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The variability of the species of the Genus *Zygaena* F. *(Lepidoptera: Zygaenidae)* in Poland

[Pls. VIII—XI and 141 text-figures]

Zmienność gatunków rodzaju *Zygaena* F. *(Lepidoptera: Zygaenidae)* na terenie Polski

Изменчивость видов рода *Zygaena* F. *(Lepidoptera: Zygaenidae)* на территории Польши

CONTENTS

I. THE PROBLEM

The genus *Zygaena* F. is very richly represented in the European entomological literature. In the Polish literature there are only poor data concerning this genus and most of these are only faunistic notes contained in about 60 papers. Only a few papers deal in whole with the genus *Zygaena* F. (KLEMENSIEWICZ 1900, 1902; HOLIK 1939). Of these, the only paper comprising a detailed study of all the Polish species of *Zygaena* F., is that of HOLIK (loc. cit.).

The present paper is a study of the variation of the species of the genus *Zygaena* F. occurring in Poland. It also contains some data on the ecology of the group in question. A thorough study of a group of insects, continued for a long time, is necessary to observe such phenomena as real pattern of the variation of studied populations, migration, genetic contacts, ecological barriers, extinction or abundant appearance of individual species in some localities.

I do not split the genus *Zygaena* F. into smaller genera or subgenera, for in my opinion, the genus is a very compact and homogenous one in external characters and also in the genitalia. However, many authors treat this genus as a complex of several distinct subgenera or even genera (BURGEFF, FORSTER & WOHLFAHRT, HOLIK, REISS). Especially, the male genital armatures show that the genus in question is only one genus. Also the larvae of *Zygaena* F. species do not fall into distinct groups which might be treated as belonging to distinct genera.

Because of the very wide range of the variation observed in the *Zygaena* F. species, the identification of individual specimens is often not easy. Many workers described a large number of local forms or aberrations under the name „varietas", which should no longer be used. I use subsequently the followings infraspecific terms (after FORD, TREMEWAN etc.): Subspecies (ssp.) — specimens of populations that live in a continuous, limited area, and which are characterized by subspecific characters; forma alicuius loci (f. loc.) — a form appearing in a very small area; forma tempestatis (f. t.) — specimens of populations occurring on the wing at a different time from that of the typical form occurring in the same area (TREMEWAN, 1961, DĄBROWSKI, 1963). The

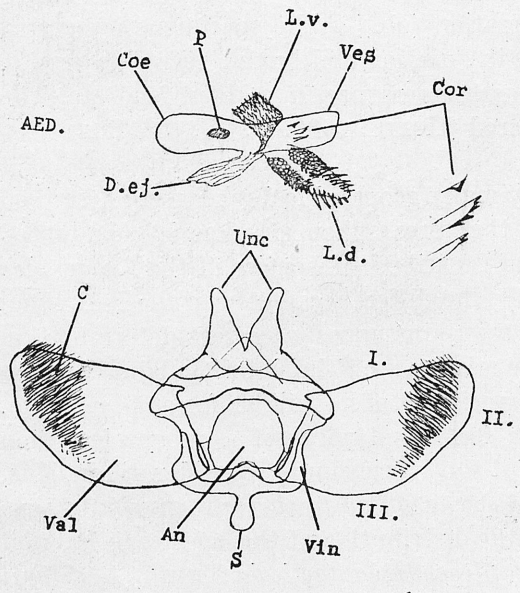
differences in the time of appearance and the ecological barriers are due to the genetic isolation of such a form; aberration (ab.) — the specimens appearing in the whole of the range of the species in question and having recessive genetic features due to external factors, such as temperature, humidity, food etc. The teratological forms are also here considered (HOLIK, 1939, pl. IV, 108, SCHWARZ, 1942) and also pathological forms.

In the thirties of the present century many geographical races were described under the term „varietas". Recently the term subspecies has been adopted for these races. However, the number of described subspecies of the *Zygaenidae* is still increasing and, on the other hand, the differences between the individual subspecies are often so minute that, in many instances, a correct determination of the specimens is impossible in the absence of the locality labels. These difficulties appear even when the type specimens are available for a comparison. Moreover, the specimens bearing some features typical of a subspecies often within the ranges of several subspecies of the species under consideration. Thus, the individuals with features typical of *Zygaena loti austrosilesia* PRZEG. & PRACK. occur singly in the whole of the area of the distribution of this species in Poland. Then, specimens with characters of *Z. filipendulae anglicola* TRMN., *Z. trifolii pajini* TRMN., *Z. lonicerae transferens* VRTY., *Z. lonicerae leonensis* TRMN. or *Z. lonicerae jocelynae* TRMN. appear often in Poland (being not described from Poland). Because of these facts, the present author lists only the most outstanding subspecies appearing in Poland.

The aberrations are considered here only for the practical purposes. So far as enormous number of aberrations of the *Zygaenidae* have been described. Many of these were described on base of such slight differences that the practical purpose of them is neglible. Therefore the present paper includes descriptions of only a few very outstanding aberrations and the proposed names are similiar to those used for similiar aberrations occurring in other species, e.g. *Z. viciae* (DEN. & SCHIFF.), ab. *pygmaea* **ab. n.** and *Z. trifolii* (ESP.), ab. *pygmaea* COCKAYNE. In other instances the name indicates the change of the pattern, e.g. *Z. purpuralis* (BRÜNN.), ab. *reducens* **ab. n.** The undescribed aberrations which are characterised by a combination of the characters of two or more known aberrations (e.g. *Z. carniolica berolinensis* LEDERER, ab. *cingulata* DZIURZ. + ab. *weileri* STGR., or *Z. filipendulae* (L.) ab. *conjuncta* TUTT + ab. *miniata* TUTT) have not been described in order to avoid introduction of new names.

Material examined

The following material of the genus *Zygaena* F. was examined: the collections of the Institute of Zoology of the Polish Academy of Sciences in Warszawa, the Institute of Systematic Zoology of the Polish Academy of Sciences in Kraków, the Museum of Upper Silesia in Bytom, the Museum of the National Park in Pieniny, private collections of S. BATKOWSKI, W. DOBRAŃSKI,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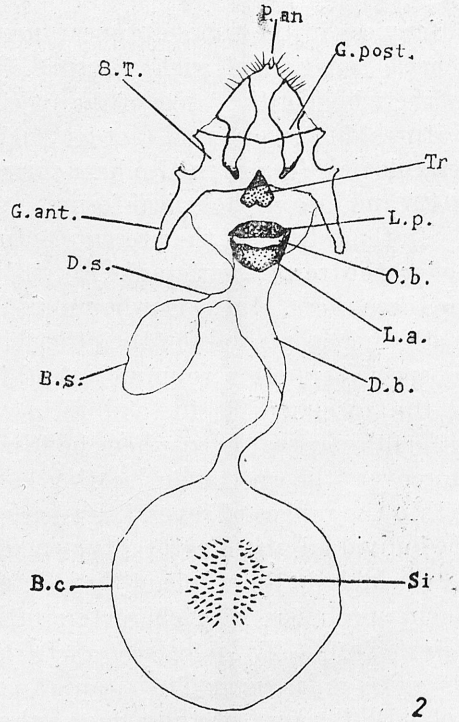
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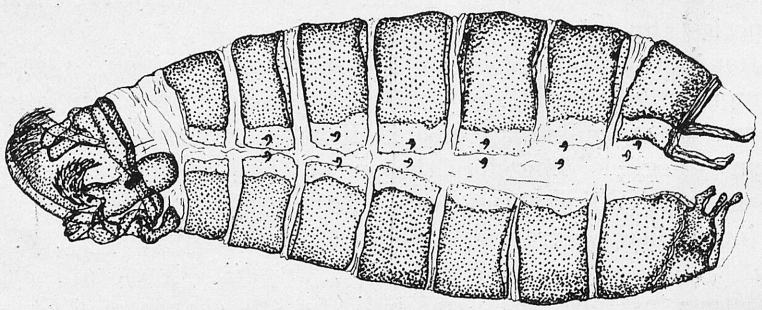

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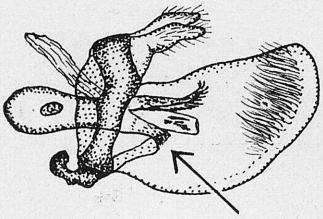

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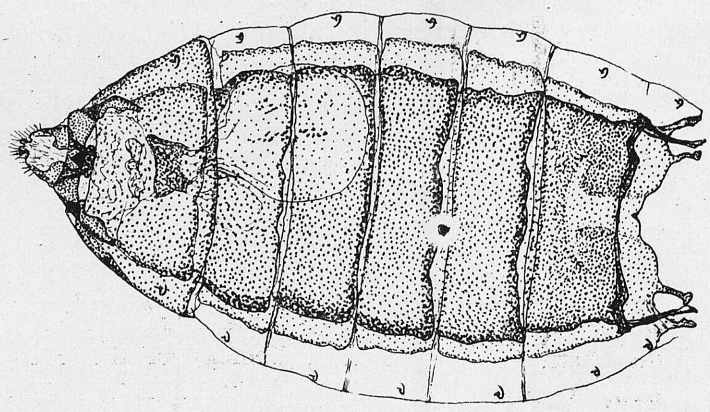

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E. Palik, E. Pruszyński, the late P. Raebel, mgr K. Siuda, mgr A. Skalski, S. Skrabania, Dr. R. Szpor, the late Dr. S. Toll, Ing. W. Węglarski, Prof. Dr. R. J. Wojtusiak, as well as my private collection containing about 4100 specimens of *Zygaena* F. It is a pleasure to express my thanks to everybody who has helped me during the preparation of this paper.

In spite of the rather extensive material which has been studied, *Zygaena* F. species are not well known from many regions of Poland. This is partly due to serious damages to many collections during the last war. Thus, much of the material is incomplete and, in some instances, impossible to reconstruct, as many areas have been changed by agriculture, industry, and sometimes by natural processes.

The material studied comprises over 9000 specimens. The specimens with incorrect data have not been considered in the preparation of this paper. It is of much importance to note, that in many instances, the private collections do not show real range of the variation of the individual species. The amateurs usually collect only specimens in good condition, then, decidedly aberrant specimens, or, sometimes, species with they like. As very good example, one can cite *Zygaena carniolica* (Scop.). Most specimens of this species in the private collections are pretty females and specimens with a red belt on the abdomens, while the males and specimens of a form similiar to the less pretty ssp. *berolinensis* Lederer are decidedly fewer in number. In fact, specimens similiar to this subspecies represent the most common form in populations occuring in South Poland. However, judging by the collections, it would be impossible to detect this phenomenon.

It is also noticeable, that the collectors often take specimens on one occasion only and a sufficient number has been taken for their collection further collection ceases. However, this does not show the real pattern of the respective population, for some forms do not appear every year, or appear only at the beginning or at the end of the broad. Thus, it is necessary to visit a locality for a long time and collect long series of males and females for comparative study. However, sometimes it is easy to destroy completely a population in a small locality, so one should be very careful in collecting scarce species.

Figs. 1—5. 1 — male genital armature of a member of the genus *Zygaena* F. aed. — aedoeagus, cor. — cornuti, ves. — vesica, l. d. — lamina dorsalis, l. v. — lamina ventralis, d. ej. — ductus ejaculatorius, p. — „plate", coe. — coecum, unc. — uncus, c. — corona, val. — valva, vin. — vinculum, an. — anellus, s. — saccus, I — costal margin, II — caudal margin, III — ventral margin. 2 — female genital armature of a member of the genus *Zygaena* F. B. c. — bursa copulatrix, si. — signum, d. b. — ductus bursae, d. s. — ductus seminalis, b. s. — bulla seminalis, l. a. — lamella antevaginalis, o. b. — ostium bursae, l. p. — lamella postvaginalis, p. — „plate", 8. T. — eighth tergite, ant. a. — anterior apophyses, p. a. — posterior apophyses, p. an. — papillae anales. 3 — an abdomen of a *Zygaena* F. from lateral side. 4 — male genital armature of a member of the genus *Zygaena* F. from lateral side. One valva removed. 5 — an abdomen of a female of *Z. ephialtes* (L.), ventral view.

Method

The genital slides are prepared in Damara or Canada balsam. The lightly sclerotized parts of the genital armatures are coloured in chrysoidine or eozine. Because of the very strong sclerotization of the tergites and sternites of the abdomen in the representatives of the genus *Zygaena* F., the genital armatures are removed from the abdomen. The genital armatures are prepared in a ventral position which shows best the most important taxonomic characters. In the male genital armatures the aedoeagus is always removed (fig. 3). The aedoeagus is shown in lateral position and the lamina dorsalis and lamina ventralis are slightly deflected in order to show their shape. The cornuti are always shown in larger magnification. Every female genitalia figure has an additional figure of a part of the signum in high maginification to show the structure and situation of the spines of the signum. The figures 6—117 are made in the same magnification for a comparison of the differences in the size and proportions of the genital armatures whithin individual species. The figures 125—136 and 139—154, as well as those in colour plates are made in the same magnification.

The terminology of the male and female genital armatures follows that of ALBERTI (1959). The uncus sensu ALBERTI is, in the *Zygaenidae*, homologous to socii occourring in some *Lepidoptera*, according to the opinion of the present author. However, most authors use the terminology of ALBERTI. The parts of the genital armatures are considered here in the following sequence:

male (fig. 1) — valva, corona, uncus, tegumen, saccus, anellus, aedoeagus, „plate" (a bulb full of very thiny, hair-shaped spikes), cornuti, lamina ventralis and lamina dorsalis;

female (fig. 2) — signum of bursa copulatrix, ductus bursae, ostium bursae, lamella antevaginalis (surrounding ostium bursae), lamella postvaginalis, „plate", 8th tergite, posterior apophyses, anterior apophyses, papillae anales.

The present work is not a complete monograph of the Polish *Zygaena* species, and a further detailed field study would certainly bring new data as the fauna of the *Zygaena* species of some regions of Poland is still poorly known. Moreover, several existing collections have not been studied because of various difficulties.

II. SYSTEMATIC PART

1. *Zygaena carniolica* (SCOPOLI, 1763)

Male genital armature (figs. 6, 7): Valva elongate, rather ractangular, being more rounded in other species of the genus in question; costal and auter edges straight, ventral edge convex. Corona strongly developed. The arms of the uncus slender, strongly tapering apicad, broadly opened. Saccus in some instances narrowed at base. Anellus rectangular, rather lightly sclerotized through-

out. Aedoeagus slender, as long as valva. „Plate" well developed, full of numerous, tiny, dark spines; situated in the central part of the coecum, however, its position is very often changed after preparation, it may even be removed out from the aedoeagus, through the short, broad vesica. Cornuti in form of a pair of lightly sclerotized lamellas sovered with numerous, small spines.

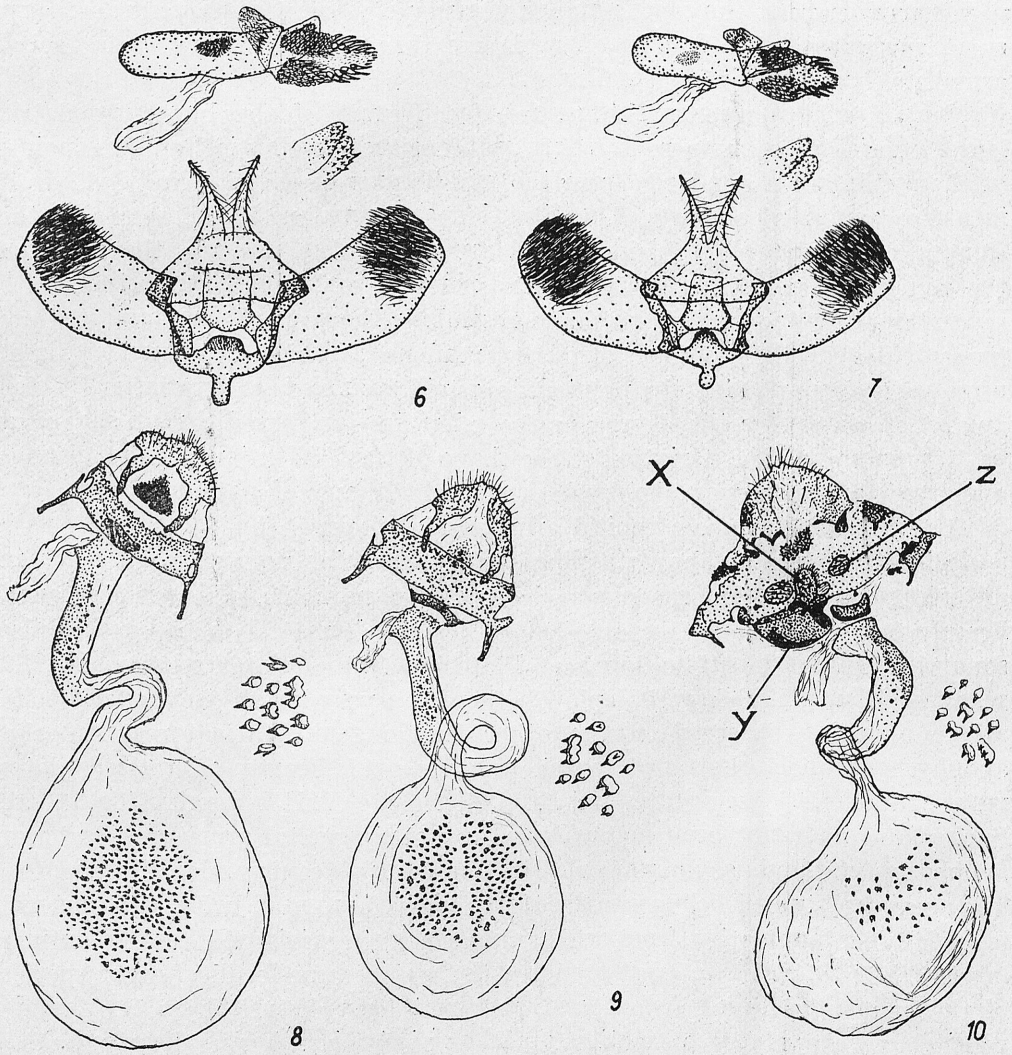
In general, the male genital armatures of *Z. carniolica* (SCOP.) are constant, showing only little variation. The only differences found were slight and were in individual dissected specimens, in the armature of the „plate", the degree of the narrowing of the saccus and in the shape of the lamina ventralis. Very small specimens (with forewing length less than 9,5 mm.) have their genital armatures proportionately smaller.

Female genital armature (figs. 8—10): Signum of the bursa copulatrix large, consisting of numerous, short spines situated elliptically. The points of these spines are outwards from the middle axis of the signum, dividing it into two symmetrical parts. The situation and number of the spines of the signum varies somewhat in individual specimens. The size and the shape of the spines are constant. Ductus bursae narrow, partly well sclerotized, with several small spines which in shape resembles those of the signum. Ostium bursae cup-shaped, sometimes strongly broadehed. „Plate" heavily sclerotized, usually triangular, with tip pointed to papillae anales; the variation of the „plate" is shown by the degree of the sclerotization, the different shape, or partial reduction. The variation of the shape of the VIIIth tergite, the anterior apophyses and posterior apophyses is very little and of no significance.

A teratological, female genital armature is shown in fig. 10. Signum with a decidedly lesser number of spines with their tips pointed chaotically in different directions. Ductus bursae bent, rather normal. An additional large, heavily sclerotized body (fig. 10-y) at the ostium bursae. This body resembles somewhat enlarged ostium bursae. „Plate" in form of an irregular, heavily sclerotized lamella. Below the „plate", there is a very heavily sclerotized body unlike anything observed in the other female genital armatures. Anterior apophyses strongly shortened, pointed. Three oval, heavily sclerotized plates with characteristic sculpture are situated in the VIIIth tergite (fig. 10-z). Such plates have not been met with in any other genital armature. Posterior apophyses vestigial, asymmetrical, terminated by heavily sclerotized plates. The specimen studied belongs to ssp. *berolinensis* LEDERER. being quite normal in facies. The population from which this specimen originated became extinct in 1959. It is of much interest to note that in the same locality, other species of the genus *Zygaena* F. occur and have not been disturbed by the factors which have caused the extinction of *Z. carniolica berolinensis* LEDERER.

The species under consideration shows a wide range of variation in various regions of Poland. In facies it varies not only in the pattern and the colour of the wings, but also in the colour of the fringe, the belt of the abdomen, the size etc. This considerable variation resulted in the descriptions of several subspecies, some of which were described from regions close to Poland. These

are *Z. carniolica berolinensis* LEDERER, *Z. carniolica viridis* PRZEG., *Z. carniolica modesta* BGFF. and *Z. carniolica onobrychis* (DEN. & SCHIFF.). *Z. carniolica berolinensis* LEDERER is characterized as follows: Specimens large with forewing length 14—16 mm., of thickest shapes. The borders of the spots are almost completely reduced, the spots are carmine. The abdominal belt is absent. Patagia and tegulae are black, rarely dusted with white scales. The ground colour of the forewing and of the body is black with a blue-green sheen. Des-



Figs. 6—10. Genital armatures. 6 — *Zygaena carniolica* (SCOP.), male, Krzyżanowice, 8. VIII. 1954, Genital Slide No. 142. 7 — *Z. carniolica* (SCOP.), male, Bolechowice, 31. VII. 1950 Genital Slide No. 235. 8 — *Z. carniolica* (SCOP.), female, Ojców National Park, Sąspowska Valley, 15. VIII. 1959. Genital Slide No. 70. 9 — *Z. carniolica* (SCOP.), female, Glanów, 20. VII. 1950. Genital Slide No. 132. 10 — *Z. carniolica* (SCOP.), female, Ojców National Park, Grodzisko, 27. VIII. 1957. Genital Slide No. 250.

cribed from northern Germany (neighbourhood of Berlin). The specimens of *Z. carniolica viridis* PRZEG. have the forewing 13—15 mm. long. It is very near to the preceding subspecies and was described from the Ukraine. *Z. carniolica modesta* BGFF. Length of forewing 12—14 mm. Borders of the forewing spots narrow, spots dark, carmine. Belt of the abdomen slightly traceable, or completely absent. Patagiae and tegulae slightly dusted with white scales. Ground colour of body and forewing black, with a blue or olive-green sheen. Occurs in central and south-western Germany, and in some regions of west Czechoslovakia. *Z. carniolica onobrychis* (DEN. & SCHIFF.). Small specimens with forewing 11—13 mm. long. Borders of the forewing spots board, often displacing the ground colour of the wing. Spots light cinnaber-red. Belt of the abdomen distinct, covering two or three segments. Patagia and tegulae, as well as thorax, strongly dusted with white and white-yellow scales. From south-eastern Europe. A comparison of the specimens coming from Bulgaria, Hungary, Podolia and Czechoslovakia shows a distinct influence of the climate (especially of the thermal factor) on the development of the subspecific characters in the species in question. This species appears to be the most receptive amongst the members of the genus *Zygaena* F. to climatic stimuli and other factors.

Judging from the study of the extensive material from Poland, the dominant form in *Zygaena carniolica* (SCOP.) appearing in the localities, placed along the northern border of the range of this species, is *Z. carniolica berolinensis* LEDERER (55—70 % of the specimens). The highest percentage of this form was observed in Upper Silesia. In the same localities where *Z. carniolica berolinensis* LEDERER appears, also occur specimens similar to the nominate form and showing some similarity to *Z. carniolica modesta* BGFF. Such specimens are rather abundant and occur as 25—45 % of the total population, and the highest percentage was observed in the localities in Małopolska (Kraków and Rzeszów regions). The northern border of the range of *Z. carniolica onobrychis* (DEN. & SCHIFF.) runs through northern Moravia (GREGOR & POVOLNÝ, 1946). So far *Z. carniolica onobrychis* (DEN. & SCHIFF.) has not been observed in Poland, but some intermediate specimens called „trans. ad ab. *onobrychis* (DEN. & SCHIFF.)" were found. Such specimens are usually larger than the typical *Z. carniolica onobrychis* (DEN. & SCHIFF.) (with forewing 12—14 mm. long), and the abdominal belt is often ill-defined or reduced, while the white-yellow borders of the forewing spots are broad and well developed and the white suffusion of the patagia and of a part of the thorax is strongly marked. These specimens appear sporadically as single specimens, usually in the well insolated localities. It is of much importance to note, that in many collections formed by amateurs, such specimens are well represented due to their pretty facies.

The variation of the habitus. Antennae club-shaped with apices strongly broadened; totally black. Head black. Patagia and tegulae in the specimens of *Z. carniolica berolinensis* LEDERER are always black, however, in many instances they are sprinkled by single white scales. In the specimens close to the typical form or to *Z. carniolica modesta* BGFF. the patagia and tegulae

are bordered by white and white-yellow scales. On the other hand, in the specimens trans. ad ssp. *onobrychis* (DEN. & SCHIFF.) the white-yellow scales of the patagia and tegulae are decidedly more numerous than the black scales; often the light scales appear also on the thorax. The red abdominal belt is one of the most variable components of the pattern. In the specimens of *Z. carniolica onobrychis* (DEN. & SCHIFF.) the abdominal belt is ill-defined or completely reduced, if present, then strongly suffused with black scales. Specimens with a distinct abdominal belt on one segment are named ab. *cingulata* DZIURZ. (± = ab. *vangeli* AIGN.). Such specimens appear in Poland often among specimens of *Z. carniolica berolinensis* LEDERER. The specimens with a double abdominal belt (on two segments) are found at Ligota Dolna near St. Anna Mt. (seven males and three females, leg. RAEBEL, SKRABANIA and BIELEWICZ) and at Grodzisko near Miechów (three females leg. author). I name this form *Z. carniolica* (SCOP.), ab. *bicingulata* **ab. n.** This character appears in the specimens of *Z. carniolica berolinensis* STGR. and in the specimens close to the typical form. The females show this character decidedly more often than males. The specimens with no abdominal belt and not belonging to *Z. carniolica berolinensis* LEDERER are named ab. *hedysaroides* TUR. (= ab. *azona* WAGNER). This form has been observed in Poland usually in the specimens showing characters transitional to *Z. carniolica onobrychis* (DEN. & SCHIFF.).

The forewing pattern forms six independent spots, of which the spot 6 is half-moon shaped and is situated along the costal margin between veins r_4—cu_2 (fig. 125-c). Only rarely is this spot shortened and situated between veins r_5—cu_1. Such specimens do not often occur in the region of Kraków (5—12% of the populations). A quite different reduction of spot 6 is its even narrowing or even absence. The narrowed spot is always of the same length as in the typical form. Such specimens are named ab. *dupuyi* OBERTHÜR (fig. 125-b). The specimens transitory to ab. *dupuyi* OBERTH. [BURGEFF described under the name ab. *dupuyi* BGFF. a specimen with the spot 6 completely missing; such a specimen has not as yet been found in Poland] appear only sporadically and are very scarce: Mników near Kraków two males, Glanów near Wolbrom one male, Klonów near Miechów two males [leg. author] Bętkowska Valley near Rudawa three males [leg. PRUSZYŃSKI]. Specimens with spot 4 divided into two parts, each of them bordered with white-yellow (8-like figure) are named ab. *octonotata* BGFF. One male Sterczów near Miechów, and one female with left forewing pattern asymmetrical [DĄBROWSKI, 1963, pl. 1 — fig. B 1, leg. author]. Also other spots in the forewing may be partly reduced, thus to ab. *dastrichi* HIRSCHKE belong specimens with spot 3 reduced to a white dot, or completely absent. Two males from Ojców National Park (leg. author); then ab. *privata* **ab. n.** is characterized by the spot 4 reduced to a white dot: one male in Glanów near Wolbrom (leg. author). Ab. *nigra* REISS is characterized by the forewing with all the spots completly missing. This form has not as yet been found in Poland. Another group of forms are those in which the forewing spots are enlarged and then confluent with each other. Specimens

with spot 5 connected with spot 6 by a narrow bridge are named ab. *blachieri* DZIURZ. (fig. 125-f). This form is rather common: five females from Bolechowice near Kraków (leg. author and PRUSZYŃSKI), six females from Mydlniki near Kraków (leg. author), two males and five females from the Ojców National Park (leg. author), six males and seven females from Klonów near Miechów (leg. author), two males and five females from Ligota Dolna in Silesia (leg. BIELEWICZ and SKRABANIA). To ab. *costalielongata* **ab. n.** (fig. 125-d) belong specimens with the spot 1 extended along the vein sc and linked with spot 3: one female in Ligota Dolna in Silesia (leg. SKRABANIA), one female in Grodzisko in the Ojców National Park (leg. author). The specimens with spots 3 and 5 confluent are named ab. *confluenta* KOCH: one male in Ligota Dolna in Silesia (leg. SKRABANIA). The specimens with spots 1, 2, 3, 4 and 5 confluent, but with the spot 6 separated belong to ab. *weileri* STGR.: one male in Krzyżanowice near Pińczów (leg. TOLL). One male transitional to ab. *weileri* STGR. found in the Ojców National Park (leg. author). Ab. *totirubra* SEITZ (fig. 125-i) is characterized by the forewing being red with the outer margin black. This form has not as yet been found in Poland. One male transitional to ab. *totirubra* SEITZ (fig. 125-h) was found in the Ojców National Park (leg. author).

Z. carniolica (SCOP.) is the only species of *Zygaena* F., found in Poland, having the white-yellow borders around the forewing spots. The variation of these borders was the basis of the descriptions of further aberrations. The width of these borders depends on the geographic location and on climatic factors. Thus, the borders become reduced in specimens occurring towards the north, and in specimens from localities on the northern border of the range of the species they are completely missing. On the other hand, in specimens from the southern part of the distribution, the borders become wider, and may be spread over the major part of the forewing. These borders have taxonomic significance. The most characteristic forms are *Z. carniolica berolinensis* LEDERER with the borders completely absent and in comparison *Z. carniolica onobrychis* (DEN. et SCHIFF.) with the borders very wide. The dependence of the development of the borders of the forewing spots on the thermal factor and geographic location (and even microclimate of the individual localities), was studied and proved by BURGEFF (1956). One of the most characteristic forms here is ab. *amoena* STGR. in which the white borders are spread over the major part of the forewing. In the typical specimens of this aberration the red of the hindwing is lighter than that in the forewing. So far only one female of this aberration (Ligota Dolna in Silesia, leg. SKRABANIA) has been found, moreover, several transitional specimens were found, e.g., two males and two females at Grodzisko in the Ojców National Park, and one male at Klonów near Miechów (leg. author). Some specimens with the white-yellow ground colour, as in ab. *amoena* STGR., show the characters of other aberrations, e.g. ab. *meteora* REISS which has features common to ab. *amoena* STGR. and ab. *weileri* STGR., or ab. *amoenaconfluens* HOLIK (GREGOR & POVOLNÝ, 1946, pl. 3).

The colour of the wings is also rather variable. The ground colour of the forewing in most specimens is dark with a strong blue-green sheen (about 40—70 % of specimens). Specimens with the forewing ground colour navy blue with a strong sheen are fewer in number (25—50 %). Such specimens are more abudant in Silesia than in other regions of Poland.

The most scarce specimens are those with the forewing ground colour deep olive-green with a sheen (5—20 %). Such coloration is found more common only in females than in males.

The fringe of the forewing in most specimens (60—70 %) is white or white-grey, and in a few examples black (especially in *Z. carniolica berolinensis* LEDERER). The fringe of the hindwing is always grey or white-grey, and only in specimens transitional, to *Z. carniolica onobrychis* (DEN. & SCHIFF.) is it white or yellowish-white.

The spots in the forewing and the ground colour of the hindwing in most specimens is carmine with an amaranth hue. In many specimens transitional to *Z. carniolica onobrychis* (DEN. & SCHIFF.) the colour of the spots is cinnabar or even orange (20—40 %). Ab. *dichroma* HIRSCHKE has the forewing spots carmine and the ground colour of the hindwings yellow. One female from Grodzisko, Ojców National Park (leg. author). A larger number (3—8 %) of the specimens are transitional to ab. *dichroma* HIRSCHKE. Ab. *tricolor* OBERTH. is characterized by features common to ab. *amoena* STGR. and ab. *dichroma* HIRSCHKE. One female from Grodzisko, Ojców National Park (leg. author). Ab. *flaveola* ESP. — specimens with the forewing spots and the ground colour of the hindwing yellow. This form has not as yet been found in Poland. Ab. *grossi* HIRSCHKE — specimens with the spots of the forewing and the ground colour of the hindwing coffee brown. One male was found at Bolechowice near Kraków (leg. author) and one female in the Kraków region (leg. DOBRAŃSKI).

There are considerable differences in the size of specimens of the species in question. The average length of the forewing (from apex to base) is 12,5 mm. in the males and 13,5 mm. in the females. The largest specimens have the forewing 14,5 mm. long in the males and 15,5 mm. long in the females. Some populations show a dominance of large or small specimens. For example, most specimens from Glanów near Wolbrom are large (14 mm. in the males and 14,5 mm. in the females), while in the region of Pińczów they are small (13,2 mm. in the males and 14 mm. in the females). This phenomenon probably depends on the feeding conditions and climate of the individual habitats. The dwarf specimens with the forewing shorter than 9,5 mm. appear sporadically in large populations.

The material examined contains one pathological specimen with decidedly shortened antennae (fig. 139).

Z. carniolica (SCOP.) is an apparently stenoxerothermophilous species occuring exclusively in limestone and chalk regions. It occurs in discontinuous localities in xerothermic meadows. The populations are large but are found very locally. Agriculture and industry has destroyed many localities of *Z. car-*

niolica (Scop.). However, it has been observed that the species is becoming extinct even localities practically nearly untouched by the activity of man. This phenomenon especially has been observed for the last 15 years in the region of Kraków (Dąbrowski, 1961). It has probably resulted from the genetic processes which cause lethal characteres (see teratological female genital armature and fig. 10). These processes may be accelerated by a long lasting strong isolation which accelerates the development of the lethal characters of the isolated populations. Judging by the field studies in the Ojców National Park, *Z. carniolica* (Scop.) is one of the most local species of the genus *Zygaena* F. Specimens of this species have not been observed out of their very restricted locality (Dąbrowski, 1959). This factor, as well as others such as an unsuitable microclimate, or parasites, may have caused the extinction of the populations of this species in several localities in the region of Kraków. Diametrically different phenomena were observed in Ligota Dolna near St. Anna Mt. (studies made by the late P. Raebel and then by M. Bielewicz and S. Skrabania who kindly provided me with the results presented here). The species had not been observed in this locality till 1944. The nearest localities are Kamień Śląski, about 8 km. north from Ligota Dolna. For the next five years no field studies were made at Ligota Dolna. However, in 1949 *Z. carniolica* (Scop.) was found there in abundance (6000—8000 specimens). In the years 1956—1959 the species has appeared in large numbers of more than 3000 specimens. Then, in 1960—1961, the number of specimens observed became fewer (about 2000). The variation of the specimens appearing at Ligota Dolna is rather considerable and characteristic. The problem of *Z. carniolica* (Scop.) in Ligota Dolna need further study. The number of specimens affected by the parasites is by far larger in localities where this species appears in masses (e.g. in Ligota Dolna, Klonów, Glanów) than in the localities in which the species is rather scarce, when the number of specimens affected is rather small (e.g. Koziarnia and Grodzisko) (see table VIII).

Specimens of *Z. carniolica* (Scop.) fly slowly and heavily. During strong insolation and temperature above 20°C the activity of the specimens increases. The flight of the specimens depends on the locality and is usually very limited. especially in localities with small populations or those which are surrounded by ecological barriers that are difficult to cross, e.g. thick wood or habitats with no limestone or chalk. The migration of *Z. carniolica* (Scop.) from Kamień Śląski to Ligota Dolna was probably caused by the tendency, known in several species occuring in ecotones. Such species occur in the biotopes strongly destroyed as the balks along the roads. The foodplant of *Z. carniolica* (Esp.) grows along the 8 km. road between both localities. This caused probably the migration of the species to be much easier. The species found the new locality to be very suitable, for it is now settled down there very well. At night the specimens rest together in large, characteristic groups on the herbs. The larvae feed in most instances on *Onobrychis viciaefolia* Scop. and *Coronilla varia* L.

Table I

The locality and the year of collecting	Pupae with parasites	Cocoons with dead imagines or larvae	Imagines emerged	Total
Ligota Dolna, 1961	16	10	29	55
Klonów — Wały, 1961	8	7	21	36
Grodzisko, 1956 (extinct since 1959)	1	5	12	18
Sąspowska Valley, 1956 (extinct since 1961)	—	7	18	25

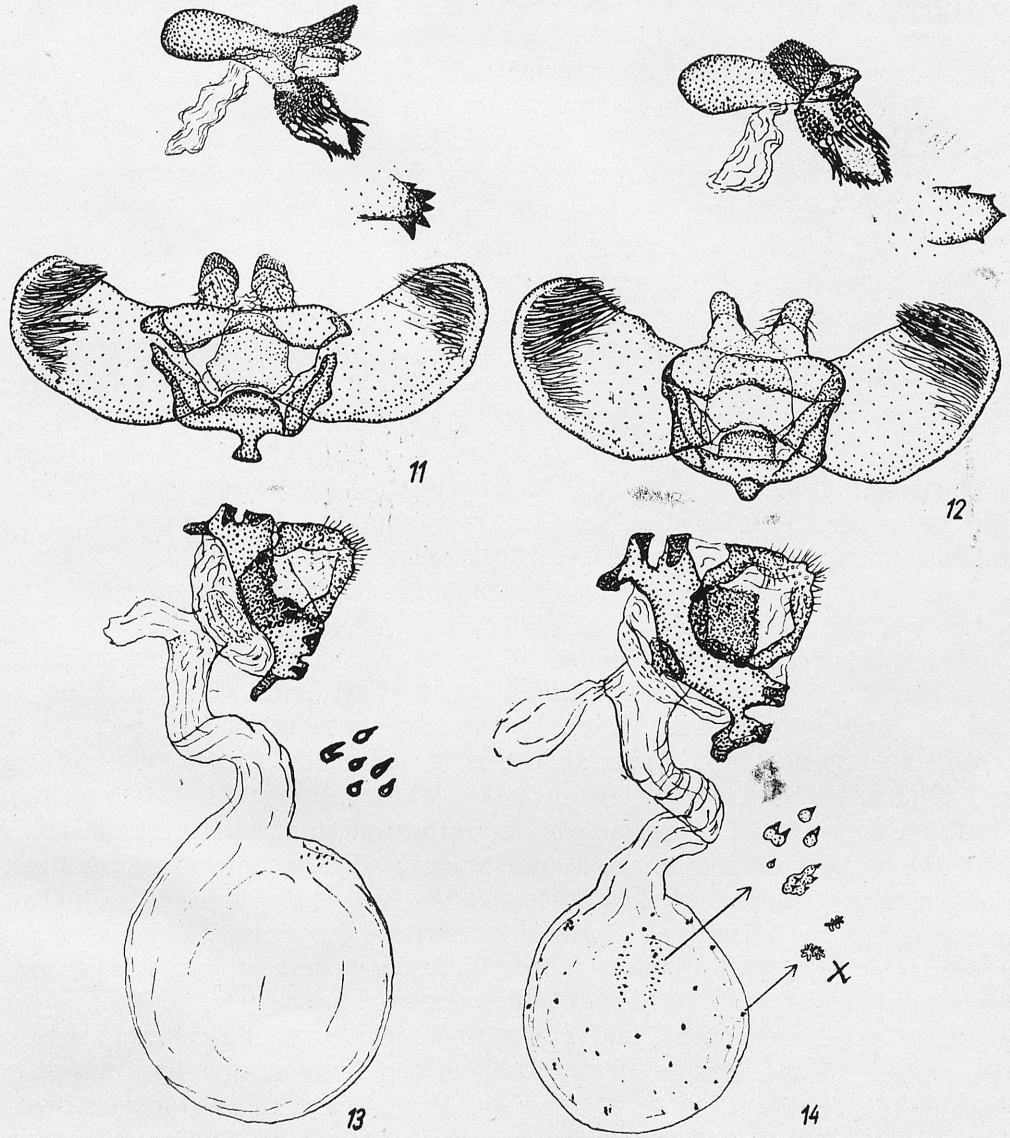
Z. carniolica (SCOP.) is a ponto-mediterranean element in the Polish fauna. It is distributed in central, south-eastern and partly eastern Europe. The northern edge of its range runs through Poland. Because of the fact that the species usually appears in masses, it is rather easy to find the edge of its range (fig. 137—139). However, many localities where the species occured are now destroyed, so the only evidence are specimens preserved in collections. The localities of *Z. carniolica* (SCOP.) are restricted to the submontaneous of southern Silesia and Małopolska. The species occurs in Poland from 190 to 470 m. above sea level, whilst in Bulgaria (BURESH & TULESCHKOW, 1943) it reaches 1400 m.

2. *Zygaena osterodensis* REISS, 1921

(=*Zygaena scabiosae* AUCT.)

Male genital armature (figs. 11, 12). Valva broad with caudal and ventral edges rounded. Corona rather well developed. Processes of uncus rather short, broad, rounded. Individual specimens show variation in the width of the processes of the uncus, the degree of the sclerotization of their edges and the distance between their apexes. Tegumen elongate, not domed. Saccus variable, developed as a slight (fig. 12) to strong projection (fig. 11), when strong, then distinctly narrowed near the base. Anellus broad, rather five-sided, with no special sculpture. Aedoeagus as long as, or slightly longer than valva. „Plate" absent. Cornuti developed as a plate terminated by four or five heavily sclerotized spines. These spines are variable in shape: from rather long, heavily sclerotized, to slightly demarcated and lightly sclerotized. Lamina ventralis as long as one-third of the aedoeagus, evenly covered with minute spines. Lamina dorsalis as long as half of the aedoeagus. In general, the male genital armatures show the tendency of distinct variation, especially in the cornuti, saccus and uncus. The differences in these structures are not in parallel but occurr independently in individual specimens.

Female genital armature (figs. 13, 14). Signum slightly developed, as two rows of tiny spines, with rounded bases and tapering to sharp points. They appear singly, or in some instances, are grouped in clusters of two to five spines connected at their bases. Very seldom is the bursa copulatrix totally scobinate. The scobinations appear in concentrations and appear not to be homologous with the signum (fig. 14-x). Scobinations were also found in the female genital



Figs. 11—14. Genital armatures. 11 — *Zygaena osterodensis* Reiss, male, Grudziądz, Jamy, 7. VII. 1914, Genital Slide No. 133. 12 — *Z. osterodensis* Reiss, male, Bydgoszcz, Stronno, 19. VII. 1960. Genital Slide No. 143. 13 — *Z. osterodensis* Reiss, female, Bydgoszcz, Rynkowo, 5. VIII. 1956. Genital Slide No. 286. 14 — *Z. osterodensis* Reiss, female, Bydgoszcz, Stronno, Genital Slide No. 224.

armature of *Z. ephialtes* (L.). Ductus bursae broad, lightly sclerotized throughout. Ostium bursae very lightly sclerotized. „Plate" oval, heavily sclerotized, broader than ductus bursae, in some instances pointed proximally. Eight tergite evenly sclerotized. Anterior apophyses short and broad with apices rounded, in some instances rather narrowed. Posterior apophyses usually longer than anterior ones. The most variable structures in the female genital armatures are the anterior apophyses, „plate", and the signum, the spines of which are often reduced.

Antennae spindle-shaped, broadened, with apices distinctly pointed; totally black. Patagia, tegulae and abdomen always totally black.

No specimen with a red abdominal belt has as yet been found in Poland. The pattern in the forewing consists of five spots, which in the typical form (fig. 126-d) are confluent: 1+2+4 and 3+5. Both streaks have characteristic constrictions at half their length. Such a pattern may occur in about 50—75% of specimens in individual populations observed in Poland. The specimens with the streaks partly reduced are also common (ab. *divisa* STGR., fig. 126-c); specimens of ab. *interrupta* REISS (fig. 126-b) appear in 20—40% in most studied populations of the species. More rarely is the ab. *mediointerrupta* VRTY. (fig. 126-a) with all five spots separated from each other, and often reduced (about 2—25%). Specimens transitional to ab. *confluens* SPULER (fig. 126-e) with spots confluent in broad and enlarged streaks appear sporadically and are very scarce. Two females (leg. TOLL) were found at Jamy near Grudziądz, and one male and one female (leg. RODOWICZ) in the region of Bydgoszcz. Typical specimens of ab. *confluens* SPULER (with all five spots confluent) have not as yet been found in Poland.

The black border of the hindwing may be reduced, but the variation in this character is very slight. Forewing ground colour black with a faint navy-blue hue and without sheen. The forewing is slightly transparent and in this respect the species differs from all others in the genus. Fringes of the fore- and hind wing black.

The colour of the forewing spots is rather constant, and the specimens with the spots carmine with amaranth hue are slightly more numerous than those with spots cinnaber which appears more frequently in the females than in the males. Specimens of ab. *flavaola* ZICKERT are very scarce. This aberration is characterized by the orange-yellow hindwing ground colour and orange forewing spots. Typical specimens of this aberration have not as yet been found in Poland, while transitional individuals are known from the Grudziądz region, two males and two females (leg. TOLL) and the Bydgoszcz region, one male and one female (leg. RODOWICZ). Ab. *flava* PIESZCZEK with the forewing spots and ground colour of the hindwing ochreous-yellow and ab. *citrina* SPULER with the forewing spots and ground colour of the hind-wing yellow have not as yet been found in Poland. Also the forms with brown coloration are unknown from Poland (in the collection of JAROSIEWICZ there are two specimens of this species with the forewing spots and ground colour of the hindwing brown,

however, these specimens have no locality labells; they probably come from the Lvov region).

The material examined does not show distinct variation in the size of the moths. The forewing length is 14—15 mm. in the males and 14·5—15·5 mm. in the females.

Z. osterodensis REISS is confined to woodlands. It appears in dry and not very damp glades, in thin woods and clearings. The species appears rather singly and abundant populations are very scarce.

The larvae feed on *Lathyrus vernus* BKH. and probably on some species of the genus *Vicia* L.

The specimens fly not so heavily as other species of the genus *Zygaena* F. They are most active on sunny days with the temperature above 18° C, in early the afternoon. In spite of a rather rapid flight, the specimens disperse from their restricted habitat only as far as 400 m. The thin wood is not such an effective ecological barrier to *Z. osterodensis* REISS as to other species of the genus *Zygaena* F. The specimens rest singly during the night in the grass and on herbs.

The species is an euro-siberian element in the Polish fauna (HOLIK, 1939). It is distributed in western, central and eastern Europe, western and central Asia. In Poland it occurs very locally. Most of the localities are in Pomerania. In so called Great Poland the species is more scarce and local, but occurs in the regions of Warszawa, Sandomierz and in the Białowieża Virgin Forest. In Silesia it is known only from Dzierżoniów (two males, leg. SZPOR) as ab. *interrupta* REISS. In Małopolska was found one typical male at Kasinka near Myślenice (leg. WĘGLARSKI), then several males in Bogucice distr. Pińczów in a steppe locality [1].

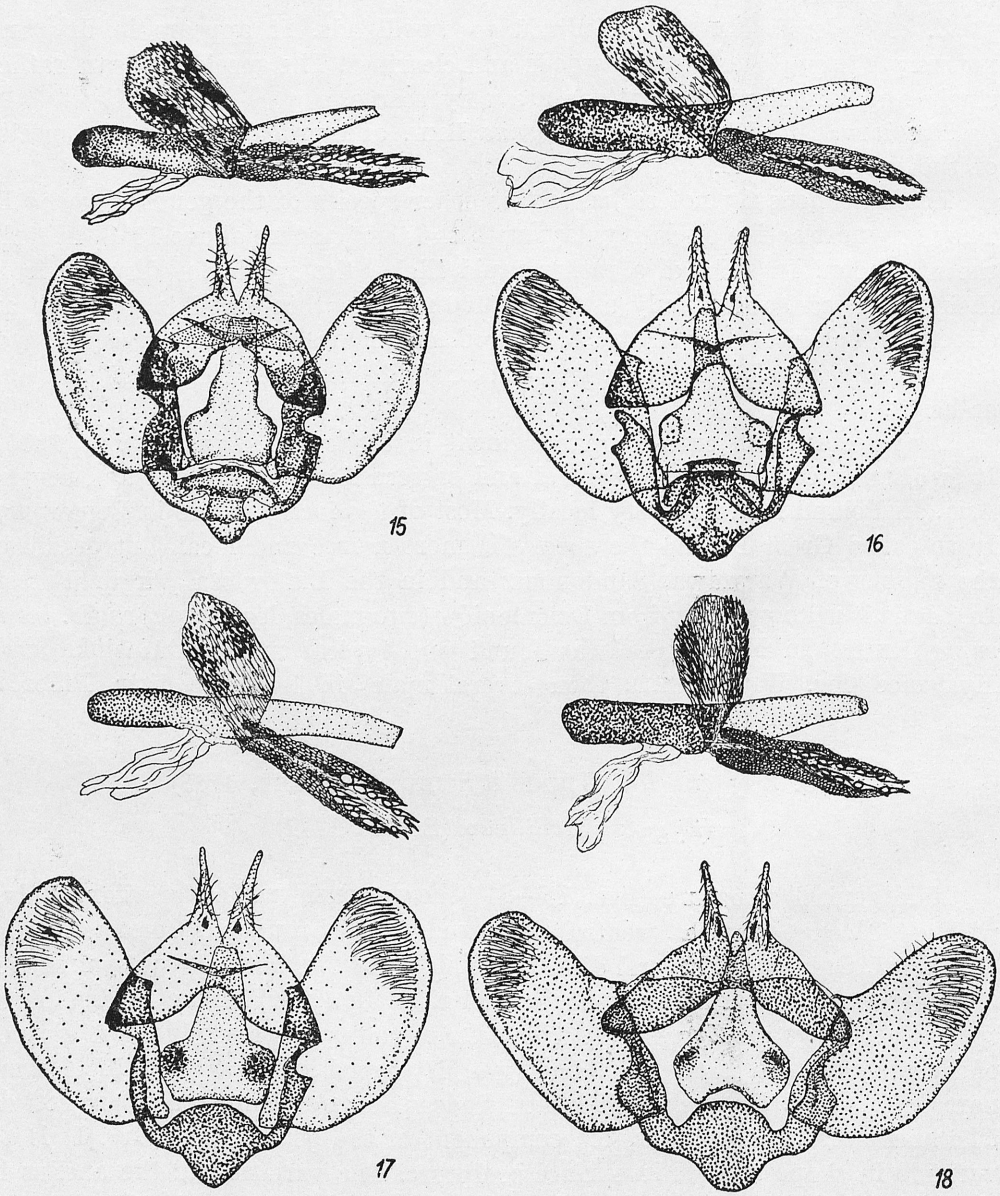
3. *Zygaena loti* (DENIS & SCHIFFERMÜLLER, 1775)

(*Zygaena achilleae* (ESPER, 1779)

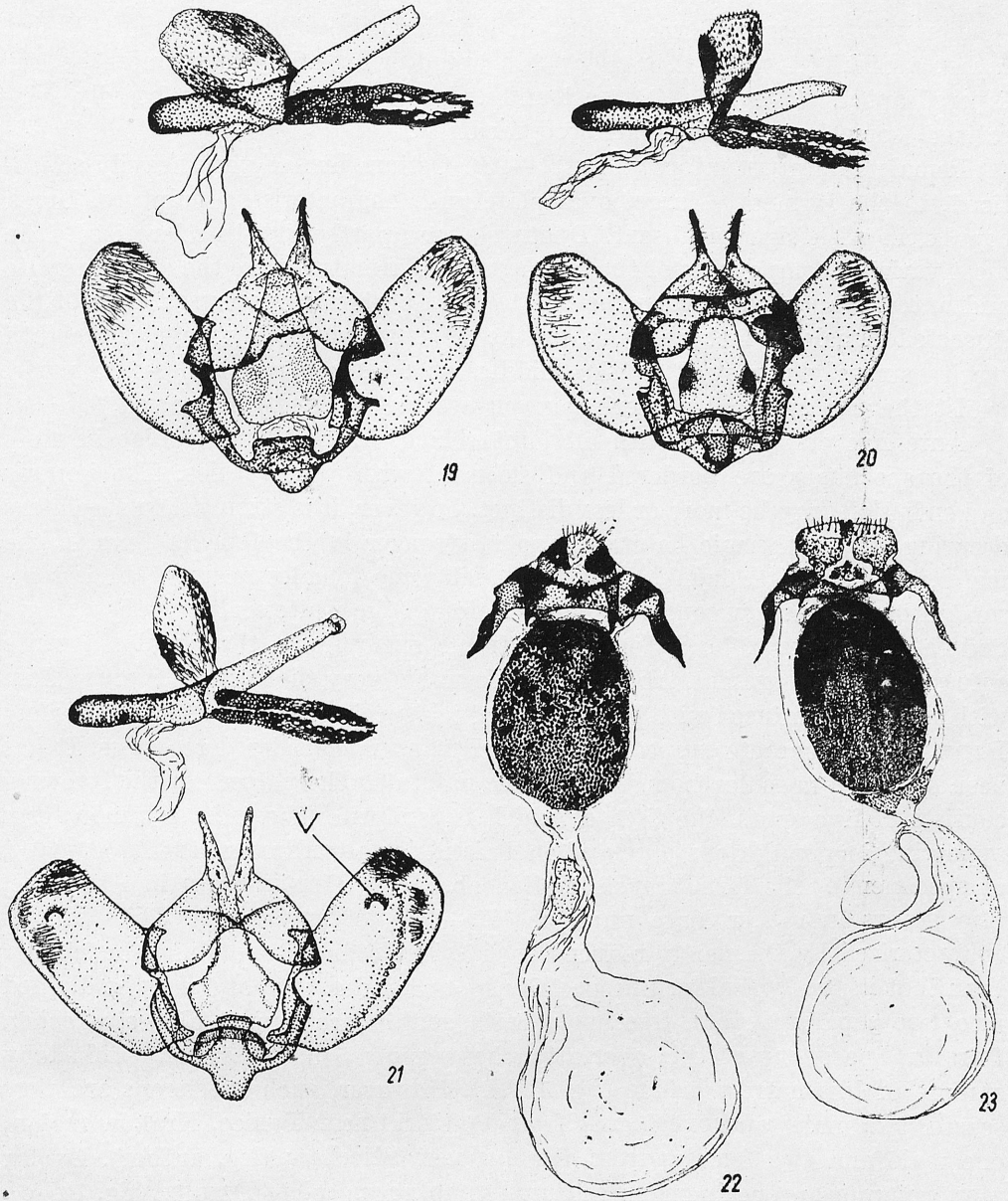
Male genital armature (figs. 15—21) shows considerable variation. Valva with costal edge straight, ventral and caudal edges rounded. Corona slightly developed. Only one of several dissected males shows on both valvae symmetrical, heavily sclerotized half-ring shaped sclerites (fig. 21-v) unlike in any other species of the genus *Zygaena* F. This sclerite somewhat resembles the clasper of members of most of the *Noctuidae* (well developed in *Agrotinae*). Uncus arms narrow, tapering. Tegumen well domed. Saccus a broad, semicircular projection. The anellus is the most variable component of the genital armature. It is as variable in shape as it is in surface sculpture. The variation of the anellus is shown in fig. 120-b. This variability is not parallel to geographical or to ecological factors. It also does not correspond with the variation of other parts

[1] Specimen quoted by MIODOŃSKI (1952) from Tyniec distr. Kraków was misidentified as an aberrant specimen of *Z. purpuralis* (BRÜUNNICH), ab. *plutoides* REISS.

of the genital armature. Judging by the material examined, the most common type of the anellus is that shown in fig. 20. Aedoeagus slightly longer than valva. Lamina vantralis and lamina dorsalis are as well as the vesica, longer than coecum. Spines of the lamina ventralis very considerably developed; they are well



Figs. 15—18. Male genital armatures. 15 — *Zygaena loti* (D. & SCHIFF.), Ojców National Park, Sąspowska Valley, 25. VII. 1958. Genital Slide No. 157, 16 — *Z. loti* (DEN. & SCHIFF.), Bydgoszcz, Myślęcinek, 28. VII. 1956. Genital Slide No. 296. 17 — *Z. loti* (DEN. & SCHIFF.), Ojców National Park, Grodzisko, 8. VIII. 1958. Genital Slide No. 151. 18 — *Z. loti* (DEN. & SCHIFF.), Ojców National Park, Grodzisko, 8. VIII. 1958. Genital Slide No. 159.



Figs. 19—23. Genital armatures. 19 — *Zygaena loti* (Den. & Schiff.), male, Cieszyn, Tuł, 25. VII. 1943. Genital Slide No. 279. 20 — *Z. loti* (Den. & Schiff.), male, Ojców National Park, Grodzisko, 28. VII. 1958. Genital Slide No. 155. 21 — *Z. loti* (Den. & Schiff.), male, Sudeten Mts., Rościszów, 10. VII. 1958. Genital Slide No. 229. 22 — *Z. loti* (Den. & Schiff.), female, Ojców National Park, Grodzisko, 27. VIII. 1958. Genital Slide No. 169. 23 — *Z. loti* (Den. & Schiff.), female, Ojców National Park, Sąspowska Valley, 7. VII. 1958. Genital Slide No. 158.

sclerotized and form two bands at the sides of the lamina. Lamina dorsalis slender with spines rather constant in length in individual specimens. Vesica rather variable: it may be broad with a broad orifice (fig. 19) or more or less tapered apically (fig. 15). Cornuti and „plate" absent. Coecum heavily sclerotized, sometimes weakly narrowed medially.

Female genital armature (figs. 22—23). Ostium bursae very heavily sclerotized, in the form of a large, oval plate with characteristic sculpture. Bursa copulatrix with signum absent. Ductus bursae partly lightly sclerotized. The most variable components of the female genital armatures are the eighth tergite and anterior apophyses, then the „plate" and posterior apophyses. Two of the dissected females which seem to be the most atypical ones have the eighth tergite strongly narrowed in the middle, or even separated into two parts, whilst the anterior and posterior apophyses are decidedly narrowed.

Antennae club-shaped with all joints black. Patagia and tegulae in most of the specimens are bordered and sufussed with white scales. The borders and suffusion may be more or less distinct, however, it is strongest in specimens occuring in xerothermic habitats, and is stronger in the females than in the males. On the other hand, the males, and some females occuring in less insolated localities show considerable reduction of the white scales on the patagia and tegulae. Thorax black, only in extreme exemples of the females a white sufussion may be present. Abdomen black with a very slight sheen, very seldom with a red belt suffused with black scales. Such specimens belong to ab. *cingulata* Dziurz. This character appears sporadically and is considered recessive. It has been observed in males from xerothermic habitats. The pattern of the forewing consists of five spots, the fifth of which is reniform. The most common form appearing in populations observed in Poland is shown in fig. 127-f (50—60 % of specimens). The form transitional to ab. *viciae* Hbn., shown in fig. 127-c, also occurs in rather large numbers (20—30 % of specimens). This form is characterized by the partly reduced spot 5. The reduced spots may be smaller than that in the typical form, especially spots 3 and 4, or spot 5 may be divided into two separate spots. Specimens with spot 6 are named ab. *sexmaculata* Dziurz. Specimens of this aberration have spots 5 and 6 usually linked by a more or less narrow bridge (fig. 127-d). However, such specimens are very scarce: two males and one female from Podgórki near Tyniec, Kraków region, one male and two females from Klonów near Miechów (leg. author). By far more common are specimens transitional to ab. *sexmaculata* Dziurz. (fig. 127-e). Specimens of ab. *viciae* Hbn. (fig. 127-b) show further reduction of the forewing spots. In such specimens spot 5 is smaller and rounded and spots 3 and 4 are slightly smaller than in typical individuals. Such specimens are very scarce, and appear sporadically. However, in Podgórki near Tyniec, in the region of Kraków, specimens of this aberration appear singly every year. The aberrations showing the strongest reduction of the forewing spots, as ab. *blachieri* Dziurz. known from Moravia, have not as yet been found in Poland.

Quite a different direction of the variation of the forewing pattern is found

in specimens with enlarged spots. The first stage is the enlargement of the spots, then the spots show a tendency to be confluent, e.g. ab. *costalielongata* Vorbr. Specimens of ab. *costalielongata* Vorbr. have spot 1 extended along vain sc. Such specimens are rather common and appear as 10—15 % of the populations. By far scarcer is the ab. *analiconfluens* Vorbr. (fig. 127-g) representatives of which have spots 2 and 4 confluent and forming a streak. Such specimens (males and females) have been observed in xerothermic localities in the Pieniny Mts., in the steppe regions of Kielce, Pińczów and Miechów, in Podgórki near Tyniec and in the Ojców National Park. Very scarce, and found only in the females, is ab. *parallela* Vorbrodt, specimens of which have spots 1 and 3, as well as 2 and 4 confluent with each other, and spot 5 enlarged. Such specimens were found in the xerothermic localities: two females in the Pieniny Mts., one female in the Ojców National Park (leg. author), and one female in St. Anna Mt. (leg. Skrabania). Another form is ab. *rubescens* Reiss, in which the spots are so confluent with each other, that the ground colour is restricted to a small area between the spots 3, 4 and 5; the margins of the wings are strongly suffused with yellow scales. This aberration has not yet been found in Poland.

The black margin of the hindwing is very narrow and may be completely reduced especially in females. This aberration usually occurs in the xerothermic localities.

The ground colour of the forewing shows distinct sexual dimorphism. Thus, in the females the ground colour is suffused with yellow scales. The wing with blue-green coloration looks yellow-green. Very rarely the yellow suffusion at spot 4 appear also in the males. However, most of the males have the forewing ground coluor black with navy-blue hue and slight sheen. The fringes of the forewing are, in both, sexes white or black. However, specimens with white fringes are more common (60—70 %) than those with black fringes. The fringes of the hindwing are always black.

The colour of the forewing spots is rather variable. The specimens with the spots carmine with an amaranth hue are rather more common (50—60 %) than those with the spots cinnabar, which appear more frequently in the females than in the males. Specimens of ab. *fulva* Spuler are rather scarce. The specimens belonging to this form are characterized by the cinnabar spots distinctly lightened by the yellow-orange hue. In such specimens the hindwing also shows a distinct yellow-orange hue. The specimens of ab. *flava* Rom. (one female found by Błeszyński at Bogucice near Pińczów) have yellow forewing spots and hindwing. Ab. *brunnea* Dziurz. is characterized by the dark brown colour of the forewing spots. One male of this form was found by Masłowski in Smoleń near Pilica.

The average length of the forewing is 13—14·5 mm. in males and 13—15 mm. in females. Very large specimens with the forewing length up to 15·8 mm. appear very seldom in both esxes. Still more scarce are dwarf individuals in which the forewing length is, at the most, 10·5 mm.

The species is rather strongly confined to xerothermic habitats. In the

slightly insolated and damp localities *Z. loti* (DEN. & SCHIFF.) appears only as single specimens. On the other hand, in dry and well insolated localities, especially in limestone areas, the species flies in thousands, often in very small areas.

The larvae of *Z. loti* (DEN. & SCHIFF.) feed on *Lotus corniculatus* L., *Coronilla varia* L., and *Hippocrepis comosa* L.

The flight of the adults is heavy and rather slow. As in most species of the *Zygaenidae* they show the greatest activity, in warm and sunny days, especially in the late morning and early afternoon. Their flight depends on the situation and the size of the locality, as well as on the ecological barriers which may surround it, however, it is always limited to several hundred metres. The individuals do not leave their habitat, and only occasionally they may be found in the near vicinity e.g. in thin woodland. They spend the night on grass or on stems or under the flowers of herbs, especially of *Scabiosa* L. and *Cirsium* Adans. In the localities where the species is abundant, one can find clusters of specimens under the flowers.

Z. loti (DEN. & SCHIFF.) is a ponto-mediterranean element in the fauna of Poland (HOLIK, 1939). It is distributed partly in southern Europe, then in central, western and eastern Europe, partly in Asia Minor, and in western Asia. In Poland the northern limit of its range probably runs through the Pomeranien Lake District and Mazurian Lake District to Białowieża Virgin Forest. It has been found from 50 m. alt. (Bydgoszcz region) to 980 m. alt. (Pieniny Mts.). In has not been found in the Tatry Mts. It is of interest to note that, in spite of the fact that this species is rather easily recognised and is abundant in several localities in the Pieniny Mts., neither NOWICKI nor SITOWSKI (1906) recorded this species from that region.

4. *Zygaena viciae* (DENIS & SCHIFFERMÜLLER, 1775)
(=*Zygaena meliloti* (ESPER, 1793)

Male genital armature (figs. 24, 25). Valva rounded with costal, caudal and ventral edges rounded. Corona rather well developed. Processes of uncus conical, tapering, with rounded apexes. The size and the distance between both processes is in some individuals slightly variable. Tegumen strongly domed. Saccus well produced with a slight basal narrowing; it is usually narrow, rather seldom broadened. Anellus sub-rectangular with margins rounded at base. It is very lightly sclerotized and does not form any characteristic sculpture. Aedoeagus slightly longer than valva. „Plate" well developed, oval, full of very thin spines. Cornuti in the form of two spined lamellas. The spines are very different in individual specimens. The larger lamella generally has five, heavily sclerotized spines, however, their number may be reduced to two. The smaller lamella is terminated by two small, pointed spines. Lamina ventralis as long as one-fifth of the length of the aedoeagus covered basally with

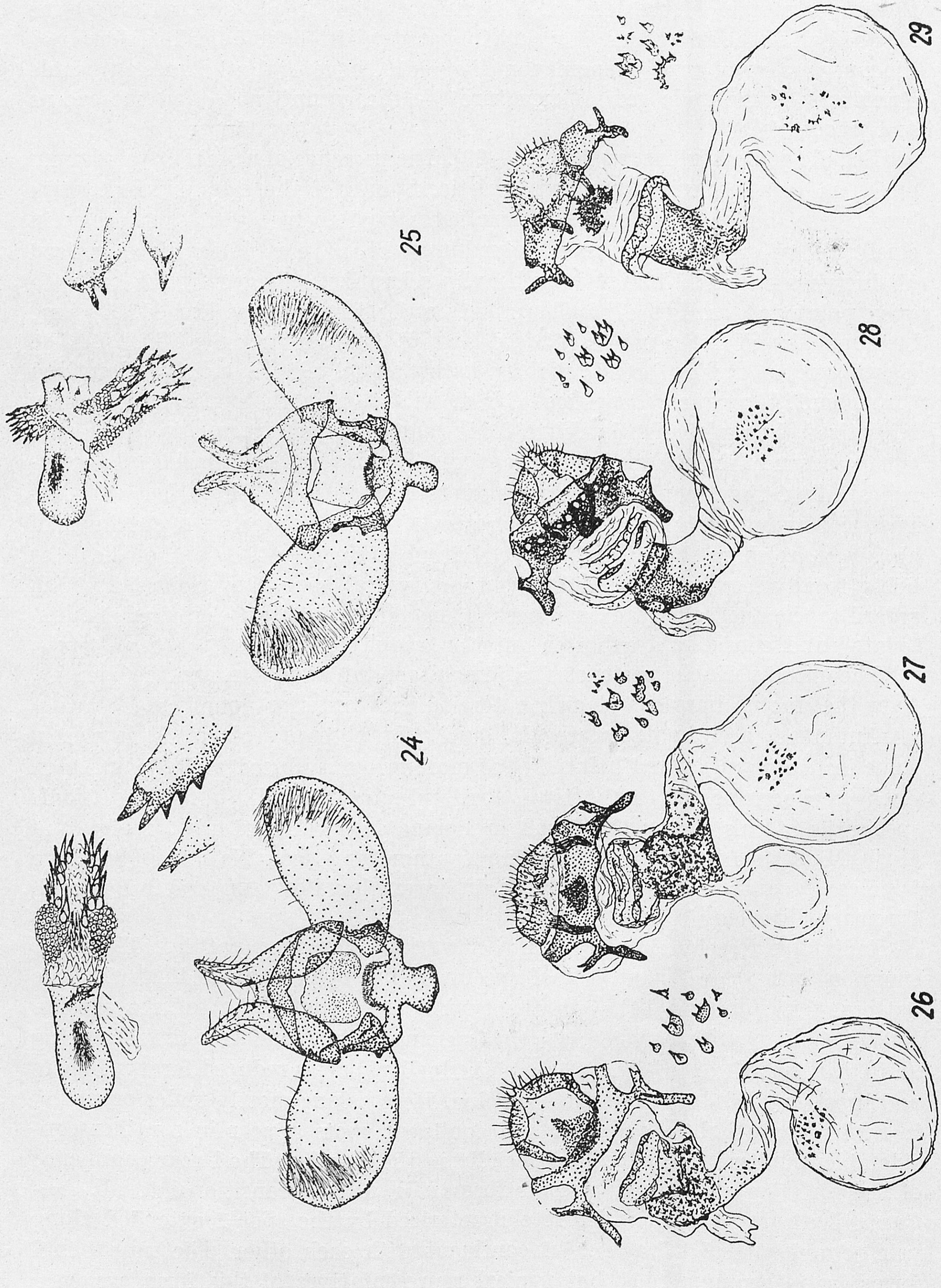
very small spines, which are longer and rather more heavily sclerotized at the upper margin of the lamina. Vesica short and broad. Coecum always as long as half of the aedoeagus; it is slightly narrowed in the middle. The shortened coecum is a very rare phenomenon (fig. 25). In general, the most variable structures of the male genital armature are the cornuti and then the saccus and uncus.

Female genital armature (figs. 26—29). The presence of a small, oval signum on bursa copulatrix is here characteristic. Spines of the signum small, with broad bases and pointed apexes. Their bases tend to fuse with each other, in clusters of two four or even six. Ductus bursae broad, partly heavily sclerotized at ductus seminalis. „Plate" very heavily sclerotized, always triangular, with apex pointed towards the papillae anales and with the base arched. In some instances the sclerotization is reduced (figs. 27, 28), or irregular (fig. 29). The eighth tergite usually broad, slightly narrowed in middle, evenly sclerotized throughout. Very rarely, specimens occur with the eighth tergite very heavily sclerotized, but with lightly sclerotized window-shaped fragments. Such specimens occur in several species of the genus *Zygaena* and are considered teratological. Posterior apophyses heavily sclerotized with length rather variable. Posterior apophyses also heavily sclerotized, tapering apically. A specimen of ab. *pygmaea* **ab. n.** shown in fig. 29 (slide no. 210) is rather pathological, as being totally less heavily sclerotized than typical specimens (especially with regard to the ductus bursae), and having smaller and lightly sclerotized signum, „plate" and considerably shorter anterior apophyses.

The most variable parts of the female genital armature are the „plate", then the ductus bursae and eighth tergite with anterior apophyses.

Antennae, head, patagia, tegulae and thorax totally black. Abdomen in some instances with a red belt which is more or less suffused with black scales. Such specimens belong to ab. *stenzii* Frr. and appear usually in females. Single specimens of this form were found in Poland in the Dzierżoniów region and Sowie Mts., six females (leg. Szpor and author), in Ojców National Park, two females (leg. author), in Białowieża Virgin Forest (leg. Prüffer) and in Baligród, three females (leg. Toll).

Individual specimens show a rather variable forewing pattern. The most common form (more than 50% of specimens in populations) is that with the pattern very similar to that in the typical form (fig. 128-e) of the species. Rather common are specimens with the forewing pattern similar to that occurring in ab. *chubergi* Reuter (fig. 128-d), with smaller, partly reduced forewing spots and broader black border of the hindwing. Here belong mostly males occurring in rather damp habitats. Larger and confluent spots appear in a rather considerable number of specimens, especially in the females. The linear confluence of the forewing spots show various forms (fig. 128-f) transitional to ab. *confluens* Tutt (fig. 128-g), which is characterized by the spot 1 extended along vein sc and spots 3+5 and 2+4 confluent with each other. The transitional forms are rather numerous, but typical representatives of this form are very



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scarce. One male was found in Srebrna Mt. in the Sudeten Mts. (leg. SZPOR) and one male was taken in the Ojców National Park (leg. author). On the other hand, the enlargement of the forewing spots may be caused by the presence of additional spot 6, and such specimens are called ab. *sexpunctata* TUTT (fig. 128-c). The specimens of this form are not very scarce (about 2—10 % of specimens in populations). Very scarce are specimens with the forewing spots confluent with each other as follows: 1+2, 3+4 and 5+6 (fig. 128-a). One female taken in the Ojców National Park (leg. author) and one male and one female in the Sowie Mts. (leg. SZPOR).

The width of the black borders of the hindwing is variable, being in the males always broader than that in the females. The specimens with very broad borders are rather scarce (3—10 % of specimens in populations) and appear usually in males. These specimens are named ab. *obscura* REISS.

The forewing ground colour is black, slightly transparent, with a blue-green hue and a slight sheen.

The forewing spots are, in most specimens, carmine with an amaranth hue (about 50—60 % of specimens in populations). Females often have the hindwings lighter than those in the males (about 20—30 % of specimens in populations), and rather with a cinnabar hue, in some instances tinged with yellow. The specimens of ab. *flava* BGFF. with yellow forewing spots and hindwings have not as yet been found in Poland. However, in the Ojców National Park were taken one male and two females each with one of the hindwings yellow, but with the other hindwing and the forewing spots of normal colour (pl. 19). According to DRYJA (1959) such forms with asymmetrical coloration are genetic. The author captured at Klonów near Miechów one male specimen with the hindwings and ferewing spots brown, it is here named *brunnea* **ab. n.**

Z. viciae (DEN. & SCHIFF.) is a rather small species. The average length of the forewing is 13 mm. in the males and 13·5 mm. in the females. Larger specimens with forewing 13·5—14·5 mm. in length are rather scarce (about 2—5 % of specimens in populations studied in southern Poland and in Silesia). Not so scarce are dwarf specimens with the forewing length less than 9·5 mm. (up to 10 % of specimens in populations). Specimens of ab. *pygmaea* **ab. n.** (fig. 143) with forewing 9 mm. long are characterized by broad and rounded forewings. The spots 3, 4 and 5 are concentrated, but still separated from each

Figs. 24—29. Genital armatures. 24 — *Zygaena viciae* (DEN. & SCHIFF.), male, Ojców National Park, Młynnik, 9. VII. 1954. Genital Slide, No. 61. 25 — *Z. viciae* (DEN. & SCHIFF.), male, Ojców National Park, Młynnik, 3. VII. 1958. Genital Slide No. 127. 26 — *Z. viciae* (DEN. & SCHIFF.), female, Ojców National Park, Młynnik, 22. VII. 1959. Genital Slide No. 62. 27 — *Z. viciae* (DEN. & SCHIFF.), female, Sudeten Mts., Sowie Mts., 12. VII. 1958. Genital Slide No. 281. 28 — *Z. viciae* (DEN. & SCHIFF.), female, Baligród—Czarna, 5. VII. 1959. Genital Slide No. 273. 29 — *Z. viciae* (DEN. & SCHIFF.), female, Ojców National Park, Koziarnia, 22. VII. 1958. Genital Slide No. 210.

other. Hindwings in that specimen are also shorter, rounded and have a rather narrower black border. The forewing spots and hindwing are red with a carmine hue. One female was taken at Koziarnia in the Ojców National Park (leg. author). The above mentioned characters were probably caused by the recessive genetic factors. The aberration is analogous to *Z. trifolii* ab. *pygmaea* COCKAYNE.

Z. viciae (DEN. & SCHIFF.) appears in various types of habitats, e.g., it was found in the marshy meadows flying together with *Z. trifolii* (ESP.) (Dzierżoniów region and Sowie Mts.), but also in the xerothermic lime-stone localities together with *Z. carniolica* (SCOP.) (Miechów region and Ojców National Park). This species is especially confined to the vicinities of woods, the glades and localities along roads and wood tracts.

The larvae of *Z. viciae* (DEN. & SCHIFF.) feed on several species of plants: *Vicia cracca* L., *Lotus cornicolatus* L., *Onobrychis viciaefolia* SCOP., and on several species of the genera *Trifolium* L. and *Medicago* L.

This species finds suitable conditions to live only in such areas which are practically untouched by the activity of man, as pasturage and other factors. In such localities the populations of *Z. viciae* (DEN. & SCHIFF.) are abindant, e.g. in the Sowie Mts. where numerous specimens were found in meadows. On the other hand, in the areas under cultivation, the species disappears very quickly.

Like other species of the genus, this species is most active on warm and sunny days, however, it is not one of the most xerothermophilous insects. The adults are quick-moving and nimble, which is rather unique among the representatives of the genus *Zygaena* F. The distances which the specimens can fly depend on the character of the locality and surrounding ecological barriers. However, the species is very local and specimens do not cross the edge of the limited habitat. Sometimes, however, they fly rather long distances along the wood tracts. During the night the species rests on herbs like other species of the genus, however, always singly.

Zygaena viciae (DEN. & SCHIFF.) is distributed in Europe except for Ireland and Greece. In Asia it is known from its central areas, as well as in Siberia. In Polish fauna it is an euro-siberian element (HOLIK, 1939). In spite of fact that Poland practically is within the range of the species, *Z. viciae* (DEN. & SCHIFF.) is known from this country as a rather rare species, and was found to be abundant only in limited number of localities.

The species occurs from 100 to 980 m. alt. (the latter altitude in the Bieszczady Mts.), however, beyond Poland, in Rila Monastyr it was found at about 1600 m. alt. (BURESCH and TOULESCHKOW, 1943). It has not been found in the Tatra Mts. but from the Pieniny Mts. it was cited by NOWICKI and then by SITOWSKI (1906). However the latter record was after that of Nowicki. I did not found any example of this species taken in the Pieniny Mts. in any of the collection examined. Also detailed field study of the Pieniny Mts. did not bring positive results. Maybe this species is now extinct in the Pieniny Mts.,

however, it is of much interest to note that neither NOWICKI nor SITOWSKI cited *Zygaena angelicae* OCHSEN. which is similar to *Z. viciae* (DEN. & SCHIFF.) and, on the other hand, is very common in the Pieniny Mts.

5. *Zygaena ephialtes* (LINNAEUS, 1767)

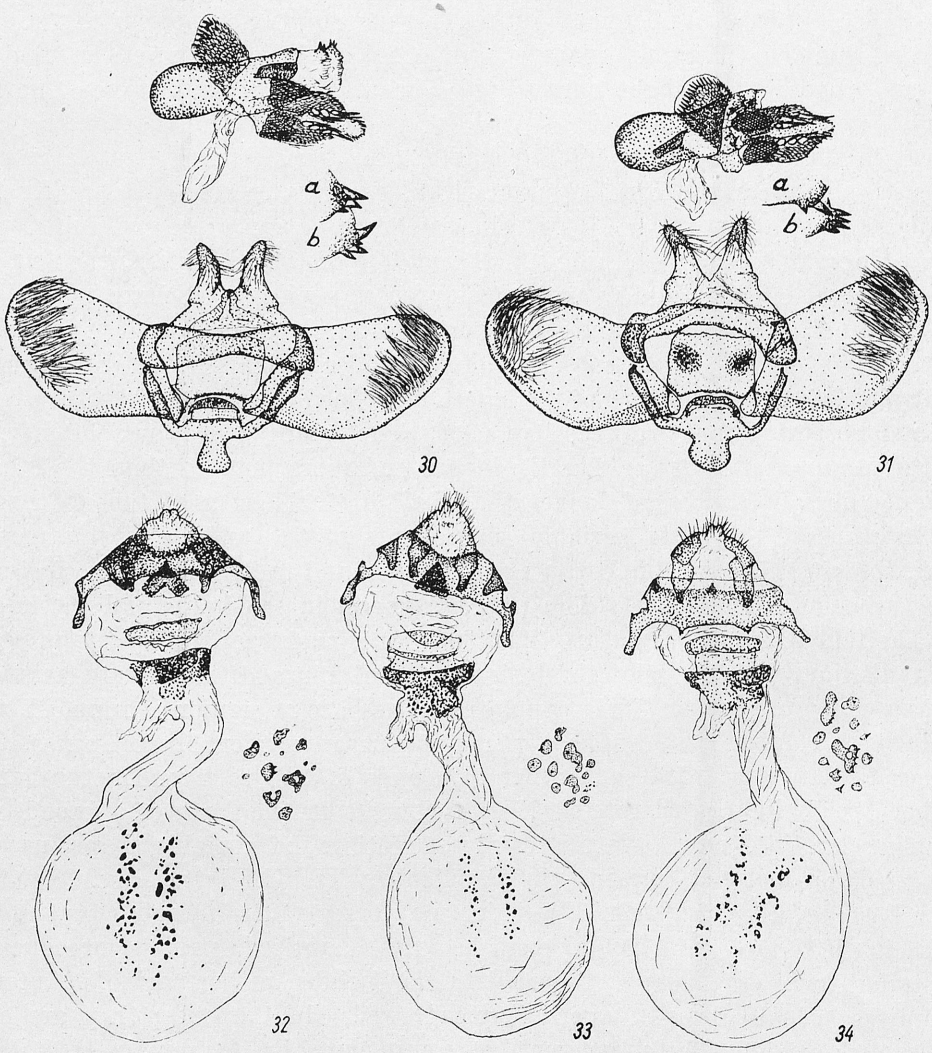
Male genital armature (figs. 30, 31). Valva proportionately elongate with costal and ventral margins straight; caudal margin domed. Corona rather well developed. Processes of uncus rather broad, slightly tapering posteriorly, apexes rounded. Tegumen narrow, elongate, slightly narrowed in middle. Saccus broad with a slight narrowing at base, or, in some instances, narrow with a rather strong narrowing. Anellus in the form of a rectangular plate, often (in slightly less than 40 % of genital armatures studied) with a characteristic sculpture in the form of symmetrical, heavily sclerotized patches (fig. 31). Aedoeagus as long as valva. „Plate" elongate, rectangular, armed with numerous tiny spines; it is usually situated in the middle of the coecum. Cornuti in the form of two lamellas which are armed with more heavily sclerotized spines. The number of these spines are two to three on one lamella and always four in the other one. The size and shape of the spines are rather variable. Lamina ventralis as long as one-third of the length of the aedoeagus it is evently covered with spines, which are arranged like scales. The spines lying along the margins of the lamina ventralis are slightly longer and more pointed than the others. Lamina dorsalis somewhat longer than half of the length of the aedoeagus.

In general, the most variable components of the male genital armature of *Z. ephialtes* (L.) are: the cornuti and anellus, and then the saccus. However, the variation of these parts does not correspond in the individual specimens.

The female genital armature (figs. 32—34) is characterized by the presence of a distinct, heavily sclerotized signum, the spines of which are arranged in two elongate rows on bursa copulatrix. The base of signum is rounded, well defined and heavily sclorotized, the spines have rather blunt apexes. The spines tend to fuse with each other in groups of two to five. Ductus bursae rather broad, lightly sclerotized. Ostium bursae in the form of a broad, unevenly sclerotized cup. „Plate" heavily sclerotized, of variable shape, usually as a triangle pointed towards the papillae anales. The latter (fig. 33) often with base deeply incised (fig. 32), which may be considerably reduced (fig. 34). The eighth tergite with caudal edge heavily sclerotized, straight or concave. Posterior apophyses narrow, tipped with small clubs; rather variable. Anterior apophyses usually broad, tapering apicad, with blunt apexes; they are considerably variable. The most variable components in the female genital armatures of the species under consideration are: „plate", and then the eighth tergite, anterior and posterior apophyses and ostium bursae. However, the size and number of spines of the signum are also variable characters.

Antennae club-shaped apically, with very pointed apexes. The apical jeint is white-yellow, the others are black. Patagia, tegule and thorax black with

a navy-blue sheen. The abdomen with a red or yellow belt, suffused with dark scales on one segment. The belt is a constant specific feature (as far as the material from Poland and its neighbourhood is concerned). In one male and two females taken at Klonów near Miechów (leg. author) the abdominal belt is spread over two or even three segments on the ventral side of the abdomen, being coloured as in the forewing spots 1 and 2. *Z. ephialtes* (L.) may be divided into two main groups of forms:



Figs. 30—34. Genital armatures. 30 — *Zygaena ephialtes* (L.), male, Ojców National Park, Brama Krakowska, 24. VII. 1959. Genital Slide No. 145. 31 — *Z. ephialtes* (L.), male, Ojców National Park, Grodzisko, 28. VII. 1958. Genital Slide No. 161. 32 — *Z. ephialtes* (L.), female, Ojców National Park, Grodzisko, 10. VIII. 1954. Genital Slide No. 160. 33 — *Z. ephialtes* (L.), female, Jaworzno, Grodzisko, 3. VIII. 1960. Genital Slide No. 228. 34 — *Z. ephialtes* (L.), female, Kraków, Skała Kmity, 5. VIII. 1961. Genital Slide No. 171.

I. *ephialtoid* — forewing spots 1 and 2 red or yellow, 3, 4, 5 and 6 white. Hindwings black-navy-blue with a sheen and a spot corresponding to forewing spot 5. These forms appear in Poland very rarely and sporadically.

II. *peucedanoid* — all forewing spots unicolorous, red or yellow. Hindwings red or yellow with a black margin. This is the dominant group appearing in Poland.

The scheme of these forms is shown in table II. (Partly after DRYJA, 1959).

Table II

ephialtoid	red	*Z. ephialtes* (L.) — typical form	Pl. X, fig. 20
		Z. ephialtes (L.) — ab. *medusa* PALL.	Pl. X, fig. 21
	yellow	*Z. ephialtes* (L.) — ab. *coronillae* ESP.	Pl. X, fig. 22
		Z. ephialtes (L.) — ab. *trigonellae* ESP.	Pl. X, fig. 23
peucedanoid	red	*Z. ephialtes* (L.) — ab. *peucedani* ESP.	Pl. X, fig. 24
		Z. ephialtes (L.) — ab. *athamanthae* ESP.	Pl. XI, fig. 1
	yellow	*Z. ephialtes* (L.) — ab. *icterica* LED.	Pl. XI, fig. 2
		Z. ephialtes (L.) — ab. *aeacus* (DEN. & SCHIFF.)	Pl. XI, fig. 4

The tendencies from reduction to enlargement of the fore- and hindwing pattern are shown in fig. 129.

The absence of specimens with the most reduced forewing spots (ab. *wullschlegeli* OBTHR.) in the populations occurring in Poland is very characteristic of this species. Only spot 6 may be partly or even completely reduced. Spots 1, 2, 3, 4 and 5 show only little reduction. In the ephialtoids the hindwing spot (5) may be reduced and in the peucedanaoids the black margin of the hindwing may be broadened. This species does not show any confluences of the forewing spots, which is so characteristic of other species of the genus in question.

The forms of *Z. ephialtes* (L.) found in Poland are as follows: ab. *peucedani* ESP. (fig. 129-f) appears in about 30% of individuals in the populations; the females of this form are more frequent than the males. The majority of specimens (about 40—60% in the populations) belong to the form transitional to ab. *athamanthae* ESP. (fig. 129-e). Typical specimens of ab. *athamanthae* ESP. (fig. 129-d) are decidedly less common (about 10—20%). The forms intermediate between peucedanoids and ephialtoids may occur, but they are always very scarce and appear sporadically (the forms considered here are the most characteristic of those found in Poland; the range of the variation of this species is very wide as shown by Dryja, 1959, pp. 390—391, pl. I—VII on the material of the bred specimens). A proportionately common form is ab. *metzgeri* HSKE. (fig. 129-c). In some localities, as at Podgórki near Tyniec, distr. Kraków, they appear as 8—15% of the population. However, this form is usually very scarce

and occurs sporadically. Individuals of the typical form of *Z. ephialtes* (L.) are very scarce. Single specimens were found in the Gdańsk region (SPEISER) and at Jary Winiarskie near Sandomierz, central Poland (leg. KARPOWICZ). Individuals of ab. *medusa* PALL. were found singly at Zbrza Wielka near Sandomierz, central Poland (leg. KARPOWICZ), Gdańsk region (SPEISER), Segiet near Bytom (WOLF, RAEBEL), Ligota Dolna near St. Anna Mt. (Upper Silesia), one male (leg. RAEBEL), Ojców — one male (leg. STUGLIK), Podgórki near Tyniec, distr. Kraków, one male (leg. MIODOŃSKI). Specimens transitional to ab. *medusa* PALL., two males, were found in the Bydgoszcz region (leg. RODOWICZ), then two males and four females at Podgórki near Tyniec (leg. DOBRAŃSKI and PRUSZYŃSKI), and one female from the Ojców National Park (leg. author).

The forewing spots 1—6 in the considered here peucedanoids, and spots 1 and 2 in the above mentioned ephialtoids, are red with a crimson hue, and the spots 3—6 in the ephialtoids are white. The hindwing of the peucedanoids is concolours with the forewing spots, and only in very rare examples is the hindwing cinnaber-orange, such specimens are named ab. *prinzi* HSKE. (pl. XI, fig. 3). Ab. *prinzi* HSKE. was found in the Ojców National Park, two female (leg. author), Podgórki near Tyniec, distr. Kraków, one female (leg. DOBRAŃSKI), two females at Segiet near Bytom, Upper Silesia (leg. SKRABANIA). The specimens transitory to ab. *prinzi* HSKE.: two females in Ligota Dolna near St. Anna Mt., Silesia (leg. RAEBEL), three females at Segiet near Bytom (leg. RAEBEL), one female at Skała Kmity near Kraków (leg. author). Ephialtoids and peucedanoids with a yellow pattern are known only from a few localities in Poland: ab. *coronillae* ESP. was found in Zbrza Wielka near Sandomierz, central Poland (leg. KARPOWICZ), then ab. *icterica* LED., one male from Tuł near Cieszyn, Silesia (leg. TOLL), ab. *trigonellae* ESP., from Zbrza Wielka near Sandomierz (leg. KARPOWICZ), ab. *aeacus* DEN. & SCHIFF. from Segiet near Bytom (leg. SKRABANIA) and Brzezinki near Łódź (leg. KRECZMAR). The ab. *aurantiacomutabilis* DRYJA, which is characterized by the brown coloration of the forewing spots and hindwings, was found at Zgierz, central Poland (one female, coll. JARISCH).

The species is rather constant in size. The average length is 14·5—16 mm. in the males and 15—16·2 mm. in the females. The specimens with the forewing longer than 17 mm. (only females) are scarce and dwarf individuals with the forewing shorter than 12·5 mm. are extremly rare (one female found in the Ojców National Park).

Z. ephialtes (L.) is confined to grassy xerothermic localities in the vicinities of mixed-woods or pine-woods. It also occurs along country roads and in the woodland clearings. Populations of this species are rather small, even in localities which show ecological conditions most suitable for other species of the genus *Zygaena* F.

The larva of *Z. ephialtes* (L.) feeds on *Coronilla varia* L. According to some authors (ROMANISZYN, 1929, GREGOR & POVOLNÝ, 1955) the larva lives also

on some species of the genera *Trifolium* L. and *Vicia* L., as well on some *Umbelliferae*, however, according to my opinion, these data need verification.

The adults are most active in the warm and sunny days, however *Z. ephialtes* (L.) is not one of the most xerothermophilous species. The imagines fly quickly and are rather fast. Their flight is not so limited by the ecological barriers as in other species of *Zygaena* F. The author (1959) observed the flight of *Z. ephialtes* L. over 1 km. In spite of this fact *Z. ephialtes* (L.) appears to be a rather local species. The species generally occurs singly and only on the flowers of *Cirsium* Adans one may find several specimens.

Z. ephialtes (L.) is distributed in central, south and east Europe, as well as in Siberia. In Poland it ranges about as far north as *Z. loti* (Den. & Schiff.). It probably form southern Pomerania to the Gdańsk region and to the Mazurian Lake District and the Białowieża Virgin Forest. Because of the incomplete records of *Z. ephialtes* (L.) from northern Poland, it is rather difficult to show a detailed pattern of its distribution in that area. The species appears to be most abundant in the Małopolska Highland and Lubelska Highland. In the Polish Carpathians, the species was found to be very scarce and sporadic. However, Toll discovered in the Baligród region in the Eastern Carpathians, some localities in which *Z. ephialtes* (L.) is fragment. The species was recorded from the Pieniny Mts. by Sitowski and later by Romaniszyn (the record of the latter author was based on the data of Sitowski). Since Romaniszyn record, *Z. ephialtes* (L.) has not been recorded from the Pieniny Mts. The collections studied lack any specimens of this species from the Pieniny Mts. So far there are not data on the occurence of this species in the Tatry Mts.

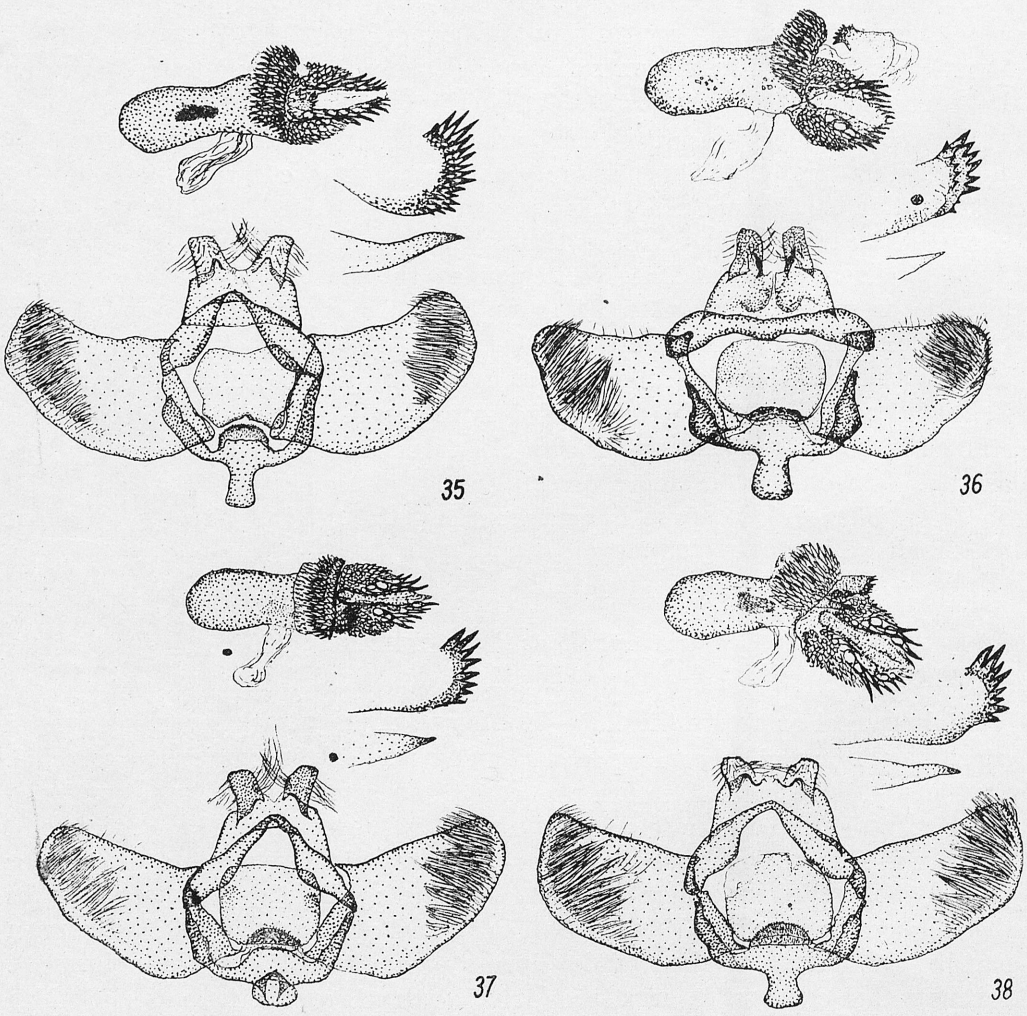
Z. ephialtes (L.) occurs in Poland from 50 m. alt. (Gdańsk-region) to about 850 m. alt. (Baligród-region).

6. *Zygaena angelicae* Ochsenheimer, 1808

Male genital armature (figs. 35—39). Shape of valva rather variable; costal edge straight or slightly concave, caudal and ventral edges more or less rounded. Corona well developed. A rather rare case of an asymmetrical armature, with one of the valvae shorter (especially corona) is shown in fig. 36. Processes of uncus variable: they may be broad with apexes bluntly truncate (the major part of the studied specimens) (fig. 35), to tapering (fig. 39). In some instances these processes are much shorter than in typical specimens (fig. 38). Tegumen narrow, constricted in the middle (during preparation it may be deformed). Saccus rather constant in armature, only the basal constriction and the width to length ratio may vary slightly. Anellus always sub-rectangular with margins more or less rounded; base sometimes notched. In some instances anellus slightly more heavily sclerotized at some places. Aedoeagus slightly longer than valva. „Plate" rather variable but always elongate (fig. 35), full of tiny spines. The number of these spines may be reduced (fig. 38), or the „plate"

may even be vestigial (figs. 36, 37 and 39). Cornuti in the form of two lamellas, one of which is armed by eight (fig. 38) to sixteen spines. The other lamella is less heavily sclerotized, narrow, pointed. Lamina ventralis reaching nearly one-fourth of the length of the aedoeagus, with base covered with tiny, scale-shaped spines, which gradually become longer and more strongly pointed towards the margins. Lamina dorsalis shorter than half the length of the aedoeagus.

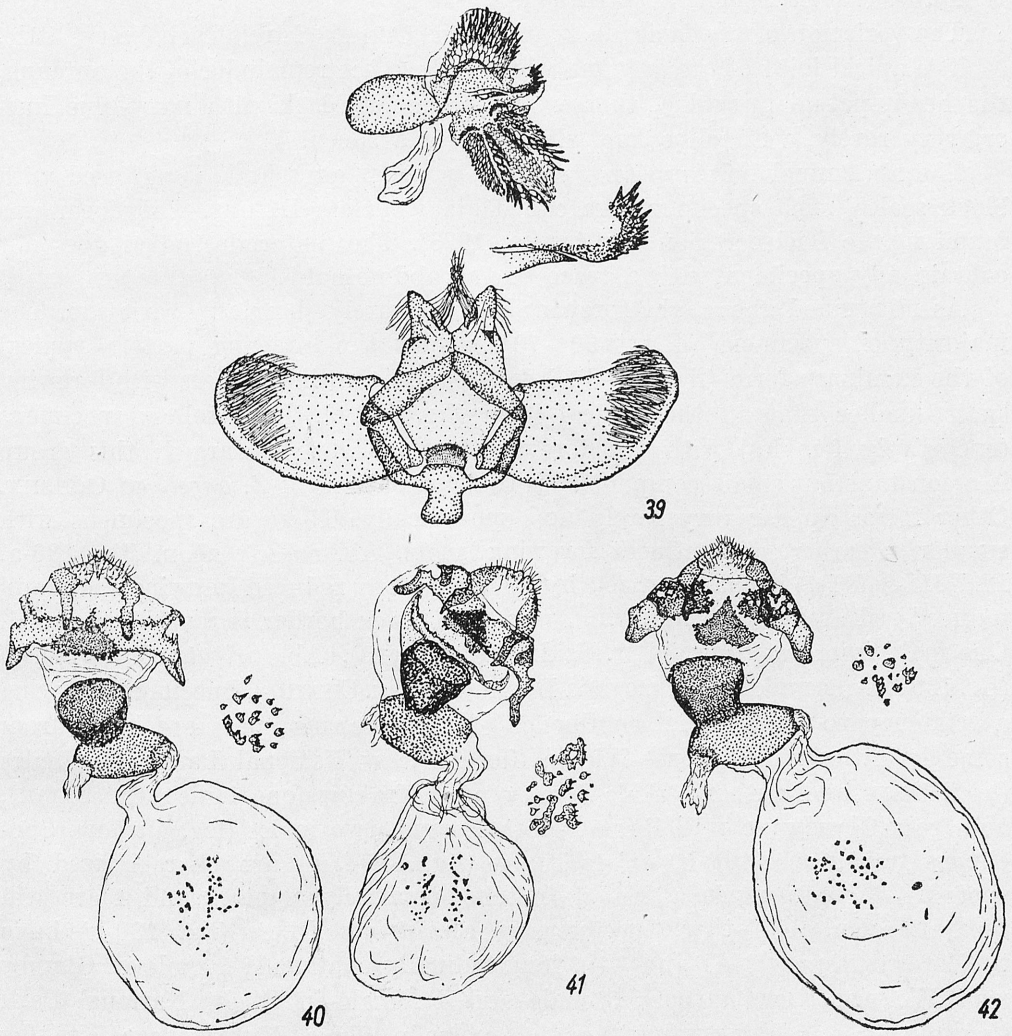
In general, the most variable structures of the male genital armatures are:



Figs. 35—38. Male genital armatures. 35 — *Zygaena angelicae* Ochsen., Ojców National Park, Młynnik, 6. VII. 1959. Genital Slide No. 101. 36 — *Z. angelicae* Ochsen., Kraków, Mydlniki, 2. VIII. 1955. Genital Slide No. 114. 37 — *Z. angelicae* Ochsen., Ojców National Park, Grodzisko, 26. VIII. 1957. Genital Slide No. 85. 38 — *Z. angelicae* Ochsen., Ojców National Park, „Wędrowcy", 17. VIII. 1957. Genital Slide No. 130.

the „plate“ and then the cornuti and uncus. Less variation is found in the armature of the saccus, anellus and valvae.

Female genital armature (figs. 40—42): Signum present, spines of signum in two rows; they have broad bases and tend to be confluent in irregular rugged agglomerations consisting of two to seven spines. Ductus bursae partly heavily sclerotized, rounded and more heavily sclerotized at ductus seminalis. Ostium bursae heavily sclerotized, in the form of a broad bowl. „Plate“ triangular with irregular, rugged margins; pointing towards papillae anales. Lower margin



Figs. 39—42. Genital armatures. 39 — *Zygaena angelicae* OCHSEN., male, Glanów, Imbramowice, 9. VIII. 1959. Genital Slide No. 176. 40 — *Z. angelicae* OCHSEN., female, Ojców National Park, Grodzisko, 28. VIII. 1957. Genital Slide No. 112. 41 — *Z. angelicae* OCHSEN., female. Sudeten Mts., Srebrna Mt., 5. VIII. 1959. Genital Slide No. 58. 42 — *Z. angelicae* OCHSEN., female, Ojców National Park, Brama Krakowska, 31. VII. 1958. Genital Slide No. 104.

of „plate" always notched. The notch and the size of the „plate" are slightly variable. The eighth tergite short and broad. A teratologically sclerotized eight tergite is shown in fig. 42: it is medially-longitudinally divided into two very heavily but irregularly sclerotized areas with rugged margins. Anterior apophyses as long as one- third of the width of the eighth tergite, always narrow (fig. 40), more or less pointed.

The most variable components of the female genital armature are the signum, and then in less degree the ostium bursae and the anterior and posterior apophyses. However, the female genital armature of *Z. angelicae* OCHSEN tend to show little general variation.

The variation of the facies in *Z. angelicae* OCHSEN is relatively very little.

The apical joint of the antenna white-yellow, the remainder of the antenna, the head, patagia, tegulae, thorax and abdomen black with navy-blue hue, or, very rarely, with olive hue, always with a sheen.

The abdominal belt appears very rarely, when present it is suffused with black scales, such specimens are called ab. *cingulata* DZIURZ. This form was found in the Kielce region (BIEŻANKO, 1923). The material studied does not contain any specimen with a trace of the abdominal belt.

As mentioned above, the forewing pattern rarely show any variation. The majority of specimens (about 60—70%) show the forewing pattern typical of the nominate form (fig. 130-d). Less frequent are individuals with forewing spots smaller than in the typical form (fig. 130-c). Then follow specimens (exclusively females) with the forewing spots slightly enlarged; this group is a constant but small component of the populations of *Z. angelicae* OCHSEN. Other forms appear very rarely and sporadically. These are specimens with smaller or larger, or confluent forewing spots. Ab. *reducta* **ab. n.** (fig. 130-a, Pl. VIII-8, XI-7) is characterized by the completely reduced forewing spots and reduced red area of the hindwing, when the black border is much broadened. One male from Jaworów, distr. Szkło (leg. SOŁTYS). Ab. *privata* SHELJUZHKO (fig. 130-b), one male from Przeginia Duchowna (leg. CHMIEL). Specimens showing a tendency to longitudinal confluence of the forewing spots are know from some localities in Kraków—Wieluń Jura: Ojców National Park, two males (leg. PALIK and author), Skała Kmity near Kraków, one male (leg. PALIK), and from Glanów near Wolbrom, south Poland, two males (leg. author). Specimens transitional to ab. *striata* REISS (fig. 130-f, g) are characterized by spots 3+5 confluent in a triangle notched ventrally; spots 2 and 4 are still separate from each other. Specimens of ab. *striata* REISS (fig. 130-h) have the forewing spots 2—4 and 3—5 longitudinally confluent; 1 male in Glanów near Wolbrom (leg. author), 3 male and 4 female in Ojców National Park (leg. author and PRUSZYŃSKI), and 1 male in Skała Kmity near Kraków (leg. PALIK). Ab. *confluens* DZIURZYŃSKI — one female in Podgórki Tynieckie near Kraków (leg. PRUSZYŃSKI). Specimens of ab. *sexmaculata* DZIURZ. (fig. 130-e) are very scarce, they show a small additional spot 6 which is always linked with the spot 5 by a narrow bridge. One female from Klonów near

Miechów (leg. author), Bieżanko (1923) cited this form from the Kielce region. RAZOWSKI (1953) captured in Podgórki near Tyniec, distr. Kraków, one male showing asymmetry of the forewing pattern: left forewing normal, while the right forewing shows the spots broadly confluent with each other.

Fringes of the fore- and hindwing black. The black margin of the hindwing is rather constant. The ground colour of the forewing is black with a navy-blue hue and a strong sheen. Some females show a green-olive hue. Wings non transparent. The majority of specimens (about 60—70 %) show the forewing spots carmine with a crimson hue. A good number of individuals, however, have these spots carmine with a cinnabar hue. Such specimens, especially females, show in many instances the hindwing partly lightened with orange-yellow, this is ab. *dichroma* REISS. Very scarce are specimens of ab. *doleschalli* RÜHL., which is characterized by the light yellow forewing spots and hindwings: one female from Segiet near Bytom (leg. RAEBEL), one male and three females from Podgórki near Tyniec, distr. Kraków (leg. PRUSZYŃSKI and SKALSKI). STUGLIK captured in Cisownica near Cieszyn one male of ab. *brunnensis* SKALA, which is characterized by the dark brown forewing spots and the hindwings.

The average length of the forewing in the majority of specimens is 14·8 mm. in the males and 15·5 in the females. About 5 % of individuals show the forewing longer than 16 mm. Dwarf specimens with the forewing shorter than 10 mm. are in 5—10 % of the individuals and are on the wing towards the end of the brood of the species (August).

The species finds the optimal conditions to live on the grassy limestone, xerothermic localities where, even in very small areas, the populations are very large, which is a constant factor in spite of a proportionately large number of specimens that are affected by parasites. This species also occurs in damp biotopes (e.g. Sowie Mts. and several localities in Lover Silesia), where it may be found in glades together with *Z. trifolii* (ESP.), however, the populations are very poor, which suggests that the conditions are not suitable for the species.

The larva of *Z. angelicae* OCHSEN. feeds on *Coronilla varia* L., *Oxytropis pilosa* D. C. and on *Lotus corniculatus* L.

The adult individuals are generally most active on warm and sunny days, especially in the early afternoon; the flight of the females being more heavy than that of the males. The flight is limited, and the specimens do not disperse from their habitat which is always in the vicinity of a woodland. The species is confined to open areas. The specimens rest singly during the night on the stems or under the flowers or herbs. They do not gather in clusters even in localities where there are very large populations.

Z. angelicae OCHSEN. is distributed mainly in eastern Europe, however, it is known also from Poland, Czechoslovakia, east Tirol, Bavaria, Hungary and Roumania, and in the Balkans ranges to north Greece. The northernmost localities of this species in Northern Poland. The detailed data on the occurence of this species in northern Poland need of further through study, since *Z. ange-*

licae OCHSEN. is rather scarce in Poland and, on the other hand, the northern territories of Poland are still poorly worked by lepidopterist. As far as I know, *Z. angelicae* OCHSEN. ranges from western Pomerania to the Gdańsk region, then the edge of distribution runs through the Mazurian Lake District south-east to the Łomża region, and from there south to the Zamość region. However, the distribution of this species in Poland is not uniform, and depends on the region; the largest populations were found in south Poland, especially in the Małopolska and Lubelska Highlands, and locally in the Pieniny Mts. and the Bieszczady Mts. Populations from the north Poland and Lower Silesia are always poor.

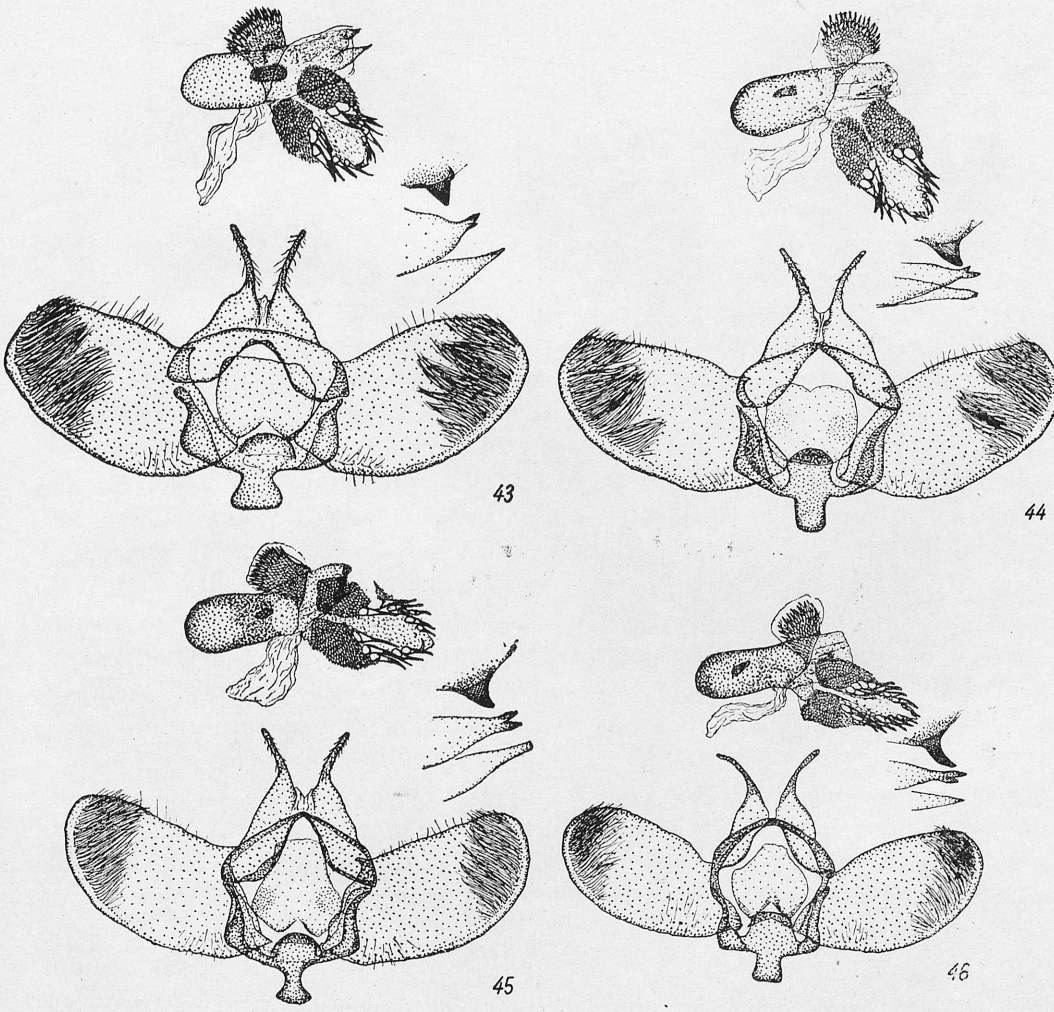
The species appears from 50 m. alt. (Gdańsk-region) to 980 m. alt. (Pieniny Mts., Bieszczady Mts.). NIESIOŁOWSKI (1929) cited this species (after NOWICKI, ŻEBRAWSKI and KLEMENSIEWICZ) from the Tatra Mts. However, in spite of the investigations of the author and the study of many collections, no specimen from the Tatra Mts. has been found. In the Balkans, *Z. angelicae* OCHSEN. appears over 2300 m. alt. (BURESCH & TULESCHKOV, 1944) and from the Czechoslovakian Tatra it was recorded from the Mlynica and Furkotna Valleys (1500 m. alt.) by GREGOR & POVOLNÝ, 1951.

7. *Zygaena filipendulae* (LINNAEUS, 1758)

Male genital armature (figs. 43—46): valva rather elongate with margins elongate; corona well developed. Uncus with base broad, the paired processes in caudal halves narrowed to thin, broadly opened rods. Tegumen semi-circularly domed, narrowed in middle. Saccus variable, it may be broad (fig. 43), or narrowed (fig. 44), with or without basal constriction. Anellus rather variable but always notched basally, with no special sculpture. Aedoeagus slightly longer than valva. „Plate" elongate, its size variable; full of short tiny spines. Three lamella-shaped cornuti. The first cornutus with a variable, heavily sclerotized spine: it may be triangular (fig. 43) to elongate and curved (fig. 46). The remaining two cornuti are rather similiar to each other in individual specimens, however, they differ in the number of spines. The second cornutus is rather broad, tapering terminally and is armed with two short spines. The third cornutus is narrower than the second one, it is lancet-like pointed, has usually only one spine, while the other one, when present is vestigial (fig. 44). Lamina ventralis rather shorter than half of the length of aedoeagus. The most variable structures of the male genital armatures are the cornuti, the saccus, the „plate", and the anellus.

Female genital armature (fig. 47—52): very characteristic is the signum, the spines of which are in two rows on the bursa copulatrix; the spines are short, sharply pointed, with more or less broad bases, which only rarely are joined with each other in clusters of two to four. In some specimens the spines of the signum show a tendency to become smaller and fewer in number (fig. 50). Ductus bursae near bursa copulatrix narrowed and lightly sclerotized, becoming

broader and more heavily sclerotized towards the ostium bursae. The degree of the sclerotization of the ductus bursae is rather variable in individual specimens. Ostium bursae broad, very slightly sclerotized. „Plate" heavily sclerotized, with margins rugged; very variable in shape. The eighth tergite evenly sclerotized, always very slightly narrowed in the middle. Anterior apophyses more or less tapered and pointed apically. Posterior apophyses broad basally, strongly tapering apicad. In a specimen taken in the Miechów region (fig. 52) there is an asymmetrical atrophy of half of the ovipositor: papillae anales are partially reduced and posterior apophyses are vestigial. The remainder



Figs. 43—46. Male genital armatures. 43 — *Zygaena filipendulae* (L.), Rabka, Grzebień, 22. VII. 1955. Genital Slide No. 306. 44 — *Z. filipendulae* (L.), Hel, Jurata, 6. VIII. 1956. Genital Slide No. 276. 45 — *Z. filipendulae* (L.), Myślenice, Stróża, 27. VII. 1957. Genital Slide No. 301. 46 — *Z. filipendulae* (L.), Wrocław region, Radunia ad Ślęża, 4. IX. 1960, Genital Slide No. 244.

of the genital armature as the habitus of the specimen in question are normal. The most variable structures of the female genital armatures are the ductus bursae and the „plate", then the signum, the eighth tergite and anterior apophyses.

Antennae, head, patagia, tegulae and thorax black with a navy-blue sheen. Abdomen entirely black with no red belt.

The forewing pattern is composed of six spots which are separate from each other (fig. 131-c). This type of forewing pattern, typical of the nominate form of *Z. filipendulae* (L.), is the dominant one in the Polish populations of this

Figs. 47—52. Female genital armatures. 47 — *Zygaena filipendulae* (L.), Tatra Mts., Żar, 9. IX. 1957. Genital Slide No. 122. 48 — *Z. filipendulae* (L.), Tatra Mts., Żar, 7. IX. 1957. Genital Slide No. 123. 49 — *Z. filipendulae* (L.), Klonów, Wały, 23. VIII. 1960. Genital Slide No. 307. 50 — *Z. filipendulae* (L.), Myślenice, Stróża, 17. VIII. 1958. Genital Slide No. 239. 51 — *Z. filipendulae* (L.), Bydgoszcz, Zacisze, 18. VIII. 1956. Genital Slide No. 315. 52 — *Z. filipendulae* (L.), Klonów, Wały, 23. VIII. 1960. Genital Slide No. 310.

species (about 50—80 % of specimens). The reduction of the forewing pattern is shown by the diminution of all six spots. Spot 6 may be completely reduced such specimens are named ab. *quiquemaculata* VORBR. (fig. 131-b); this form, is very scarce, one male was taken in the Pieniny Mts., and two males transitional to this form were captured by the author at Klonów near Miechów, South Poland. Extreme forms with spots 3, 4 and 5 reduced, named ab. *holingeri* GREG. & POVOLNY (fig. 131-a) and described from Moravia, have not as yet been found in Poland. The forewing spots may be enlarged and in such instances the spots are linked with each other in pairs: ab. *basiconfluens* VORBR. have linked spots 1+2, then ab. *medioconfluens* VORBR. 2+4, ab. *unitella* CROMBRUGGE (= ab. *apicaliconfluens* VORBR.) 5+6 (fig. 131-f), ab. *basalimedioconfluens* VORBR. 1+2 and 3+4, ab. *medioapicaliconfluens* VORBR. 2+4 and 5+6, ab. *apicalielongata* VORBR. 3+4 and 5+6, ab. *basimedioconfluens* VORBR. 1+2 and 3+4, ab. *trimaculata* VORBR. (= ab. *cytisi* HBN.) (fig. 131-g) 1+2, 3+4 and 5+6, and ab. *confluenta* **ab. n.** (fig. 131-e) with 3+5, one male from Pilica: Czarny Las, Central Poland (coll. MASŁOWSKI) and one male captured by the author at Myślenice, south Poland. The representatives of the above mentioned forms appear in Poland rather rarely and sporadically. Also very scarce are specimens with the forewing spots showing a tendency to a longitudinal confluence: ab. *proconfluens* TUTT with spots 1 separate, and 2+3+4+5+6 confluent. One female transitional to ab. *polygalae* ESP. (fig. 131-h) was taken in the Ojców National Park, and one female in Racławice near Miechów (leg. author). The ab. *polygalae* ESP. with forewing spots confluent over nearly the entire wing surface (only the costa is outlined with black) has not yet been found in Poland. The forewing is non-transparent, being intensively coloured: dark blue-green, rarely in the females with an olive hue, always with a sheen. The fringe of the fore- and hindwing is always black. The forewing spots and hindwing in 60—80 % of specimens are carmine with a crimson hue. Also rather common, especially in the populations occuring in the xerothermic grassy localities, are specimens transitional to ab. *miniata* TUTT, which is characterized by the lighter, rather cinnaber forewing spots and hindwings. Typical specimens of ab. *miniata* TUTT, which the forewing spots and hindwings cinnaber-bricky are extremely scarce. To ab. *aurantia* TUTT belong individuals with the forewing pattern and hindwings dark orange-yellow; one male and one female of this form were taken in Bydgoszcz, by RODOWICZ. Specimens of ab. *flava* ROBSON have the forewing pattern and hindwings yellow; one example of each sex taken by RAEBEL at Segiet near Bytom. Ab. *intermedia* TUTT is characterized by orange red spots and hindwings; one male from Segiet near Bytom (leg. RAEBEL). — Specimens of ab. *brunnescens* COCKAYNE, with coffee-brown spots and hindwings have not as yet been found in Poland. Ab. *chrysanthemi* BKH. is characterized by the dark brown colour with a violet hue; two females at Skotniki near Kraków (leg. author).

The average length of the forewing in the majority of specimens is 14·8 mm. in the males and 15·5 mm. in the females. The specimens with forewing 16·5 mm.

long are very scarce. Specimens of ab. *minor* TUTT with forewing shorter than 10 mm. are also scarce and sporadical, they occur always towards the end of the brood of the species in the second half of August and in early September: one male in St. Anna Mt. (leg. RAEBEL) and two males at Radunia near Ślęza Mt. (leg. SZPOR).

As *Z. filipendulae* (L.) occurs in many types of ecological habitats, it is one of the most common *Zygaena*-species in Poland. It occurs in moist meadows and peat-bogs, but also in grassy xerothermic localities. The populations appearing from mid-June in the moist meadows or peat-bogs, are called f. t. *stephensi* DUP. The individuals of this seasonal-form do not differ in genital armatures or habitus from those of the typical form which is decidedly more abundant and appears in the xerothermic habitats. It is of interest to note that ecological barriers and the different time of the appearance of the two forms, prevent genetic contact between them (DĄBROWSKI, 1964). In the region of Kraków f. t. *stephensi* DUP. was found at Skotniki and Kostrze (leg. author and DOBRAŃSKI). It is also known from the vicinity of Weyherowo (north Poland), three males and one female (leg. author). Individuals of the nominate form are on the wing from mid-July to early September. The species occurs in glades, woodland clearings, along country roads and even in partly cultivated areas. Thin woodlands are not ecological barriers for this species. It is a proportionately less xerothermophilous species than the other members of the genus *Zygaena* F. The larva feeds on *Oxytropis pilosa* D. S., *Coronilla varia* L., *Lotus corniculatus* L., and *Trifolium* L.

The flight of the adults is rather heavy and slow. They are most active on warm and sunny days in the afternoon. Individuals do not disperse from their habitats which are surrounded by effective ecological barrier, such as thick woods, large cultivated fields etc. In other cases, the specimens may fly for over 500 m. distance from their habitat. The populations are rather numerous, however, they never appear in masses as other species, e.g. *Z. carniolica* (SCOP.), or *Z. angelicae* OCHSEN. The specimens rest singly during the night on the stems and flowers of herbs.

The species is distributed in west, central, south and partly north-east Europe, as well as west Asia. According to HOLIK (1939), *Z. filipendulae* (L.) is a ponto-mediterranean element in the Polish fauna. The species is distributed throughout Poland, even in the mountains. It appears from practically sea level to about 1600 m. alt. in the Tatra Mts. (Żar).

The species appears to be decidedly resistant to the negative factors of the habitat, showing a good ability to endure and even partly to accomodate itself to habitats changed under cultivation.

8. *Zygaena trifolii* (ESPER, 1783)

Male genital armature (figs. 53—57): valvae rather broad, costal margin slightly convex, ventral and caudal margins arched. Corona rather well developed. Processes of uncus short, broad basally, tapering apically, more or

less acuminate; they may be more or less opened. Tegumen elongate, not domed, with a strong median constriction. Saccus rather variable, from short and broad with no basal constriction (fig. 54) to elongate, narrow with a basal constriction (fig. 55). Anellus usually sub-squared, often with basal edge notched. The basal portion of the anellus is more heavily sclerotized than the remainder (fig. 57). Very rarely there are two symmetrical „spots" on the anellus. Aedoeagus slightly longer than valva. „Plate" very lightly sclerotized, very small (fig. 56), or even completely reduced. Three lamella-shaped cornuti present. The first cornutus in the shape of a broad, triangular or prong-curved spine. The second cornutus is armed with three to seven spines. The third cornutus is narrow, elongate, less heavily sclerotized than the remaining two cornuti, and is terminated by two tiny spines. Lamina ventralis as long as one-fourth of the lenght of the aedoeagus covered with very tiny spines; its upper margin is armed with numerous larger spines. Lamina dorsalis slightly longer than half of aedoeagus.

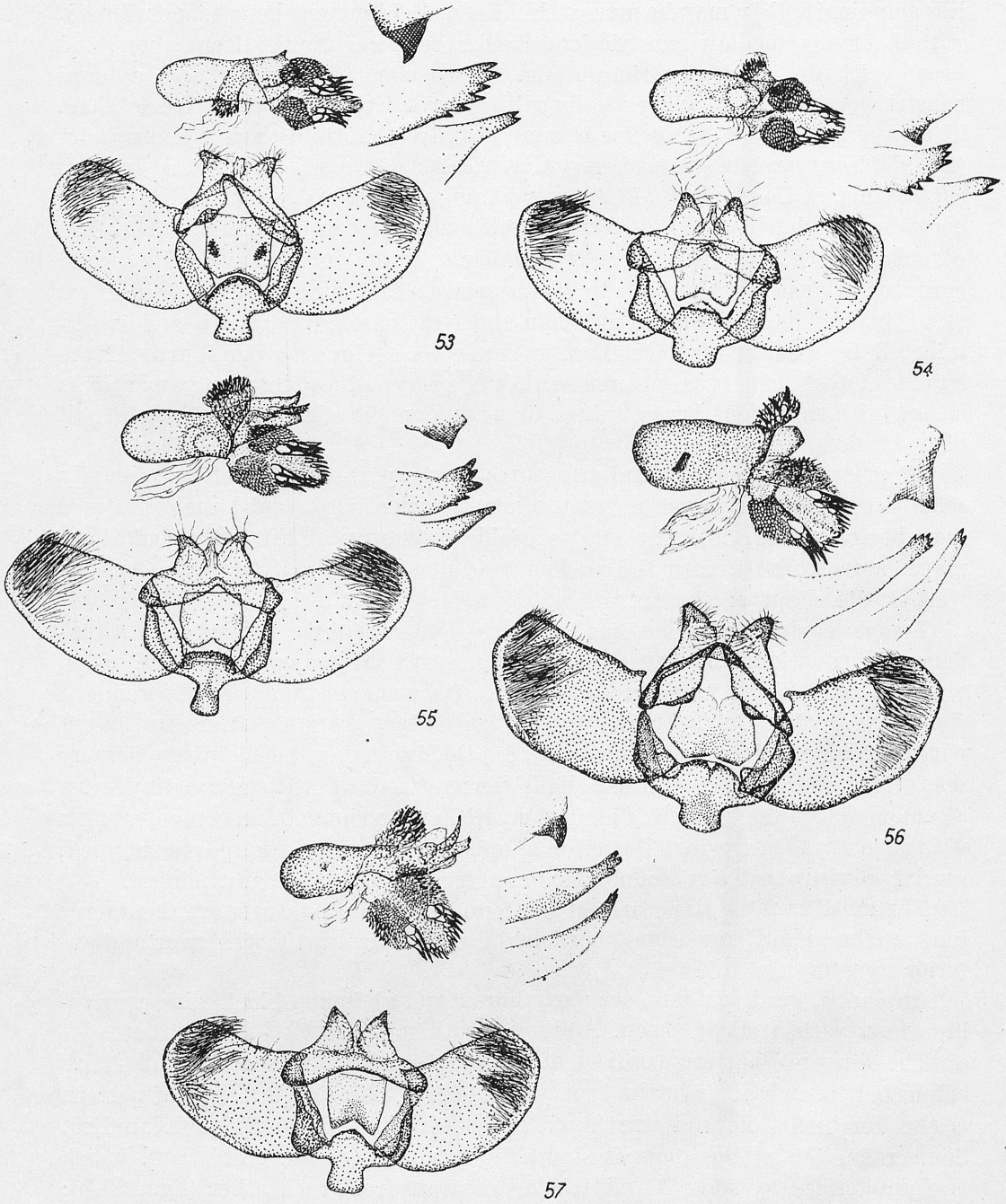
In general, the male genital armatures are proportionately not very heavily sclerotized, however, sometimes more heavily sclerotized, and large armatures may be found (fig. 56). The most variable structures of the male genital armatures are cornuti, then the anellus, the uncus, the „plate", and saccus, as well as the shape of the valva.

Female genital armature (figs. 59—62): signum slightly marked with a tendency to reduction. The spines of the signum with sharp apexes and oval bases, always arranged in two broad rows; tiny, in some instances partly reduced (fig. 59). Ductus bursae rather broad, with very variable sclerotization of part of the walls. In one specimen (fig. 61) the ductus bursae is entirely heavily sclerotized. Ostium bursae broad, lightly sclerotized. „Plate" always tiny, with a tendency to reduction (fig. 61). The eighth tergite elongate, in some instances with a median narrowing. Posterior apophyses narrow, their apexes rounded, rarely pointed. Anterior apophyses broad basally, with apexes pointed.

The most variable structures of the female genital armatures are the ductus bursae, the „plate" and signum, then the eight tergite, the posterior and anterior apophyses.

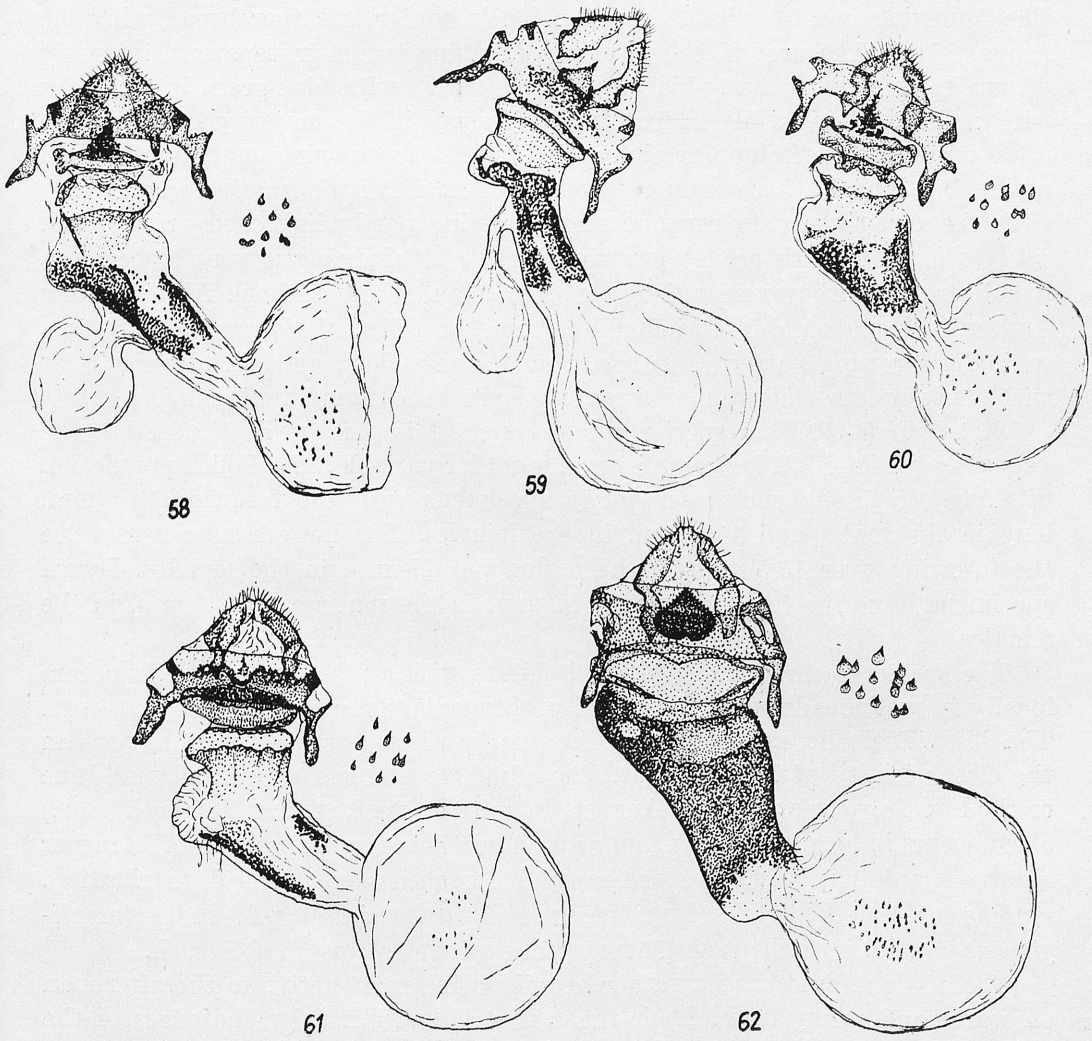
Antennae, head, patagia, tegulae, thorax and abdomen black with a navy-blue hue, with a slight sheen. Abdomen with no red belt.

The forewing pattern consists of five spots, of which spots 3 and 4 are connected to each other in the typical form (fig. 132-c). Such a type of pattern is the dominant one and was found in 50—75 % of the individuals studied. Some reduction of the spots is shown in specimens of ab. *orobi* Hbn. which is characterized by spots 3 and 4 being separate from each other (fig. 132-b); they are rather common as and occur as 10—20 % of the population. The diminuation of the forewing spots with spot 3 reduced appears rarely, one male transitional to ab. *obsoleta* Tutt was found in Jamy near Grudziądz (leg. Toll). No specimen with spot 3 completely reduced has as yet been found in Poland. Rather fragment is the enlargement of the forewing spots in the



Figs. 53—57. Male genital armatures. *Z. trifolii* (Esp.), Oliwa—Jelitkowo, 6. VII. 1956. Genital Slide No. 83. 54 — *Z. trifolii* (Esp.), Oliwa—Zwierzyniec, 28. VII. 1956. Genital Slide No. 248. 55 — *Z. trifolii* (Esp.), Tyniec, Podgórki, 23. VII. 1960. Genital Slide No. 240. 56 — *Z. trifolii* (Esp.), Grudziądz, Jamy, 20. VII. 1916. Genital Slide No. 97. 57 — *Z. trifolii* (Esp.), Dulowa ad Trzebinia, 13. VII. 1953. Genital Slide No. 121.

forewing and their longitudinal confluence. Ab. *basalis* SELYS-LONGSCHAMPS has the forewing spots 1+2+3+4 and spot 5 separate. Then ab. *costalielongata* VORBR. (fig. 132-d) show spot 1 extended along vein sc and linked with spot 3; this form is very scarce. Ab. *glycirrhizae* HBN. is characterized by confluent spots 1+2 and 3+4+5. Ab. *minoides* SELYS-LONGSCHAMPS (= ab. *confluens* STGR.) (fig. 132-f) has all five spots linked with each other by narrow bridges. In extreme cases the red spots are spread over nearly the entire surface of the forewing while the black ground is limited to a narrow edge along the costa,



Figs. 58—62. Female genital armatures. 58 — *Zygaena trifolii* (ESP.), Dzierżoniów, Dębowa Góra, 15. VII. 1958. Genital Slide No. 96. 59 — *Z. trifolii* (ESP.), Grudziądz, Jamy, 27. VII. 1916. Genital Slide No. 324. 60 — *Z. trifolii* (ESP.), Oliwa—Jelitkowo, 24. VII. 1956. Genital Slide No. 84. 61 — *Z. trifolii* (ESP.), Oliwa—Jelitkowo, 24. VII. 1956. Genital Slide No. 39. 62 — *Z. trifolii* (ESP.), Oliwa—Zwierzyniec, 28. VII. 1956. Genital Slide No. 88.

such specimens are called ab. *extrema* TUTT. No specimen of ab. *extrema* TUTT has as yet been found in Poland. Also ab. *sexmaculata* OBERTH. with spots 1, 2 separate, spots 3+4 confluent with each other and an additional spot 6 connected to spot 5 is unknown from Poland. The specimen cited by STUGLIK (1934: 22, pl. 1, fig. 5) belonged to *Z. filipendulae* (L.). Ab. *confluenssexmaculata* OBERTH. (fig. 132-g) with all six spots confluent with each other; one male and one female were taken at Podgórki near Tyniec, distr. Kraków (leg. DOBRAŃSKI and author). The majority of the specimens with confluent spots are females. A slight asymmetry in the pattern of these specimens is observed. The hindwing is not variable and the black border is rather broad with the fringes black. The ground colour of the forewing is non-transparent, intensely coloured; black with navy-blue hue, more rarely with blue-green hue, always with a sheen. Fringes black. The forewing spots in the majority of specimens are crimson. Also common are individuals with the forewing spots lighter with a cinnabar hue. Rather common (especially females) is ab. *semilutescens* HIGGS with the forewing spots carmine and hindwing partly lightened orange. Ab. *intermedia* TUTT with orange forewing spots and hindwing is very scarce: one female from Jelitkowo near Oliwa (north Poland) (leg. author). Ab. *incarnata* TURATI with spots and hindwing pale carmine, as well as ab. *lutescens* COCKERELL with the forewing pattern and hindwing lemon-yellow, and ab. *obscura* TUTT with dark brown coloration have not as yet been found in Poland.

Z. trifolii (ESP.) is a species rather constant in size, while the size of the very closely related *Z. lonicerae* SCHEV. is rather variable. The Polish population of *Z. trifolii* (ESP.) show a majority specimens with the forewing 14·5 mm. long in the males and 15·5 mm. in the females. The largest specimens have the forewing over 15·5 mm. in the males and 17 mm. in the females. Dwarf specimens have the forewing length 12 mm. in the males and 12·8 mm. in the females.

The species occurs exclusively in habitats with a marshy ground. It occurs locally in wet meadows in the vicinity of woodlands, as well as in peat-bogs. The individuals do not enter xerothermic localities, even when these are in the close vicinity of their habitat. The adults are on the wing from mid-June to the late July, or even early August. In spite of the fact that *Z. trifolii* (ESP.) often occurs in localities in lowland or with north-eastern exposure, it is a rather xerothermophilous species, as one can judge from its geographical distribution.

The larva of *Z. trifolii* (ESP.) feeds on *Lotus corniculatus* L. and *Lotus uliginosus* SCHK., as well as on some species of the genus *Trifolium* L.

The adult individuals fly rather heavily being most active in the afternoon on warm and sunny days. Their flight is strictly limited by the edges of the habitat. Dry, grassy, xerothermic localities, cultivated fields, high dry slopes or thick woods are very effective ecological barriers to this species. The populations are rather large, but are not as large as those of *Z. carniolica* (SCOP.) or *Z. angelicae* OCHSEN. The specimens rest singly during the night on stems of grass and *Cirsium* Adans.

Z. trifolii (Esp.) is distributed in west, south and east Europe, and in north of Africa (Holik, 1959). According to Holik (1939) this species is an European-west-mediterranean element in the fauna of Poland. It occurs throughout Poland except for the Tatra Mts. Also it has not been found in the Pieniny Mts., and the data of Sitowski (1910) are referable to the allied *Z. lonicerae* (Scheven). Still we have no detailed data on the occurrence of the species under consideration in the Carpathians. On the other hand, the species is very abundant in the Sudeten Mts., where it appears up to 980 m. alt. (Sowie Mts.). It is also very common in north Poland.

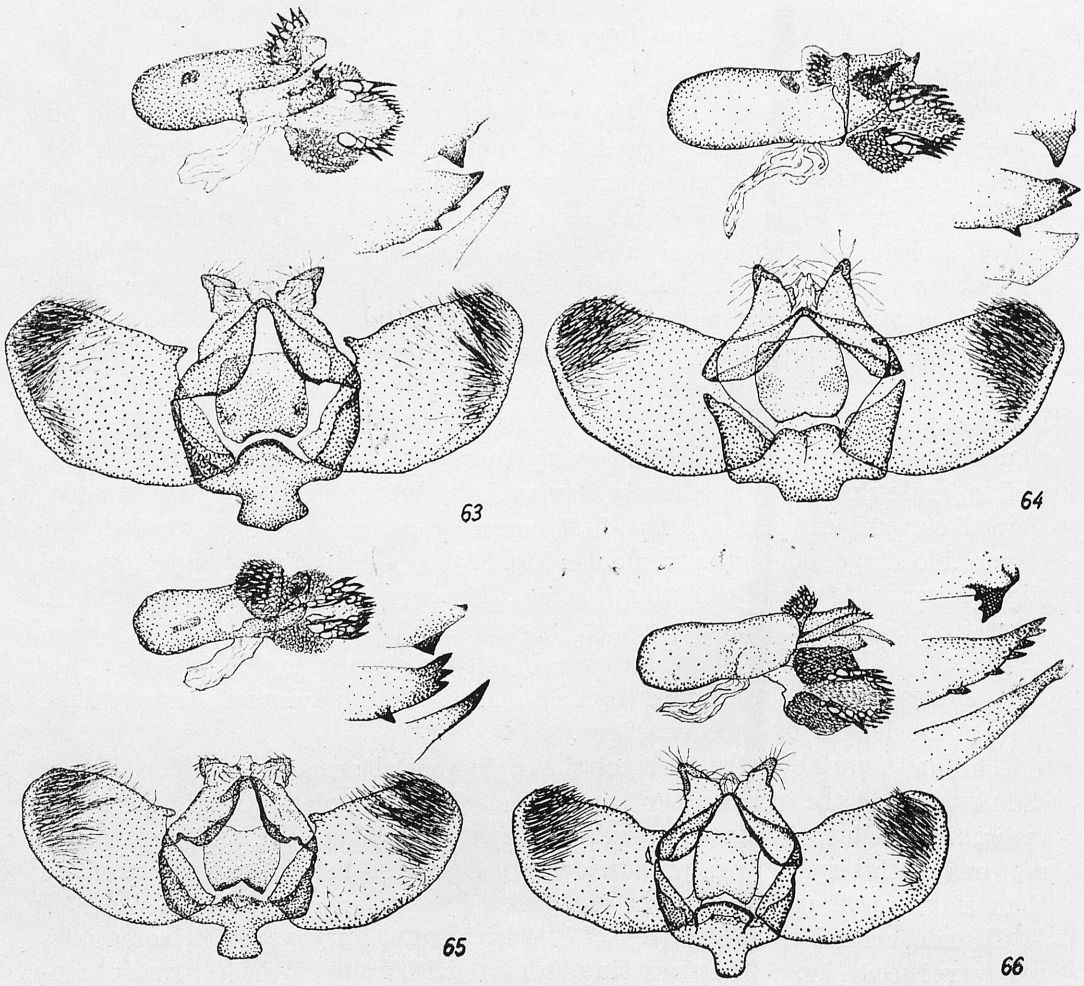
9. *Zygaena lonicerae* (Scheven, 1777)

Male genital armature (figs. 63—66): valvae rather broad, costal margin straight or slightly arched, caudal and ventral margins arched. Corona well developed. Processes of uncus short, more or less opened (figs. 64, 65), broad basally, tapering to acuminate apexes. Length of uncus slightly variable (figs. 65 and 66). Tegumen broad, with a strong median constriction. Most variable is the saccus which may be slightly developed, broad (fig. 64) to narrow with a basal constriction (fig. 65). Anellus sub-squared, always with base notched; the margin of the base may be more heavily sclerotized than the remainder (fig. 65) or, in some instances anellus shows some symmetrical, heavily sclerotized spots (fig. 64), the which are of no taxonomic importance. Aedoeagus slightly longer than valva. „Plate" very thiny, lightly sclerotized, full of just visible, scale-shaped spines; rarely it may be reduced (fig. 66). Three lamella-shaped cornuti are present. The first cornutus is armed with a single spine of variable shape: it may be triangular (fig. 63, 65), rarely prong-shaped, curved (fig. 64), or with rugged margins (fig. 66). The second cornutus is armed with three (fig. 63) to six (fig. 66) spines. Lamina ventralis from one-third to one-eighth of the length of the aedoeagus; it is characterized by a crown of rather large spines variable in number (figs. 63 and 66). Lamina dorsalis shorter than half of the length of the aedoeagus.

The most variable structures of the male genital armatures in *Z. lonicerae* (Scheven), are the cornuti, the saccus, and then the „plate", the lamina ventralis, the anellus, the uncus and the shape of the valva. The male genital armatures of this species are proportionately large and more heavily sclerotized than those in *Z. trifolii* (Esp.).

Female genital armature (figs. 67—69): signum very variable, sometimes partly reduced (fig. 68); spines tiny, conical with rounded bases, rarely confluent in pairs, grouped in two broad bands, variable in number (figs. 67 and 68). One of the examined specimens shows an additional, oval, heavily sclerotized plate outside of signum (fig. 69), however, it is a rather teratological feature. This specimen is of a very small size (forewing 13 mm. long). Ductus bursae in all specimens examined very heavily sclerotized with a mouth of ductus

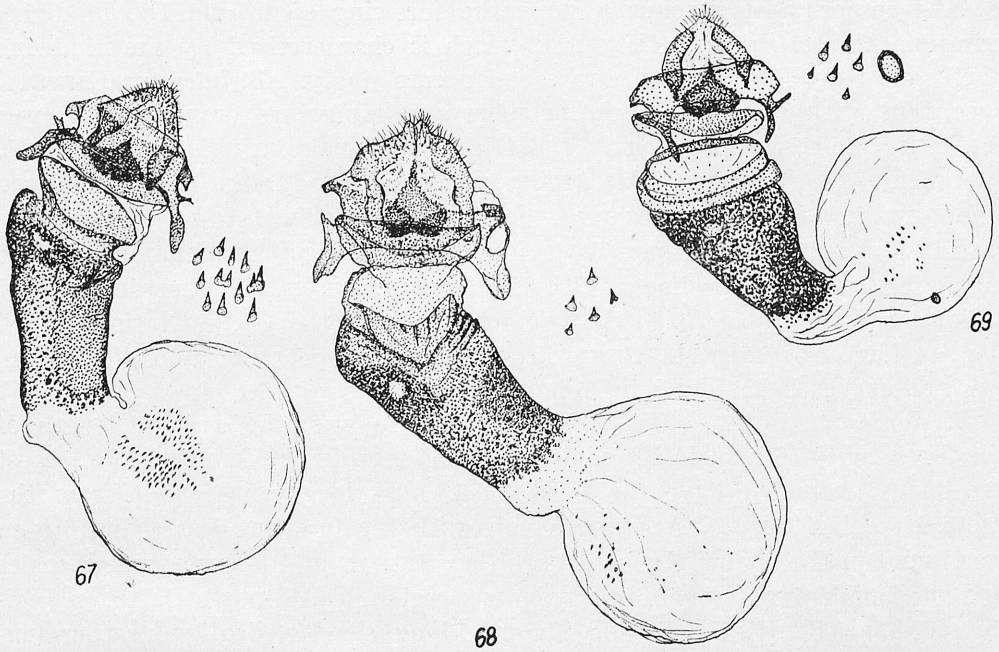
seminalis rounded. The variation of the degree of the sclerotization is rather slight. Ostium bursae broad, lightly sclerotized. „Plate" always heavily sclerotized, well developed, usually heart-shaped. Anterior apophyses in most instance rather narrow, with apexes rounded (fig. 67) or broad (fig. 68), rarely pointed (fig. 69). Posterior apophyses always broad and rounded (figs. 67, 68), only in some instances thin and pointed (fig. 69). In general, the female genital armatures are proportionately heavily sclerotized. The most variable structures are signum, anterior and posterior apophyses, then the ductus bursae and the „plate".



Figs. 63—66. Male genital armatures. 63 — *Zygaena lonicerae* (SCHEVEN), Ojców National Park, Młynnik, 2. VII. 1957. Genital Slide No. 96. 64 — *Z. lonicerae* (SCHEVEN), Ojców National Park, Młynnik, 15. VII. 1958. Genital Slide No. 263. 65 — *Z. lonicerae* (SCHEVEN), Ojców National Park, Sąspowska Valley. 22. VII. 1958. Genital Slide No. 165. 66 — *Z. lonicerae* (SCHEVEN), Ojców National Park, Młynnik, 19. VII. 1959. Genital Slide No. 236.

Antennae, head, patagia, tegulae, thorax and abdomen black with a navy-blue hue and a slight sheen. Red abdominal belt always absent.

The forewing pattern consists of five spots which, in the typical form, are separated from each other (fig. 133-c). Such a pattern is shown in the majority of specimens (50—80 %). The reduction of the forewing pattern is shown by the diminution of the spots. Ab. *kratochvili* Gregor & Povolný (fig. 133-a),



Figs. 67—69. Female genital armatures. 67 — *Zygaena lonicerae* (Scheven), Ojców National Park, Młynnik, 3. VII. 1957. Genital Slide No. 87. 68 — *Z. lonicerae* (Scheven), Rabka, Grzebień, 25. VII. 1954. Genital Slide No. 93. 69 — *Z. lonicerae* (Scheven), Bydgoszcz, Rynkowo, 3. VIII. 1956. Genital Slide No. 237.

which is characterized by the completely reduced spots 2, 3, 4 and 5, has not as yet been found in Poland. The enlargement of the elements of the forewing pattern is found in the species in question by far more rarely than in *Z. trifolii* (Esp.). Especially scarce is longitudinal confluence of the forewing spots. Ab. *centripunctata* Tutt (fig. 133-d) is characterized by spots 3+4 confluent with each other; this is most common form showing some confluence (10—25 % of specimens). Ab. *confluens* Oberth. (fig. 133-e), characteristic by the confluence of spots 3 and 5 by a narrow bridge, is known only by one male from the environs of Bydgoszcz (leg. Rodowicz) and one male from the Ojców National Park (leg. author). Ab. *rubescens* Bgff. (fig. 133-g) is characterized by the ground colour suffused with red scales between spots 2, 4 and 5, as well as the diffused edges of the spots; one female from Grzebień near Rabka, south Poland (leg. author). A female specimen transitional to ab. *rubescens* Bgff.

(fig. 133-f) was taken in the Bydgoszcz region (leg. RODOWICZ). Forms characterized by the stronger confluences of the forewing spots (e.g. ab. *bercei* SAND., fig. 133-h) have not as yet been found in Poland. Also ab. *sexmaculata* DZIURZ. with an additional spot 6 is unknown from Poland.

Ground colour of the forewing is non transparent, intensively coloured, however, not so as in *Z. trifolii* (ESP.); it is black with a navy-blue hue, more rarely with blue-green hue, always with a strong sheen. Fringes always black.

The majority of specimens show the forewing spots and the hindwing crimson. Ab. *semilutescens* HEWETT, which is characterized by the hindwing partly orange-yellow, is rather rare and occurs singly. Ab. *lutescens* HEWETT, specimens with have the forewing spots and hindwings orange-yellow, was found in one male specimen in the Ojców National Park (leg. author). No specimen of typical ab. *chalybea* AURIV., which is characterized by the darkened smoky-red forewing spots, has as yet been found in Poland. However, specimens transitional to this form have been found in the Ojców National Park (four males leg. author). Specimens with the forewing spots and hindwings bright yellow are called ab. *citrina* SPULER; one male in the Ojców National Park (leg. author). Ab. *hades* METSCHL with the forewing spots and hindwing brown, has not as yet been found in Poland.

Z. lonicerae (SCHEVEN) is rather variable in size: the average length of the forewing is 16 mm. in the males and 16·5 mm. in the females. The largest specimens examined have the forewing 19 mm. long (one female from the Złote Mts., leg. SZPOR). A dwarf female with the forewing less than 13 mm. was found in the Ojców National Park (leg. author) and two very small males and one female were taken in the Bydgoszcz region (leg. RODOWICZ). Ab. *sphingiformis* **ab. n.** (Pl. IX-4) forewing 16·5 mm. long, slender with apex rather acuminate; spots 5 and partly 4 enlarged, with edges indistinct; the shape of the forewing resembles that of the members of the family *Sphingidae*.

Z. lonicerae (SCHEVEN) is local and occurs exclusively in xerothermic grassy localities. The populations occuring in the mountanious regions (Sudeten Mts., Carpathians) are usually small. The adults are on the wing form early July to mid-August. The species is decidedly xerothermophilous flying on slopes well exposed to sunshine.

The larva of *Z. lonicerae* (SCHEVEN) feeds on *Onobrychis viciaefolia* SCOP., *Lotus corniculatus* L. and on some species of the genus *Trifolium* L.

The imago flies heavily, being most active in the afternoon on warm and sunny days. They are rather local and their flight is limited by the ecological barriers, however, they can pass through a thin wood. Specimens rest singly during the night on stems and under the flowers of the herbs.

This species is more widely distributed than *Z. trifolii* (ESP.) (HOLIK, 1959) It ranges through west, central, east and partly northern Europe, as well as in west Asia. According to HOLIK (1939) the species is an Euro-siberian element in the Polish fauna. The range of *Z. lonicerae* (SCHEVEN) covers nearly the whole of that of the preceding species. According to HOLIK (1959) *Z. trifolii*

(Esp.) evolved from *Z. lonicerae* (Scheven) and this is suggested by their geographical distribution. The latter species invaded ecological habitats distinct from those of the former. Judging also by the similiar facies, male and genital armatures and easy copulation between the two species, they are very closely related. *Z. lonicerae* (Scheven) occurs locally throughout Poland. It is most abundant in the Małopolska and Lubelska Highlands, and in the Pieniny Mts. In the lowlands, as well as in the mountains (Sudeten Mts. and Carpathians it is rather scarce and local. According to the data of Niesiołowski (1929) one specimen of *Z. lonicerae* (Scheven) was found in the Tatra Mts. (Strążyska Valley, leg. Rutkowski). However, since 1929 this species has not been recorded from that region.

The species occurs from practically sea level up to 980 m. alt. in the Pieniny Mts. and probably to 1200 m. alt. in the Tatra Mts.

10. *Zygaena cynarae* (Esper, 1789)

Male genital armature (figs. 70 and 71): valva stocky with curved margins; corona slightly developed. Processes of uncus straight, conical, faintly opened. Tegumen well domed. Saccus strongly projected, rounded with a basal constriction, variable in size. Anellus rounded, in some instances slightly broadened, rather evenly sclerotized. Aedoeagus one and a half times the length of valva. „Plate" absent. Two lamella-shaped, lightly sclerotized cornuti which are thickly covered with tiny, sharply pointed spines. One of the cornuti is usually smaller than the other and may even be reduced. Lamina ventralis slightly shorter than half of the length of the aedoeagus; it is evently clothed with tiny, sharp spines. Lamina dorsalis as long as half of the length of the aedoeagus. Coecum usually broad, rarely slender, with a slight constriction.

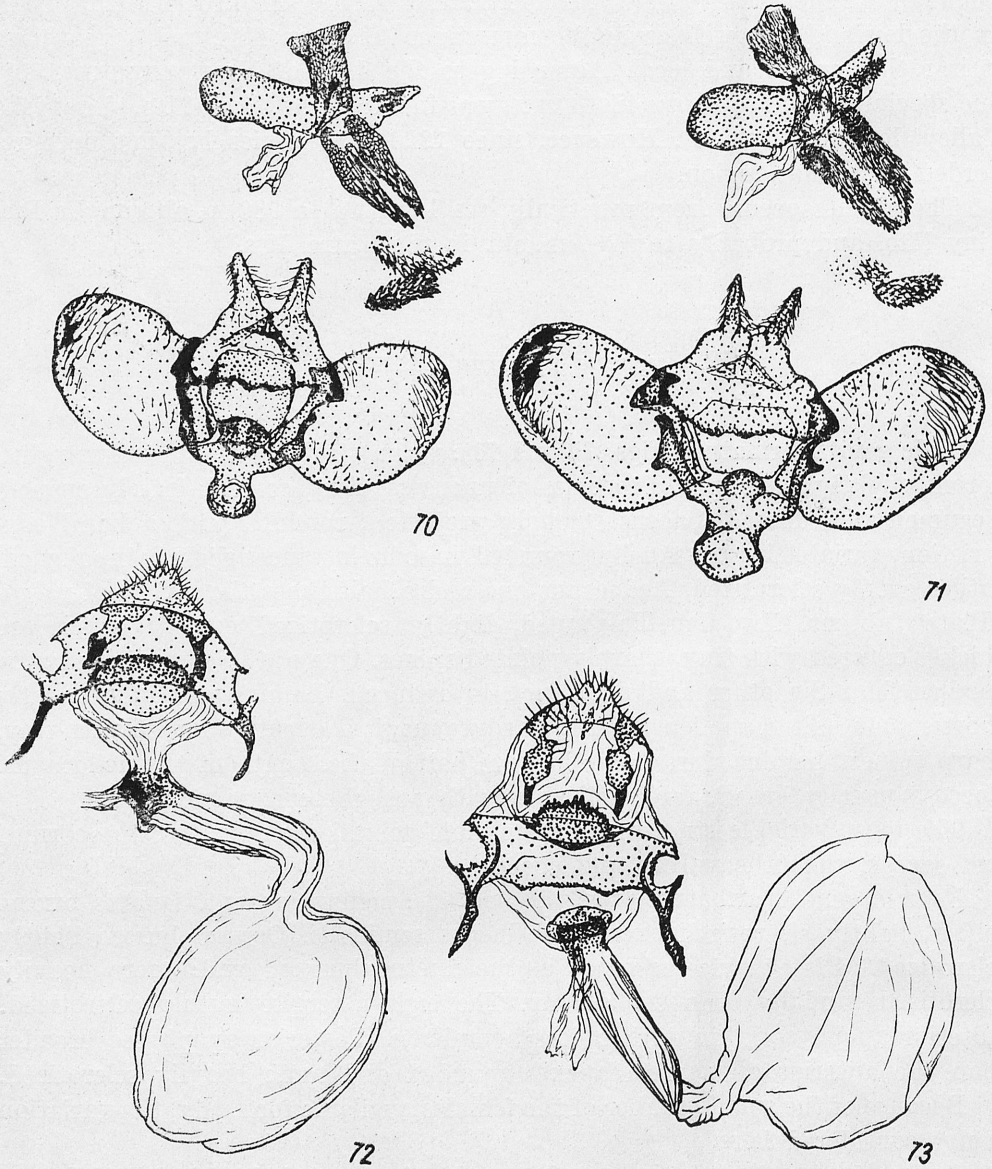
The most variable structures of the male genital armature are the cornuti and saccus, then the valvae and coecum.

Female genital armature (figs. 72 and 73): signum absent. Ductus bursae folded, lightly sclerotized except at ductus seminalis. Ostium bursae lightly sclerotized. „Plate" twice as broad as the ductus bursae, oval; more heavily sclerotized caudally than cephalicaly. The eighth tergite evenly sclerotized. Anterior apophyses thin with apices acuminate. Posterior apophyses broader than the anterior ones, with apexes rounded and more heavily sclerotized.

Because of the small number of the females available for study, the variation is not considered here.

Antennae, head, patagia, tegulae and thorax entirely black. Abdomen black with a red belt which is more or less interspersed with black scales. In typical specimens the abdominal belt covers one segment of the abdomen. Specimens of ab. *demininata* Rocci have the abdominal belt absent. This form occurs in Poland very rarely and sporadically. No specimen of ab. *tri-*

cingulata BGFF., which is characterized by the abdominal belt covering three segments of the abdomen, has as yet been found in Poland. The forewing pattern consists of five separate spots. The reduction of the pattern in the specimens studied is shown by the general diminution of the forewing spots, especially of spots 3 and 4 (fig. 134-a). Ab. *analiconfluens* HOLIK was found



Figs. 70—73. Genital armatures. 70 — *Zygaena cynarae* (ESP.), male, Toruń, 26. VII. 1933. Genital Slide No. 2106. 71 — *Z. cynarae* (ESP.), male, Warszawa, Placówka, 4. VII. 1949. Glenital Slide No. 17. 72 — *Z. cynarae* (ESP.), female, Janów ad Lvov, 13. VII. 1906. Genital Side No. 2107. 73 — *Z. cynarae* (ESP.), female, Lubaczów, Nowa Grobla, 11. VIII. 1962. Genital Slide No. 326.

in one male specimen from Wawer near Warszawa (leg. author). However, specimens transitional to this form are fairly common. According to DRYJA (1959) specimens with the forewing spots enlarged or longitudinally confluent are rather common. However, the majority of specimens belong to the typical form, which shows a slight tendency to enlargement of the spots, especially of spots 4 and 5 (fig. 134-b). Specimens of ab. *unita* ROCCI with the forewing spots 1+3+5 and 2+4 confluent as well as ab. *depuncta* ROCCI with spot 3 completely reduced have not as yet been found in Poland.

The ground colour of the forewing is slightly semi-transparent, grey-black with a navy-blue hue in male and female specimens, and only very rarely and sporadically with an olive-green hue in the female. The sheen may or may not occur. Specimens transitional to ab. *diaphana* ROCCI occur sporadically and are characterized by more transparent ground colour of the forewing. Fringes of both wings black.

The forewing spots and hindwings are, in the majority of specimens, crimson. Females often show the hindwings lightened to cinnabar-orange, those are transitional to ab. *bicolor* ROCCI; two females were taken at Nowa Grobla near Lubartów (coll. author). Ab. *fumata* HOLIK is characterized by the brown forewing spots and hindwings; this form is analogous to *Z. filipendulae* ab. *nigrolimbata* COCKAYNE; one male taken by KRECZMAR at Miłosna near Warszawa (this specimen, paratype, was destroyed during the war, in 1944).

The hindwings always have a rather broad, grey-black margin, which, however, may be partly reduced.

The species is rather constant in size. The average length of the forewing is 14·1 mm. in the males and 14·8 mm. in the females. Very large or dwarf specimens have not as yet been found.

Z. cynarae (ESP.) is not an extreme xerothermophil. The species occurs very locally and in rather small numbers or singly in meadows and wood clearings, rarely in dry grassy localities, always in the vicinity of a wood. The adults are on the wing from mid-July to mid-August.

The larvae of *Z. cynarae* (ESP.) feed on *Peucedanum oreoselinum* MNCH.

The specimens fly rather heavily, being most active on sunny afternoons of warm days. There are no other data on the ethology of this species.

The distribution of *Z. cynarae* (ESP.) is rather uneven and shows many gaps. According to HOLIK (1939) the species has the centre of its distribution in the Lower Volga region and Ural, where it occurs in many localities together with *Z. centaureae* F. W. The typical form comes from Lvov region, where it was collected in 1787 by RUMMEL; these specimens were subsequently described, in 1789 by ESPER. The species is distributed in east and south Europe, and probably in west Asia. *Z. cynarae* (ESP.) is a ponto-mediterranean element in the fauna of Poland. The westernmost localities of this species are in the region of Leszno and Poznań and the northernmost ones are in the region of Toruń, Pomiechów near Warszawa and Białystok. *Z. cynarae* (ESP.) is uncommon and local in Poland. It is also known from the environs of Warszawa,

Łomża, Sandomierz and Kielce. Moreover two males were taken by ŻUKOWSKI on Zielona Skałka near Niedzica, Pieniny Mts. and ten males and four females by SOŁTYS (?) at Nowa Grobla near Lubaczów, South Poland.

11. *Zygaena laeta* (HÜBNER, 1790)

A ponto-mediterranean species so far unknown from Poland. However, it may occur in some xerothermic localities in the south of Poland. The nearest localities of this species are in Moravia (POVOLNÝ & GREGOR, 1946, GREGOR & POVOLNÝ, 1955) and in Podolia (KUNTZE & NOSKIEWICZ, 1938). The male and female genital armatures are shown in figs. 74 and 75. The larva feeds on *Eryngium campestre* L.

12. *Zygaena punctum* OCHSENHEIMER, 1808

Also a ponto-mediterranean species. So far it has not been found in Poland. It was recorded from Iwonicz (Carpathians) by GARBOWSKI (1892), but this record needs confirmation. It is probable that GARBOWSKI misidentified an aberrant specimen of *Z. loti* (DEN. & SCHIFF.). However, the species may occur in the south of Poland. The nearest localities of this species are also in Moravia and Podolia. The male and female genital armatures are shown in figs. 76 and 77. The larva feeds on *Eryngium campestre* L.

13. *Zygaena brizae* (ESPER, 1784)

Male genital armature (figs. 78 and 79): costal margin of valva straight or faintly concave, caudal and ventral edges (up especially caudal one) strongly curved. Corona rather well developed. Processes of uncus narrow, pointed, slightly opened. Saccus in the form of a rounded bulb, always with a basal constriction. Anellus elongate, with base rounded, tapering apicad; it does not show any special structures. Aedoeagus slightly longer than valva. „Plate" absent. Two lightly sclerotized, lamella-shaped cornuti which are clothed with small, pointed spines. Lamina ventralis as long as one third of the length of the aedoeagus; it is evently clothed with tiny spikes all of the same size. The axial groove reaches only the middle of the lamina dorsalis, which is very characteristic of this species.

In general, the male genital armatures do not show any distinct variation of taxonomic importance.

Female genital armature (figs. 80 and 81): the absence of the signum is very characteristic. Ductus bursae narrow, long bent, in part heavily sclerotized Ostium bursae narrow, lightly sclerotized. „Plate" absent. The eighth tergite with margins rather heavily sclerotized. Anterior apophyses long and thin,

heavily sclerotized. Posterior apophyses rather broad basally, decidedly tapered and elongate at apexes.

The most variable structures of the female genital armatures are the ductus bursae, the eighth tergite and posterior apophyses. However, the variation is rather small in comparison to that on other species of the genus. This species is rather constant in genital armatures as shown by the material studied. Also the pattern and colour of the wings of Polish specimens do not any great variation.

Antennae, head, patagia, tegulae, thorax and abdomen uniformly black. Abdominal belt always absent. Fringes black. The pattern of the forewing in both sexes of specimens from Poland is like that of the typical form (fig. 135-c). Specimens transitional to ab. *confluens* BGFF. (fig. 135-d) are rather scarce: five males and four female taken in Nowa Góra in the Pieniny Mts. (leg. WĘGLARSKI and ŻUKOWSKI). ŻUKOWSKI also captured in Nowa Góra one female transitory to ab. *interrupta* HSKE. (fig. 135-b), which is characterized by the reduction of the forewing spots. Typical specimens of both mentioned forms, known from Moravia (POVOLNÝ & GREGOR, 1946) have not as yet been found in Poland.

The forewing spots and hindwing colour in the majority of specimens is crimson, however, in many instances (especially in females) the hindwings are lighter, with a cinnaber hue. The forewing ground colour is dark, with a very slight blue-green hue, with no sheen, slightly semi-transparent.

The average length of the forewing in the males is 11·5—12 mm. and in the females 12—12·5 mm. The smallest specimens show the forewing not longer than 11 mm. However, atypical specimens are very scarce.

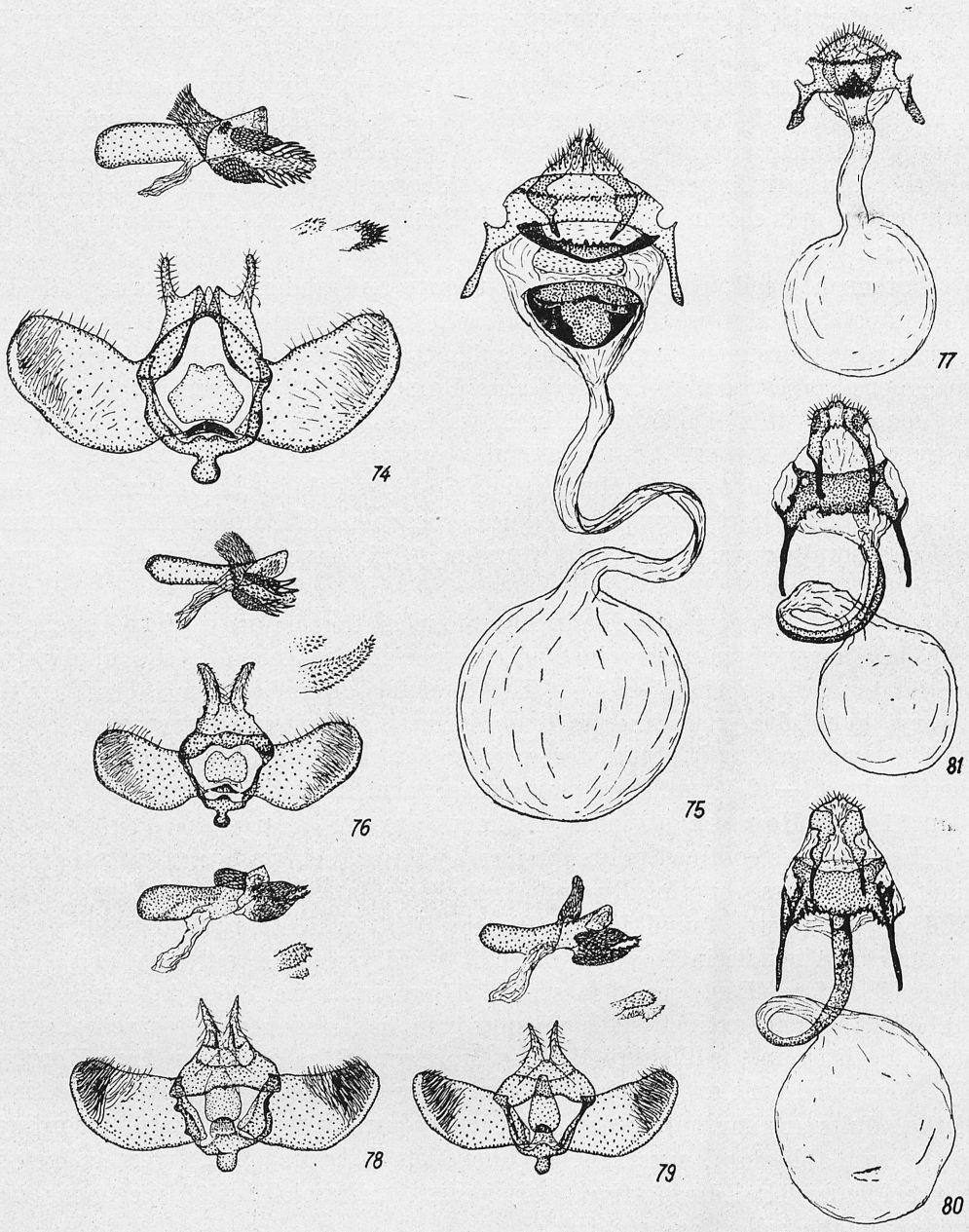
The species is confined to steppe-forest habitat, being a typical xerothermobiont. It appears very locally and singly from late June to late July.

The species was found in the Pieniny Mts. in 1947 by MIODOŃSKI, who captured one female in Nowa Góra. This locality was the only one in Poland where *Z. brizae* (ESP.) was not scarce. However, since 1960 the species has probably become extinct. This phenomenon has also been observed in two other localities in the Pieniny Mts., in Macelowa Góra and near Trzy Korony Mts. Very likely the extinction of the species was caused by the over-collecting of the adults and larvae for several years by various lepidopterists. According to the available data, over 120 specimens of *Z. brizae* (ESP.) were collected in the Pieniny Mts. during five to six years. Of these about 60 specimens are present in the collections studied.

The larva feeds only on *Cirsium arvense* L.

The adults, in spite of fast and nimble flight, are very local in their habitats which are surrounded by ecological barriers.

Z. brizae (ESP.) according to HOLIK (1939) a ponto-mediterranean element in the Polish fauna. The distribution of this species in Poland is still rather poorly known. KARPOWICZ cited this species from the region of Sandomierz (1930), and OSTROWSKI found in the region of Przemyśl (HOLIK, 1939). These



Figs. 74—80. Genital armatures. 74 — *Zygaena laeta* (Hbn.), male, Zaleszczyki, Podolia, VII. 1932. Genital Slide No. 2103. 75 — *Z. laeta* (Hbn.), female, Podolia, Krzywe, 26. VII. 1935. Genital Slide No. 2102. 76 — *Z. punctum* Ochsen., male, Podolia, Krzywe, 13. VII. 1936. Genital Slide No. 2105. 77 — *Z. punctum* Ochsen., female. 78 — *Z. brizae* (Esp.), male, Pieniny Mts., Nowa Mt., 28. VII. 1958. Genital Slide No. 2130. 79 — *Z. brizae* (Esp.), male, Pieniny Mts., Nowa Mt., 28. VII. 1958. Genital Slide No. 2132. 80 — *Z. brizae* (Esp.), female, Pieniny Mts., Krościenko, 17. VII. 1958. Genital Slide No. 2133. 81 — *Z. brizae* (Esp.), female, Pieniny Mts., Nowa Mt., 28. VII. 1958. Genital Slide No. 2131.

localities are on the northern edges of the range of the species. In the neighbouring countries of Poland the species is known from Czerwony Klasztor in the Pieniny Mts. (Czechoslovakia), where in 18 males and 9 females were found by PRUSZYŃSKI. These specimens are nearly identical with those from the Polish Pieniny Mts., being only in some cases slightly different in the width of the black margin of the hindwing. Moreover, the species is known from Moravia and Bielskie Tatry Mts., as well as from the environs of Lvov.

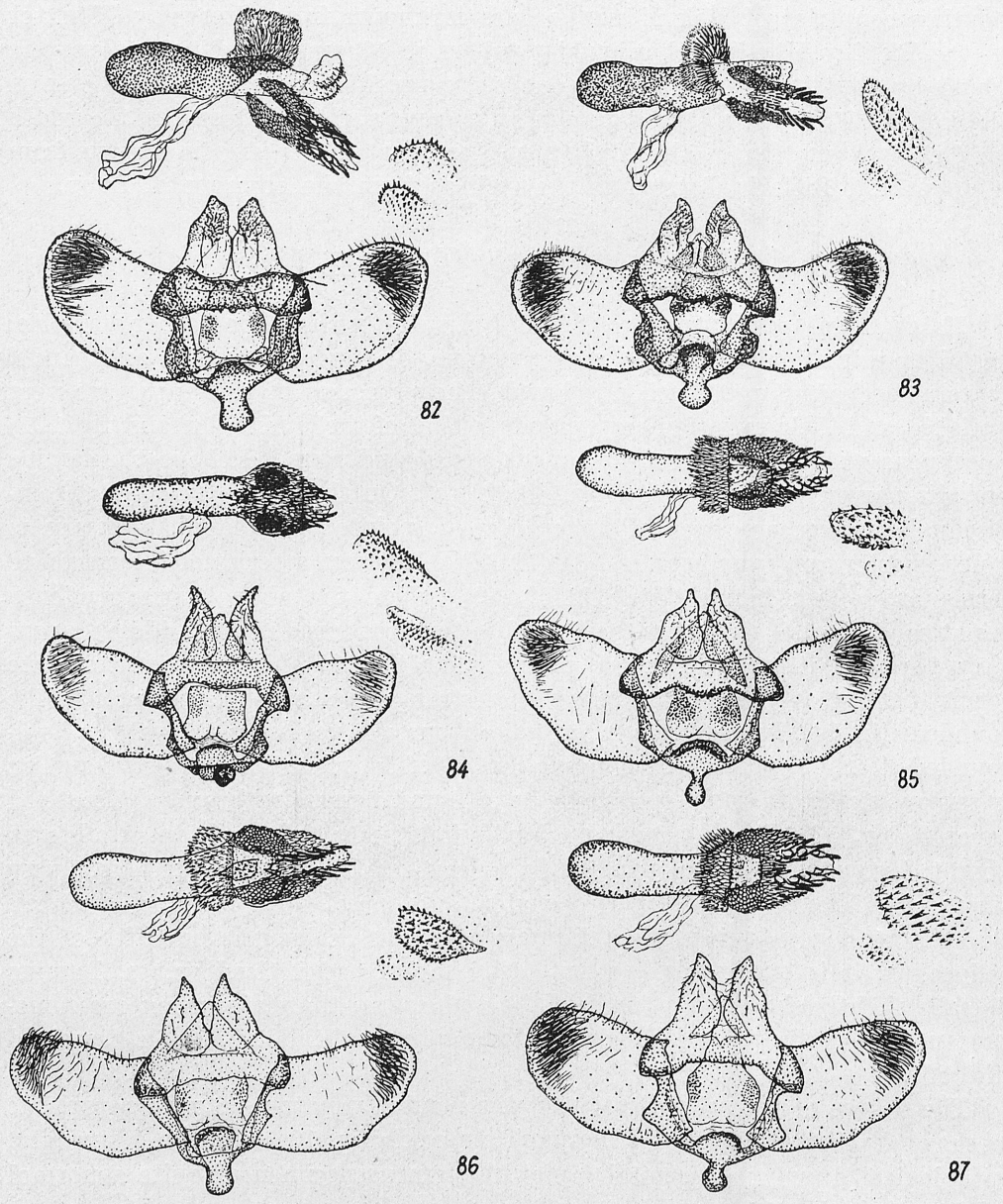
14. *Zygaena purpuralis* (BRÜNNICH, 1763)

Male genital armature (figs. 82—106): valva with shape rather variable; costal margin usually straight, rarely convex or concave, ventral and caudal margins arched. Corona well developed. The processes of the uncus are very variable, and their variation corresponds to that of the lamina dorsalis (fig. 121) Specimens with processes of the uncus broad and rounded, have the lamina dorsalis narrow and elongate (figs. 89, 121-a). On the other hand, in the individuals having processes of uncus conical, pointed, the lamina dorsalis is much shorter and rounded (figs. 84, 121-e). Moreover, a series of intermediate forms have been found (figs. 121-b, c, d), where the above correspondence is not so distinct. Tegumen rather broad, often broadened in the middle. Saccus very variable, it may be broad, semicircular (fig. 97), through intermediate forms (figs. 98, 93, 100) to narrow with a strong basal constriction, vesicle-like rounded (fig. 94). Anellus rather variable: it may be rectangular (fig. 84), oval-rounded (fig. 100) or slightly elongate (fig. 99). The sclerotization of the anellus is very variable: in some specimens were found two more heavily sclerotized „spots" (figs. 83, 87). Aedoeagus one and a half times as long as valva. „Plate" absent. Cornuti in form of two lightly sclerotized lamellas, clothed with very tiny spines. The cornuti are very variable, and one of these in some instances, shows a tendency to reduction. Lamina vantralis as long as one-fifth of the aedoeagus; it is evenly clothed with tiny, lightly sclerotized spines. Lamina dorsalis slightly shorter than half of the aedoeagus; the main spines are sometimes more heavily sclerotized than in the majority of the individuals examined (fig. 83).

The degree of the sclerotization of the genital armatures is rather variable as shown by the evidence of a thorough study. In fig. 106 is shown a strongly, pathological dwarf male genital armature from a specimen of quite a normal habitus (forewing 15 mm. long).

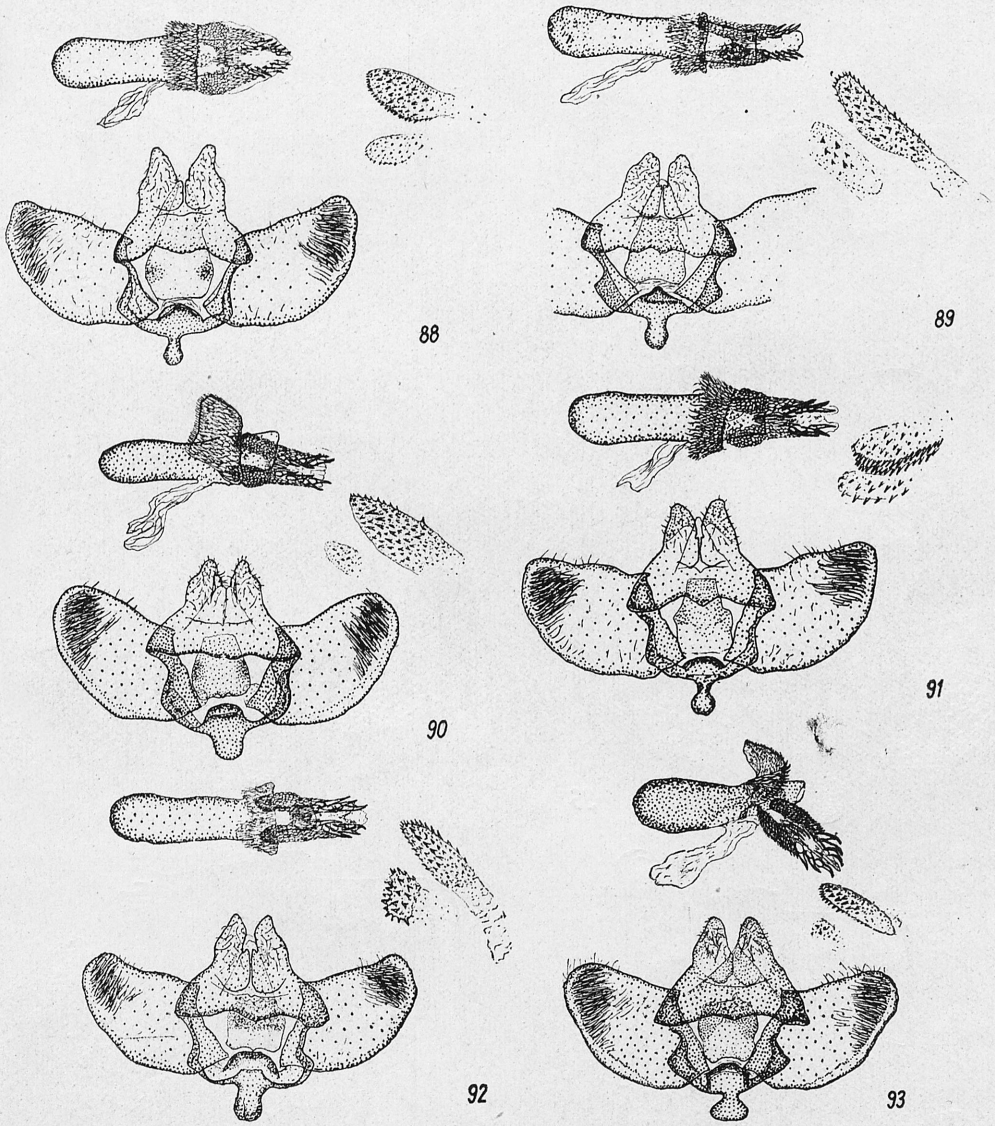
In general, the most variable structures of the male genital armatures are the uncus and lamina dorsalis, the variation of which correlates with each other; and then the saccus, cornuti, anellus, valva and tegumen.

Female genital armature (figs. 107—117): signum absent. Ductus bursae long, very narrow, very lightly sclerotized. One of the most variable parts of the female genital armature is the ostium bursae. „Plate" very heavily sclerotized with rugged margins and scobinate surface; very variable; always

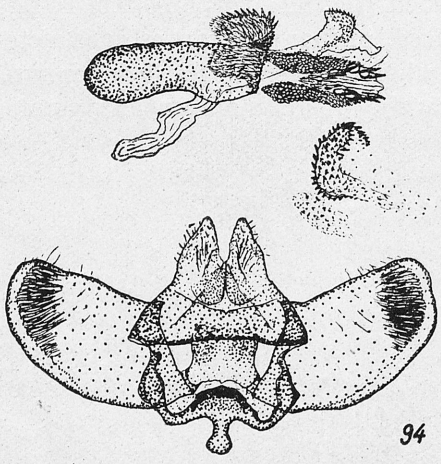


Figs 82—87. Male genital armatures. 82 — *Zygaena purpuralis* (BRÜNNICH), Baligród, 5. VII. 1959. Genital Slide No. 206. 83 — *Z. purpuralis* (BRÜNNICH), Baligród, 4. VII. 1954. Genital Slide No. 192. 84 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 10. VII. 1954. Genital Slide No. 32. 85 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 15. VII. 1954. Genital Slide No. 74. 86 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 10. VII. 1954. Genital Slide No. 77. 87 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 9. VII. 1954. Genital Slide No. 71.

triangular (figs. 107, 116), sometimes rounded (fig. 113) or broadened (figs. 109, 114). The eighth tergite evenly sclerotized, in many instances constricted in the middle (figs. 108, 114), rarely with straight margins. Anterior apophyses usually narrow, pointed (figs. 107, 104), rarely broad, more or less pointed



Figs. 88—93. Male genital armatures. 88 — *Zygaena purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 15. VII. 1954. Genital Slide No. 76. 89 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 2. VIII. 1954. Genital Slide No. 78. 90 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 10. VII. 1954. Genital Slide No. 80. 91 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 15. VII. 1954. Genital Slide No. 73. 92 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 5. VII. 1954. Genital Slide No. 72. 93 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 19. VIII. 1958. Genital Slide No. 164.



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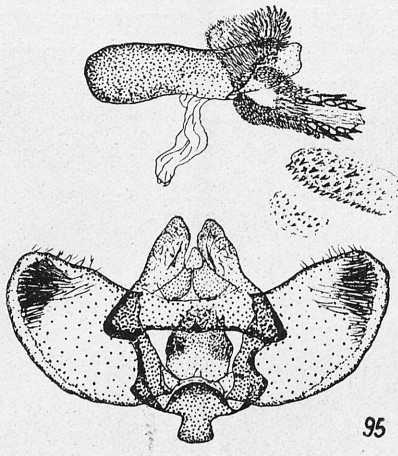

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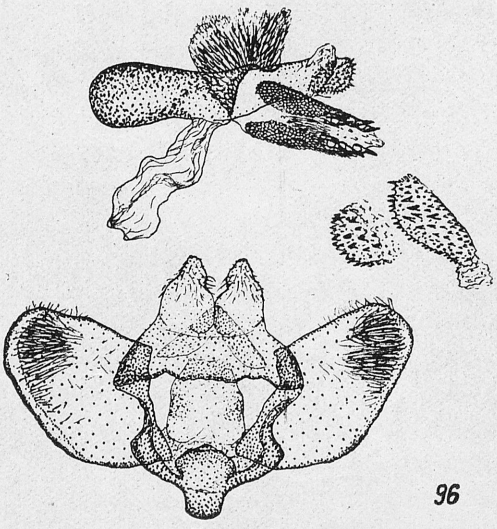

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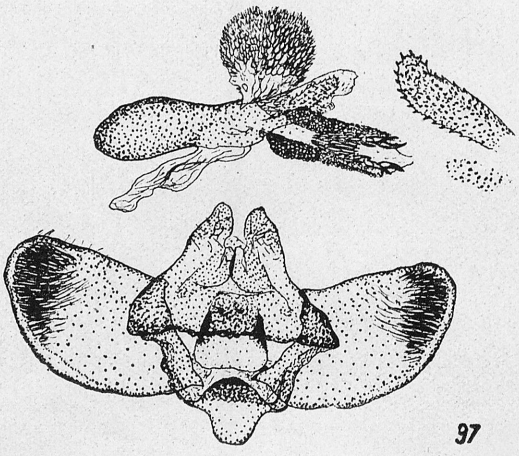

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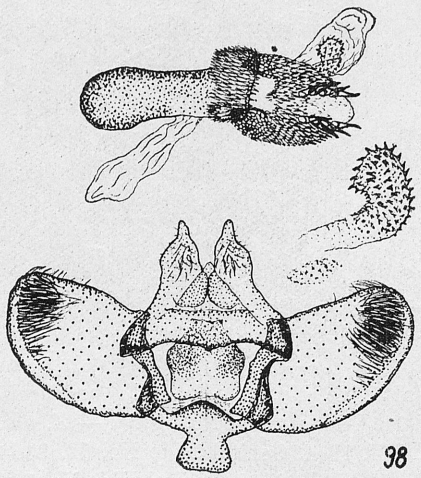

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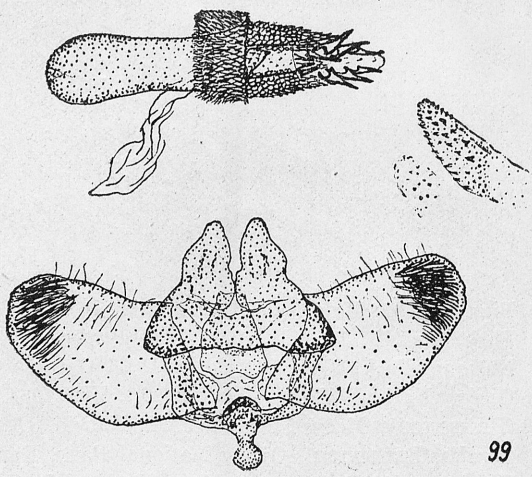

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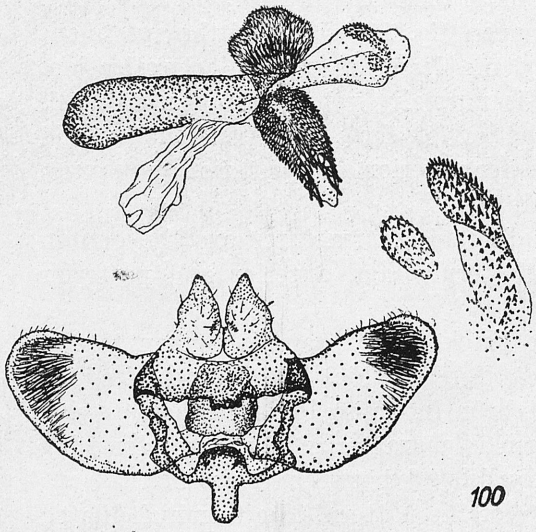
(figs. 112, 107). Posterior apophyses in most instances narrow, pointed (figs. 109, 114), rarely broad with rounded apexes (fig. 113). One of the specimens examined (fig. 117) is characterized by the lesser degree of sclerotization, especially of the ostium bursae, which is normally very heavily sclerotized. This armature shows, moreover, a reduction of the „plate", a smaller and strongly narrowed eighth tergite and broader anterior and posterior apophyses. The specimen shows quite a normal habitus.

The most variable parts of the female genital armatures are the ostium bursae and „plate", and then the eighth tergite and anterior and posterior apophyses.

Antennae, head, patagia and tegulae black. Thorax and abdomen totally dull black. The specimens of ab. *cingulata* BGFF., which are characterized by the red abdominal belt, have not as yet been found in Poland. The forewing pattern is very variable. The typical form is characterized by three forewing streaks (fig. 136-f). Streak 2 is decidedly dilated between the veins r_4—cu_2; it is one of the most variable components of the pattern. The terminal dilated part of this streak may be more or less broad and the outer edge may be more or less abruptly truncate (fig. 124). The tendency to reduction and enlargement of the forewing spots is shown in fig. 136. The streaks may be divided into six separate spots, this is ab. *sexmaculata* BGFF. (fig. 136-a), however, no specimen of this aberration has as yet been found in Poland. Ab. *quinquemaculata* BGFF. (fig. 136-b) with forewing spots: 1, 2, 3, 4, 5+6 is very scarce: three males and two females in the Ojców National Park, one male and two females at Klonów near Miechów (leg. author). Specimens of ab. *analiinterrupta* VORBRODT with the forewing spots: 1, 2, 4, 3+5+6, and specimens of *mediointerrupta* VORBRODT with the forewing spots: 1, 3, 2+4, 5+6 have been found singly in the Małopolska Highland. Transitional specimens with streaks II and III strongly constricted (fig. 136-c) appear singly in the Małopolska Highland. Specimens occurring in the most localities in Poland have the terminal portion of the streaks II very gently truncate; in these specimens streaks II is rather elongate and reaches the vein cu_1 (fig. 136-d). Such specimens appear in 60—75% of the populations occurring in the Małopolska Highland. However, in the lowlands and in the mountainous regions of Poland (Sudeten Mts., Pieniny Mts., Bieszczady Mts., Tatry Mts.) they are more rarer and occur singly, while the majority of specimens have streak II in the forewing more or less abruptly truncate (fig. 136-e, f). Specimens similar to *Z. diaphana* STGR.

Figs. 94—99. Male genital armatures. 94 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Grodzisko, 28. VII. 1958. Genital Slide No. 125. 95 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Grodzisko, 28. VII. 1958. Genital Slide No. 125. 96 — *Z. purpuralis* (BRÜNNICH), Glanów, 8. VIII. 1959. Genital Slide No. 198. 97 — *Z. purpuralis* (BRÜNNICH), Glanów, 28. VII. 1959. Genital Slide No. 204. 98 — *Z. purpuralis* (BRÜNNICH), Klonów, Dąbie, 13. VIII. 1959. Genital Slide No. 186. 99 — *Z. purpuralis* (BRÜNNICH), Kraków, Mników Valley, 6. VIII. 1955. Genital Slide No. 75.



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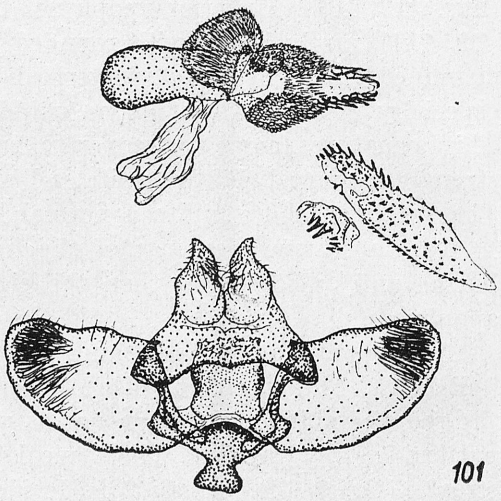

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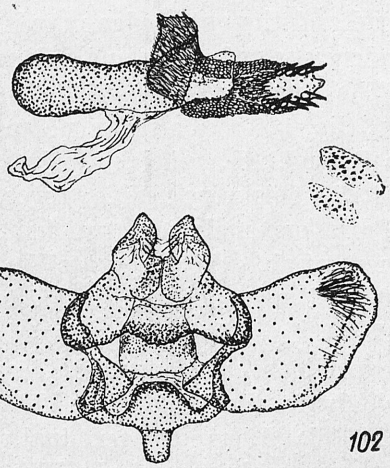

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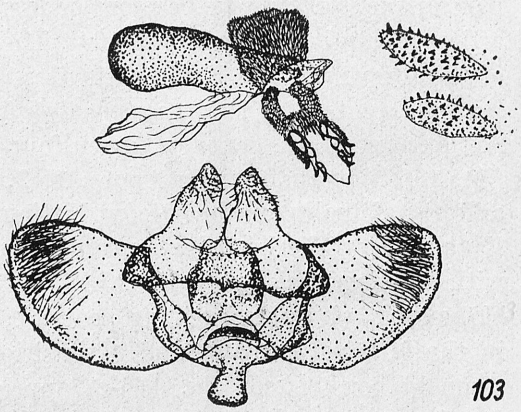

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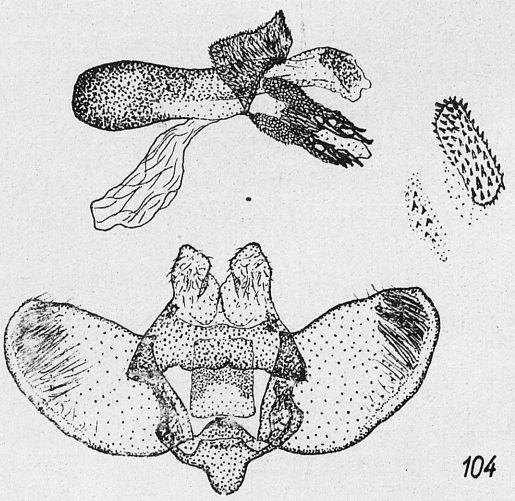

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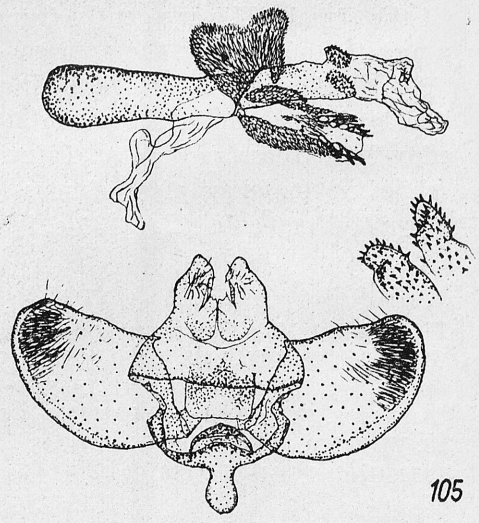

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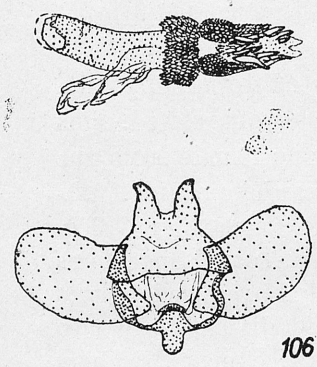
(fig. 136-e) are characterized by the strongly enlarged and confluent streaks. This aberration occur rather in females than in males, in most instances in the xerothermic localities of the Małopolska Highland, Pieniny Mts., and rarely in the Sudeten Mts. and in the lowlands. In extreme aberration is ab. *marginata* BGFF. in which the red streaks cover the entire surface of the forewing except for the costal and outer margins. This aberration has not as yet been found in Poland. Specimens of the typical form (fig. 136-f) occur in large numbers in the lowlands and in the mountains, whilst in the Małopolska Highland they represent 30—45 % of the populations. Specimens of ab. *plutoides* REISS (= ab. *plutonia* VERITY) have streak II narrowed and not dilated terminally (fig. 136-g); streaks I and III (fig. 136-h) are in some instances also narrowed. This aberration occurs sporadically and singly: two males and one female from the Pieniny Mts. (leg. author), one female taken at Podgórki near Tyniec (leg. MIODOŃSKI), one male from the neighbourhood of Biecz (East Carpathians) (leg. CHROSTOWSKI), one male at Baligród (East Carpathians) (leg. TOLL). Specimens of ab. *reducta* **ab. n.** (fig. 136-i) are characterized by streak II reduced to two small specks (spots 3 and 5) and streak III narrowed and divided into two separate spots 2 and 4; two males were taken at Racławice near Miechów (leg. author). The border of the hindwing is very narrow. Specimens from xerothermic localities show a tendency to the complete reduction of this border.

The experimental studies of BURGEFF (1956) proved that the forewing pattern in *Z. purpuralis* (BRÜNNICH) may be strongly changed under the influence of high temperatures on the pupae. The modified pattern shows enarged streaks; moreover, the scales are less numerous, and the wing is more transparent than in typical specimens. However, the author captured such specimens (one male and one female) in the Pieniny Mts. (Pl. IX—8). On the other hand, according to DRYJA (1959) the forewing pattern depends mostly on the genetic factor.

The forewing ground colour is dark-navy blue in the males and dark-navy blue-olive in some females; the sheen is absent in both sexes. The fringe of the fore- and hindwing is black. The majority of specimens show the streaks of the forewing and hidnwings crimson (60—80 %). This is observed especially in populations from the lowlands and the Sudeten Mts. Specimens from the xerothermic localities of the highlands often have the forewing pattern and the hindwings cinnabar (20—45 %). Specimens of ab. *obscura* TUTT are characterized by the smoky black forewing stripes and hindwing; one male was taken

Figs. 100—105. Male genital armatures. 100 — *Zygaena purpuralis* (BRÜNNICH), Biecz, Kornuty, 19. VII. 1956. Genital Slide No. 184. 101 — *Z. purpuralis* (BRÜNNICH), Sudeten Mts., Srebrna Mt., 6. VII. 1958. Genital Slide No. 207. 102 — *Z. purpuralis* (BRÜNNICH), Pieniny Mts., Zagroń, 8. VII. 1959. Genital Slide No. 189. 103 — *Z. purpuralis* (BRÜNNICH), Pieniny Mts., Cisowiec, 4. VII. 1959. Genital Slide No. 195. 104 — *Z. purpuralis* (BRÜNNICH), Pieniny Mts., Zamczysko, 5. VII. 1959. Genital Slide No. 178. 105 — *Z. purpuralis* (BRÜNNICH), Pieniny Mts., Zagroń, 8. VII. 1959. Genital Slide No. 202.



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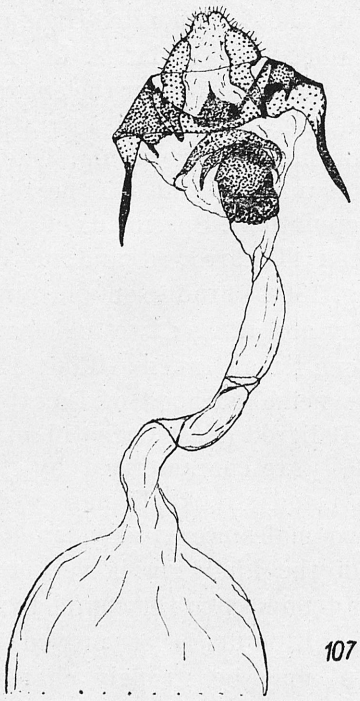

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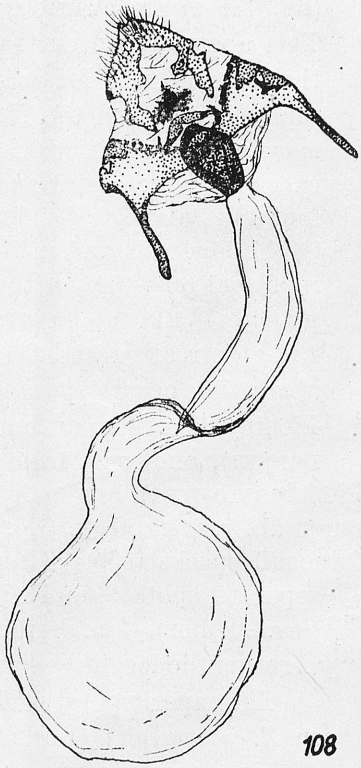

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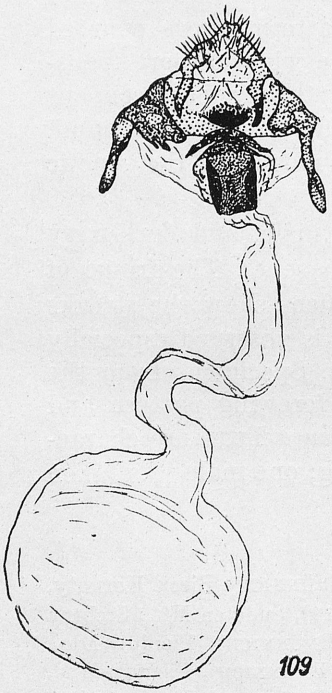

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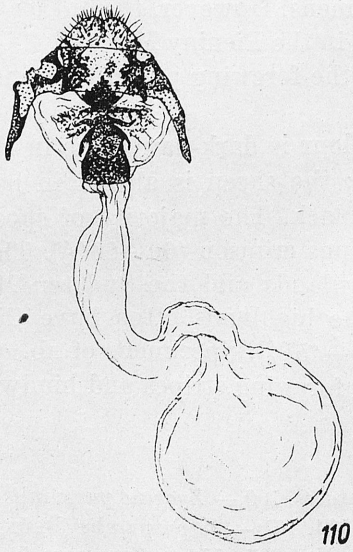

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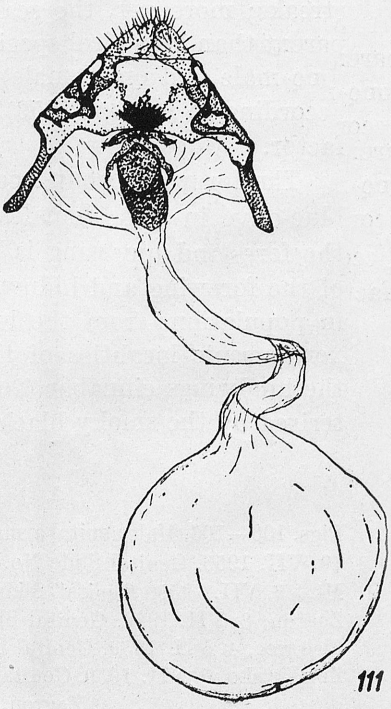

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at Racławice near Miechów (leg. author), and two intermediate males were found in the neighbourhood of Dzierżoniów (leg. SZPOR and author). Specimens of ab. *lutescens* TUTT have the forewing pattern and hindwing yellow. No typical specimen of this aberration has as yet been found in Poland, however, two intermediate specimens with slight cinnaber hue were taken in the Pieniny Mts. and at Ojców (leg. author). Specimens of ab. *bicolor* **ab. n.** are characterized by the forewing streaks carmine-red and hindwings orange-yellow: one female taken at Ojców and two males found at Klonów near Miechów (leg. author).

The variation of the size in this species is rather slight. The average length in the males is 14·5 mm., and in the females 15·5 mm. Very large specimens with the forewing 16—17 mm. long are very scarce. Dwarf specimens with the forewing shorter than 15 mm. are also scarce; they appear sporadically, normally towards the end of the brood.

The specimen shown in Pl. IX—6 has atypical antennae which are shorter and thinner than those in typical individuals. Moreover, this specimen has streaks II and III narrow, constricted medially, and streak I is extended along vein sc. This specimen [taken in Srebrna Mt. in the Sudeten Mts. (leg. SZPOR)], is strikingly similiar to *Z. exulans* R. & H. A correct identification of this specimen was possibly only after the genitalia were dissected.

Z. purpuralis (BRÜNNICH) lives in various habitats. It occurs together with *Z. trifolii* (ESP.) (e.g. in the neighbourhood of Dzierżoniów and in the Sowie Mts.), but also in the moist glades in the Carpathians. However, the species finds the most suitable conditions in the xerothermic localities, were the populations are large.

The larva of *Z. purpuralis* (BRÜNNICH) lives on *Thymus* L. and *Trifolium* L.

Z. purpuralis (BRÜNNICH) is an euro-siberian element in the Polish lepidopterous-fauna (HOLIK, 1939). It is distributed in Europe except for the Iberian Peninsula, Sardinia, Corsica, Sicilia and North Africa. Beyond Europe, it occurs in west Asia and Siberia. In Poland the species is distributed as far north as Łeba and as far east as Suwałki. The distribution of this species in Poland is uneven. In north and central Poland it is generally rather scarce and local. It is most frequent in the Małopolska Highland, however, it occurs there also locally. It occurs in the Pieniny Mts. but is scarcer in the other ranges of the Carpathians. In the Tatra Mts. it occurs singly. NIESIOŁOWSKI (1929) cited this species from Skupniowy Upłaz (two specimens, leg. ADAM-

Figs. 106—111. Genital armatures. 106 — *Zygaena purpuralis* (BRÜNNICH), male, Pieniny Mts., Czarny Potok, 3. VII. 1959. Genital Slide No. 179. 107 — *Z. purpuralis* (BRÜNNICH), female, Tatra Mts., Żar, 26. VII. 1959. Genital Slide No. 188. 108 — *Z. purpuralis* (BRÜNNICH), female, Kraków, Mydlniki, 8. IX. 1956. Genital Slide No. 203. 109 — *Z. purpuralis* (BRÜNNICH), female, Kraków, Mydlniki, 8. IX. 1956. Genital Slide No. 196. 110 — *Z. purpuralis* (BRÜNNICH), female, Ojców National Park, Grodzisko, 26 VIII 1958. Genital Slide No. 126. 111 — *Z. purpuralis* (BRÜNNICH), female, Ojców National Park, Kaliski, 6. VII. 1954. Genital Slide No. 56.

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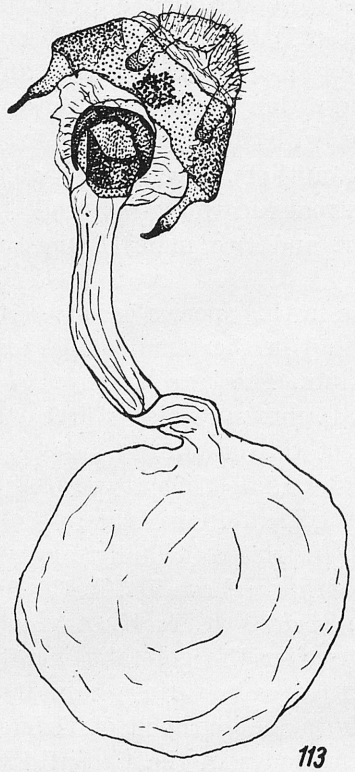

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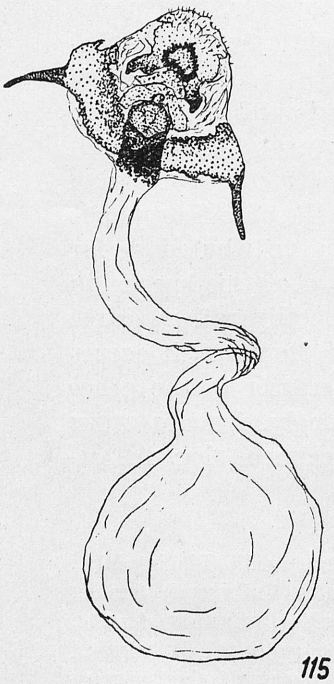

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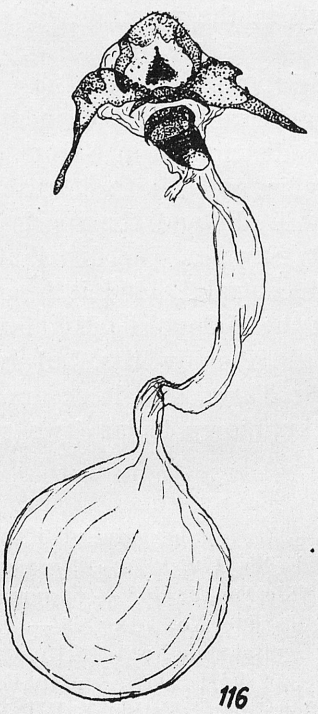

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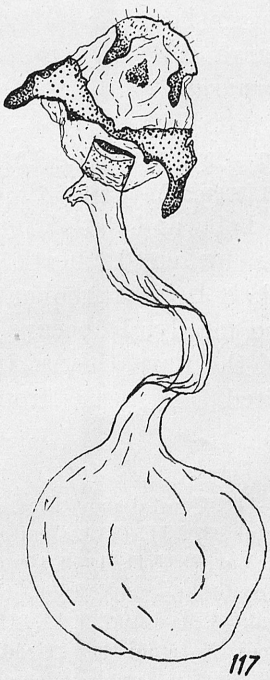

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CZEWSKI and RUTKOWSKI). Moreover SZPOR captured one female in Żar and one male was taken by the author at Przysłop Miętusi. The species occurs at 1100 m. alt. in the Bieszczady Mts. (East Carpathians) and at 1600 m. alt. in the Tatra Mts.

H. REISS (1940) separated a distinct species, *Z. diaphana* STGR. TOLL (1947) published the data on the characters of the larvae and adults of both *Z. purpuralis* (BRÜNNICH) and *Z. diaphana* STGR., based on the material coming from Poland. Male genital armatures of the two species were figured. TOLL gave a list of localities in the regions of Grudziądz and Poznań, where, according to his opinion, occurs *Z. diaphana pimpinellae* REISS. Subsequently, D. POVOLNÝ (1951) judging from a genital study of a large material, proved that the opinion of REISS was wrong. D. POVOLNÝ believed that there is only one species. However, B. ALBERTI (1957) considered *Z. purpuralis* (BRÜNNICH) and *Z. diaphana* STGR. as distinct species. This author based his opinion on the different foodplants of the two species, each of them being monophagous. *Z. purpuralis* (BRÜNNICH) according to ALBERTI feeds on *Thymus* L., whilst the other species feeds on *Pimpinella nigra* WILLD. Moreover, according to ALBERTI, there are differences in the colour of the larvae of the two species, the time of the appearance, and some differences in the genital armatures. This author mentioned that the two species are well separated from each other in the Alps and in Germany.

The author of the present paper examined more than 1600 specimens of the species under consideration. Of these, 37 males and 24 females were dissected. Judging from this study, the specimens with characters of *Z. diaphana pimpinellae* REISS are in the majority in the warm xerothermic localities, especially in the Małopolska Highland and are scarcer in the mountains and in the lowlands. Both *Z. purpuralis* (BRÜNNICH) and *Z. diaphana pimpinellae* REISS occur in the same localities. The former occur in majority in the mountains, e.g. in the Sudeten Mts., Pieniny Mts., and the Tatra Mts., as well as in the lowlands. Quite a similar situation was observed in Germany by ALBERTI and in Czechoslovakia by POVOLNÝ. However, it is of interest to note that the differences in the facies do not correspond with the differences in the structure of the genital armatures. Moreover, the species is extremely variable and all transitional forms may be found, thus a correct identification of any of the two species is in most instances very difficult. W. FORSTER & T. A. WOHLFAHRT (1958) considered both species as distinct, however, they did not give any

Figs. 112—117. Female genital armatures. 112 — *Zygaena purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 5. VII. 1954. Genital Slide No. 79. 113 — *Z. purpuralis* (BRÜNNICH), Ojców National Park, Kaliski, 5. VII. 1954. Genital Slide No. 81. 114 — *Z. purpuralis* (BRÜNNICH), Pieniny Mts., Zamczysko, 5. VII. 1959. Genital Slide No. 194. 115 — *Z. purpuralis* (BRÜNNICH), Pieniny Mts., Czarny Potok, 3. VII. 1959. Genital Slide No. 182. 116 — *Z. purpuralis* (BRÜNNICH), Pieniny Mts., Zamczysko, 5. VII. 1959. Genital Slide No. 177. 117 — *Z. purpuralis* (BRÜNNICH), Pieniny Mts., Macelowa Mt., 7. VII. 1959. Genital Slide No. 181.

practical data for the identification of them. According to the opinion of the present author, *Z. diaphana* STGR. is probably a species „in statu nascendi", and in the present stage of our knowledge of this problem, it would be practically impossible to give the correct diagnosis of the two species. Also the problem of the subspecies of the species under consideration occurring in Poland is still rather obscure and needs further thorough study.

III. DISCUSSION

1. Variation in genital armatures of *Zygaena* F. and its taxonomic significance

The literature on the genus *Zygaena* F. is rather large, however, the major part of the papers deal with the habitus of the moths, whilst there are rather poor data on the genital armatures of the genus under consideration. In fact, the male and female genital armatures of the species of the genus *Zygaena* F. provide us with very important taxonomic characters. According to ALBERTI (1958, 1959), the first data on the genital armatures of the genus *Zygaena* F. were given by BUCHANANA WHITE in 1878, who recorded specific differences of some species found in the male genital armatures. However, that author gave only some figures of the uncus and valva of the species considered. Later, BURGEFF in 1914 and HOLIK in 1933 and 1938 mentioned the general differences in genitalia between some species of the genus *Zygaena* F. and they did not figure any genital armatures. HEWER in 1932 gave the descriptions and figures of the male and female genital armatures of thirteen species of the genus *Zygaena* F. HAAF in 1952 published a rather large paper dealing with 57 species of the genus *Zygaena* F. However, the descriptions of the genital armatures are very brief and the figures are rather poor as they are depicted in general outlines only. POVOLNÝ in 1955 gave a key to fourteen species of the genus *Zygaena* F. in question mentioning the genital armatures and giving very poor photographs of the armatures of both sexes. ALBERTI in 1955 published figures of 56 species or forms of the genus *Zygaena* F. The same author in a large paper published in 1958—1959 gave a phylogenetical review of 93 known species of the genus *Zygaena* F. This important paper contained numerous figures of the male and female genital armatures, as well as the diagnoses containing the most significant taxonomic characters. TREMEWAN in 1960 and 1961 gave very good photographs of the genital armatures of several species of the *Zygaena* F. However, according to the opinion of the present author, even the best photograph could not show all the important tiny structures of the genital armatures which are easy to mark in the hand-made figure. In the Polish literature there is only one short note of TOLL (1947) in which this author recorded genital distinctness of *Z. purpuralis* (BRÜNNICH) and *Z. diaphana* STGR. giving figures of the male genital armatures of these species, however, with no comments.

The present paper contains detailed data on the male and female genital armatures and their variation based on the material originating from various territories in Poland. The number of genital slides prepared for this paper is 496.

The general characteristics of the genital armatures of the genus *Zygaena* F. are as follows:

Male: Valva flat, oval with slight specific characters, rather simple with no processes or other distinct structures which appear in very close genera e.g. *Orna* KIRBY, *Neurosymploca* WALL. and especially *Epizygaena* JORDAN which, together with the genus *Zygaena* F., belong to the tribe *Zygaenini*. The specific differences in the structures of the valvae are limited to slight variation of the shape or the size, which, in less degree, is found also within individual species. The corona is the distal area of the valva; it shows bristle-like hairs, which are generally dark and may be lighter, broader or thinner; these hairs are pointed towards the base of the valva. Moreover, the valvae are clothed with scales as in other *Lepidoptera*. The corona does not show any variation within the individual species, providing only secondary taxonomic characters. Uncus developed in the form of a pair of processes (? socii). These processes show specific differences, they may be more elongate or stout with rounded or acuminate apexes. These differences are of taxonomic importance, however it is of much importance to note that a rather strong variation within the individual species is found here and during the identification the characters of the uncus should be considered in connection to other features of the genital armature examined. The tegumen may be more or less domed in some groups of species. The ratios of the length to the width and the medial constriction may also show some group differences. No variation within the individual species was observed. The saccus, which is already marked in the genera close to *Zygaena* F., is, in the genus *Zygaena* F. well developed. However, the taxonomic importance of the saccus is small. The saccus shows rather strong variation within the individual species of the genus *Zygaena* F. (fig. 119). The anellus is one of the more variable structures in the male genital armatures of *Zygaena* F. In the majority of the species of this genus the anellus is very variable in shape and sculpture. This is very well shown in *Z. loti* (DEN. & SCHIFF.). It is of much interest to note that even in some species which are not close to each other show some common tendencies in the structure of the anellus are observed e.g. sporadical or regular occurrence of paired more heavily sclerotized spots, or rarely a notch of the base of the anellus which is usually straight (fig. 120). The aedoeagus is rather uniform in shape and this is very characteristic of all the species of the genus in question. It is rather broad, heavily sclerotized. The specific differences in the aedoeagus are found in the structures of the cornuti and the ratio of the length to the width of the aedoeagus. The most characteristic part of the aedoeagus is its distal portion, the ventral and dorsal parts of which are transformed into shields armed with numerous, differentiated spines. Both shields are linked laterally by the membraneous, surrounding vesica which, in the majority of the species, is armed with the

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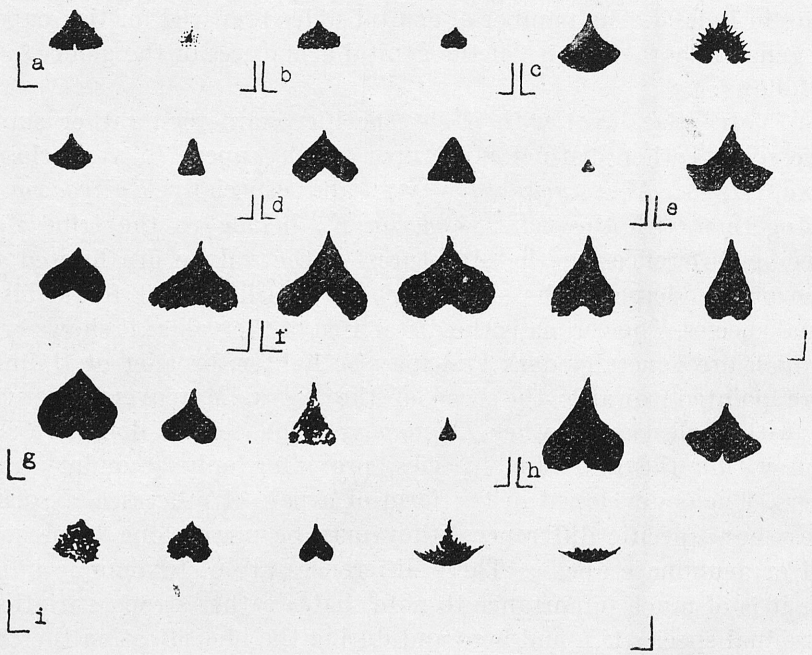

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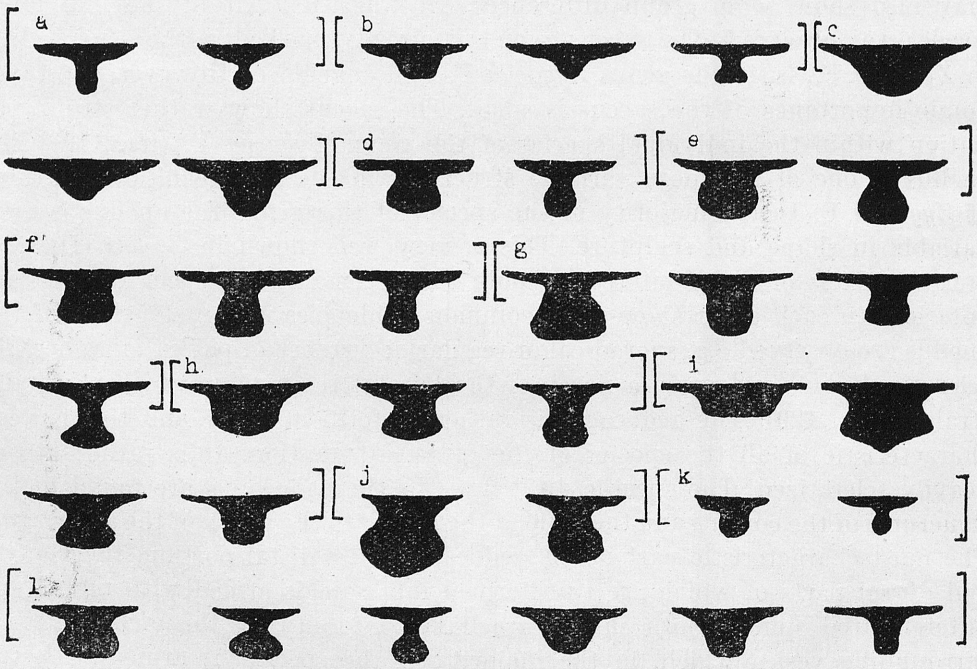
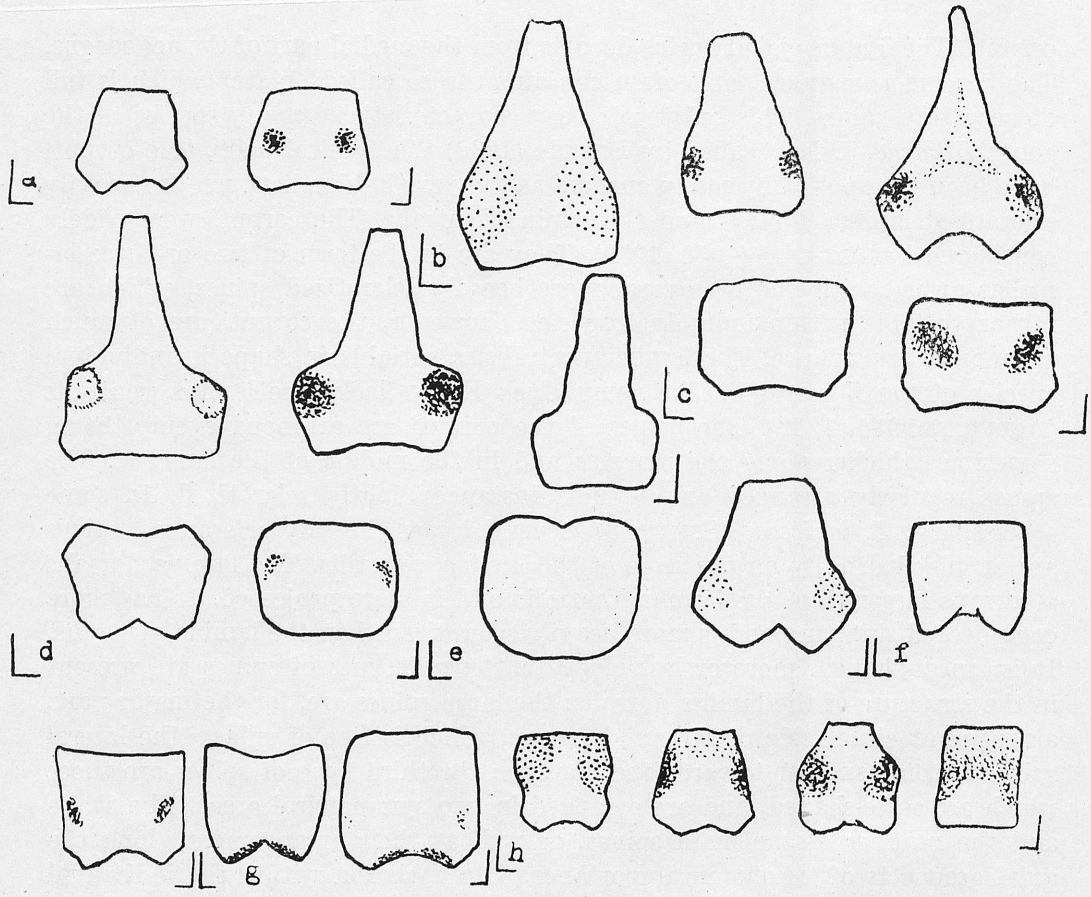


cornuti. The ductus ejaculatorius departs from the medial part of the aedoeagus. The coecum is rounded, and often contains the so called „plate" which is full of very tiny spines. This „plate" is very characteristic of many species of the genus *Zygaena* F. It is called by HEWER (1932) the „vesical pad". The cornuti have been overlooked by many authors as they are hidden between the heavily sclerotized lamina dorsalis and the lamina ventralis. The cornuti were widely considered by ALBERTI (1958, 1959). They are in the form of two or three lamellas armed with one or several more heavily sclerotized spines, which are rather variable within individual species. However, the cornuti are of much taxonomic importance. The lamina ventralis is variable in shape in individual species of the *Zygaena* F. The genus *Orna* KIRBY lacks the lamina ventralis (ALBERTI, 1958, 1959). The spines of the cornuti are arranged evenly, being sometimes thicker along the margins and in the middle of the lamellas. The spines regularly arranged are in most instances lightly sclerotized. In some species, e.g. *Z. lonicerae* (SCHEVEN), several larger, heavily sclerotized spines are arranged distally on the edge of the lamina ventralis. The lamina dorsalis is always larger than the lamina ventralis and is more projected. It has more complicated structure and is more heavily sclerotized than the lamina ventralis. It is lancet-shaped, more or less elongate. Several types of spines are present in the structure of the lamina dorsalis: the large spines are, for the major part, arranged at either side of the axial groove, which is free of spines; the lateral spines become smaller towards the margins; the third type of spines are those which are scale-shaped, and are arranged in two symmetrical areas. The shape and the number of the main spines, as well as their arrangement along the axial groove is of taxonomic importance. The variation within the individual species is rather slight. The morphology of the lamina dorsalis is also of phylogenetical importance.

Female: the signum consists of two bands of short spines with broad bases. The signum is in the majority of the *Zygaena* — species well developed, however, it may be reduced to several tiny spines, or may be completely absent. The spines of the signum are pointed and often their bases are confluent in irregular clusters of two to six spines. The structure of the signum may be used as a secondary character in the determination of the specimens examined. Individual specimens show rather considerable variation, especially in the number of spines of the signum, the degree of the sclerotization and the shape of the

Figs. 118—119. 118 — The variation of the „plate" in the male genital armatures: a — *Zygaena carniolica* (SCOP.), b — *Z. loti* (DEN. & SCHIFF.), c — *Z. viciae* (DEN. & SCHIFF.), d — *Z. epialtes* (L.), e — *Z. angelicae* OCHSEN., f — *Z. filipendulae* (L.), g — *Z. trifolii* (ESP.), h — *Z. lonicerae* (SCHEVEN), i — *Z. purpuralis* (BRÜNNICH). 119 — The variation of the saccus: a — *Z. carniolica* (SCOP.), b — *Z. osterodensis* REISS, c — *Z. loti* (DEN. & SCHIFF.), d — *Z. viciae* (DEN. & SCHIFF.), e — *Z. ephialtes* (L.), f — *Z. angelicae* OCHSEN., g — *Z. filipendulae* (L.), h — *Z. trifolii* (ESP.), i — *Z. lonicerae* (SCHEVEN), j — *Z. cynarae* (ESP.), k — *Z. brizae* (ESP.), l — *Z. purpuralis* (BRÜNNICH).



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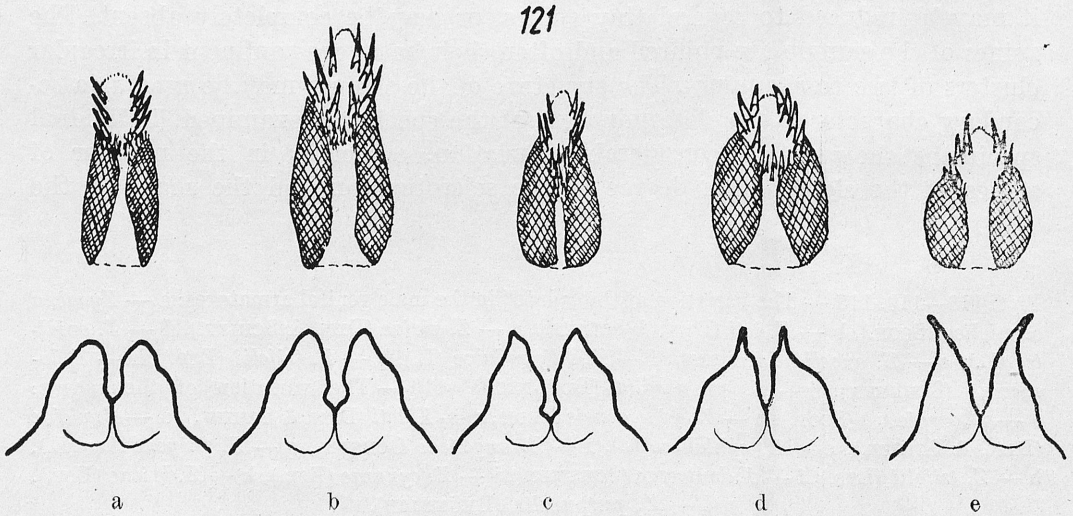

spines. The ductus bursae show many differences in the different groups of the *Zygaena* species. It may be short and rather broad, or decidedly narrow and long, often coiled; in most instances it is heavily or at least partly sclerotized. The species allied to *Z. carniolica* (SCOP.) show some tiny spines in the ductus bursae. The distal portion of the ductus bursae is strongly broadened, as in other genera of the tribe *Zygaenini* (ALBERTI, 1958, 1959). The ductus seminalis and bulla seminalis are very lightly sclerotized, and do not offer any character of taxonomic importance. The ostium bursae is of very variable width in the different species; it may be funnel-shaped, often it is terminated by a marginal ring (lamina postvaginalis). The margins of the ostium bursae are always heavily sclerotized, and are rather constant in the armature. The introitus vaginae is rather difficult to observe as it is guarded by a special structure, which prevents the sperm from being lost until it is in the bulla seminalis (ALBERTI, 1958, 1959). In some species, e.g. in *Z. loti* (DEN. & SCHIFF.), the ostium bursae may be decidedly larger and more heavily sclerotized than in the majority of the *Zygaena*-species. It is of much taxonomic importance, however, in some species, e.g. *Z. trifolii* (ESP.) or *Z. filipendulae* (L.) in which it shows a considerable, individual variation. The plate („Schildchen" sensu ALBERTI) in some species is in the form of an irregular triangle, which points towards the papillae anales; more rarely it is rounded with rugged and perforated margins. This plate is missing in some species, and according to ALBERTI (1958—1959) it has group significance, being, however, a secondary taxonomic character. It shows considerable individual variation (fig. 118) in several species. The eighth tergite is characterized by the deep, semicircular, lateral notches. It is often constricted or even totally divided medially, e.g. in *Z. loti* (DEN. & SCHIFF.) or in *Z. purpuralis* (BRÜNNICH). This constriction appears in varying degrees in nearly all species of the genus *Zygaena* F. occurring in Poland (fig. 122). Anterior apophyses always neavily sclerotized, they vary in length and width, also vary, however, their variation does not correspond with that of the anterior apophyses. The papillae anales are short, rounded and are clothed with short, bristle-like hairs. They are very constant in all species of the tribe *Zygaenini* and do not offer any important taxonomic feature.

The generic characters are better represented in the male genital armatures. The female genital armatures, in spite of their considerable differentiation are not as characteristic of the genus as those of the male. Generally, the genital armatures of the Polish species of the genus *Zygaena* F. have, in many instances, rather little taxonomic importance because of their considerable individual

Figs. 120—121. 120 — The variation of the anellus: a — *Zygaena carniolica* (SCOP.), b — *Z. loti* (DEN. & SCHIFF.), c — *Z. ephialtes* (L.), d — *Z. angelicae* OCHSEN., e — *Z. filipendulae* (L.), f— *Z. trifolii* (ESP.), g — *Z. lonicerae* (SCHEVEN), h — *Z. purpuralis* (BRÜNNICH). 121 — The variation of the lamina dorsalis and uncus in *Z. purpuralis* (BRÜNNICH). The lamina dorsalis and uncus shown in figs. a—e are from the same specimens to show the correlation between these two parts.

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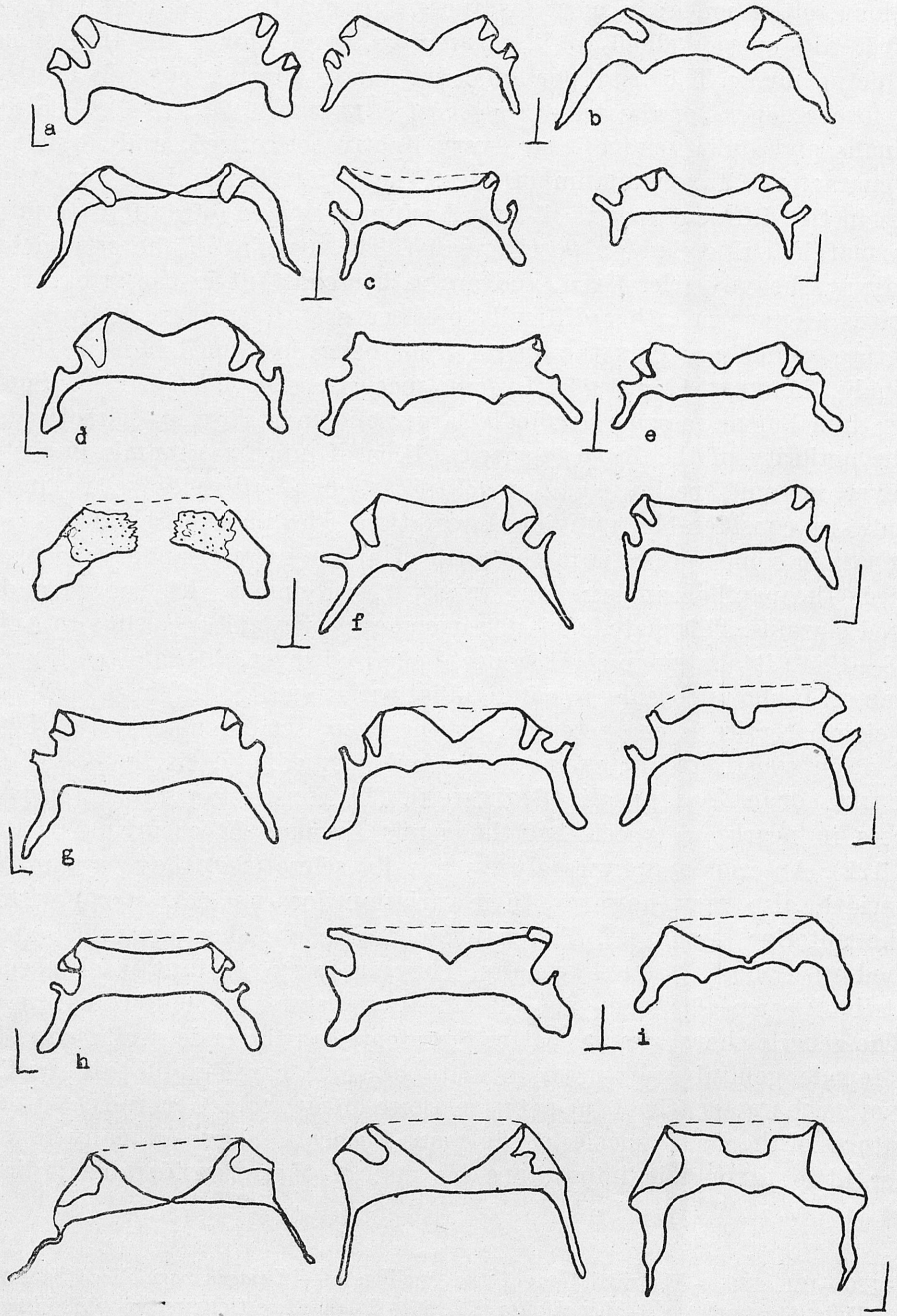
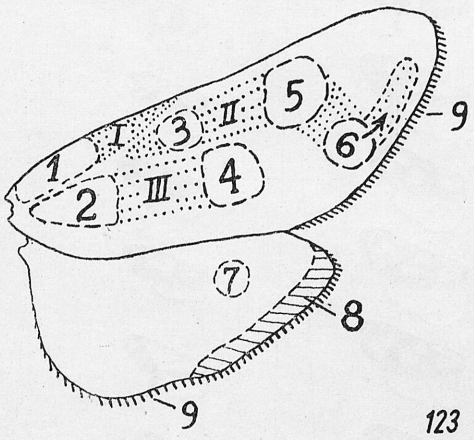


Fig. 122. The variation of the eighth tergite and the anterior apophyses: a — *Zygaena osterodensis* REISS, b — *Z. loti* (DEN. & SCHIFF.), c — *Z. viciae* (DEN. & SCHIFF.), d — *Z. ephialtes* (L.), e — *Z. angelicae* OCHSEN, f — *Z. filipendulae* (L.), g — *Z. trifolii* (ESP.), h — *Z. lonicerae* (SCHEVEN), i — *Z. purpuralis* (BRÜNNICH).

variation. This is especially evident in such species as *Z. trifolii* (Esp.) and *Z. lonicerae* (Scheven). It is of importance to note that the genital variation in the species of the *Zygaena* F. does not correspond with that of the habitus.

2. Variation in pattern

The most important taxonomic characters of the pattern of the *Zygaena* F. species are to be found in the forewing, then in the hindwing. The pattern of the body other than the wings has only general taxonomic importance. The



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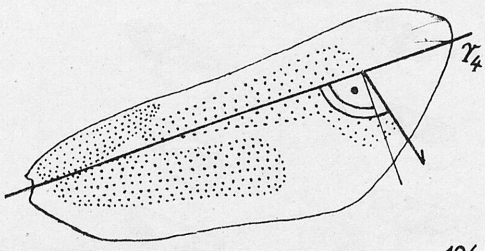

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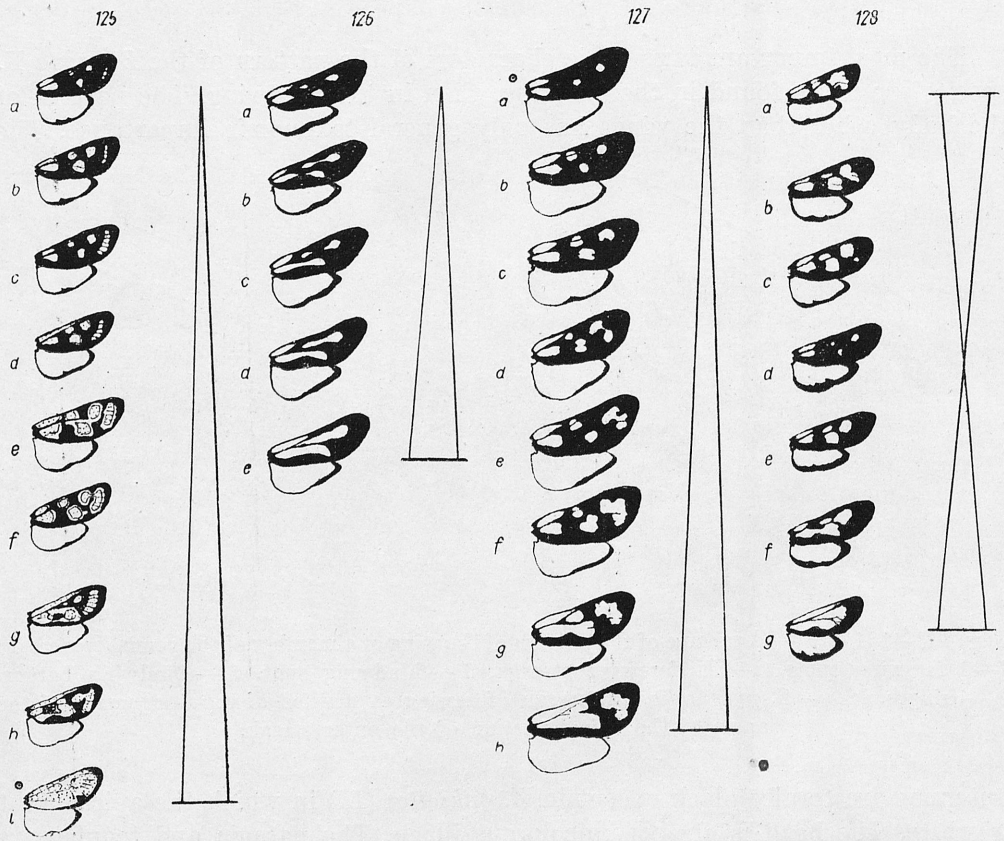
Figs. 123—124. 123 — A scheme of the pattern of the wing of a member of the genus *Zygaena* F. 1—6 forewing spots. I—III forewing streaks. 7 — hindwing spot. 8 — hindwing border. 9 — fringes. 124 — *Z. purpuralis* (Brünnich), forewing. A — method of the designation of the angle of the apical portion of the outer streak.

antennae are totally black except in *Z. ephialtes* (L.) in which the apical joint is white. The head is always unicolorous black. The patagia and tegulae are variable in colour in the different species. In the majority of the species they are black with a navy-blue sheen, but sometimes they are rather dull. In *Z. carniolica* (Scop.) and *Z. loti* (Den. & Schiff.) they are suffused with white-yellow scales, which form distinct borders of the patagia and less distinct borders of the tegulae. This character is very variable in individual species and may be completely absent. However, it is of much importance for the determination of some geographical races. *Z. laeta* (Hbn.) has the patagia and tegulae clothed with red scales. Red scales may occur in very rare instances on the abdomen in other species e.g. *Z. purpuralis* (Brünnich) ab. *rubrianata* Bgff., or *Z. cynarae* (Esp.) ab *rubrianata* Bgff. However, no such a specimen has as yet been found in Poland. The thorax is uniformly coloured exception *Z. carniolica* (Scop.) and *Z. loti* (Den. & Schiff.) in which in some specimens (especially in the females) there is a slight white-yellow suffusion in the dorsal portion of the thorax. The abdominal belt is present in some species, it may

be a constant character in the individual species, such as in *Z. ephialtes* (L.), or may be very variable e.g. in *Z. carniolica* (SCOP.). In the latter species the abdominal belt is a subspecific character. The majority of the specimens of *Z. cynarae* (ESP.) shows the abdominal belt, however, it may sometimes be

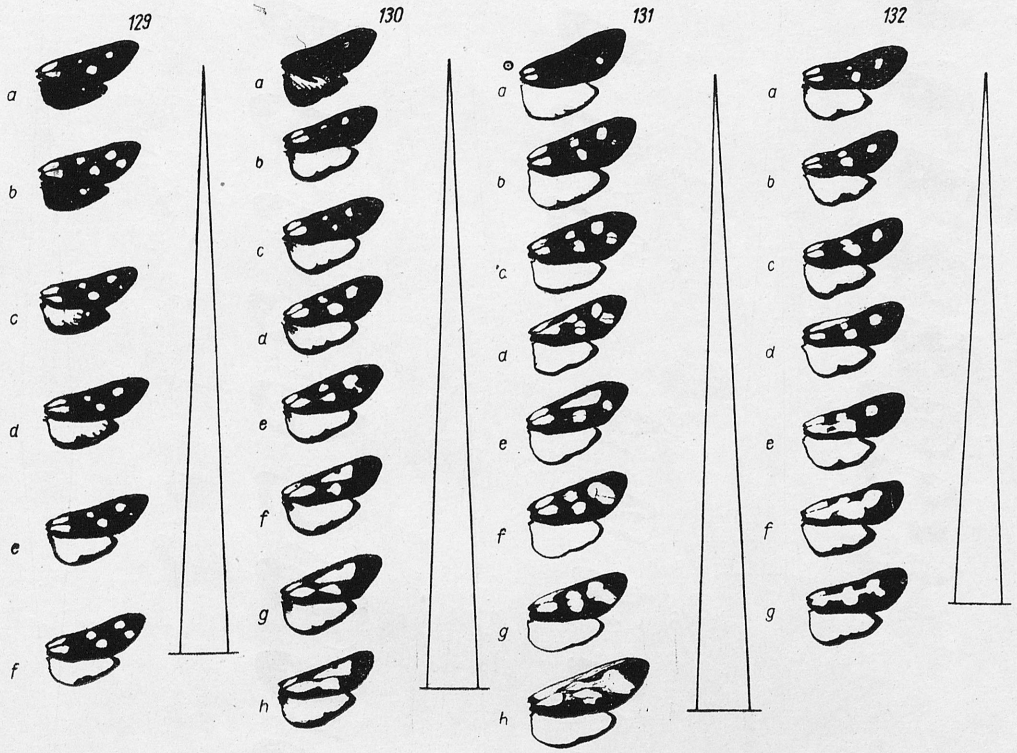


Figs. 125—128. The variation of the forewing pattern. 125 — *Zygaena carniolica* (SCOP.). 126 — *Z. osterodensis* (SCHEVEN). 127 — *Z. loti* (DEN. & SCHIFF.). 128 — *Z. viciae* (DEN. & SCHIFF.). Note: Aberrations shown in figs. 125-i, and 127-a have not as yet been found in Poland.

Remark: Convergent lines alongside figs. 125—136 show only tendency of direction of the wing-pattern variability.

reduced. Normally the abdominal belt covers only one segment of the abdomen, however, it may be spread into two or even three segments and this is better developed on the ventral side than in the dorsal side of the abdomen. Such specimens are extremely rare in Poland. Judging from experimental studies (BURGEFF, 1956, DĄBROWSKI, 1963) the external factors (thermal, chemical) do not affect the pattern of the above mentioned parts of the body. However, they are on the genetically influenced as shown by DRYJA (1959) and other workers.

The forewing pattern consists of six spots (fig. 123). The two basal spots are slightly separated from each other. Spots 3 and 4 are oval and are situated in the middle of the wing and are normally separated from each other. They show the greatest tendency to a reduction, especially spot 3. Spots 5 and 6 lie in the distal portion of the wing. Spot 6 in the majority of the species is oval and may be narrowed, of a half-moon shape, e.g. in *Z. carniolica* (Scop.).

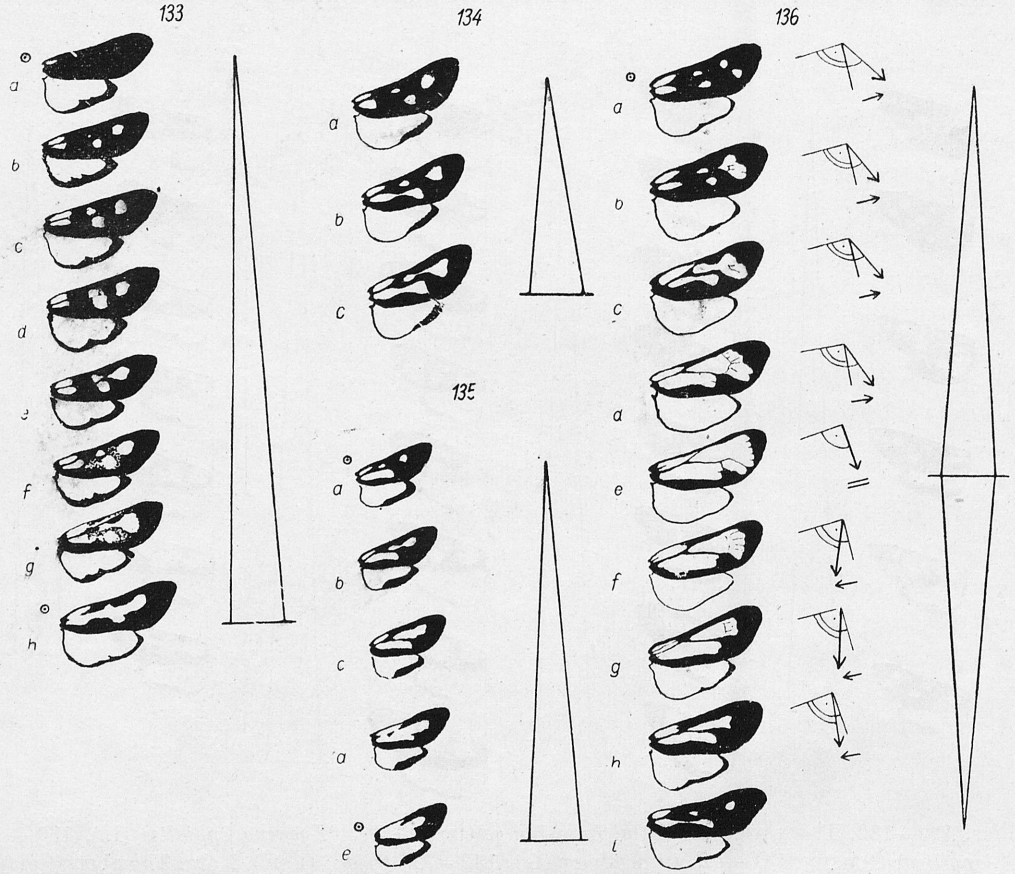


Figs. 129—132. The variation of the forewing pattern. 129 — *Zygaena ephialtes* (L.). 130 — *Z. angelicae* Ochsen. 131 — *Z. filipendulae* (L.). 132 — *Z. trifolii* (Esp.). Note: The aberrations shown in fig. 131-a is unknown from Poland.

It may also be confluent with spot 5, being reniform or of another shape as in *Z. loti* (Den. & Schiff.) and others. The longitudinal confluence of the spots forms the streaks. Varying degrees of such confluence show may be found or numerous aberrations in all the Polish species of *Zygaena* F. except for *Z. ephialtes* (L.). In some species, e.g., *Z. osterodensis* Reiss, *Z. brizae* (Esp.), or *Z. purpuralis* (Brünnich), the streaks occur in the typical forms. The aberrations of these species with the forewing streaks reduced to spots are scarce and are recessive. In general, the variation of the forewing spots in the majority of the species is great. However, specimens with the forewing spots completely missing or spraed over the total surface of the wing occur very rarely. The variation of the forewing pattern is shown in figs. 125—136. The diagrams

show that the variation has a general pattern in most species. However, in *Z. viciae* (DEN. & SCHIFF.) (fig. 128) and in *Z. purpuralis* (BRÜNNICH) (fig. 136), spot 6 is also changed in some aberrations, this scheme is changed.

The borders of the forewing spots appear only in *Z. carniolica* (SCOP.). They are very variable and are of much taxonomic importance in the deter-



Figs. 133—136. The variation of the forewing pattern. 133 — *Zygaena lonicerae* (SCHEVEN). 134 — *Z. cynarae* (ESP.). 135 — *Z. brizae* (ESP.). 136 — *Z. purpuralis* (BRÜNNICH). Note: the aberrations shown in figs. 133-a, 135-a and 136-a have not as yet been found in Poland.

mination of the subspecies. These borders may be strongly influenced by the thermal and chemical factors. Because of this fact it is rather difficult to state the genetic influence on the borders. The specimens occurring in Poland often have the borders reduced or even missing and this character is especially frequent in the females and in the specimens occurring in the xerothermic localities. The yellow suffusion of the forewing in the *Z. loti* (DEN. & SCHIFF.) generally occurs in the females. The fringes of the outer margin of the forewing are black except in *Z. carniolica* (SCOP.) and *Z. loti* (DEN. & SCHIFF.), some specimens of which, especially females, have the fringes grey-white or white.

The pattern of the underside of the forewing. The spots may be separated from each other (fig. 137-a) or may have indistinct outlines (fig. 137-c). Moreover, in some species the spots are linked by a suffusion of coloration (fig. 137-b). In some species, e.g. in *Z. filipendulae* (L.) this suffusion is much dilated („Schleier" accordding to ALBERTI, 1958—1959) being concolorous with the spots. In such instances the spots are completely confluent with the streak or suffusion. This character is constant in some species but in the others, e.g. *Z. trifolii* (ESP.) it is variable and is of no taxonomic significance. The hindwings are, in the majority of species, without spots, and have a more or less broad, black border. In some instances the border may be much broadened, as in some forms of *Z. ephialtes* (L.) or in some aberrations of *Z. viciae* (DEN. & SCHIFF.) and *Z. angelicae* OCHSEN. Only in the ephialtoid forms of *Z. ephialtes* (L.) is the hindwing completely black with a white or red spot. The border is decidedly reduced or even absent in *Z. purpuralis* (BRÜNNICH) and in *Z. loti* (DEN. & SCHIFF.). The fringes of the hindwing is, in the majority of species black, however, in *Z. carniolica* (SCOP.) they are sometimes grey-white or white. In *Z. loti* (DEN. & SCHIFF.) the lighter fringes occurs very rarely. The two species do not show any correspondence between the coloration of the fringes of the fore- and hindwings. The fringes of the hindwings are usually darker than those of the forewings. The colour of the fringes of the hindwing is of no taxonomic significance except in *Z. carniolica onobrychis* (DEN. & SCHIFF.) which shows white fringes.

In general, the variation of the pattern in the Polish *Zygaena* F. shows the tendency to a reduction or enlargement of the forewing spots and a reduction of the hindwing border. The majority of specimens show intermediate forms in the pattern, close to that in typical forms, while extreme specimens are very scarce. Except for these general tendencies, each species shows special directions in the variation of the pattern.

3. Variation in Coloration and Melanism

The colours and pattern of the moths of the genus *Zygaena* F. are distinctly warning in character. SZWANWICZ (1956) quotes the hypothesis of PORCZYŃSKI (1885—1897), who suggests that the coloration of the burnets is mimetic, for they show a resemblance to the beetles *Mylabris* F. of the family *Meloidae* F. having similar coloration with bright red spots on the black ground-colour of a bluishgreenish shade. These beetles are characterized by their toxic haemolimph of a specific smell. However, observations of the European species of *Zygaena*F. made by other authors (SPULER; BURGEFF, 1936) show that birds and other insectivorous vertebrates avoid these moths, because, if disturbed, they exude haemolimph having an intense odour and irritating qualities. Only few species of *Zygaena* F., inhabiting the woodless regions of East Asia as far as the coast of the Pacific (e.g. *Z. niphona* BTLR.), are, according to SPULER (1936), partly devoid of this character. The Polish burnets have the faculty for warning

fully developed and the haemolimph exuded by them mostly in the regions of joints in response to a disturbance is almost identical in respect of colour and scent with the exudation of the molested *Coccinellidae*, *Coleoptera*. Therefore, there are no justified grounds to accept the theory of the mimetic nature of coloration in the burnets. They produce so effective warning substances themselves that all my attempts to feed living moths to hens and lizards failed. Only the specimens that had been cut open and washed out carefully were occasionally taken. In the ecological niches occupied by *Zygaena* F. other similarly coloured insects showing similar warning qualities are uncommon.

The essential coloration of *Zygaena* F. includes bright, mostly red (occasionally white, yellow or brown) spote or streaks on the black ground-colour of a dark blue or blue-green shade. In many species of *Zygaena* F. the dark scales of the background have the property of refracting rays of light, which results in a strong metallic sheen. In the opinion of SZWANWICZ (1956), the scales of this type are developed best in the members of *Urania* F. and they are also present in the *Papilionidae*, *Lycaenidae*, and *Erycinidae*. In the burnets such scales may occur not only on the wings but also on other parts of body. In some species a differently coloured belt extending most frequently over one segment of the abdomen, more rarely over a few segments, is a strongly genetically fixed dominant character [e.g., *Z. ephialtes* (L.)], in other species it is a labile character [(*Z. carniolica* (SCOP.), *Z. cynarae* (ESP.)] or a decidedly recessive one [*Z. loti* (DEN. & SCHIFF.), *Z. viciae* (DEN. & SCHIFF.)], at last it occurs quite exceptionally [*Z. angelicae* OCHSEN, *Z. purpuralis* (BRÜNNICH)]. The colour of the belt is, as a rule, identical with that of the spots on the wings and in *Z. ephialtes* (L.) it is analogous to the colour of spots 1 and 2 on the fore-wing.

The problem of classification of the coloration in the genus *Zygaena* F. is relatively complex because of the wide range and great differentiation of shades and their different combinations in particular species. At the present state of studies on the coloration of the burnets the genetic factors transmitting the traits of coloration to next generations in accordance with the genetic laws must be regarded as those playing the main role in the determination of variation of the coloration. The species *Z. ephialtes* (L.) has become a classical object of such studies, which owing to its variability provided rich and interesting material for many authors (BOVEY, 1949; DRYJA, 1959; POVOLNÝ & GREGOR, 1946; POVOLNÝ & PIJAČEK, 1949). In particular the studies of DRYJA (1959), based on abundant materials, elucidate among other things the inheritance of coloration.

Some authors, e.g. BERGMANN (1953), lay perhaps too strong a stress on the role of the direct action of microclimatic factors of environment. Of these factors, temperature and humidity are supposed to exert influence also upon the coloration of the *Lepidoptera*. Thus, a drop in temperature and humidity below the optimum („KT-Formen") in the period of larval development will produce the „dull and obscure red" colour of the spots of the burnets. At a de-

creased optimum temperature and high humidity of the air („KF-Formen") the colour of the spots becomes „dark red". An increased temperature and low percentage of moisture in the air („WT-Formen") bring about the brightening of the red colour to „orange-yellow", whereas a high temperature and high humidity („WF-Formen") will promote the dominance of the „fiery deep red passing into brown" colour. BURGEFF (1956) reared caterpillars of the burnets collected in the alpine climate in artificially set up tropical conditions for a number of years, but these conditions had no evident effect on the coloration of the moths. As will be seen from the temperature experiments carried out by the same author, neither in this case do the moths show any changes in coloration, in spite of considerable changes found in the pattern of the wings. The changes resulting from the increased density of coloured scales, giving an effect of brightening or even transparency of the wings, must not be related with the change of coloration, with which they have nothing in common.

Coloration, therefore, belongs to the group of characters that are directly governed mainly by genetic factors. The external factors, even so vigorous ones as temperature shocks or chemical shocks (induced by intrapupal injections), applied to a good effect for experimental changes of the pattern, in *Zygaena* F. do not produce a change in the colours themselves but only in the quantitative proportions of coloured scales in particular elements of the pattern. From the evolutionary point of view the mechanism of inheritance of traits, and among them of colour, is grounded on the action of a complex of environmental factors. However, the periods of time in which they became genetically fixed must be measured by the geological time-scale (cf. *Z. miocaenica* REISS), and then it is obvious why attempts to shake some strongly fixed characters even by means of very vigorous external stimuli do not show expected results in some cases.

The present considerations being confined only to changes in coloration of moths, these changes are treated apart from the aberrations of elements of the pattern. From this standpoint the white borders round the spots on the fore-wings of *Z. carniolica* (SCOP.) are reckoned among the elements of the pattern.

An amaranthine shade of the carmine colour is dominant in nearly all species of *Zygaena* F. The divergencies from this basic colour observed in the territory of Poland include the whole range of shades from cinnabar through orange-yellow („salmon" after FORD) to lemon-yellow. On the other hand, the red colour may be smoky (dim), or replaced by the light or dark brown. Here arises the problem of melanism in the burnets, which will be discussed a little further.

Determining the colour aberrations of *Zygaena* F. it is important to make sure that the coloration of a given specimen has not changed on account of unproper preservation or has not been rubbed off, etc. In newly caught specimens special attention should be given to the state of the fringe and the degree to which the scales have been rubbed off, because the moths flying

for a fairly long time often have their colours lighter owing to the action of the sunlight. In all probability the process of oxidation of the red pigment also contributes to these changes. This is particularly striking in specimens subjected to the action of perhydrol vapour (30 % H_2O_2), which makes the carmine colour change into the yellow. The burnets exposed to the long action of even dispersed daylight in glass cases fade relatively soon, deceptively resembling the yellow aberrations after a few years, for the ground-colour of the wings is considerably more resistant [1]. A distinct group of colour aberrations consists of moths with the spots strongly dimmed. When examining such moths, the first and most important thing to do is to distinguish colour modifications from the changes in the wing pattern [2]. Such more or less dark brown aberrations occur in Poland extremely rarely and sporadically. They are also brought about by genetic processes: the manifestation of this so recessive character in the phenotype. This has been pointed out in the papers by ALBERTI (1955), DRYJA (1959) and PRZEGENDZA (1926). The suggestion that there is an association between the dark colour of spots in the burnets and the content of some microelements in the soil, such as compounds of iron, which act on the coloration of scales via the food-plants (BURGEFF, 1910) is not conclusive. Instead, the connection of this phenomenon with the mechanism of inheritance consistent with the genetic laws has been supported by quite conclusive experimental data. The analysis of this process presented in the paper of DRYJA (1959) explains also why the aberrations of this type are so rare in nature. In literature the brown aberrations of different species were often figured in natural colours and provided with frequently very vague and superficial descriptions and various denominations (OBERTHÜR, 1896; REISS, 1926 and others).

Only single brown specimens are known from the territory of Poland, e.g., two specimens of *Z. carniolica* (SCOP.) of a coffee-brown shade instead of red (ab. *grossi* HSKE. = ±ab. *nigra* REISS) were found in the region of Kraków, one dark brown specimen of *Z. loti* (DEN. & SCHIFF.) instead of red (ab. *brunnea* DZIURZ.) from Smoleń near Pilica, one coffee-brown specimen of *Z. viciae*

[1] Tests for the response of the pigment in the red scales of the burnets carried out by the method of FORD (1941—1944) were positive, the carmine colour changing into the yellow in the vapour of concentrated hydrochloric acid (HCl). If such lightened specimens are placed in the atmosphere containing ammonia vapour (NH_3), the original coloration is restored in some dozen seconds. It is characteristic that in HCl vapour the degree of lightening of the red colour is not uniform and differs not only between species but even between particular specimens of the same species. The changed colour is deceptively similar to the natural yellow, cinnabar and orange-yellow, aberrations. However, the aberrations of this colour occurring in nature do not respond to the action of the vapour of the acid and do not change their colours under the influence of NH_3 either.

[2] To answer the question in which type of changes a given moth is to be numbered it is enough to observe the wings carefully in the slanting rays coming from a strong source of light. The pattern is then seen quite distinctly, while no outlines of spots are visible against the ground-colour of the wings in the specimens with extremely reduced spots.

(DEN. & SCHIFF.) instead of red (ab. *brunnea* **ab. n.**) from Klonów near Miechów, two dark brown specimens of *Z. filipendulae* (L.) of a violet shade instead of red of an amaranthine shade (ab. *nigrolimbata* COCKAYNE = ±ab. *chrysanthemi* BKH.) from the vicinity of Skotniki near Kraków, at last one smoky brown specimen of *Z. purpuralis* BRÜNNICH instead of red (ab. *obscura* TUTT) from the region of Klonów near Miechów and one dark brown specimen of *Z. angelicae* OCHSEN of a violet shade (ab. *brunnensis* SKALA) from Cisownica near Cieszyn, much resembling *Z. filipendulae* (L.) ab. *nigrolimbata* COCKAYNE.

From the descriptions of dark varieties of moths, mostly very laconic and vague, it is difficult to infer as to the alternative: pattern aberration or colour aberration, and they often suggest melanic changes of the type of which *Biston betularia* (L.), ab. *carbonaria* JORD. is now a classical example. No melanic changes (their establishing is also favoured by selective action of environmental factors, e.g., birds, catching pale specimens well visible on the dark background or, on the contrary, black moths resting on light objects) occur in colour aberrations of the genus *Zygaena* F., at least in the meaning of the word in which it is used for a number of groups of the *Lepidoptera*, where this phenomenon has been given the newly coined term of „industrial melanism" (FORD, 1955; MARCHLEWSKI, 1961; POVOLNÝ, 1948). Apart from some inaccuracies of the descriptions of dark aberrations of the burnets, e.g., those in the description of *Z. carniolica* (SCOP.) ab. *nigra* REISS (1926), presented here as a typical melanic („the ground-colour of the whole moth was black without a trace of red"), whereas in the coloured plate it is figured as coffee-brown with distinct spots on the fore-wings, there are specimens of an evidently dimmed red colour, which is only strongly „smoky" without any admixture of another colour. Two specimens of *Z. osterodensis* REISS (the region of Lwów?) with intensely dark, plumbago-dark, wings are to be seen in the collection of J. JAROSIEWICZ. However, even these moths cannot be regarded as typically melanic aberrations, because their colouring is partly coffee-brown. The specimens of *Z. filipendulae* (L.) ab. *nigrolimbata* COCKAYNE or *Z. angelicae* OCHSEN. ab. *brunnensis* SKALA come considerably nearer to the proper melanism. None the less, I failed to pick a moth out of the specimens of *Zygaena* F. so far found in Poland such that its coloration conformed strictly to the criteria of melanism established for other groups of the *Lepidoptera*. Probably this type of coloration would not be advantageous to the burnets, and the dark specimens void of any warning colours are presumably exposed to greater danger from its natural enemies than the specimens of normal bright coloration.

This is probably one of the reasons why the dark-coloured burnets occur so rarely both in the highland and in the lowland habitats.

4. Interspecific Crosses in the Genus *Zygaena* F.

It has been a well-known fact for long that the burnets show a strong inclination to copulate with the specimens belonging not only to other species but also to other genera and even families. Numerous records in literature

include only a small part of examples observed by many investigators in natural circumstances.

The examples of copulation between specimens representing different families deserve special attention. Of these the most frequently mentioned are between male *Syntomis phegea* (L.) and female Z. *filipendulae* (L.) (HOLIK, VIERTL, MANN, STAUDER, VORBRODT, and others). Other species of *Zygaena* F., too, can mate with the different species of *Syntomis* L., to mention only male *S. phegea* (L.) × female *Z. ephialtes* (L.) (HOLIK, VIERTL, DAHNEL), male *S. phegea* L. × female *Z. angelicae* OCHSEN. (VIERTL), and male *S. phegea* (L.) × × female *Z. purpuralis* (BRÜNNICH) (VORBRODT). S. TOLL observed such cases in Podolia several times; one of them is represented by a preparation of female *S. phegea* (L.) mating with male *Z. filipendulae* (L.) (Babińce near Krzywcze, July 7, 1937) in our collection, since they did not disjoin even in the cyanide insecticide glass. The male is quite fresh, whereas the appearance of the female, which is heavily rubbed, with a slim abdomen, indicates that it must already have laid most of its eggs before this copulation. The case is the more interesting because HOLIK (1933) will have it that in such mixed couples the male always belongs to *Syntomis* L. The above-mentioned examples form a spectacular illustration of possibilities, which under certain circumstances bring about the overcoming of such barriers as the differences in the structure of the genital apparatus and those of the genetic division between distinct systematic units. As has been shown by numerous laboratory breeding experiments, these copulations turned out fruitless and no offspring was derived from them [1].

Similarly, the cases of copulation often described between the species of the genera *Procris* F. and *Zygaena* F. (HOLIK, 1933) do not result in any progeny in the form of interspecific hybrids.

The examples of copulation between the species within the genus *Zygaena* F. are very common. HOLIK (1933) lists 54 cases of copulations recorded by a few authors and showing different combinations of different species of *Zygaena* F. under natural conditions. During my observations carried out in the territory of Poland I saw a male of *Z. filipendulae* L. mating with a female of *Z. ephialtes* (L.) twice: at Podgórki Tynieckie near Kraków (19. 7. 1958) and in the region of Racławice near Miechów (3. 8. 1961), which corroborates numerous records on the particularly high frequency of such copulations between the moths of these species. Besides, a male of *Z. loti* (DEN. & SCHIFF.) mating with a female of *Z. angelicae* OCHSEN. was observed in the Pieniny National Park (3. 7. 1959) as well as a male of *Z. viciae* (DEN. & SCHIFF.) with a female

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[1] The claim of DOLLESCHAL that he reared the offspring derived from crossing a male of *S. phegea* (L.) with a female of *Z. filipendulae* (L.), showing the dominance of the characters of the male without inheriting anything from the female was called in question by HOLIK (1933), who took it that the reared animals had been changed or mixed with other materials. The misunderstanding, however, seems to result simply from an error in the determination of sex. The female was probably *S. phegea* (L.) fertilized by a male of the same species prior to this copulation.

of *Z. lonicerae* (SCHEVEN) and a male of *Z. purpuralis* (BRÜNNICH) with a female of *Z. angelicae* OCHSEN. in the Ojców National Park (1. 7. 1955 and 28. 7. 1958, respectively). The female of the last pair laid about 130 eggs, from which no caterpillars hatched, though the copulation lasted for more than 20 hours. In all these cases the females were newly hatched and they mostly stayed near the abandoned cocoons.

In my opinion, the explanation of this phenomenon should also be looked for in the morphology as well as in the ecology and ethology of the burnets. The comparatively primitive structure of the genital apparatus both in males and in females does not form a sufficient barrier to prevent the pairing of members of different species not only within the genus but even those belonging to distinct genera or families. A general resemblance of copulatory structures exhibited by all the species of the burnets may facilitate interspecific copulations as well.

In a number of habitats there occur a few species of the genus *Zygaena* F. living together in a limited area and the emergences of moths more or less coincide in time, that is to say, take place from the second half of June to the end of August. The period of emergence of moths ranges in particular species from some dozen days to a month or two. Generally, it lasts longer in extensive areas abounding in specimens than in isolated localities with a small number of moths. The contacts between different species of the burnets are thus facilitated, the protandry, a regular phenomenon in the genus *Zygaena* F., contributing to them as an important stimulatory factor. Consequently a newly emerged male, e.g., that of *Z. filipendulae* (L.), failing to find a female of the same species, chooses that of a different species, genus, or even family out of the emerging moths. Needless to say, it is not a normal phenomenon, and where both sexes of the same species are present, the natural selection leads to an unconditional choice of a female belonging to its own species.

I repeatedly saw about 20 males of *Z. viciae* (DEN. & SCHIFF.) swarming around one female of the same species. In the Pieniny Mts. more than 10 males of *Z. angelicae* OCHSEN. were observed flying about a mating pair of this species, while in the Ojców National Park besides a few cases of such „swarms" of some dozen males surrounding pairs beginning to copulate observed in *Z. loti* (DEN. & SCHIFF.), *Z. angelicae* OCHSEN., and *Z. carniolica* (SCOP.), a few males frequently gathered about a female still emerging from the cocoon within a short time. It is interesting that the males gathering around one female paid no attention to other females of the same species flying nearby.

The opinion was held that some aberrations or even subspecies took origin from the crossing of two species [e.g., ab. *peucedani* ESP. was supposed to result from the crossing of *Z. filipendulae* (L.) and *Z. ephialtes* (L.)]. The interspecific crosses were also considered to be of great importance to the processes of formation of „races", subspecies, and even new species. However, this hypothesis has been given up (HOLIK, 1933) on account of numerous examples denying the existence of such possibilities even in exceptionally favourable

circumstances, for most part of the eggs laid by a female in consequence of interspecific mating do not develop. In rare cases, in which it comes to the hatching of caterpillars from such eggs, they are very weak and most of them perish in the course of postembryonal life, without taking any food or after the first ecdyses or when hibernating. A few specimens that succeed in reaching the stage of imago are, as a rule, infertile. It should be noted that these results were obtained in special breeding laboratories, where the development of moths proceeds in „greenhouse" conditions, the disadvantageous influences of a natural environment being eliminated to a great extent (rapid changes of weather, shortage of food, danger from parasites, etc.). It is obvious that in a natural habitat caterpillars feeding upon green plants are exposed to a complex of factors eliminating a high percentage of specimens, which, together with the extreme weakness of hybrids as compared with the specimens derived from normal parents of the same species and better adapted to the struggle for existence, give them a very poor chance of survival.

Such interspecific crosses give better results only in the species which are very closely related (HOLIK, 1933), e.g., *Z. trifolli* (ESP.) × *Z. lonicerae* (SCHEVEN) or *Z. transalpina* (ESP.) × *Z. angelicae* OCHSEN., whose progeny, showing a fairly great vitality and fertility, indicates their close relationship.

The identification of the specimens collected in the wild as interspecific hybrids should be done with utmost caution, for there are no such criteria as to make the definitive decisions in this matter possible, and the criteria used for the identification of Lepidopteran species cannot be applied whenever there is suspicion that we deal with an interspecific hybrid.

Only in the specimens whose origin from interspecific crossing has been proved to a certainty and for which the possibility of fertization of the mother by a male of the same species is ruled out beyond doubt — thus practically only in laboratory moths — some of their morphological characters may fairly safely be attributed to the influence of the characters transmitted by the male or the female. But even in these cases the variability of both species involved, so remarkable in most *Zygaena* species, ought to be taken into account. In so far as the moths collected in natural habitats are concerned this variability as a rule eliminates the possibility of numbering such specimens among interspecific hybrids. HOLIK (1933), experimenting on crossing male *Z. filipendulae* (L.) with female *Z. ephialtes* (L.), arrives at the conclusion based on his abundant material that the offspring of a mixed pair shows the specific characters of its mother alone. Both the habitus of the specimens and an analysis of the morphology of the genital apparatus in males (comparison of the uncus) leave no room for doubts in this respect. Attempts to persuade the hybrids to copulate were uneffective in spite of the abundance of material. Consequently, I have not managed to check as yet whether we have to do here with the phenomenon of the dominance of characters in the F_1 generation analogous to the dominance of the peucedanoidal characters in the case of *Z. ephialtes* (L.) or not (DRYJA, 1959; POVOLNÝ & GREGOR, 1946 and others). The offspring (F_1) which PRZE-

GENDZA (1926) obtained crossing a male of *Z. purpuralis* (BRÜNNICH) with a female of *Z. viciae* (DEN. & SCHIFF.) showed only the characters of the female. If the possibility that all the females from which the eggs for rearing were derived had been fertilized previously by males of the same species is shut out, then, according to the suggestion of above-cited HOLIK, the very act of copulation may have brought about the laying of parthenogenetic eggs fit to develop, as was the case with the bisexual parthenogenetic progeny of *Bombyx mori* L. and *Lymantria dispar* (L.) demonstrated by HERING (HOLIK, 1939). This presumption, however, seems impossible to maintain at the present state of knowledge of the burnets.

Therefore, however often interspecific crosses occur in the burnets in the wild, they do not play any role (at least in the cases so far known) affecting the variation of this group of the *Lepidoptera*, and the more so the species-forming processes.

5. Ecology. Effect of Environmental Factors on Variation in *Zygaena* F.

Most of species and subspecies of the genus *Zygaena* F. have a narrow range, which cannot be explained by the lack or deficiency of food-plants, for even where these grow in abundance over extensive areas, a given species of the burnets inhabits, for instance, a detached piece of a xerothermic slope or a meadow amidst woods, sometimes hundreds of kilometres away from the next localities of this species [*Z. brizae* (ESP.), *Z. cynarae* (ESP.), or *Z. ephialtes* (L.)]. It is characteristic that the species of *Zygaena* F., as a rule, inhabit the zone of ecotone, i.e., the areas where two or more communities come into contact. They always occur at the edge of forests, especially pine or deciduous ones, whereas in typical open steppe areas there are only scarce single species, as it happens in the Southern Russian and Asiatic steppes (e.g., *Z. niphona* BTLR.). Most *Zygaena* species find optimum conditions of living on xerothermic slopes with a limestone substratum in the temperate zone. Moreover, some species are adapted to live in cool and damp climates, singularly even in very damp habitats [*Z. trifolli* (ESP.) and partly *Z. viciae* (DEN. & SCHIFF.)] or in an alpine climate (*Z. exulans* R. & H.), as well as in a moderately cold zone and some of them even cross the Arctic Circle [*Z. filipendulae* (L.)].

The above-mentioned trend of dwelling in ecological niches in ecotone zones, namely, in marginal areas between grassland and woodland communities, may be indirectly associated, among other things, with the anatomical structure of these moths. According to SZWANWICZ (1956), the moths characterized by a considerable power and perfectness of flight have their thoracic exoskeleton strengthened by the inclusion of the coxae in its system and the formation of a strong chitin ridge inside the thorax to increase the area of attachment of the muscles. The union of the coxae with the thorax excludes them, as mobile parts, from the system of legs, thus freeing the dorso-ventral muscles from the action of moving the legs in favour of the wings. In a moth of the

genus *Zygaena* F. the breast ridge is low and the forks pertaining to it are free and uniformly developed. In well flying butterflies, like *Papilio machaon* L., the ridge is very high and the structure of the forks differentiated in particular segments, while their largely augmented branches in the mesothorax coalesce with the pleurite increasing the strength of the thoracic skeleton and enlarging the attachment area for muscles. The flight of the burnets, which are deprived of these adaptations, is slow and heavy and the moths are unable to perform long-distance passages and to withstand strong winds. This explains to some extent why the burnets occur in the close proximity of woods and avoid open grassland areas, where they cannot find any protection against strong winds, so dangerous to these badly flying and languid moths.

At the same time the poor faculty for flying may be one of the factors responsible for the local occurrence and the attachment of numerous *Zygaena* species to limited areas.

The habitats in which these moths live are surrounded by other plant associations, most of which do not give them proper conditions to develop and survive. The dispersal of the moths is restrained effectively by the so-called „ecological barriers" (Ford, 1955; Dąbrowski, 1959), e.g., steppe plains or compact forests. The burnets dwell in the ecotone zones bordering on forests, but they do not make direct use of the very forest associations either for their food supplies or seeking shelter. They are closely associated with grassland associations and visit only the poorly timbered parts of the wood presenting well lighted places allowing for the development of most part of plant species belonging to the proper habitat of *Zygaena* F. Watery meadows, peatbogs, high mountains of igneous rocks, and, as a rule, northern slopes characterized by poor insolation are other natural ecological barriers for a majority of the species of *Zygaena* F. worthy to be mentioned. Owing to the development of civilization and economic activity of man large areas have been put under cultivation, forestation, building, industrial exploitation, etc. forming a number of new man-made ecological barriers, of which cultivated fields parallel steppes and constitute a perfect waste for the burnets. The significance of these artificial ecological barriers is great, for they influence the climatic conditions and disturb the biological balance of extensive areas. However, the influence of these barriers on the evolutionary processes cannot be of any major importance, as it is still of very short standing; their role is otherwise limited to the isolation of the biotic environments of the burnets and the exertion of harmful influence upon them, leading to their complete liquidation as the economic development proceeds.

In the climatic conditions of Poland most species of *Zygaena* F. gather in very small xerothermic grassland areas [1] scattered in the regions where

[1] The term „xerothermic grasslands" (Kornasiowa-Medwecka, Kornaś, in the teamwork „Vegetation of Poland", 1959) is here used for these plant associations instead of the term „steppes" misused in different meanings, for Poland lies out of the range of proper steppe associations. Such associations occurring in this country are confined to detached islands

the relief and the limestone content of the substratum produce specific microclimatic conditions. The forest is the most important rival of steppe vegetation in Poland. The gypsum substratum inhibit the succetions of forests most effectively, favouring the steppe vegetation indirectly (KORNASIOWA-MEDWECKA, 1959). Since these localities are characterized by favourable insolution and high temperatures, most xerothermophilous species of *Zygaena* F. find the optimum developmental conditions and the sufficient quantity of food-plants in them.

In the present conditions the influence of ecological factors on the populations of *Zygaena* F. is, above all, to be distinguished in the decisive role of ecological barriers, limiting and isolating the majority of species in insular localities. Instead, their direct effect on the variation of moths is rather secondary. In some cases it may manifest itself, for instance, by changes in the pattern of the wings, in the density of scales on the wings, etc.

6. Ethology

The activity of all the species of *Zygaena* F. in Poland is uniform. It is dependent on the air temperature (above 17° C) and insolation of the habitat. The burnets are on the wing only in the daytime, showing the most intense activity in early afternoon hours, when they make the longest flights.

The flights of particular species as a rule depend on the area of the occupied habitat and the nature of the ecological barriers surrounding it. They, however, show evident differences in particular species (DĄBROWSKI, 1959), which is particularly well seen in localities inhabited by several species of *Zygaena* F. Some species [e.g., *Z. carniolica* (SCOP.)] are as a rule attached to a xerothermic fragment of a slope and confine their flights to its area, only sporadically crossing its boundary. However, other species [e.g., *Z. ephialtes* (L.)] make flights over 1 km. in length, which permits them to keep contact with localities lying within this range and facilitates their survival, if the original locality should be endangered by external factors.

In order to explain this problem it is necessary to pay respect to some psychical predispositions, which are as distinctive as, e.g., the fairly well visible morphological characters of a given species or genus. Observations of species characterized by perfect flight and potentially capable to make long and laborious passages, even against the wind (FORD, 1955, and others), show the role of the psychical element the more clearly, because these distances cannot constitute an insuperable barrier for them. At present, the explanation why, for instance, *Papilio machaon* L., *P. podalirius* L., or *Satyrus dryas* (SCOP.) at Podgórki Tynieckie near Kraków do not fly over to the neighbouring localities abounding in food-plants some scores or hundreds of metres away,

whose existence within the zone of woodland associations is conditioned by local factors. The plant composition of these xerothermic grasslands compared with the proper steppe is considerably impoverished and distorted.

but gather in small crowded localities, should be sought in their ethology and not only in the action of ecological factors.

In the genus *Zygaena* F. the trend manifested in the attachment of the moths to a limited area with a nearly complete lack of migrations and dispersal over larger areas so characteristic of a large number of different species of insects, which in spite of their often poor locomotive power show a tendency to long migrations, probably became one of the causes of their inability to adapt themselves to ecological changes.

Owing to the lack of this tendency to dispersal there is no admixture of „fresh blood" and the moths interbreed within small close populations. The great variaiblity of moths may be a factor counteracting the development of lethal characters, for which such close homozygotic populations produce favourable conditions.

7. Geographical Distribution

The genus *Zygaena* F. is associated with the eastern Holarctic, where in each more or less isolated area it is represented by a specific group of species, subspecies, and aberrations characteristic especially of open hilly or mountainous areas. Most mountainous massifs of Eurasia possess specific groups of *Zygaena* species, among which there are many endemic ones (cf. BURGEFF, 1952, Karte 13). At the same time some species have adapted themselves to the living conditions of forest-steppe environments, both lowland and upland ones, inhabiting not only mountains but also plains nearly all over Europe and Siberia. The species occurring in Poland belong to four zoogeographic elements of our fauna:

1. Ponto-Mediterranean (5 species), 2. Euro-Siberian (5 species), 3. European West-Mediterranean (1 species), and 4. East-European (1 species).

There are great differences in the geographical distribution (6 species reach the northern edge of their range in Poland), abundance, and vertical distribution of the burnets. The largest number of their species occurs in South Poland (former Galicia) (12 species), Upper Silesia (9 species), and the region of Warsaw (10 species). It is considerably smaller in the northeastern part of Poland (5 species) and the smallest on the coast of the Baltic Sea including the Hel Peninsula (4 species). It is interesting that in the Tatra Mts. the burnets are very rare, as has already been emphasized by NIESIOŁOWSKI (1929), who listed 4 species from this region. However, in spite of researches carried out for a few years and an examination of all available materials I failed to find *Z. lonicerae* (SCHEVEN) and *Z. angelicae* OCHSEN of the other two species mentioned by Niesiołowski only *Z. filipendulae* (L.) occurs in fairly large numbers in one locality exclusively, where as in other places of the Tatra National Park it is encountered with *Z. purpuralis* (BRÜNNICH) quite occasionally and as single specimens. One of the main caus es of this fact is probably the unfavourable geographical situation of the Polish portion of the Tatra Mts., embracing the northern part of the range where a xerothermic grassland area on sunny southern

	Pontine-Mediterranean species	Euro-Siberian species	European West-Mediterranean species	East-Europaean species
Reaches the northern edge of its range	*Z. carniolica* (Scop.) *Z. loti* (Den. & Schiff.) *Z. brizae* (Esp.)	*Z. ephialtes* (L.)		*Z. angelicae* Ochsen.
Reaches the northern and western edge of its range	*Z. cynarae* (Esp.)			
Whole territory of the country within range	*Z. filipendulae* (L.)	*Z. viciae* (Den. & Schiff.) *Z. lonicerae* (Schev.) *Z. osterodensis* Reiss *Z. purpuralis* (Brünnich)	*Z. trifolii* (Esp.)	

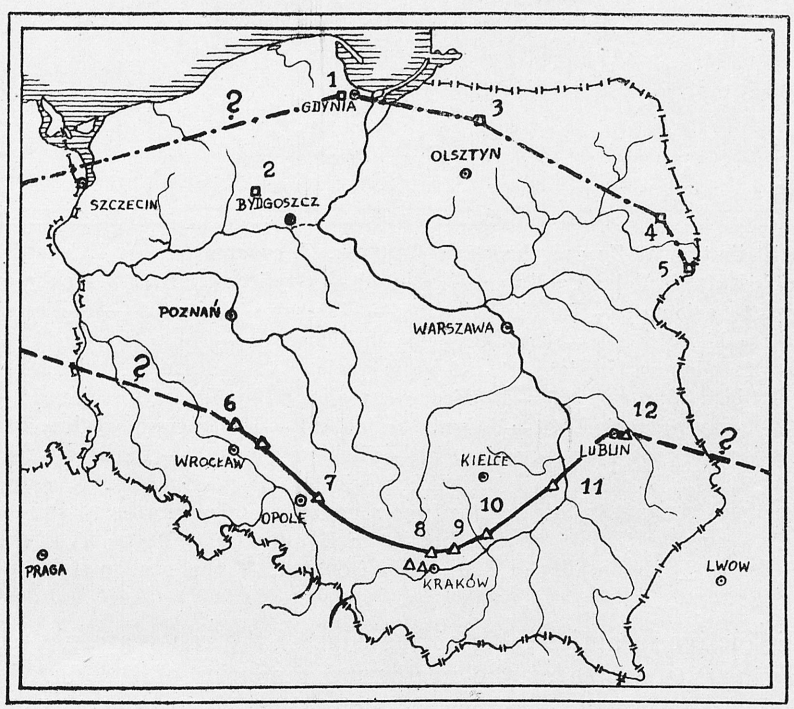

Fig. 137. Distribution of *Zygaena ephialtes* (L.), *Z. loti* (Den. & Schiff.), *Z. carniolica* (Scop.) and *Z. brizae* (Esp.) in Poland. 1 — Gdynia region, 2 — Bydgoszcz region, 3 — Bartoszyce region, 4 — Białystok region, 5 — Białowieża, 6 — Trzebnickie Mts., 7 — Strzelce Opolskie region, 8—9 — Kraków region, 10 — Sandomierz region, 11—12 — Lublin region. ——— Northern boundary of *Z. carniolica* (Scop.); —·—·— northern boundary of *Z. ephialtes* (L.) and *Z. loti* (Den. & Schiff.); △ the locality of *Z. carniolica* (Scop.); □ the locality of *Z. ephialtes* (L.) and *Z. loti* (Den. & Schiff.).

slopes is a rarity. Besides, a rapid succession of forests encroaches not only the plots of xerothermic grassland but also on the clearings, which were very frequently inhabited by *Z. purpuralis* (BRÜNNICH) and *Z. filipendulae* (L.).

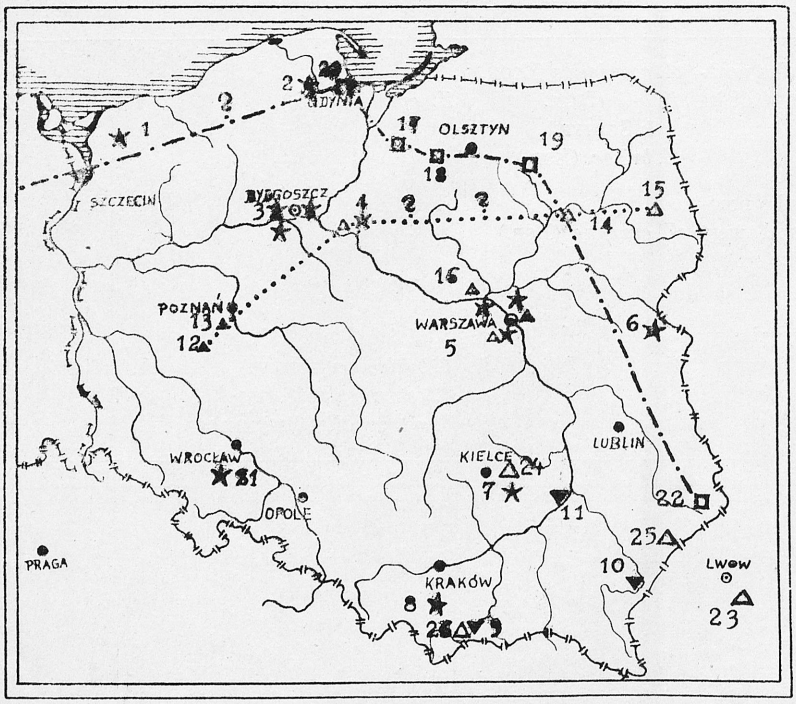

Fig. 138. Distribution of *Zygaena angelicae* OCHSEN., *Z. cynarae* (ESP.), *Z. brizae* (ESP.) and *Z. osterodensis* REISS in Poland and west Ukraine. 1 — Gryfice region, 2 — Weyherowo region, 3 — Bydgoszcz region, 4 — Toruń region, 5 — Warszawa region, 6 — Białowieża region, 7 — Świętokrzyskie Mts., 8 — Kasinka near Myślenice, 9 — Nowa Góra, 10 — Przemyśl region, 11 — Sandomierz region, 12 — Leszno region, 13 — Poznań region, 14 — Łomża region, 15 — Białystok region, 16 — Pomiechowo region, 17 — Kwidzyń region, 18 — Ostróda region, 19 — Szczytno region, 20 — Gdynia region, 21 — Dzierżoniów region, 22 — Tomaszów Lubelski region, 23 — Lvov region, 24 — Kielce region, 25 — Lubaczów region, 26 — Niedzica region.

—·—·— Northern boundary of *Z. angelicae* OCHSEN.; ····· northern and north-west boundary of *Z. cynarae* (ESP.); ★ the locality of *Z. osterodensis* REISS; △ the locality of *Z. cynarae* (ESP.); □ the locality of *Z. angelicae* OCHSEN.; ▼ the locality of *Z. brizae* (ESP.).

The distinctive localities lying at the edge of the range are plotted on the maps showing the course of the northern boundaries of the distribution of a few *Zygaena* species in the territory of Poland (Figs. 137 and 138). No boundary is marked for *Z. brizae* (ESP.), three localities of which have only been found so far and then too few to define it. In the case of *Z. osterodensis* REISS the map shows some characteristic localities and those recorded after 1939. As to *Z. carniolica* (SCOP.), reaching the northern edge of its range in South Poland (Fig. 137), the presumable expansion of the influence of the subspecies *Z. carniolica berolinensis* LEDERER and *Z. carniolica onobrychis* (DEN. & SCHIFF.)

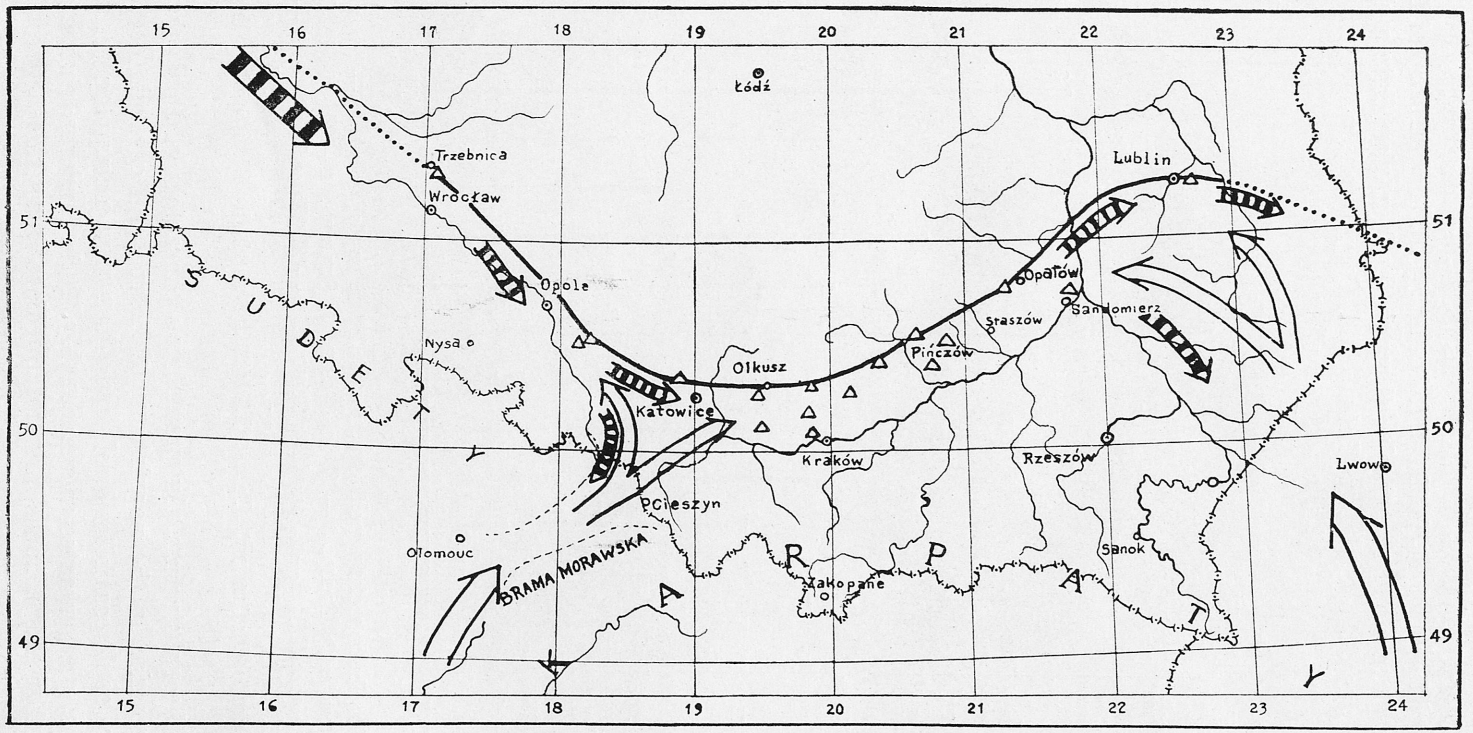

Fig. 139. Distribution of *Zygaena carniolica* (Scop.) in south Poland.
——— Northern boundary of *Z. carniolica* (Scop.); ..... anticipated course of northern boundary of *Z. carniolica* (Scop.); △ the locality of *Z. carniolica* (Scop.); ▮▮▮▮▮▮▮▷ extension of influence of ssp. *berolinensis* Lederer; ═══▷ extension of influence of ssp. *onobrychis* (Den. & Schiff.)

is presented in Fig. 139. In the periods when the development of vegetation and the climatic conditions favoured the dispersal of this species, the penetration of *Z. carniolica onobrychis* (Den. & Schiff.) into the territory of Poland supposedly took place along two tracks: through the Moravian Gate and from the south-east, since the Sudeten, Tatra, and Carpathian ranges made an effective barrier on account of their geographical position and the chemical

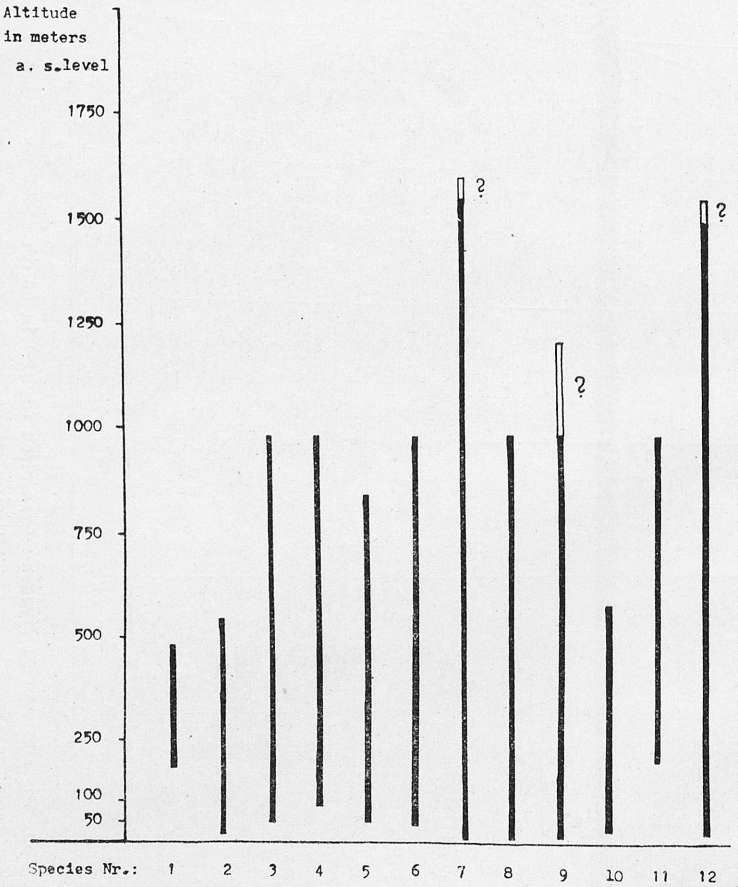

Fig. 140. Vertical distribution of the polish species of the genus *Zygaena* F. 1 — *Z. carniolica* (Scop.), 2 — *Z. osterodensis* Reiss, 3 — *Z. loti* (Den. & Schiff.), 4 — *Z. viciae* (Den. & Schiff.), 5 — *Z. ephialtes* (L.), 6 — *Z. angelicae* Ochsen., 7 — *Z. filipendulae* (L.), 8 — *Z. trifolii* (Esp.), 9 — *Z. lonicerae* (Scheven), 10 — *Z. cynarae* (Esp.), 11 — *Z. brizae* (Esp.), 12 — *Z. purpuralis* (Brünnich). Uncertain data are marked with a broken line.

composition of the substratum. At present the characters of this subspecies are decidedly recessive in the populations of Poland and occur in occasional specimens, where as *Z. carniolica berolinensis* Lederer, occupying the northernmost localities, predominates unquestionably. It is, however, characteristic that a large number of specimens have intermediate characters between those of the two subspecies.

As regards the distribution in relation to altitude (Fig. 140), most of the *Zygaena* species of this country do not occur above a height of 1000 m. above sea level. It is so owing to the ecological conditions, especially the disposition of warm xerothermic grassland plots on a limestone substratum. Only *Z. filipendulae* (L.) and *Z. purpuralis* (BRÜNNICH) were found to a certainty at altitudes over 1500 m. In the case of *Z. carniolica* (SCOP.) and *Z. brizae* (ESP.) also the lower limit below which no localities of these species have been found so far (i.e., 200 m. above sea level) is marked most clearly. The majority of other Polish species of *Zygaena* F., despite the fact that their populations may occur at altitudes approximating to the sea level, appear most numerously between about 200 m. and 700 m.a.s.l., which indicates that in Poland they find the optimum developmental conditions there. Instead, the conditions deteriorate evidently in high mountains and in lowlands. There are only many localities of *Z. osterodensis* REISS accumulated between 40 m. and 240 m.a.s.l.

Considering the problem of variation in *Zygaena* F. it must be emphasized that the process of formation of this genus goes back to relatively remote geological epochs. The species *Z. miocaenica* REISS described by REISS (1935—1936) is dated from the Tertiary, that is to say, from before 6—10 milion years. The state of preservation of this specimen is so perfect that besides its morphological details even the pattern of wings and the coloration of the specimen (only slightly changed) with-stood destruction during the process of mineralization. Thanks to this valueable find, being a palaeontological unique, it was possible to ascertain beyond doubt that the evolution of the genus *Zygaena* F. was established in the Tertiary so that the specimen from the Miocene does not differ in anything from the modern moths of the same genus.

Z. miocaenica REISS, however, does not contribute in a decisive manner to the explanation show long it is necessary to form a systematic unit of the order of species or subspecies in this group of moths. The specimen from the Tertiary (female), according to the description of the author, seems to be a well differentiated species. Nevertheless, all the hypotheses on the degree of relationship with the species of the burnets known at present are based only on the habitual characters, which in the presence of the individual variation of these moths is hardly convincing. An examination of the genital apparatus of the fossil specimen being impossible, we are destitute of one of the basic indicators in the phylogenetic investigations. On the other hand, a comparison of scales might possibly provide some new data.

IV. KEY TO THE DETERMINATION OF THE SPECIES BASED ON THE HABITUS

1. Scales on patagia and tegulae red . . . . . *Z. laeta* (HBN).
—. Scales on patagia and tegulae other than red 2
2. Scales on patagia and tegulae black except at margins where they are white 3
—. Scales on patagia and tegulae entirely black 5

3. Forewing spot 6 half-moon-shaped, parallel to costa, between veins r_5—cu_2. Forewing spots often with white-yellow borders. . . *Z. carniolica* (Scop.)
—. Forewing spot 6 missing. Other spots with no white-yellow borders. . . 4
4. Forewing spot 5 reniform; its lower portion reaching middle of disc between veins m_3—cu_1. Ground colour of forewing in male navy-blue-black, in female partly suffused with yellow scales. . . *Z. loti* (Den. & Schiff.)
—. Forewing spot 5 oval, linked by a gridge with spot 2+4. Ground colour of forewing in male slightly and in female strongly suffused with yellow-

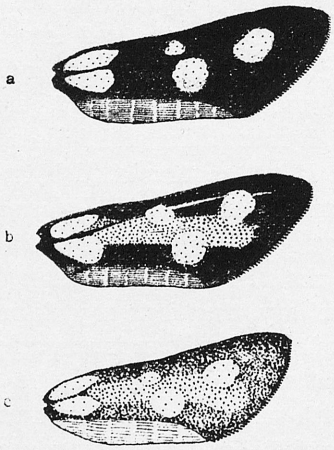

Fig. 141. Undersides of the forewings: a — *Z. lonicerae* (Scheven), b — *Z. angelicae* Ochsen., c — *Z. viciae* (Den. & Schiff.).

white scales . . . . . *Z. punctum* Ochsen. .
5. Abdominal belt red or yellow, not suffused with black scales. Forewing spots red, white or yellow. Forewing spot 6 often reduced. Apical joint of antenna white . . . . . *Z. ephialtes* (L.)
—. Abdominal belt absent, when present, then always suffused with black scales. Forewing spots red. Apical joint of antenna black 6
6. Forewing spots (especially 2 and 4) never longitudinally confluent with each other 7
—. Forewing spots (especially 2 and 4) always longitudinally confluent in streaks 12
7. Underside of forewing with a red streak or suffusion extending from base of wing to outer margin 8
—. Underside of forewing without red streak or suffusion 10
8. Forewing with six spots . . . . . *Z. filipendulae* (L.)
—. Forewing with five spots 9
9. Forewing non-transparent with a strong sheen. Streak on underside of forewing well developed (fig. 141-b) . . . . . *Z. angelicae* Ochsen.
—. Forewing slightly semi-transparent with a slight sheen. Streak on underside of forewing slightly developed (fig. 141-c) . . . *Z. viciae* (Den. & Schiff.)

10. Forewing no-transparent. Hindwing with a rather broad and even black border throughout margin. Abdominal belt absent 11
—. Forewing slightly semi-transparent. Black border of hindwing marked only at apical area. Abdominal belt present, suffused with black scales . . . . . *Z. cynarae* (Esp.)
11. Apex of forewing rounded. Spots 3 and 4 close to each other, generally confluent with each other . . . . . *Z. trifolii* (Esp.)
—. Apex of forewing rather acuminate. Spot 3 small, nearly always separated from spot 4 . . . . . *Z. lonicerae* (Scheven)
12. Antenna with apex club-shaped but with the tip pointed. Forewing spots 2 and 4 as well as 3 and 5 linked but constricted in middle . . . . . *Z. osterodensis* Reiss
—. Antenna with apex club-shaped, rounded. Forewing spots confluent in streaks which are not constricted in middle 13
13. Middle streak in forewing decidedly broadened between veins cu_1—cu_2. Hindwing with black border very narrow or missing . . . . . *Z. purpuralis* (Brünnich)
—. Middle streak in forewing limited by veins r_4—m_3, with apical portion not dilated. Black border of hindwing broad . . . . . *Z. brizae* (Esp.)

V. KEY TO THE IDENTIFICATION OF THE SPECIES BASED ON THE MALE GENITAL ARMATURES

1. Processes of uncus broadly opened, of even width throughout . . . . . *Z. laeta* (Hbn.)
—. Processes of uncus close to each other, broad basally, tapering apicad. . 2
2. Aedoeagus with „plate“ 3
—. Aedoeagus with „plate“ absent 8
3. „Plate“ of aedoeagus full of dark tiny spines 4
—. „Plate“ of aedoeagus with no distinct spines 7
4. Lamina dorsalis of aedoeagus without spines; costal and ventral margins of valva parallel to each other, outer margin perpendicular to costal and ventral margins. Processes of uncus narrow, pointed . . . . . *Z. carniolica* (Scop.)
—. Lamina dorsalis of aedoeagus clothed with spines. Valva elliptically rounded 5
5. Processes of uncus broad, of even width throughout, bluntly truncate apically . . . . . *Z. angelicae* Ochsen.
—. Processes of uncus tapering apicad, with apexes rounded 6
6. In aedoeagus one cornutus in form of a lamella with a heavily sclerotized spine and two normally long cornuti. Processes of uncus broad basally, then strongly tapering, rod-shaped . . . . . *Z. filipendulae* (L.)
—. In aedoeagus one cornutus in form of a lamella armed with three triangular

spines and one normal short cornutus. Processes of uncus rather narrow basally, gradually tapering apicad . . . . . *Z. viciae* (Den. & Schiff.)

7. „Plate" in aedoeagus minutely scobinate. Processe of uncus gradually tapering apicad. Margins of anellus straight . . . . . *Z. ephialtes* (L.)

—. „Plate" in aedoeagus small, with a scale-like sculpture. Processes of uncus short, broad basally, with pointed apexes. Lower margin of anellus semi-circularly notched . . . . . *Z. trifolii* (Esp.) or . . . . . *Z. lonicerae* (Scheven)

Note: The male genital armatures of both *Z. trifolii* (Esp.) and *Z. lonicerae* (Scheven) are strikingly similar to each other. However, those of *Z. lonicerae* (Scheven) are always larger and more heavily sclerotized than those of *Z. trifolii* (Esp.).

8. Vesica and lamina dorsalis in aedoeagus longer than half the length of aedoeagus . . . . . *Z. loti* (Den. & Schiff.)

—. Vesica and lamina dorsalis in aedoeagus shorter than half the length of aedoeagus 9

9. Valva broad, semi-circularly rounded 10

—. Valva rather elongate, narrowed apically 12

10. Processes of uncus short and broad, broadly rounded apically . . . . . *Z. osterodensis* Reiss

—. Processes of uncus slender, tapering apicad 11

11. Processes of uncus short, upper edge of anellus straight . . . . . *Z. cynarae* (Esp.)

—. Processes of uncus rather long, upper edge of anellus notched . . . . . *Z. punctum* Ochsen.

12. Processes of uncus thin, pointed apically. Anellus narrow, elongate . . . . . *Z. brizae* (Esp.)

—. Processes of uncus broad basally with apexes variable: from strongly pointed to broadly rounded. Anellus not elongate . . . . . *Z. purpuralis* (Brünnich)

VI. KEY TO THE IDENTIFICATION OF SPECIES BASED ON THE FEMALE GENITAL ARMATURES

1. Signum of bursa copulatrix present 2

—. Signum absent 7

2. Spines of signum very broad and rounded basally, arranged elliptically . . . . . *Z. carniolica* (Scop.) .

—. Spines of signum otherwise 3

3. Spines of signum tiny, rather lightly sclerotized, arranged elliptically. . 4

—. Spine of signum in the form of heavily sclerotized plates arranged in two bands parallel to each other 6

4. Ductus bursae broad, entirely or partly heavily sclerotized . . . . . *Z. trifolii* (Esp.)
or . . . . . *Z. lonicerae* (Scheven)

Note: The female genital armatures of both *Z. trifolii* (Esp.) and *Z. lonicerae* (Scheven) are very similar to each other. However, those in *Z. lonicerae* (Scheven) are always proportionately larger than those in *Z. trifolii* (Esp.); moreover, in *Z. lonicerae* (Scheven) the ductus bursae is entirely heavily sclerotized, while in *Z. trifolii* (Esp.) it is only partly heavily sclerotized.

—. Ductus bursae narrow, partly lightly sclerotized 5
5. Ductus bursae fairly broad. Diameter of „plate" shorter or as long as width of ductus bursae. Signum in the form of multilateral plates . . . *Z. viciae* (Den. & Schiff.)
—. Ductus bursae narrow. Diameter of „plate" twice as long as the width of ductus bursae. Signum in the form of several tiny spines. . . . . *Z. osterodensis* Reiss
6. „Plate" triangular with base arched. Edge of eighth tergite not more heavily sclerotized than the remainder of it. Signum consisting of evenly shaped plates . . . . . *Z. angelicae* Ochsen.
—. „Plate" absent. Edge of eighth tergite more heavily sclerotized than the remainder of it. Signum consisting of variously shaped plates . . . . . *Z. ephialtes* (L.)
7. „Plate" present, heavily sclerotized 9
—. „Plate" absent 8
8. Ostium bursae in the form of an oval, heavily sclerotized plate with distinct scobinations . . . . . *Z. loti* (Den. & Schiff.)
—. Ostium bursae narrow, very lightly sclerotized . . . . *Z. brizae* (Esp.)
9. „Plate" in form of a flattened ellipse. Lamella antevaginalis lightly sclerotized. Ductus bursae only partly heavily sclerotized, partly longitudinally wrinkled . . . . . *Z. cynarae* (Esp.)
—. „Plate" narrow, much wider than it is long. Lamella antevaginalis heavily sclerotized, bowl-shaped. Ductus bursae lightly sclerotized, narrow, long . . . . . *Z. laeta* (Hbn.)
10. „Plate" triangular 12
—. „Plate" heart-shaped with apex close to papillae anales 11
11. Ductus bursae partly heavily sclerotized, decidedly broadened . . . . . *Z. filipendulae* (L.)
—. Ductus bursae totally lightly sclerotized, evenly narrow throughout. „Plate" in form of an equilateral triangle 12
12. Ostium bursae cup-shaped, heavily sclerotized, very variable. Ductus bursae lightly sclerotized, narrow and long . . . *Z. purpuralis* (Brünnich)
—. Ostium bursae very lightly sclerotized. Ductus bursae shorter and broader than in the preceding species . . . . . *Z. punctum* Ochsen.

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STRESZCZENIE

W niniejszej pracy przedstawiono syntetyczny obraz krajowej fauny motyli z rodzaju *Zygaena* F., ze szczególnym uwzględnieniem wielkiej zmienności, która cechuje tę grupę motyli.

Podział systematyczny u *Zygaenidae* wciąż jeszcze jest dyskutowany. Rodzaj *Zygaena* F. jest dzielony przez niektórych autorów na szereg rodzajów lub podrodzajów, jednak wydaje się, iż jest to pogląd nieuzasadniony. Krajowe gatunki rodzaju *Zygaena* F. należy uznać jako jedną, naturalną jednostkę systematyczną.

Bogata zmienność indywidualna gatunków rodzaju *Zygaena* F. doprowadziła do wyróżnienia bez wystarczających kryteriów bardzo wielkiej ilości niższych jednostek systematycznych jak podgatunki (ssp.), rasy (var.), formy (f.) i aberacje (ab.). Autor niniejszej pracy odrzuca bliżej nieokreślony termin „rasa", jak również i te podgatunki, które nie zasługują na taką rangę ze względu na zbyt nieznaczne różnice. Wyróżniono jedynie wyraźne podgatunki geograficzne. W opracowaniu uwzględniono również aberacje (ab.) oraz tzw. formy sezonowe (f. t.) i formy lokalne (f. loc.) czyli populacje lokalne, izolowane genetycznie przez bariery ekologiczne.

Omówiono 12 gatunków z rodzaju *Zygaena* F., występujących na terenie Polski. Znalezienie stanowisk dwu dalszych gatunków jest prawdopodobne.

W omówieniu poszczególnych gatunków, u każdego z nich podano szczegółowy opis narządów kopulacyjnych samca i samicy z zaznaczeniem zmienności i odchyleń w wykształceniu poszczególnych części posiadających znaczenie taksonomiczne. Opisano także teratologiczne zmiany u niektórych okazów. Do opisu włączono ubarwienie skrzydeł i rysunek, barwę obrączki na odwłoku, rozmiary ciała itp., które zostały rozpatrzone pod względem zmienności. Ponadto zebrano krótkie dane o rozsiedleniu geograficznym omawianych gatunków, zasięg ich występowania pionowego, ekologię i etologię.

W rozdziale dyskusyjnym omówiono zmienność aparatów kopulacyjnych oraz znaczenie taksonomiczne ich poszczególnych części. Z rozważań tych

wynika, że prawie każda część może podlegać daleko posuniętym zmianom tak, że przy oznaczaniu powinno się uwzględniać zespoły części aparatów kopulacyjnych, a nie wyłącznie pojedyncze ich części. Zmienność aparatów kopulacyjnych nie idzie w parze ze zmiennością habitualną motyli.

Kierunkowość zmienności ubarwienia, rysunku skrzydeł itp. przedstawiono na odpowiednich rycinach. Uwzględniono przy tym wyniki badań nad wpływem czynników genetycznych i warunków zewnętrznych na zmienność omawianych gatunków. Odnośnie do znaczenia krzyżówek międzygatunkowych, które w tej grupie motyli trafiają się dość często, należy zaznaczyć, że napotkane w naturze kopulujące okazy należące do dwu różnych gatunków nie dają pewności uzyskania potomstwa mieszańców międzygatunkowych, gdyż samica mogła już przedtem kopulować ze samcem własnego gatunku. Sprawa dominacji cech u znanych dotychczas mieszańców nie została definitywnie rozstrzygnięta z powodu niemożności uzyskania drugiego pokolenia.

Ociężałość lotu *Zygaena* F., wynikająca częściowo z ich budowy anatomicznej, utrudniająca im dalsze przeloty jest przyczyną lokalnego występowania wielu gatunków. Dużą przy tym rolę odgrywają także bariery ekologiczne naturalne i sztuczne, ograniczające terytoria występowania gatunków. Aktywność tych motyli jest związana z nasłonecznieniem i temperaturą powietrza i jest ona największa we wczesnych godzinach popołudniowych. Na tę porę przypadają ich dłuższe przeloty. Zasięg nieznacznych stosunkowo migracji jest różny u poszczególnych gatunków i jest uzależniony od charakteru zajmowanego biotopu.

Pod względem rozsiedlenia geograficznego rodzaj *Zygaena* F. jest związany z Palearktyką. Z gatunków polskich do elementów pontyjsko-śródziemnomorskich należy siedem gatunków, do euro-syberyjskich pięć, do wschodnio-europejskich jeden, oraz do europejsko-zachodniośródziemnomorskich jeden gatunek. Omówiono również rozsiedlenie na terenie Polski, gdzie kilka gatunków [*Z. carniolica* (Scop.), *Z. loti* (Den. & Schiff.), *Z. ephialtes* (L.), *Z. brizae* (Esp.) i *Z. angelicae* Ochsen.] osiąga północną granicę zasięgu, a jeden [*Z. cynarae* (Esp.)] północną i zachodnią. Pozostałe gatunki obejmują całą Polskę. Ilość gatunków zmniejsza się ku północy: od 10 w Małopolsce do czterech gatunków na wybrzeżach Bałtyku. W podobny sposób maleje liczba gatunków w miarę wzrostu wysokości w górach, gdzie w Tatrach dwa gatunki dochodzą do około 1500 m. n. p. m.

Nie wyróżniono z gatunku *Z. purpuralis* (Brünnich) odrębnego gatunku *Z. diaphana* Stgr. ze względu na brak dostatecznych kryteriów morfologicznych w dostępnych materiałach.

РЕЗЮМЕ

В настоящей работе представлена синтетическая картина польской фауны бабочек из рода *Zygaena* F., с учётом большой изменчивости, характерной для этой группы бабочек.

Систематика сем. *Zygaenidae* ещё до настоящего времени является спорной. Некоторые систематики род *Zygaena* F. делят на несколько родов и подродов, но такое деление вероятно не имеет оснований. Польские виды рода *Zygaena* F. следует считать одной, естественной систематической единицей.

Большая индивидуальная изменчивость рода *Zygaena* F. привела к выделению, без достаточных критериев, большого количества систематических единиц низшего порядка, как подвиды (ssp.), расы (var.), формы (f.) и аберрации (ab.). Автор настоящей работы отбрасывает ближенеопределенное понятие „раса" и незначительно отличающиеся между ссбой подвиды. Выделены лишь чёткие географические подвиды. В работе учтены также аберрации (ab.), сезонные формы (f. t.) и местные формы (f. loc.), т. е. местные популяции генетически изолированные экологическими барьерами.

Рассмотрены 12 видов из рода *Zygaena* F. выступающие на территории Польши. Весьма правдоподобна находка местоположений ещё двух видов.

В описании каждого рассматриваемого вида приводится подробное описание копуляционных органов самца и самки и отмечены изменчивость и отклонения формы отдельных частей этих органов, имеющих таксономическое значение. У некоторых особей описаны также тератологические изменения. В описание включены, рассмотренные с точки зрения изменчивости, окраска и узоры на крыльях, цвет кольца на брюшке, размеры тела и т. п. Собраны также краткие данные о географическом распространении рассматриваемых видов, о пределах вертикального размещения, о их экологии и этологии.

В дискуссии рассмотрены изменчивость копуляционных органов и таксономическое значение их отдельных частей. Автор приходит к заключению, что почти каждая составная часть копуляционного органа может подвергаться далеко идущим изменениям и при определении следует учитывать не отдельные части, а целые комплексы частей копуляционного аппарата. Изменчивость копуляционных аппаратов не согласуется с изменчивостью внешнего облика бабочек.

Направленность изменчивости окраски, узора крыльев и т. п. представлена на соответствующих рисунках. При этом учтены результаты исследований влияния генетических факторов и внешней среды на изменчивость этих видов. Что касается межвидовых гибридов, которые в этой группе бабочек случаются довольно часто, следует отметить, что встречаемые в природе копулирующие особи двух разных видов не дают уверенности получения потомства межвидовых гибридов, потому, что самка могла раньше копулировать с самцом своего вида. Вопрос доминирования у известных, в настоящее время, гибридов окончательно ещё не разрешён ввиду невозможности получить второго поколения.

Тяжёлый полёт *Zygaena* F., отчасти вызванный их анатомическим строением, препятствует более далёким пролётам и у многих видов является причиной локального их выступания. В этом большую роль играют естественные и искусственные экологические барьеры, ограничивающие ареалы распространения видов. Наиболее высокая активность у этих бабочек имеет место в ранне послеполуденное время, т. к. она связана со степенью освещённости и температурой воздуха. В эту пору дня они совершают найболее далёкие полёты. Дальность относительно

назначительных миграций у отдельных видов разная и зависит от характера занимаемого биотопа.

В отношении географического распространения род *Zygnaea* F. связан с восточной Палеарктикой. Семь из польских видов принадлежат к понтическо-средиземноморским элементам, пять к европейско-сибирьским, один к восточно-европейским и один к европейско-западно-средиземноморским элементам. Рассмотрено также распространение на территории Польши, где несколько видов [*Z. carniolica* (Scop.), *Z. loti* (Den. & Schiff.), *Z. ephialtes* (L.), *Z. brizae* (Esp., *Z. angelicae* Ochsen.)] достигают северного предела распространения, а один [*Z. cynarae* (Esp.)] северного и западного пределов. Остальные виды выступают на всей территории Польши. Количество видов уменьшается по направлению с юга на север: от 10 видов в южных районах Польши до 4 видов на побережьи Балтийского моря. Сходным образом уменьшается количество видов на разных высотах в горах и в Татрах два вида достигают около 1500 м н. у. м.

Ввиду отсутствия, в доступных материалах, достаточных морфологических критериев — из вида *Z. purpuralis* (Brünnich) не выделен вид *Z. diaphana* Stgr.

PLATES

Plate VIII

Fig. 1. *Z. carniolica berolinensis* LEDERER. Ojców National Park, Grodzisko, 19. VII. 1954, leg. author A male with pathological antennae.

Fig. 2. *Z. carniolica berolinensis* LEDERER, ab. *privata* **ab. n.** A male from Glanów, 9. VIII. 1959.

Fig. 3. *Z. carniolica berolinensis* LEDERER, ab. *costalielongata* **ab. n.** A female from Ojców National Park, Grodzisko, 1. VIII. 1954.

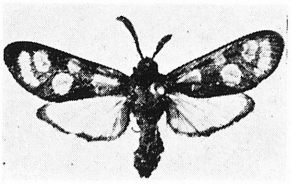
Fig. 4. *Z. loti* (DEN. & SCHIFF.). Male. Podgórki ad Tyniec near Kraków, 12. VII. 1943, leg. MIODOŃSKI.

Fig. 5. *Z. viciae* (DEN. & SCHIFF.), ab. *pygmaea* **ab. n.** Female. Ojców National Park, Koziarnia, 22. VII. 1958, leg. author.

Fig. 6. *Z. viciae* (DEN. & SCHIFF.). Male. Ojców National Park, Młynnik, 4. VII. 1957, leg. author. Right forewing assymetrically shortened.

Fig. 7. *Z. viciae* (DEN. & SCHIFF.). Female. Sudeten Mts., Srebrna Mt., 10. VII. 1960, leg. author. Hindwing abnormally enlarged.

Fig. 8. *Z. angelicae* OCHSEN., ab. *reducta* **ab. n.** Male. Szkło, Jaworów, 2. VIII. 1942, leg. E. W. SOŁTYS.



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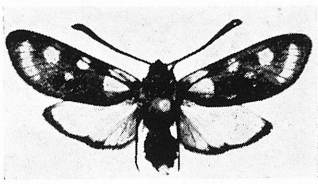

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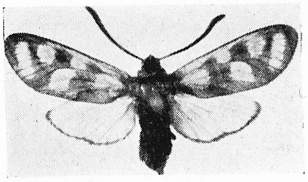

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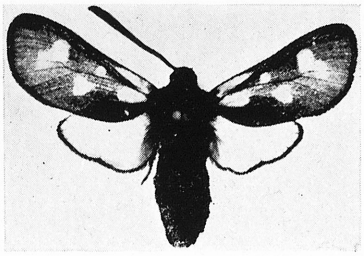

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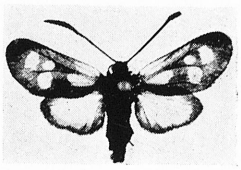

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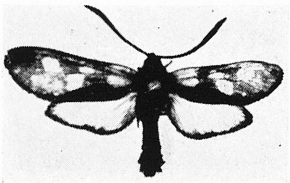

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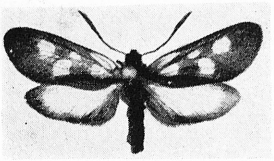

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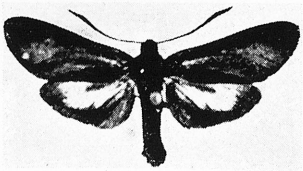

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Plate IX

Fig. 1. *Z. angelicae* OCHSEN. Male. Ojców National Park, Grodzisko, 19. VII. 1957, leg. author. Forewing pattern assymetrical.

Fig. 2. *Z. filipendulae* (L.) trans. ad ab. *confluenta* ab. n. Myślenice, Stróża, 1. VIII. 1957, leg. author.

Fig. 3. *Z. lonicerae* (SCHEVEN) trans. ad ab. *confluens* OBERTHÜR. Ojców National Park, Młynnik, 11. VII. 1958, leg. author. A male with asymmetrical forewing pattern.

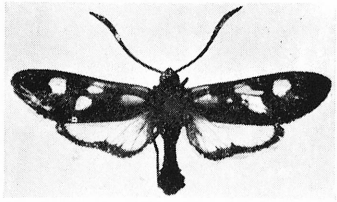
Fig. 4. *Z. lonicerae* (SCHEVEN) ab. *sphingiformis* **ab. n.** Male. Ojców National Park, Młynnik, 22. VII. 1959, leg. author.

Fig. 5. *Z. purpuralis* (BRÜNNICH) trans. ad ab. *reducta* **ab. n.** Male. Klonów, Wały, 1.—10. VIII. 1962, leg. author.

Fig. 6. *Z. purpuralis* (BRÜNNICH). Female. Sudeten Mts., Sowie Mts., 6. VII. 1959, leg. SZPOR.

Fig. 7. *Z. purpuralis* (BRÜNNICH). Male. Mników Valley near Kraków, 18. VII. 1951, leg. author. Right forewing asymmetrically smaller.

Fig. 8. *Z. purpuralis* (BRÜNNICH). Female. Pieniny Mts., Zagroń, 8. VII. 1959, leg. author.



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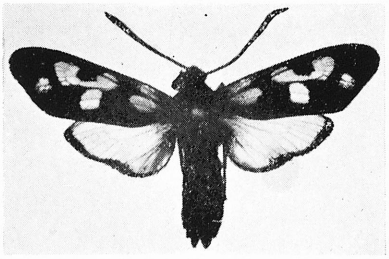

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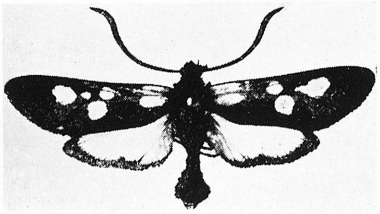

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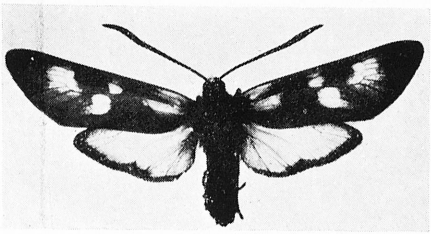

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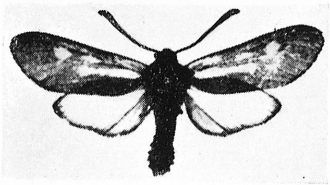

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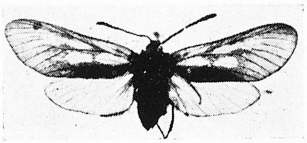

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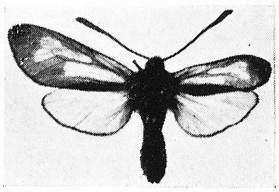

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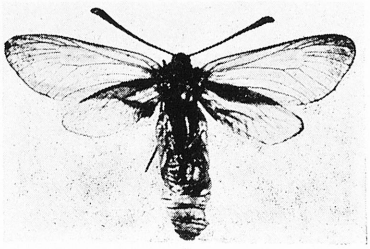

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Plate X

Fig. 1. *Zygaena carniolica onobrychis* (Den. & Schiff.). Female. Podolia, Ubieżowa, 12. VII. 1939, coll. S. Toll.

Fig. 2. *Z. carniolica berolinensis* Lederer. Male. Glanów ad Wolbrom, 10. VIII. 1959, leg. author.

Fig. 3. *Z. carniolica berolinensis* Lederer, ab. *dupuyi* Oberthür. Male. Glanów ad Wolbrom, 9. VIII. 1959, leg. author.

Fig. 4. *Z. carniolica berolinensis* Lederer, ab. *cingulata* Dziurz. + ab. *weileri* Stgr. Male. Ojców National Park, Grodzisko, 29. VIII. 1954, leg. author.

Fig. 5. *Z. carniolica berolinensis* Stgr. ab. *bicingulata* ab. n. + ab. *blachieri* Dziurz. Female. Ligota Dolna, Opole region, 11.—20. VII. 1961, leg. S. Skrabania.

Fig. 6. *Z. carniolica berolinensis* Stgr. (?), ab. *amoena* Stgr. Female. Ligota Dolna, Opole region, 16. VII. 1956. Leg. S. Skrabania.

Fig. 7. *Z. carniolica berolinensis* Stgr. ab. *dichroma* Hske. + ab. *blachieri* Dziurz. Female. Ojców National Park, Grodzisko, 10. VIII. 1954, leg. author.

Fig. 8. *Z. carniolica berolinensis* Stgr. ab. *grossi* Hske. Male. Bolechowice near Kraków, 31. VII. 1952, leg. author.

Fig. 9. *Z. osterodensis* Reiss. Male. Reda ad Weycherowo, 19. VII. 1954, leg. author.

Fig. 10. *Z. loti* (Den. & Schiff.). Male. Rynkowo near Bydgoszcz. 5. VIII. 1956, leg. W. Rodowicz.

Fig. 11. *Z. loti* (Den. & Schiff.). Female. Podgórki near Kraków, 31. VII. 1960, leg. author.

Fig. 12. *Z. loti* (Den. & Schiff.) ab. *costalielongata* Vorbrodt + ab. *cingulata* Dziurz. Male. Ojców National Park, Młynnik, 10. VII. 1954, leg. author.

Fig. 13. *Z. loti* (Den. & Schiff.) ab. *fulva* Spuler + ab. *paralella* Vorbrodt. Female. Pieniny Mts., Upszar, 4. VII. 1959, leg. author.

Fig. 14. *Z. loti* (Den. & Schiff.) ab. *flava* Rom. Female. Bogucice ad Pińczów, leg. Błeszyński.

Fig. 15. *Z. loti* (Den. & Schiff.) ab. *brunnea* Dziurz. Male. Smoleń ad Pilica, 10. VII. 1940, coll. Masłowski.

Fig. 16. *Z. viciae* (Den. & Schiff.). Female. Ojców National Park, Młynnik, 16. VII. 1958, leg. author.

Fig. 17. *Z. viciae* (Den. & Schiff.) ab. *stentzi* Frr. + ab. *sexpunctata* Tutt. Female. Sudeten Mts., Srebrna Mt., 10. VII. 1960, leg. Szpor.

Fig. 18. *Z. viciae* (Den. & Schiff.) ab. *brunnea* **ab. n.** Male. Opalonki near Miechów, 13. VII. 1949, leg. author.

Fig. 19. *Z. viciae* (Den. & Schiff.). Male. Ojców National Park, Młynnik, 8. VII. 1954, leg. author.

Fig. 20. *Z. ephialtes* (L.). Male. Podgórki ad Tyniec near Kraków, 20. VII. 1955, leg. Dobrański.

Fig. 21. *Z. ephialtes* (L.) ab. *medusa* Pall. Female. Białe Błota ad Bydgoszcz, 4. VII. 1961, leg. Rodowicz.

Fig. 22. *Z. ephialtes* (L.) ab. *coronillae* Esp. Female. Podolia, Ubieżowa near Zaleszczyki, 12. VII. 1939, coll. Toll.

Fig. 23. *Z. ephialtes* (L.) ab. *trigonellae* Esp. Male. Podolia, Ubieżowa near Zaleszczyki, 15. VII. 1939, coll. Toll.

Fig. 24. *Z. ephialtes* (L.) ab. *peucedani* Esp. Female. Skała Kmity near Kraków, leg. author.

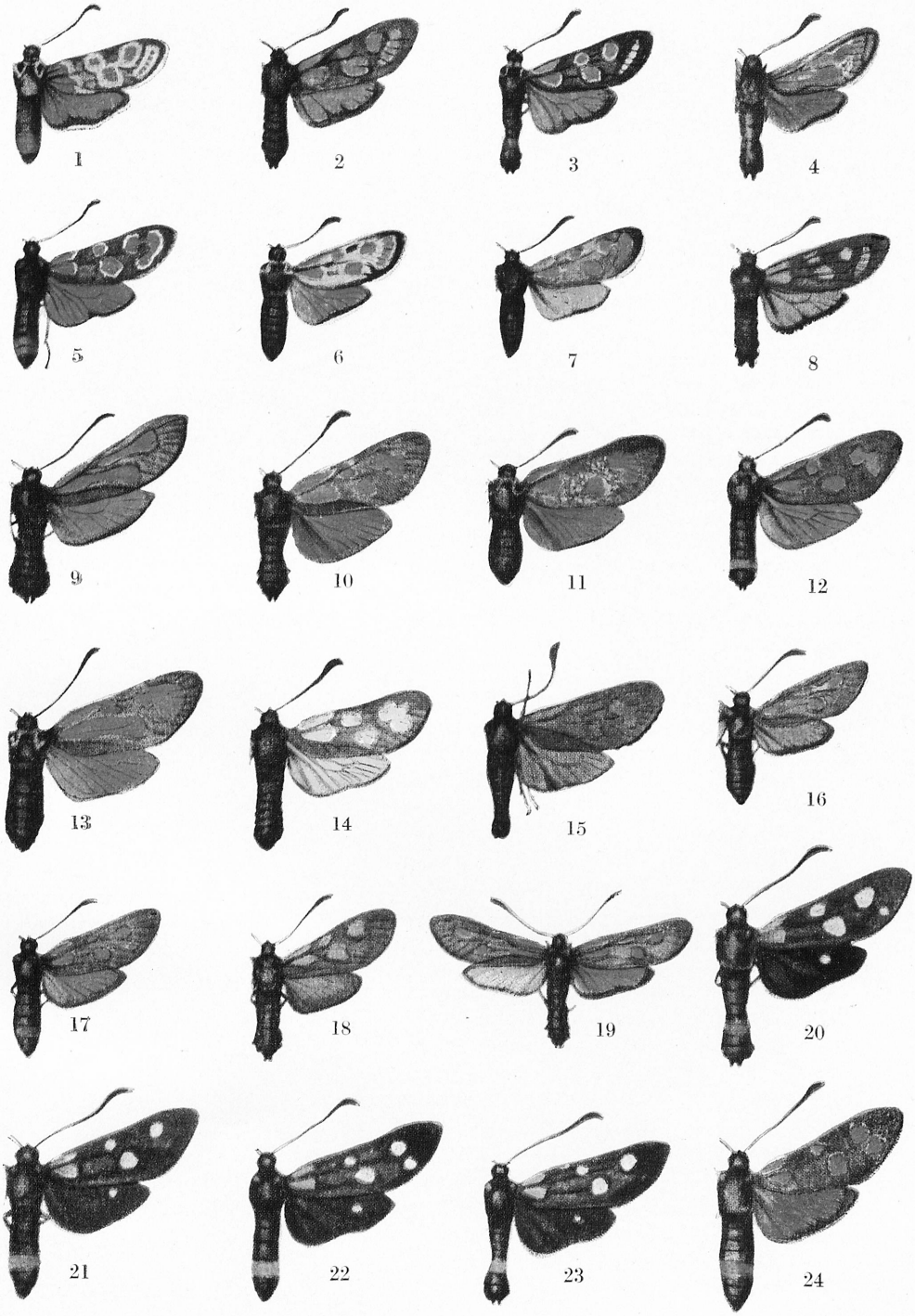

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Plate XI

Fig. 1. *Z. ephialtes* (L.) ab. *athamanthae* Esp. Male. Wały ad Racławice, 1.—10. VIII. 1962 leg. author.

Fig. 2. *Z. ephialtes* (L.) ab. *icterica* Led. Male. Podolia, Ubieżowa near Zaleszczyki, 7. VII. 1939, coll. Toll.

Fig. 3. *Z. ephialtes* (L.) ab. *prinzi* Hske. Female. Ojców National Park, Grodzisko, 18. VII. 1954, leg. author.

Fig. 4. *Z. ephialtes* (L.) ab. *aeacus* (Den. & Schiff.) Male. Podolia, Ubieżowa near Zaleszczyki, 7. VII. 1939, coll. Toll.

Fig. 5. *Z. ephialtes* (L.) ab. *aurantiacomutabilis* Dryja. Female. Zgierz, 28. VII. 1940, coll. Jarosch.

Fig. 6. *Z. angelicae* Ochsen. Male. Mydlniki near Kraków, 2. VIII. 1955, leg. author.

Fig. 7. *Z. angelicae* Ochsen. ab. *reducta* **ab. n.** Male. Szkło—Jaworów, 2 VIII. 1942, leg. Sołtys.

Fig. 8. *Z. angelicae* Ochsen. ab. *dichroma* Reiss. Female. Podgórki ad Tyniec near Kraków, 15. VIII. 1962, leg. Pruszyński.

Fig. 9. *Z. angelicae* Ochsen. ab. *doleschalli* Rühl. Female. Podgórki ad. Tyniec near Kraków, 15. VIII. 1962, leg. Pruszyński.

Fig. 10. *Z. angelicae* Ochsen. ab. *brunnensis* Skala. Male. Cisownica near Cieszyn, 18. VII. 1937, leg. Stuglik.

Fig. 11. *Z. filipendulae* (L.). Female. Białe Błota near Bydgoszcz, 17. VIII. 1962, leg. Rodowicz.

Fig. 12. *Z. filipendulae* (L.) ab. *miniata* Tutt + *conjuncta* Tutt. Female. Ojców National Park, Młynnik, 18. VII. 1954, leg. author.

Fig. 13. *Z. filipendulae* (L.) ab. *flava* Robson. Male. Segiet near Bytom, 10. VIII, leg. Raebel.

Fig. 14. *Z. filipendulae* (L.), f. t. *stephensi* Dup., ab. *brunnescens* Cockayne. Female. Skotniki near Kraków, 28. VI. 1961, leg. author.

Fig. 15. *Z. trifolii* (Esp.). Male. Jelitkowo near Oliwa, 24. VII. 1956, leg. author.

Fig. 16. *Z. lonicerae* (Scheven) trans. ad ab. *chalybea* Auriv. Female. Ojców National Park, Młynnik, 19. VII. 1958, leg. author.

Fig. 17. *Z. lonicerae* (Scheven) ab. *citrina* Spuler. Male. Ojców National Park, Młynnik, 18. VII. 1954, leg. author.

Fig. 18. *Z. cynarae* (Esp.). Male. Wawer near Warszawa, 4. VII. 1949, leg. author.

Fig. 19. *Z. laeta* (Hb.). Podolia, Krzywe, 12. VII. 1939, leg. Toll.

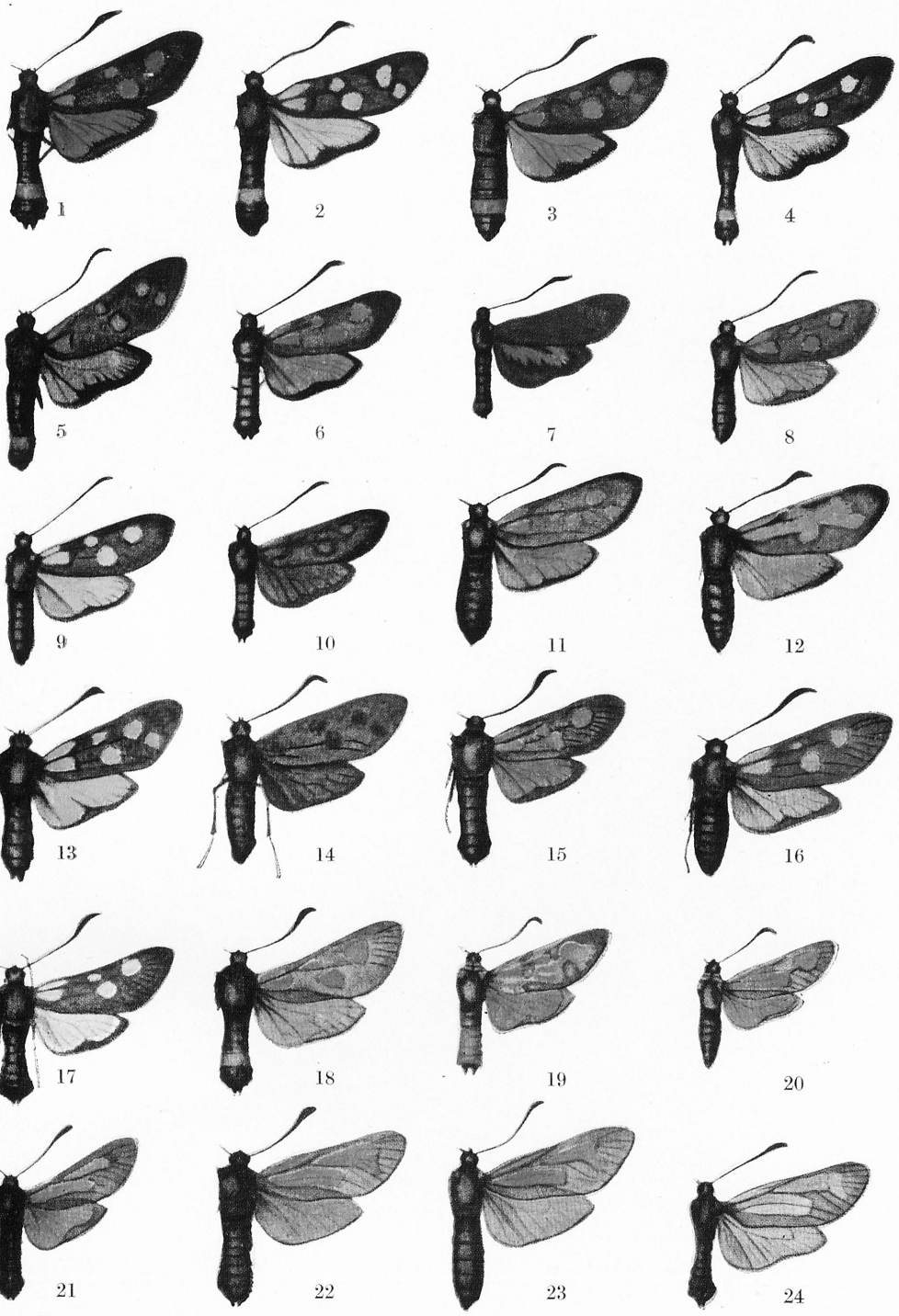
Fig. 20. *Z. punctum* Ochsen. Male. Podolia, Krzywe near Zaleszczyki, 3. VII. 1938, leg. Toll.

Fig. 21. *Z. brizae* (Esp.). Male. Pieniny Mts., Nowa Mt., 7. VII. 1957, leg. Miodoński.

Fig. 22. *Z. purpuralis* (Brünnich). Male. Dzierżoniów, Dębowa Mt., 7. VII. 1960, leg. author.

Fig. 23. *Z. purpuralis* (Brünnich) ab. *bicolor* **ab. n.** Female. Ojców National Park, Koziarnia, 24. VII. 1959, leg. author.

Fig. 24. *Z. purpuralis* (Brünnich) ab. *obscura* Tutt. „Grodzisko" near Miechów, 1.—10. VII. 1962, leg. author.



Jerzy S. Dąbrowski

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