*Plusia chrysitis* L.; 3—*Autographa gamma* L.; 4—*A. confusa* Steph.

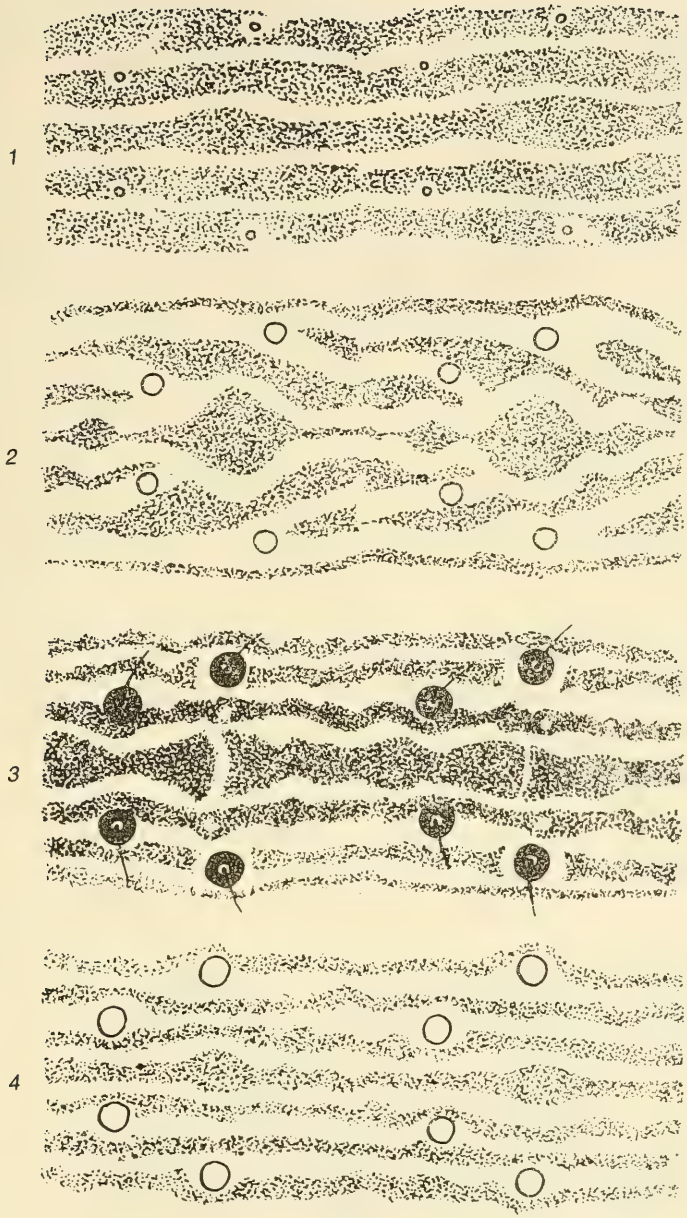
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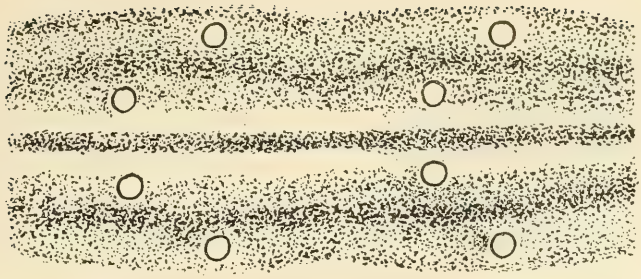
Figure 93 continued.

5—*Polychrysia moneta* F.; 6 and 7—*Abrostola triplasia* L.; 8—*A. trigemina* Wern. (segments 1 and 2).



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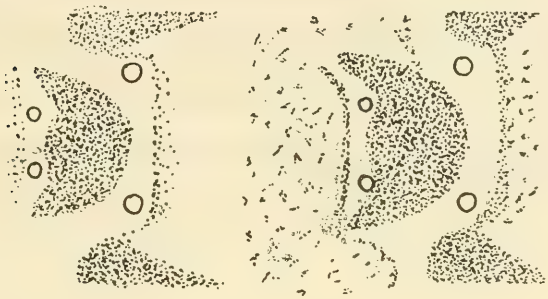

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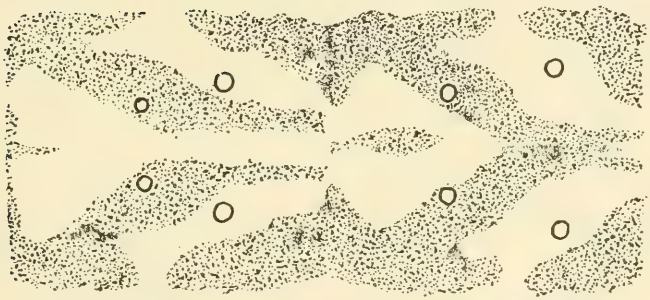

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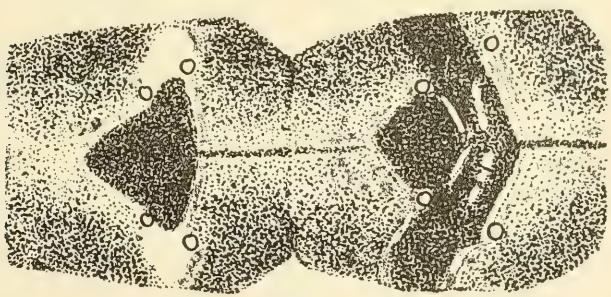

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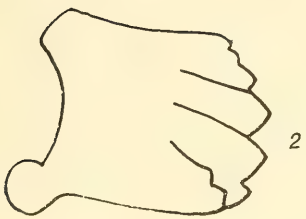
Figure 94. Mandible of *Chrysaspidia festucae* L.:
1—outer side; 2—inner side.

Figure 95. Pattern on segment 2 in *Lygephila viciae* Hbn.

Figure 96. Setae on thoracic leg in *Herminia barbalis* Cl.

Figure 97. Seta IVa (spuria poststigmalis) in *Scoliopteryx libatrix* L.



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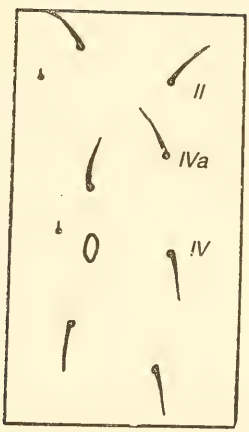

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