POLSKA AKADEMIA NAUK
INSTYTUT ZOOLOGICZNY

ANNALES ZOOLOGICI

Tom XXIV Warszawa, 20 VI 1967 Nr 9

Bolesław BURAKOWSKI

Biology, Ecology and Distribution of *Amara pseudocommunis* BURAK. (*Coleoptera, Carabidae*)

Biologia, ekologia i rozmieszczenie *Amara pseudocommunis* BURAK. (*Coleoptera, Carabidae*)

Биология, экология и распространение *Amara pseudocommunis* BURAK. (*Coleoptera, Carabidae*)

[With 47 figures]

In memory of the eminent specialist on *Carabidae* – Józef MAKÓLSKI, deceased on July 9, 1954.

It was Józef MAKÓLSKI who first recognised *Amara pseudocommunis* BURAK. as a separate species but he has not left any description. J. MAKÓLSKI in his correspondence with other specialists referred to the species as „*Amara mülleri* MAK." and he labelled with this name many specimens in his collection.

The name „*Amara mülleri* MAK." (i. l.) is mentioned in the papers of ROUBAL (1941) and FASSATI (1951). Whereas the name *A. pseudocommunis* MAK. (i.l.) is listed in the publication: „Sprawozdanie Komitetu Badań Fizjograficznych Wydziału Matematyczno-Przyrodniczego Polskiej Akademii Umiejętności za lata 1946 i 1947", Kraków, 1949. The species in question has been recorded, moreover, as „species nov." from the Białowieża Primeval Forest (KARPIŃSKI, MAKÓLSKI, 1954: 112, 128, 133).

The investigations, the results of which are given in the present paper, were carried out at several stations in Poland, mainly in the years 1956–1957; they were later supplemented by observations made upon reared material, as well as by those obtained in the field, particularly in the east part of Kampinoska Forest near Warsaw. This considerable extension of investigation time was necessary to obtain a correct and full picture of development, life-cycle and the distribution of the species discussed.

The present paper constitutes a supplement to my studies on the imagines of the species (Burakowski, 1957). It contains descriptions of younger developmental stages, biology, phenology, ecology and the distribution of this species the adult of which has been described by me previously (Burakowski, 1957). A key to the identification of all species of *A. communis* (Panz.) group is also included.

Among *Carabidae* the imagines of the species of *Amara* Bon. occupy a unique position as they are very difficult to identify, and this opinion is to be found in many papers dealing with the group in question. The identification of larvae presents even greater difficulty as of 50 Central European species only the larvae of half that number have been described. The descriptions of eggs, and pupae are lacking. The biology of the immature stages has, of course, been scarcely studied. Larsson (1941) in his key to the identification of larvae includes only 17 species while there are over 30 species recorded from Denmark. An identification table for larvae of particular subgenera of *Amara* Bon. as well as headwidth of particular larval stages of 13 species of the genus mentioned has been given by Emden (1942). Šarova (1958, 1964) gave a key to the identification of the larvae of 21 species of the European part of the USSR.

Since the existing identification keys are based on an incomplete larval material and the published larval descriptions are often short and inaccurate, I tried to include in the present paper descriptions as ample and detailed as possible, and to illustrate by numerous figures the described body parts.

Egg

A freshly laid egg is spindle-shaped with apices slightly rounded. Gradually swelling as the development proceeds, it finally becomes ellipsoidal in both transversal and longitudinal sections. Egg length varies from 1.3 to 1.5 mm, its width from 0.7 to 0:8 mm. The chorion is pale yellowish, mat, under a highly magnifying glass it shows microreticulation with round meshing arranged somehow in rows (fig. 2). Eggs with a rich content of yolk in general differ slightly from those of other *Carabidae*.

The oviposition occurs in late summer and the eggs are laid in earth at a depth of 0.5–2 cm below surface into small pits dug by female with help of its abdomen. The postembrionic development depends on the temperature and may last 8–15 days counting from the moment of oviposition. A pale yellowish colouring of egg changes then to a whitish one. Prior to hatching a coiled, creamy larva is visible through a translucent egg shell. The larva leaves the egg by cutting through one of its poles by the means of its frontal tubercles (fig. 5). The slightly coiled larva accomplishes this by shifting its body within the egg shell and by pressing against the inner egg wall with the organs mention-

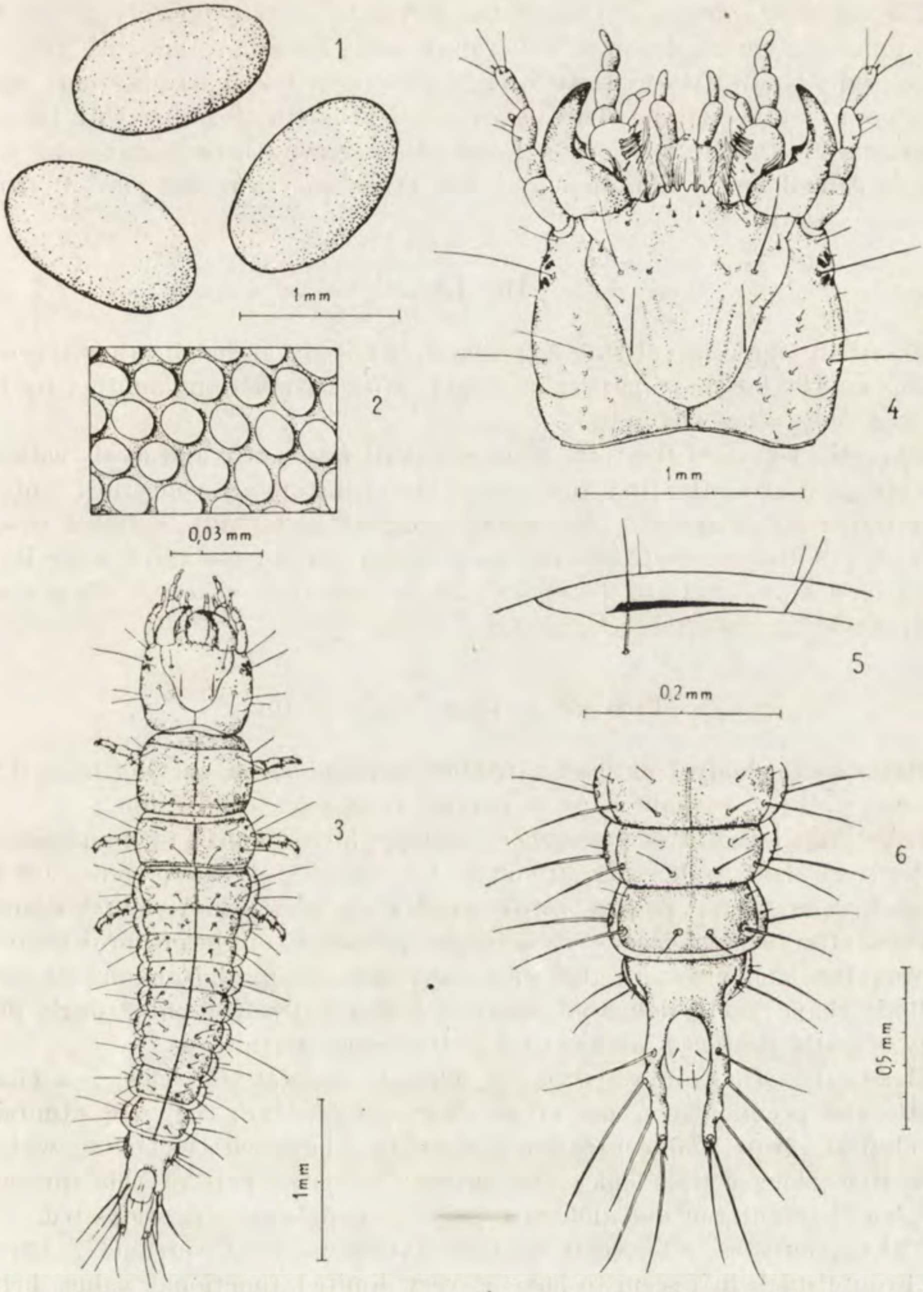


Fig. 1–6. *Amara pseudocommunis* BURAK. 1 — eggs; 2 — microsculpture of egg; 3–6: first stage larva; 3 — larva, dorsal view; 4 — head, dorsal view; 5 — egg-burster, lateral view; 6 — VI–IX abdominal segments, dorsal view.

ed, thus leading to its final breaking. A full emergence of the larva results by a sudden distending and expanding of its body.

The material examined: 15 eggs laid in the laboratory on July 20–30, 1958 by a female in copula found in Zaborówek distr. Pruszków on July 18, 1958, leg. et cult. B. BURAKOWSKI; two eggs preserved, the remaining ones reared until the first stage larvae. Three eggs found in humus together with imagines on August 21, 1960 in Dziekanów Leśny, distr. Nowy Dwór Mazowiecki; 1 egg preserved, and larvae obtained from the other two; leg. and cult. B. BURAKOWSKI.

The Larva

There are three larval stages, probably similarly as in all other species of *Carabidae*. The larvae of particular stages differ between one another by their size and some other characters.

Since the larvae of the third stage are most frequently and easily collected, I include, as far as the first and second larval instars are concerned, only the most important diagnostic characters, without going into detailed descriptions. A full and complete description is given only of the third stage larvae, which I hope, will help to distinguish them from those of other allied species of *Amara communis* (PANZ.) group.

First Stage Larva (figs. 3, 10)

Dimensions: body length of a freshly emerged larva varying from 3.2 to 3.8 mm; width of cephalic capsula varying from 0.62 to 0.75 mm.

Colouring: larva after emergence creamy-whitish, apices of mandibles and egg-bursters dark yellowish; antennae, appendages of head, spines on legs, tarsal claws and setae, pale yellowish; ocelli dark brownish. A whitish colouring darkens after a few days — it becomes yellowish on head, brownish-olive on pronotum and brownish-grey on meso-, metanotum and abdominal sterna.

Body shape: body elongated, tapering feebly anteriorly and strongly posteriorly, slightly flattened, almost oval in transverse section.

Head: (fig. 4). Frontale with egg-bursters (frontal tubercles) — a characteristic and peculiar structure of the first stage larvae; they are situated at the clypeal suture and consist of a strongly sclerotized thickening which is three times longer than epicranial suture; posterior part of this thickening is higher than anterior one and its upper edge is delicately denticulated.

The egg-bursters, referred to by German writers as „Eisprengel", „Eizahn" or „Frontalstacheln", seem to have a very limited functional value, helping merely the larvae to break out of their shield, and they disappear completely in the second larval stage. In other genera of *Carabidae* these organs have an entire different shape and they may possess taxonomic significance. They are also known to occur in other insect groups. H. HAGEN (1852) observed for the first time these perforating divices in *Osmylus chrysops* L. Later they were described by various authors. According to R. HEYMONS (1906) they are to be found in embryos or first stage larvae of certain species of *Thysanura*, *Odonata*, *Orthoptera*, *Dermaptera*, *Homoptera* and *Heteroptera*.

It should be noticed that a structure similar to egg-bursters occurs in birds: a well pointed, robust spine is, namely, to be observed on the chicks beak, shortly before and after hatching. This structure helps to perforate the egg shell similarly as the frontal tubercles of the insect larvae do. The spine falls off after a couple of days, and no full grown birds have been seen to possess it.

Abdomen posterior part from segments I–IX tapering gradually towards apex. Cerci long, about 1.4 times longer than IXth tergite length.

Thorax length equalling $^{1}/_{3}$ of body length.

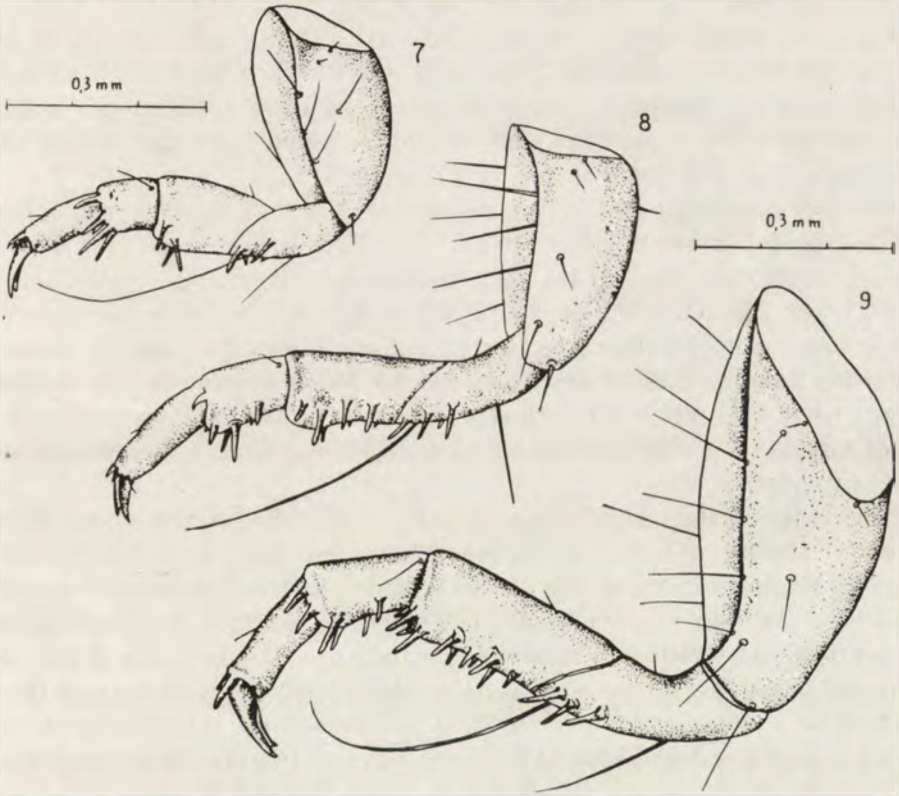


Fig. 7–9. *Amara pseudocommunis* BURAK., right middle leg of larva, frontal view. 7 — first stage; 8 — second stage; 9 — third stage.

Legs (fig. 7) similar as in the third larval stage, save for a smaller number of spines; anterior and posterior femur surfaces with 2 spines, those of tibia with 3 spines respectively.

Chaetotaxy. In relation to body size the setae seem to be longer than in the subsequent larval stages. The arrangement of setae in general similar to that in the second and third stages, except that some setae are wanting: there is no small seta below nasale and some of minute setae on epicranium are equally absent; cerci with only 6 setae: in comparison with subsequent larval stages, four setae: one superior, one inferior and two lateral are lacking. Anal syphon with only 10 setae, it lacks a pair of inferior setae in its proximal part.

Material examined: Zaborówek distr. Pruszków: July 18, 1958, female in humus; July 31–August 11, 1958, ex ovo, 13 first stage larvae, 1 reared until second stage (August 11, 1958), the remainder preserved in alcohol. Dziekanów Leśny distr. Nowy Dwór Mazowiecki: July 17, 1960, 2 females in humus, July 27, 1960 — 5 larvae obtained ex ovo; August 15, 1960, 8 larvae in humus. Woszczele distr. Ełk: August 12, 1960, 2 females in humus, 3 larvae ex ovo obtained on August 12, 1960.

Biology. A newly born larva grows fast. It attains 4.25–4.8 mm of length shortly before the first moulting. The width of strongly sclerotized head capsule, however, does not change — hence its significance as a taxonomic character in the identification of particular larval stages, which has been already proved on an ample material of *Carabidae* by Emden (1942).

After leaving its egg shell, the larva wanders on a surface layer of rot which is created by fallen birch leaves. It does not feed during these first days after emerging from egg, but presumably consumes a gelatinous yolk; this yolk is often given away by the larvae placed in alcohol. In subsequent days it is possible to see a dark content of larva intestine. I presume that the larva may feed at this time upon small detritus particles. When rearing larvae in my laboratory, I used 0.5 l jars filled with soil mixed with sand and covered by a 1 cm layer of humus. Whether the larva may take animal food, I was unfortunately, not able to state.

The first larval stage lasts about 10 days. Shortly before the second moulting (1–2 days) the larva ceases to wander about and begins to move feebly its abdomen. During this time the larva becomes c. 1 mm longer oving mainly due to an extention of a very elastic epidermis between its body segments. A separation and shifting of a new epidermal layer below the old one can be then observed on the larva head: 6 pale ocellar spots may be seen in the dark ocellar area. A completely formed larva of the second stage leaves by a rift on head and thorax the empty skin of the larva of the preceding stage.

Second Stage Larva (fig. 11)

Dimensions. Altogether 11 larvae have been measured. Length 4.8–6.1 mm, head width 0.85–0.95 mm; coefficient of a cephalic capsule growth in relation to the first larval stage 1.29.

Body form in general similar to that of larva of the first stage; the larva seems to be slightly more „stocky" then that of the preceding stage. Abdomen conical, gradually tapering towards apex. The absence of the head tubercles („egg-bursters"), a greater number of setae, an additional seta below nasale, two setae on abdominal hypopleurae and four additional cercal setae — one superior, one inferior and two lateral ones and a greater number of leg spines on anterior and posterior faces of tibia, and femur with four spines, seem to be most important characters which distinguish the larvae of the second stage from those of the first one.

Material examined: Zaborówek distr. Pruszków: August 30, 1956, 1 larva in humus; first stage larvae ex ovo on July 31, 1958, moulting on August 11, 1958. Dziekanów Leśny distr. Nowy Dwór Mazowiecki, August 15, 1960, 3 larvae in humus; August 21, 1960, 5 larvae and one egg in humus; larvae reared and moulting on August 30, 1960.

Biology. A freshly emerged larva is whitish in colour but it becomes fully pigmented within several hours. The larvae have been found in July and August in a surface layer of rot among the birch roots. They were also reared from eggs in laboratory as well as from first stage larvae collected in the field. The prey consists of larvae of various small insects and the feeding takes place in rot up to three cm below the surface. Within 10–11 days of the first moulting the larva digs an oval pit in which it undergoes the second moulting. Actually the larva remains about 2–3 days in the pit before and after the moulting. Larvae which emerge from later deposited eggs have a longer development period which may be accounted for by a usual drop in temperature toward the end of summer.

Third Stage Larva (figs. 12–14)

Dimensions. Body length of fully grown larva varying from 7.2 to 9.0 mm; the majority of larvae, being c. 8.0 mm long. Shortly before the pupation the larva contracts its body thus becoming up to 2 mm shorter (fig. 13). Head width 1.13–1.30 mm; coefficient of growth of cephalic capsule in relation to second larval stage is 1.42.

Colouring. Dorsal side yellowish, save for brownish praetergum and mesotergum; apical part of mandibles, nasale, talus and ocelli dark brownish; underside creamy-whitish.

Body elongated, cylindrical, slightly flattened and gradually tapering posteriorly in apical part. Last (IXth) abdominal segment with long cerci. In the feeding and active period, the maximum width of abdominal segments exceeding only slightly that of pronotum, whereas in the prepupal stage the body is more robust and the maximum width of fourth abdominal segment exceeds by one quarter the width of pronotum.

Head (fig. 17, 18) quadrangular with sides slightly converging both posteriorly and anteriorly, its width exceeding by one third its length measured from posterior margin to nasale denticulated edge; maximum width in posterior part of head distinctly exceeding width between the eyes. Neck posterior surface

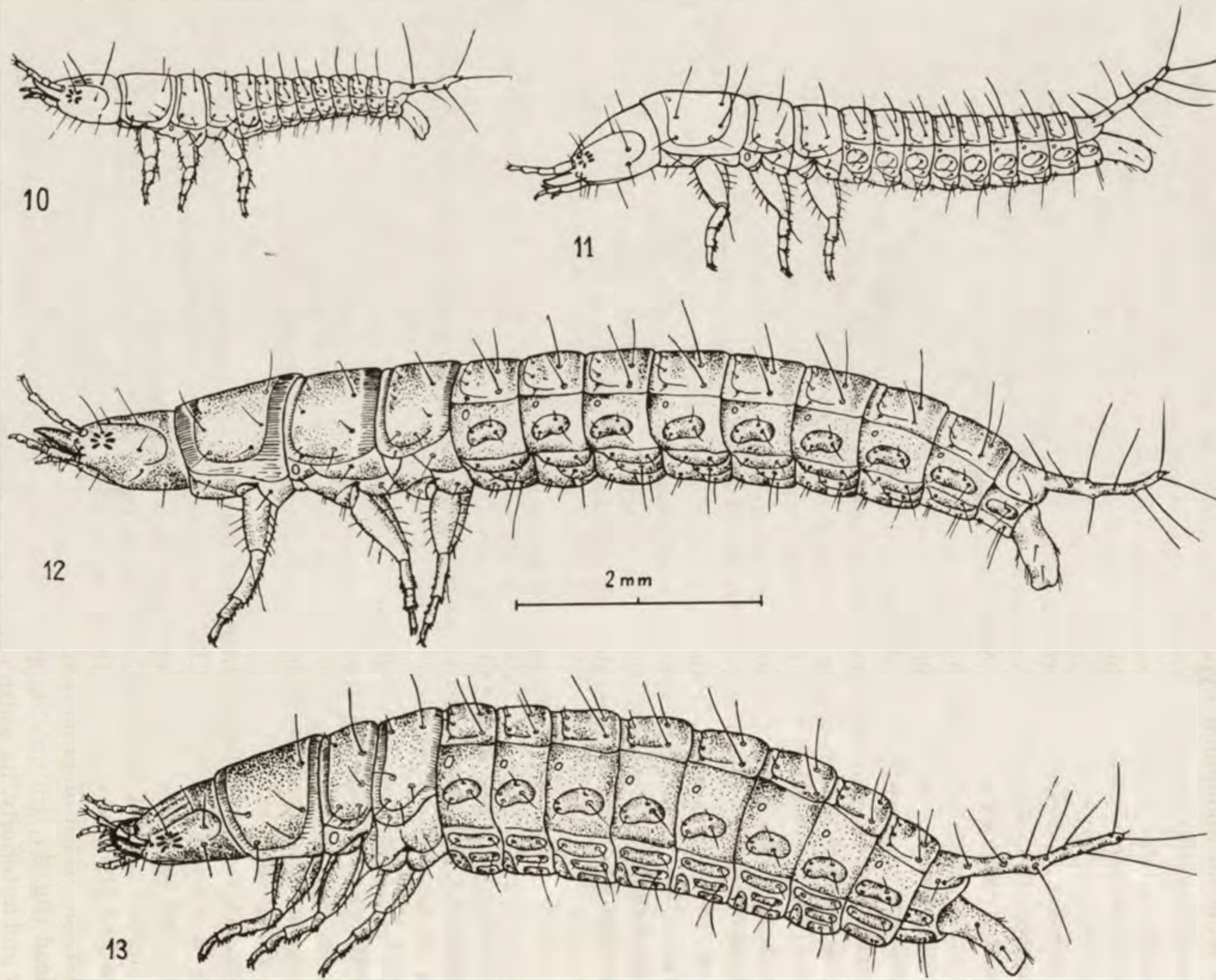


Fig. 10–13. *Amara pseudocommunis* Burak., larva, lateral view. 10 – first stage; 11 – second stage; 12 – third stage taken at the feeding period; 13 – third stage taken at the prepupal period.

distinctly concave, its posterior margins arcuate and provided with a distinct ridge; neck suture in dorsal or ventral view almost semicircular. Frontal sutures distinctly curved; epicranial suture short, equalling only one sixth of frontale length, a little shorter than the fourth antennal joint; tentorium well developed, in form of a small rib below antennal base and directed obliquely towards cephalic capsule; it reaches the frontale inner groove.

Frontale broad, slightly broader than long, posteriorly rather obtuse, with four almost parallel grooves, the outer two being deeper than the inner ones; frontale margins almost arcuate; setation consisting of two short setae near nasale base, of one median seta in the anterior part of the inner groove, and of two short and one long setae situated between tentorium and frontal suture.

Nasale (figs. 27, 30) broad, arcuate, with 6 identical teeth, the distance between their adjoining apices equalling tooth width at base; one of teeth may be reduced in certain specimens; basal part of nasale with two setae.

Subnasale (figs. 27, 30). It is formed by a transverse, strongly sclerotized plate provided with four rows of minute conical teeth. Teeth of posterior row 20–24 in number, obtuse and in form of densely arranged, tiny plugs; area between nasale and posterior teeth row with two or three very small, conical denticules, their apices are directed anteriorly and they are visible only in anterior view under a highly magnifying glass.

Anguli frontales well developed, their apices situated at the same level as nasale anterior margin; inner edge straight and longer than the outer one; slightly concave and provided with long setae and short, dense hairs; upper surface with two setae.

Epicranial plate covering a greater part of head from above, from beneath and at sides, tapering anteriorly and terminated at the antennal sclerite; from the upper side surrounding frontale, and in the middle line joining with one another along the gular suture; upper side with two, almost parallel to the head edge, grooves, the inner one deeper and provided with a long seta, the outer indistinct and carrying several tiny setae and one long seta in its anterior part; a semicircular neck groove running transversally near the inner suture; one long and two small setae situated near frontal suture. Underside slightly convex and divided in its posterior part by a gular suture; a shallow, arcuate groove present near each side of hypostome, carrying three setae; one long seta present additionally near it. Head sides with one seta in posterior part behind ocellar area, and antennal sclerite each with one seta.

Hypostome triangular, tapering posteriorly, its length, measured from anterior margin to apex, equalling length of gular suture; each hypostome side with two setae.

Ocelli 6 in number, situated externally in relation to the antenna base, visible on a darkly pigmented ocellar area; 4 ocelli visible in dorsal view and two in ventral view; ocelli of the median pair situated more apart than those of the remaining ones. Ocellar area with three setae, one very long situated

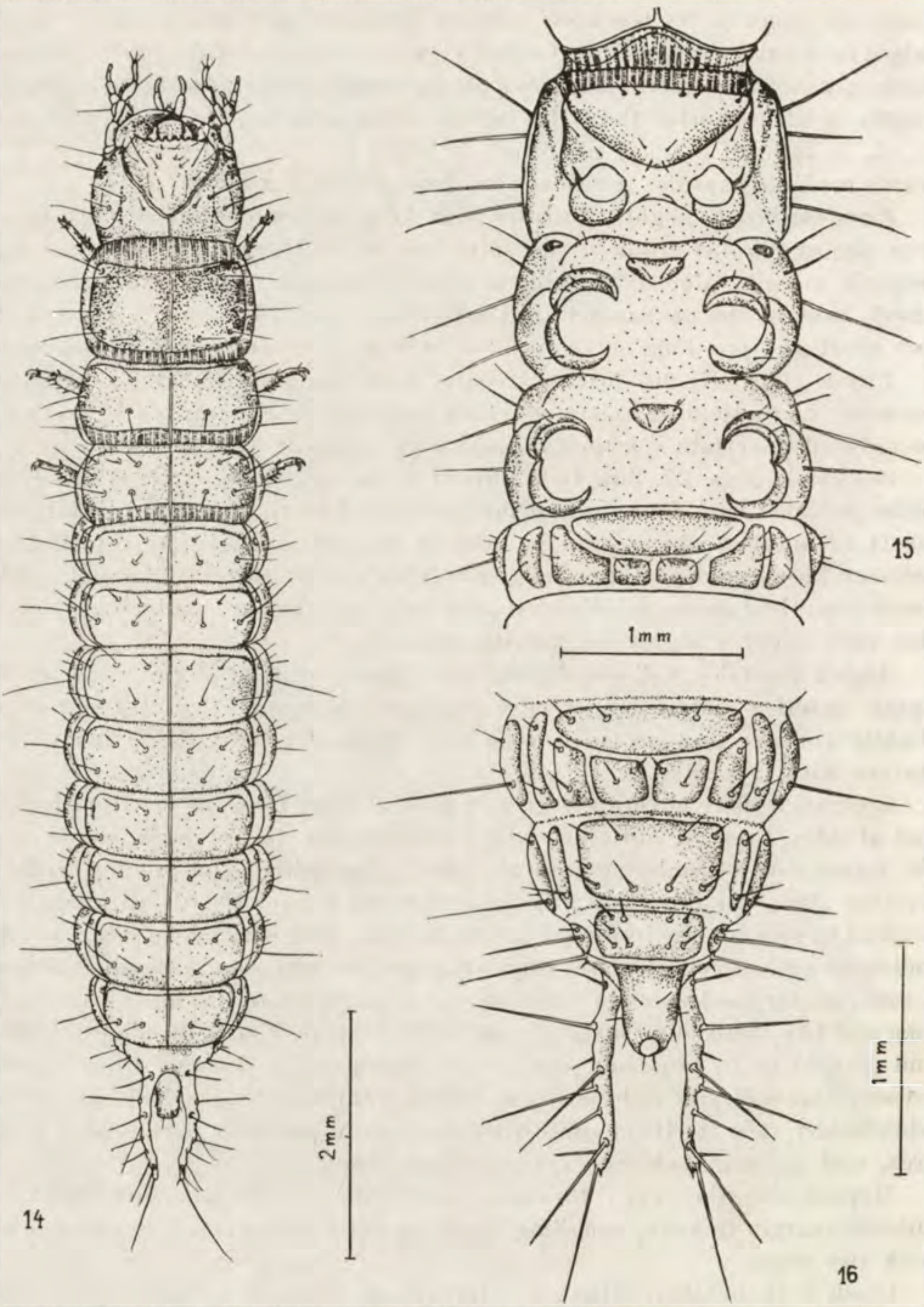
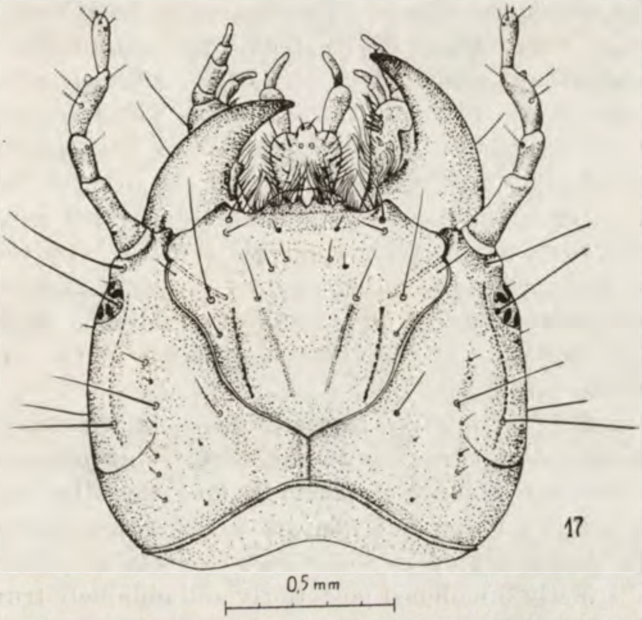


Fig. 14–16. *Amara pseudocommunis* Burak., third stage larva. 14 — larva, dorsal view; 15 — thorax and Ist abdominal segment, ventral view; 16 — VII–IX abdominal segments, ventral view.

at the inner part of its edge, and two very short one of which being at the outer part of the mentioned edge, the other situated more inside ocellar area and near the median ocellar pair.



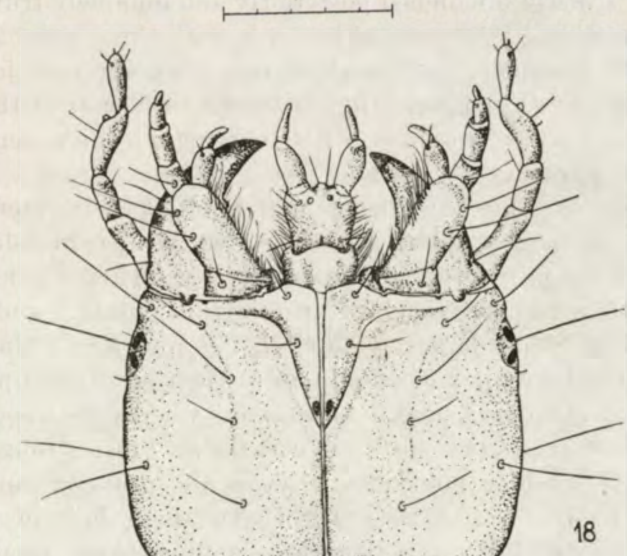


Fig. 17–18. *Amara pseudocommunis* Burak., third stage larva. 17 – head, dorsal view; 18 – head, ventral view.

Mandibles very strongly sclerotized, being the most sclerotized larval organs, in form of a short and broad sickle with a triangular base, about one and half longer than broad at base; their inner face consisting of two cutting edges of which superior running from apex to a half mandible length, whereas the inferior edge occupying almost whole mandible length up to basal bulge where a tuft of hair (penicillus) is situated; lower mandibular edge provided with a short and obtuse retinaculum at half its length; retinaculum length equalling only one quarter to one fifth of mandible width measured at the retinaculum joint; outer mandibular face carrying two setae inserted in grooves, of which one situated at retinaculum level and the other between it and the mandible base; lower triangular mandibular face provided with two insertion points: one for hypostoma receiving condylus ventralis and the other for the talus. Mandible movement depending on two muscles: adductor mandibulae of which insertion points is in the inner angle of mandibular base, and abductor mandibulae which initiates at the tubercle situated in the upper and outer angle of mandibular base.

Antennae (fig. 24) four-jointed; first antennal joint the longest, cylindrical, by two and a half times longer than broad, slightly tapering distally with two sensillae placoideae: one situated on its upper face, the other on the lower one. Second antennal joint slightly club-like, its length equalling half of length of the preceding joint, bearing on its outer face one seta at posterior end. Third antennal joint distinctly broadened posteriorly and obliquely truncate, provided with a small, additional joint conical in shape with three setae and one sensilla placoidea. Fourth antennal joint the slenderest of all antennal joints, its length equalling that of the second joint, but its width only half of that of the joint mentioned and its apex provided with four setae, three sensory processes and one sensilla placoidea.

Maxillae (figs. 25, 26) situated below mandibles at their outer side, equalling almost antennae in length, slightly exteriorly arcuate; cardo slightly rounded, provided on its lower face with a V-shaped brace — its arms joining at the articulation point (the outer one reaching an insertion point) — and with one seta on its inferior face. Stipes large, cylindrical, two and a half times longer than broad, its apex reaching apex of mandibles at their most open position, and its inner edge bearing numerous, long, setaceus hairs whereas its upper face provided with very rigid setae; stipes outer edge carrying four, strong setae, and its lower face with 3 sensillae placoideae: two in the proximal and one in distal part of stipes. Lacinia two-jointed, its length about half of that of stipes; basal joint slightly club-like, its length equalling three quarters of stipes width, and provided in its distal part with one seta; second joint elongate, its length equalling two thirds of that of the basal cone, with two sensillae placoideae at apex and with one sensory process. Galea very small, barely visible due to a coverage of hairs on stipes, only twice as broad as seta situated on its apex. Maxillary palpi four-jointed, slightly shorter than stipes; first joint slightly shorter than broad, with one seta in its lower part; second joint twice as long as the first one, without seta, but with two sensillae placoideae; third joint equalling the first one in length, with one seta and one sensilla placoidea; fourth joint very small, twice shorter than the preceding one, with several sensillae placoideae and several sensory papillae.

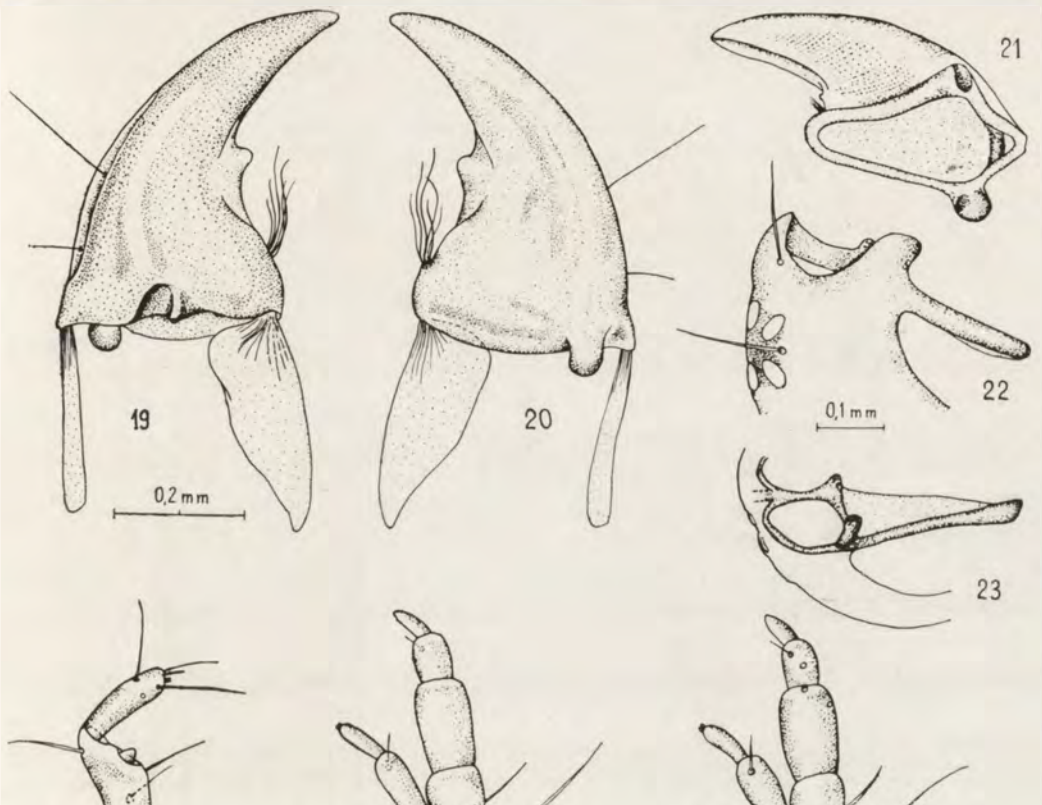


Fig. 19–26. *Amara pseudocommunis* Burak., third stage larva. 19 — left mandible, dorsal view; 20 — left mandible, ventral view; 21 — mandible seen obliquely, dorsal view; 22 — tentorium, dorsal view; 23 — tentorium, head-on view; 24 — right antenna, dorsal view; 25 — right maxilla, dorsal view; 26 — left maxilla, ventral view.

Labium consisting of a submentum and mentum. Submentum small, quadrangular, slightly rounded, its sides densely covered with hairs. Mentum trapezoid with lower concave face shorter than the upper one; lower face with six setae, of which two situated in exterior angles and the remainder at the anterior edge; upper surface with two long seta-like filaments at sides, with short setae and some sensillae placoideae in the middle part, and with several papillae

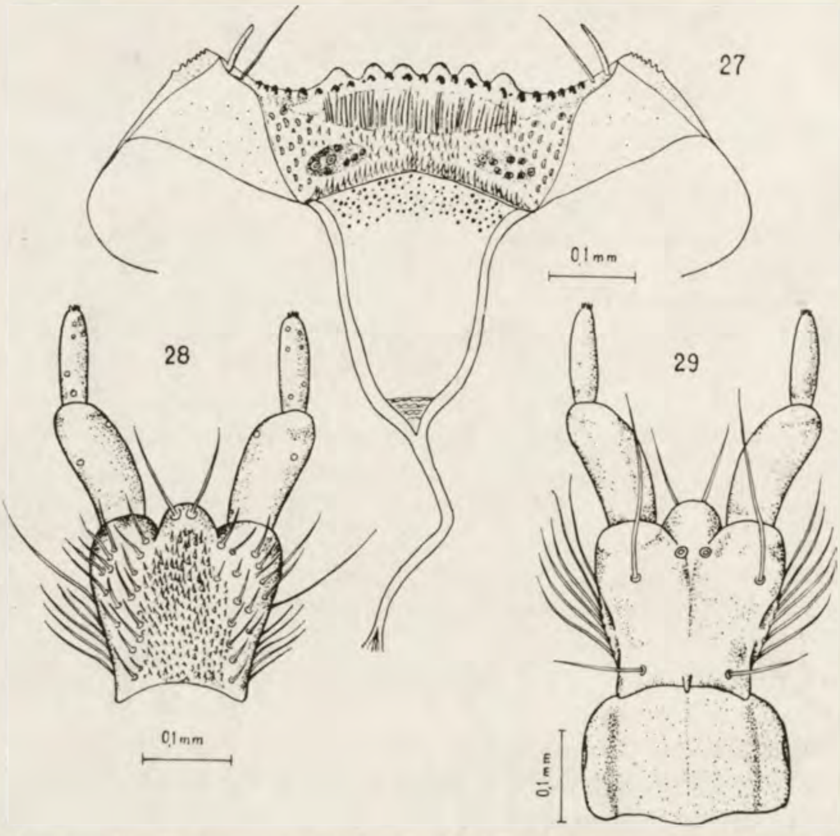


Fig. 27–29. *Amara pseudocommunis* BURAK., third stage larva. 27 – hypopharynx and pharynx, dorsal part, inner side; 28 – labium, dorsal view; 29 – labium, ventral view.

in the anterior part. Labial palpi two-jointed, its length equalling length of stipes, devoid of hairs; first joint cyllindrical, broadened anteriorly, equalling mentum in length, provided with two setae at base and with several more at apex; apex with a tuft of sensory papillae. Ligula small, semicircular, its width twice exceeding length, with two rigid, obliquely protruding setae on its upper surface.

Hypopharynx (figs. 31, 33) composed of a transverse, membranaceous plate, with sclerotized suspensoria at sides. Anterior part of hypopharynx fitting to upper and posterior edge of labium, and its posterior part passing gradually into pharynx. Lateral parts of hypopharynx attached from below to cardo, and from above to subnasal flaps. Surface of hypopharynx with conical densely scattered sensory cells; its anterior edge with two rows of fine, filamentous, erect fibers; they cover also the upper surface of labium. Longer filaments of the upper row covering shorter ones of the lower row. Filaments forming no joints in their attachement points with epidermis, thus may not be regarded as setae, and their surface provided with acuminated processes which connect them with one another (figs. 32, 34). Epidermis of hypopharynx soft and elastic.

Cibarium small, situated transversely above hypopharynx and when in rest forming a narrow slit covered by mandible penicillus and setae of other appendages as well as by filaments of preoral cavity of hypopharynx. Cibarium can be narrowed and broadened by means of muscles attached to oral cavity.

Preoral cavity is formed dorsally by subnasal flaps and ventrally by hypopharynx. Epipharynx consisting of sclerotized subnasale and of soft subnasal flaps. Dorsal surface of preoral cavity composed of a transverse, soft and supple subnasal flap situated obliquely in relation to the frontale. Posterior margin and middle part of subnasal flap covered by conical sensillae directed anteriorly. Sensillae are of a great importance as they help to held the fluid food on the receptive surfaces thus making possible a proper taste analysis of food particles. Subnasal flaps with two oval sensory „plates" each carrying 6–8 sensillae, and with small, flat sensilla at lateral margins. Middle part of anterior edge bearing long, dense, directed anteriorly, filaments. Setae and filaments of appendages of head and of preoral cavity, as well as denticules and tubercles on subnasale, have a great importance in the process of feeding as they act as a filter percolating and sorting the food particles before they pass deeper into the digestive tract.

Pharynx (figs. 27, 31, 33) elastic, covered interiorly by a thin epidermal layer and attached dorsally in its anterior part to a posterior edge of subnasal flap and ventrally passing into hypopharynx. Hypopharynx walls forming a flat sack lined with one-layer epidermis; ventral side provided with four gustatory sensillae in form of round plates. Pharynx bottom transversely wrinkled.

Oesophagus (fig. 27) in form of a long, thin pipe, and running within posterior part of cephalic capsule. Its inner wall covered with a chitinous lining. These chitinous layers, both of pharynx and oesophagus, are retained in exuvia of all larval stages.

Tentorium (figs. 22, 23) forming inner skeleton of head, and consisting of two, well sclerotized plates not connected with each other; its long, posterior "arms", in transversal section L-shaped, directed obliquely posteriorly and interiorly and terminating freely within the cephalic capsule below the frontale. Anterior and dorsal, short "arms" constituting a strong base for antennae as well as support points for mandibles and providing an attachment points for flexors of mandibles, labium and antennae.

Thorax (fig. 15) length equalling one quarter of total body length. Prothorax length equalling four fifth of length of mesothorax and metathorax taken together; each segment broader than long; terga divided by a pale suture line.

Prothorax. Pronotum almost rectangular, with slightly rounded sides, its margins slightly bordered by a dark pigmented impression. Anterior and posterior part of pronotum membranaceous, striped longitudinally, anterior stripes being broader than the posterior ones. Only mediotergum present, lateroterga

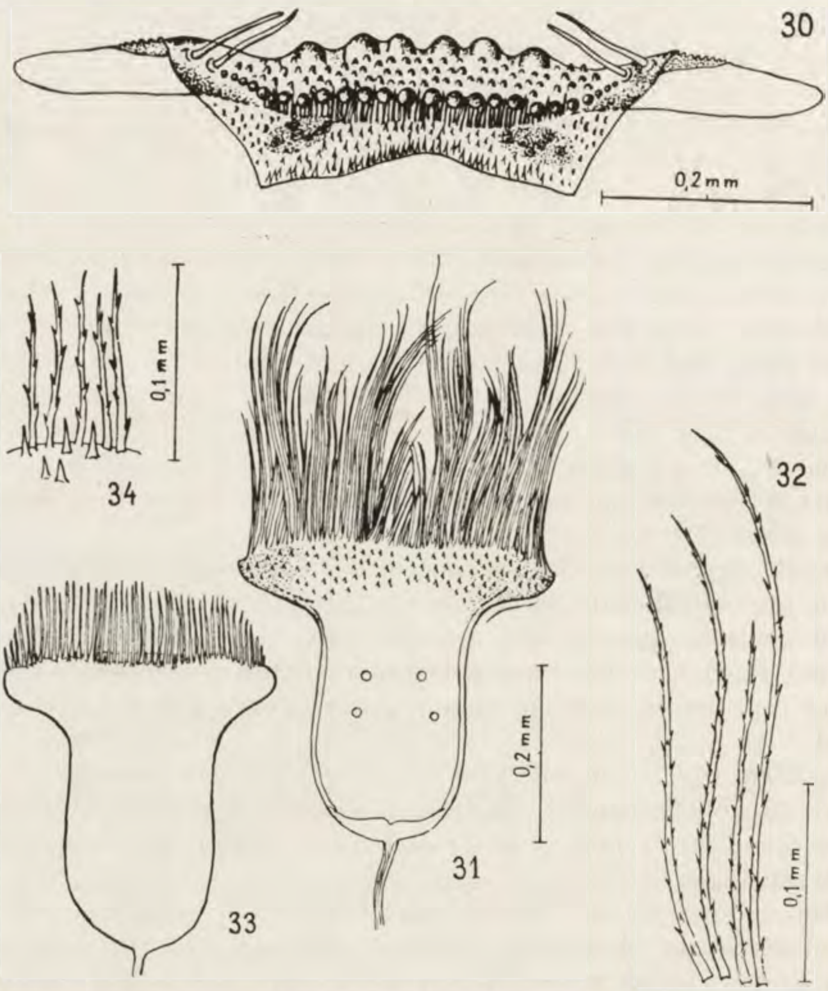


Fig. 30–34. *Amara pseudocommunis* Burak., third stage larva. 30 — hypopharynx, frontal view; 31 — hypopharynx, dorsal view; 32 — filaments of the upper row on hypopharynx; 33 — hypopharynx after removing filaments of the upper row; 34 — filaments of the lower row.

lacking. Sides of pronotum slightly upturned, each half of pronotum carrying 5 setae: 2 lateral, 2 median, and 1 posterior seta; in some specimens one more lateral seta present.

Prosternum triangular, its anterior edge broadly bordered, bordering longitudinally striped; posterior angles with 2 setae. Sternella situated between coxae, membranaceous, barely discernible. Episternum arcuate, anteriorly reaching presternum, posteriorly partly surrounding coxa base; its anterior part carrying 2 setae. Epimeron semicircular, its anterior part sclerotized and forming a joint with episternum; middle part bearing one seta.

Mesothorax about twice broader than long; mesonotum consisting of mediotergum and both anterior and posterior laterotergae; mediotergum quadrangular with membranaceous posterior edge, longitudinally stripped; anterior margin with a distinct, darkly pigmented emargination. Chaetotaxy as on prothorax, save for additional medio-anterior seta, which is lacking on prothorax, but present on mesothorax; lateral parts of mediotergum with one small seta; anterior laterotergum triangular, fitting latero-anterior edge of mediotergum, with one large spiracle (three times broader than posterior ones) in its anterior part, and with one small seta in its posterior part; posterior laterotergum narrow, bent semicircularly, with one seta on its lateral margin; episternum and epimeron semicircular, surrounding coxae exteriorly, each with one seta in the middle. Mesosternum small, with anterior margin straight and posterior one arcuate, with four directed anteriorly setae; sternella membranaceous, hardly discernible.

Metathorax similarly developed as mesothorax, its anterior laterotergum, however, without spiracles.

Legs (fig. 9) well developed, relatively long, the anterior and posterior ones of equal length, the middle ones slightly longer than the other; shape of all pairs of legs similar; coxa broadest and longest of all leg parts, slightly shorter than length of femur and trochanter combined, and twice as broad as femur, outer part of coxa with longitudinal impression to fit trochanter and femur when at rest; anterior edge of femur with 5 setae and the posterior one with 4 setae, while its anterior surface provided with 3 tiny setae at base, 1 seta in the middle and 1 short seta at the coxa-trochanter joint. Trochanter and femur almost of equal length, forming no mobile joint. Trochanter upper surface with one short seta, its lower one with two long setae of which one situated at about a half its length, and the other at apex between a two- and a three-spine groups. Femur lower surface with 6 spines along its anterior margin (sometimes only 5), with 4 spines along its posterior margin (sometimes 5) and with one tiny seta on its upper surface. Tibia equalling two thirds of femur length and bearing one seta at base on its upper surface, each surface with 4 spines in posterior part. Tarsus equalling tibia in length and two thirds of tibia in width, provided on its upper surface with one seta, and two spines in its posterior part. Tarsal claws bent, narrow, acuminated and with tiny setae at base.

Abdomen equalling three fifth of the whole body length, slightly flattened, its VIth and Vth segments being the widest; segments length from Ist to VIIIth increasing slightly; length of IXth segment equalling almost half the length of the VIIIth segment.

Abdominal terga well sclerotized, segments I–VIII with narrow pre- and postterga; width of terga exceeding twice its length; each half of terga I–VIII with 5 setae; 2 lateral, 1 medio-superior and 2 median setae; IXth tergum with 1 seta at each side. Pleurae feebler sclerotized than terga from which the are well separated, slightly convex, those of segments I–VIII of similar shape; IXth segment devoid of hypopleurae; epipleurae narrowly-oval, bearing each 3 setae of which the median one very short; hypopleurae narrow, each with 2 setae.

Spiracles oval, situated in the anterior parts of segments I–VIII between terga and epipleurae.

Abdominal sterna (fig. 16) feebly sclerotized, pale, slightly darker than surrounding epidermis. Sterna I–VII consisting of an anterior part and posterior sternella two at each side. Anterior edge of sterna almost straight, the posterior one arcuate; their length equalling half of segments length; anterior part of sterna with 4 setae. Lateral sternella narrow and with 2 setae each. Median sternella almost square, each with one seta in the middle. Sternum and sternella of VIIIth and IXth segments fused into one quadrangular plate, provided with 5 (3 lateral and 2 median) setae on each side.

Cerci straight, strongly connected with IXth tergum, their length exceeding 3 times length of last abdominal segment, broadly separated at base, distance between their bases exceeding more than twice cercus width at base. Each cercus provided with 10 setae: 4 at sides, 2 on superior, 2 on inferior face, and 2 at apex. All setae, except very short intero-posterior ones, long, well developed.

Anal segment in form of a short cone, a little longer than IXth segment. Usually directed somehow obliquely it helps the larva movement by supporting its body. Setation of anal segment consisting of 16 short (6 superior, 6 inferior and 4 lateral), barely visible setae.

Material examined: several a dozen larvae and their exuviae found together with pupae or freshly emerged imagines.

Using the diagnostic characters given by Šarova (1958, 1964), for the identification of the third stage larvae of *Amara communis* (Panz.) and *A. convexior* Steph., I give a key for the identification of larvae of all three related *Amara* species:

1. Distance between median denticles of nasale smaller than width of each denticle at base. Head very broad at base. Body length 8.0–9.5 mm . . . . *A. communis* (Panz.)

—. Distance between median denticles of nasale equalling the width of each denticle at base. Head slightly narrowed at base . . . . 2.

2. Abdominal terga I–VI with only two pairs of setae in posterior part. Abdominal epipleurae with 2 setae. Second antennal joint slightly longer than the fourth one. Body length 10 mm. Head yellow, body segment whitish . . . . *A. convexior* STEPH.

—. Abdominal terga I–VI with 3 pairs of setae in their posterior part and with two pairs of setae in their anterior part. Abdominal epipleurae with 3 longer, and one very short, setae. Second and fourth antennal joint of equal length. Body length 7.0–9.0 mm. Head and pronotum yellow, remaining body parts yellowish . . . . *A. pseudocommunis* BURAK.

Biology of the Third Stage Larva

The appearance of the third stage larvae of *A. pseudocommunis* BURAK. was first noticed on Aug. 21, 1958. Most numerous specimens were encountered in September until mid-October, however, live larvae capable of pupating were found in November in frozen soil at a depth of 1–3 cm (Dziekanów Leśny, Nov. 4 and 11, 1956). The last collecting records were Nov. 18 and Dec. 2, 1956. Larvae which were collected later, throughout winter and early spring, turned out to belong, after a careful examination, to a closely related species *A. brunnea* (GYLL.). Thus my presumptions (BURAKOWSKI, 1957) with regard to the overwintering of larvae of the species discussed seem not to be confirmed. Soft, not fully pigmented imagines found in the spring must have originated from larvae which emerged late in the autumn and were not able to acquire the full pigmentation before the winter period.

The duration of the last larval stage may vary considerably, namely from c. 10 days up to several weeks. It depends on the period in which the larva emerges and on the climatic conditions. Larvae which emerge at the end of July and in the beginning of August have apparently shorter development than those which emerge after onsetting of the first slight frost. The longevity of the larval stage is also certainly influenced by the microclimatic factors and availability of food. Larvae which inhabit sand dunes sparsely overgrown with pine and birches, have shorter development than those found in mixed forest situations. In september I collected in the sand dunes a greater number of pupae than in the shaded and damp places in mixed forest stands where, conversely, the larvae seemed to be more numerous than in the aforementioned habitat.

Larvae 7–9 mm long, still feeding, were found most frequently on the earth surface under fallen last-year rotting birch leaves or under moss in a thin up to 3 cm deep humus layer. Older larvae, which had ceased feeding and prepared to pupate were taken in rather bare sandy areas sometimes with only a sparse growth of short moss at places.

The larvae lead a hidden life. They feed upon larvae and pupae of other insects living in a surface layer in the forest soil. Outdoors, I succeeded to observe the larvae and pupae of *Coleoptera* as they were attacked, captured and sucked out. In laboratory the larvae are often cannibalistic. Little agile specimens which are just in their prepupation period are preyed upon by the agile, younger and aggressive inmates. Pupae also are a favorite prey. I also observed the sucking out of fragments of rainworms which were occasionally given as food, as well as taking of the water by the larvae. The structure and location of the head appendages, a very small mouth opening indicate the intake of either a fluid or extremely strongly fragmentated food. An elastic, easily contractable pharynx, richly provided with muscles, acts as a sucking pump. Numerous setae and conical processes around the mouth opening as well as in the mouth cavity percolate and filter the already sucked out food.

Prior to pupation the larvae change their actual feeding ground and wander to seek dryer, more exposed, higher, usually sandy places. Two or three days before pupation the larva settles in a terminal part of its feeding channel. At this time the larva, by the means of transversal body movements enlarges its channel and closes it behind. This future pupal chamber is 10–15 mm long, 4–7 mm broad and ovoid in form. The larvae finaly cease to move altogether and their body visibly contracts (up to 6–8 mm). The change of habitat prior to pupation plays an important role in the survival of the species in the biocenosis in which it lives. This phenomenon has been studied mainly with respect to adults, however, the migration of larvae seems to be no less of interest. Attacks of various predators such as larvae of *Carabidae*, *Staphylinidae* and *Elateridae*, usually would render a pupation in a habitat in which the larva normally lives, impossible. Even younger larvae of the same species could disturb and hinder the older ones preparing for pupation and pupae could even make an easy prey. Larvae remaining in the humus layer could also be easily invaded by parasiting fungi.

The migration of larvae of *A. pseudocommunis* BURAK. referred to above have a definitely local character. The larvae do not venture beyond an area covered by humus and litter, even though seeking, as already said, somehow dryer, sandy places as pupating sites. The first and second stage larvae wander short distances within the litter layer during the feeding period. These larval stages are however of short duration and the larvae are relatively small, thus they are less endangered by the predator attacks than the older ones of greater size and longer feeding period.

Pupa (figs. 35—37)

Male pupae are usually smaller than the female ones, and their joints of anterior tarsi are broader; moreover, the sexes can be separated on the form of the VIIth and VIIIth abdominal sterna and that of the gonothecae.

Dimensions. Body length in both sexes smaller than in imagines, varying from 4.8 to 6.0 mm (length of imago 5.6–7.2 mm); max. width 2.3–2.6 mm.

Colour. Body of a freshly emerged pupa whitish, feebly shining and provided with transparent setae and hairs. With further development a gradual pigmentation process can be observed: in the first days the ocellar area remains white and only 6 black ocelli at its posterior border can be distinguished; with a further development the eyes become yellow, then brownish and finally black so that the particular ocelli are no longer visible. At the end of the pupal stage the apices and the inner edges of mandibles become black, the tibia distal parts brownish, and tarsi and tarsal claws yellowish, the rest of the body remaining white.

Body shape. Longitudinally oval with abdomen tapering posteriorly; body epidermis only very feebly sclerotized. Body flattened dorso-ventrally, with a convex, arched dorsum and concave ventral side.

Chaetotaxy. Body covered by both shorter and longer setae. Their number and arrangement are fairly constant and are used as taxonomic characters. A detailed description of these parts is therefore given with the description of the particular body segments. Some of the setae may break off partly or completely due to pupa frequent movements inside the pupal cell and rubbing against its sand walls; the position of lost setae is easy to tract by their distinct dark root punctures which they leave as they fall off.

Head strongly declined ventrally and completely hidden in dorsal view. Labrum liguliform, very long and covering almost completely other mouth parts thus affording them a certain protection against possible soiling; only edges of mandibles and apices of palpi maxillares are visible. Antennae fitting body sides and reaching up to anterior pair of wings. Eyes reniform, visible well through a transparent epidermis; in the initial stage only 6 ocelli at the eye posterior margin can be discerned, but with time complex eyes composed of numerous ommatidia become more and more visible. Number and arrangement of particular setae of both sides of head are constant: there are 3 temporal, 2 preantennal, 1 preocular and 1 preclypeal setae on each side of head.

Pronotum almost trapezoid in shape, transversely elongate, its anterior angles almost reaching ocular area. Pronotum twice as broad as long, its length equalling combined length of meso- and metanotum. There are 2 setae on its anterior margin (sometimes two additional ones behind them), 3 setae at posterior angles and 2 setae along posterior margin of pronotum.

Mesonotum almost rectangular, about twice shorter than pronotum, three times as broad as long. Setae at each side of mesonotum 6 in number: there are 3 setae in anterior part, 2 setae in posterior one and 1 short submedian seta.

Metanotum a little shorter than mesonotum, otherwise similar in shape and chaetotaxy.

Wings. Anterior wings well developed, fitting obliquely at both sides of body and passing to the underside where they fit between median and anterior legs; wings apex reaching third abdominal sternum. Posterior wings partly visible, sticking out from beneath of the anterior ones, their apex reaching fourth abdominal sternum. Such position of wings may be seen in either live or properly fixed specimens; those preserved in alcohol usually have wings more or less spread aside due to a sudden contraction of wing muscles during fixing.

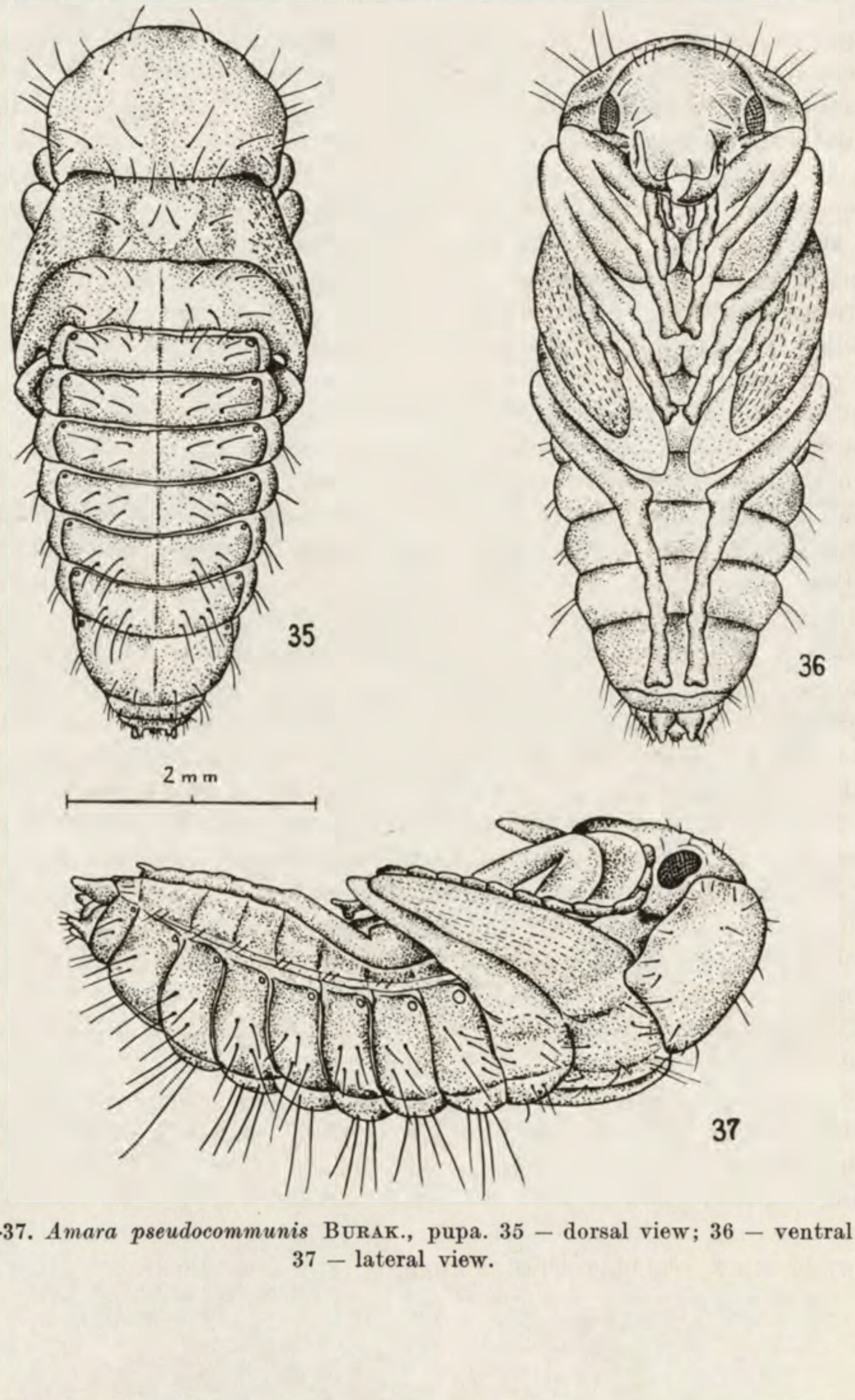


Fig. 35–37. *Amara pseudocommunis* Burak., pupa. 35 – dorsal view; 36 – ventral view; 37 – lateral view.

Legs. Anterior and middle femora directed obliquely upward, their distal parts protruding laterally between mandibles and wings, posterior ones concealed beneath the posterior wings. Distal parts of anterior tarsi reaching apices of anterior wings, those of median ones reaching beyond posterior wings, and posterior tarsi — strongly elongated — reaching beyond posterior edge of the VIIth abdominal sternum.

Abdomen convex dorsally, composed of 9 segments corresponding to the 9 segments of larva. Abdomen length equalling two thirds of total body length; width of first four abdominal segments almost equal to thorax width; following abdominal segments gradually tapering toward apex; terga separated by a shallow median groove; Ist–VIth abdominal terga almost equal in length; VIIth abdominal tergum the longest, its length equalling that of mesonotum; length of VIIIth abdominal segment only one third of that of the preceding one; IXth segment the shortest and provided posteriorly with short, rudimentary cerci with anal cone beneath them; VIIIth sternum with gonotheca; setae very long; there are 6 of them on each half of Ist tergum, 4 on each half of terga II–VI, and 2 on each half of terga VII–IX, 1 at sides of segments II–VI, and sterna VII–IX additionally with 2 short setae.

Spiracles. Nine pairs situated on antero-lateral surface of mesothorax and each of Ist–VIIIth abdominal segments. Shape elliptical. Spiracles of first

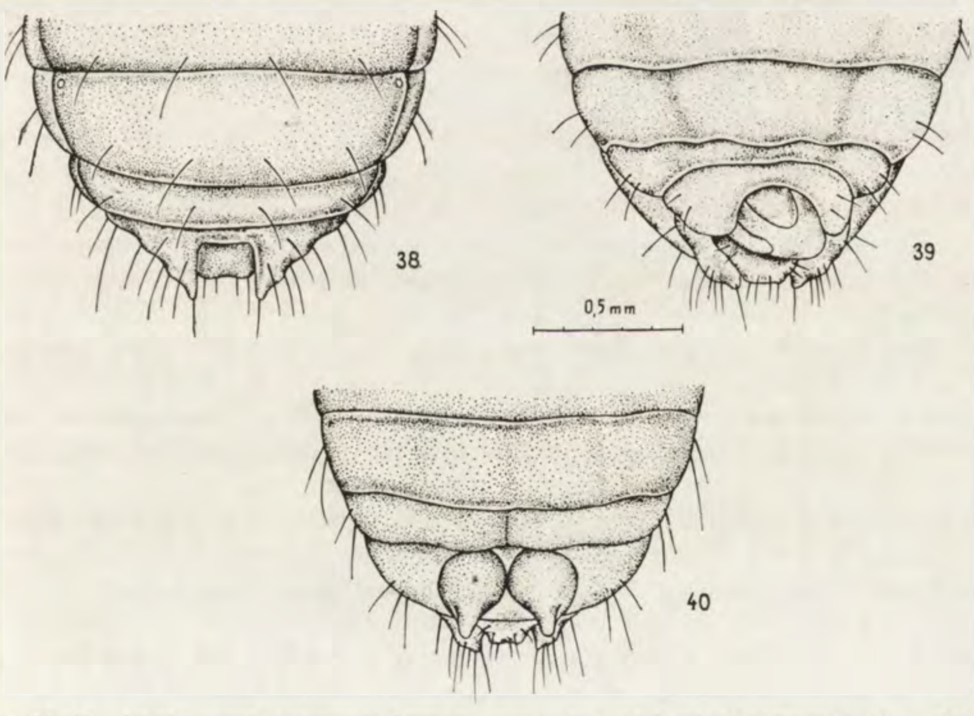


Fig. 38–40. *Amara pseudocommunis* BURAK., pupa, last abdominal segments; 38 — dorsal view; 39 — ventral view, male; 40 — ventral view, female.

pair — the largest ones — invisible, covered by anterior wings, those of second pair slightly smaller than those of first one; spiracles of following pairs small, almost of equal size, well visible, corresponding to abdominal spiracles II–IX of imago.

Cerci short, slightly flattened and provided with 8 setae: 2 at lateral margins, 2 on upper surface and 2 on lower one.

Anal cone situated between cerci and gonotheca, well visible shortly after pupation; it becomes shorter with time and finally remains fully covered by cerci; apex of cone with 4 pairs of short setae: one pair of median setae on dorsal side and two pairs of median ones and one of lateral setae on ventral side.

Underside concave in anterior part. Prosternum invisible. Mesosternum and metasternum partly visible between legs and wings; abdominal sterna I–VI identical in both sexes; abdominal sterna VII and VIII of males without median suture, excised posteriorly and asymmetrical due to shifting of gonotheca to the left side of body, those in females symmetrical, with a distinct median suture, and without posterior excision.

Gonotheca in males (fig. 39) single, triangular with obtuse apex, situated within the excision of VIIIth sternum, and covering the genital organs; only apex of penis and those of parameres are visible. A distinct shifting to the left fo this part corresponds to the position of penis of imago when not in action.

Gonotheca in females (fig. 40) paired, symmetrical, conical with obtuse apices directed somewhat outward.

Material examined. Several dozens of pupae collected in the field or reared of larvae.

Biology. The pupation process lasts several hours. The pupa leaves the exuvium through a rift along epicranial and frontal sutures. This emergence process is helped by the energical dorso-ventral movements of pupa abdomen. A freshly emerged pupa is of elongated cyllindrical shape and is roughly 7 mm long and 1.5 mm broad. Final, slightly coined form is attained after several hours; a fully formed pupa is only about 5.5 mm long, but a good 2.5 mm broad. The pupa lies on its back, its rigid setae preventing contact with a damp bottom of its pupal chamber; they may also constitute a certain protection egainst bacterial infection or mechanical injury by sand particles. The setae are fully developed, rigid and pigmented by the time the pupa leaves the larval skin.

Certain organs which are of importance for the imago, are pigmented and sclerotized earlier than the others. The eyes of pupa undergo a strong pigmentation shortly after emergence. They become first yellow, then light brown finally brown and black. A fast sclerotization and pigmentation process occurs in the inner edge of mandibles, and later in the tarsi where claws are particularly well discernible. Well sclerotized tarsi and tarsal claws help emergence of imago from its pupal moult, and the well formed sturdy mandibles are used in this early period of adult life to provide necessary food and perhaps serve as a certain defensive organ for otherwise soft, immature specimen.

The duration of pupal stage varied from 5 to 7 days in the first part of September, and from 13 to 20 days in October and November. The pupae are to be found most aboundantly in the second half of September. The end of August was the earliest finding-date. Certainly, temperature may considerably influence the pupation process and the appearance of imagines. The emergence of adults continues until onsetting of the first frost, when hardening of the soil makes difficult if not impossible for the imago to break up to the surface from its pupal cell.

The pupae are to be found even in the winter period, which is a rare phenomenon among *Coleoptera*. There are no recent records in the existing literature, as far as I could state, concerning overwintering of pupae of *Carabidae*. Larsson (1939) and Lindroth (1943) suggest that all species of *Carabidae* overwinter in either larva or imago stage, some of them in both. My observations, however, indicate an ability to overwinter also in pupae of certain species. Although Zimmerman (1832: 13) mentions overwintering of pupae of *Amara* Bon., he does not, however, indicate the species and his record has been completely overlooked by subsequent authors.

The majority of wintering pupae as I could state during my investigations in winter 1956/1957, cannot survive the onsetting of the first frost, some of them, however, menage to get through winter period. I succeeded to rear imagines from a certain number of collected in winter pupae, these were, however, not fully formed and died soon after emergence. I found on Nov. 4 and 11, 1956 at Dziekanów Leśny quite a number of alive pupae in a frozen earth layer at a depth of 1–3 cm. In the subsequent days during a thaw I was able to find freshly emerged imagines at the same spot. With the onsetting of new frost in the period of Dec. 2, 1956–March 17, 1957, I have found alive pupae only sporadically, dead specimens on the other hand, however, were come by quite frequently. In all, alive pupae were taken on Nov, 4. 11 and 18, 1956; Dec. 2 and 23, 1956; Jan. 1, 1957; Feb. 3, 1957 and March 17, 1957. It is clear from the above said that pupae may be able to survive even in most unfavourable conditions. The live pupae found on Dec. 2, 1956 were white with brown eyes. Their body gradually become pigmented during rearing, finally acquiring the colour of the freshly emerged adults. The imagines, however, did not emerge, as usually, but remained in the pupal moult, and the sclerotization and pigmentation process proceeded normally as in fully emerged adult. The beetles were still alive on Dec. 31, 1956, and they were seen to move up and down their abdomen in their pupal encasement. Their head was shining-black, the eyes were dark brown, palpi and antennae brown save for yellowish first three joints, pronotum, elytra, scutellum greyish, rest of body dark yellowish. The imagines finally died on Jan. 3, 1957. A pupa found on Feb. 3, 1957, lived 10 days, and that taken on March 17, 1957 only three days.

Imago (fig. 41)

The great similarity of particular species of *Amara* Bon., which are considered as most difficult to identify among *Carabidae*, was referred to by many authors. Lindroth (1943), Kult (1947) and Fassati (1952) indicate that there are few useful diagnostical characters separating particular species, moreover, the specific differences are slight, a strong individual variability making the identification all the more difficult. The microreticulation of the dorsal side of the body may offer here a good example. This character which is widely used in the identification of species of other genera of *Carabidae*, shows in *Amara* Bon. a striking uniformity. Similarly, the shape of genital parts of males, an excellent feature to rely upon in other groups, can not be used because of its feeble differentiation in the genus in question. This great morphological similarity brought about arguments between particular authors as to the identity of allied species such as *A. communis* (Panz.) and *A. convexior* Steph. A proper appreciation of a relationship between the species upon exterior characters met also enormous difficulties. Since the separation of related species of *A. communis* group on the basis of a single character is often not possible, the diagnosis should be based on many features, not only morphological ones but biological and ecological, as well; the latter may constitute first indicators as to the species identity.

Following characters separate related species of *A. communis* group — *A. communis* (Panz.), *A. convexior* Steph., *A. pulpani* Kult and *A. pseudocommunis* Burak. — from the remaining Central European species of subgenus *Amara* s. str.: The scutellar stria well visible, without an ocellate setigerous puncture at its base. First 2–3 joints of antennae rusty. Pronotum on both sides with two shallow impressions at base. Distance between seta-bearing puncture and lateral margin of pronotum greater than diameter of puncture itself. Anterior margin of pronotum distinctly excised, anterior angles strongly protruding anteriorly. Seventh groove at elytra apex with 2–4 punctures. Legs, or at least femora, black, pitchy-black or dark brown. Last abdominal sternum in both sexes with one setigerous puncture at each side.

Key to the identification of imagines of species of *Amara communis* group

1. Seventh stria with four setigerous punctures near the apex of the elytron. Umbilical series of punctures at eighth stria more or less continuous. Apex of penis narrower, with parallel sides.

   Larger and broader species. Body length 7.5–8.5 mm. Pronotum base densely and strongly punctured. In clear deciduous forests and in meadows, in either clay or limy soils. Frequent in submountainous regions, in lowlands sporadic and rare. Recorded from the whole Europe and from the Caucasus. The distribution is not sufficiently known; the species occurs certainly in the central and south Europe. In Poland common in its southern part in submountainous region.

   . . . . *A. convexior* Steph.

—. Seventh stria with 2–3 setigerous punctures in apical part of elytra. Umbilical series of punctures at the eighth stria usually broadly broken up in the middle. Apex of penis broader, conical.

Smaller and narrower species; body length 5.6–7.7 mm. Pronotum base with finer puncturation . . . . 2.

2. Seventh stria with 3 setigerous punctures at elytron apex. Base of pronotum with more distinct puncturation. Antennae with first three joints reddish. Tibiae reddish-brown. . . . . 3.

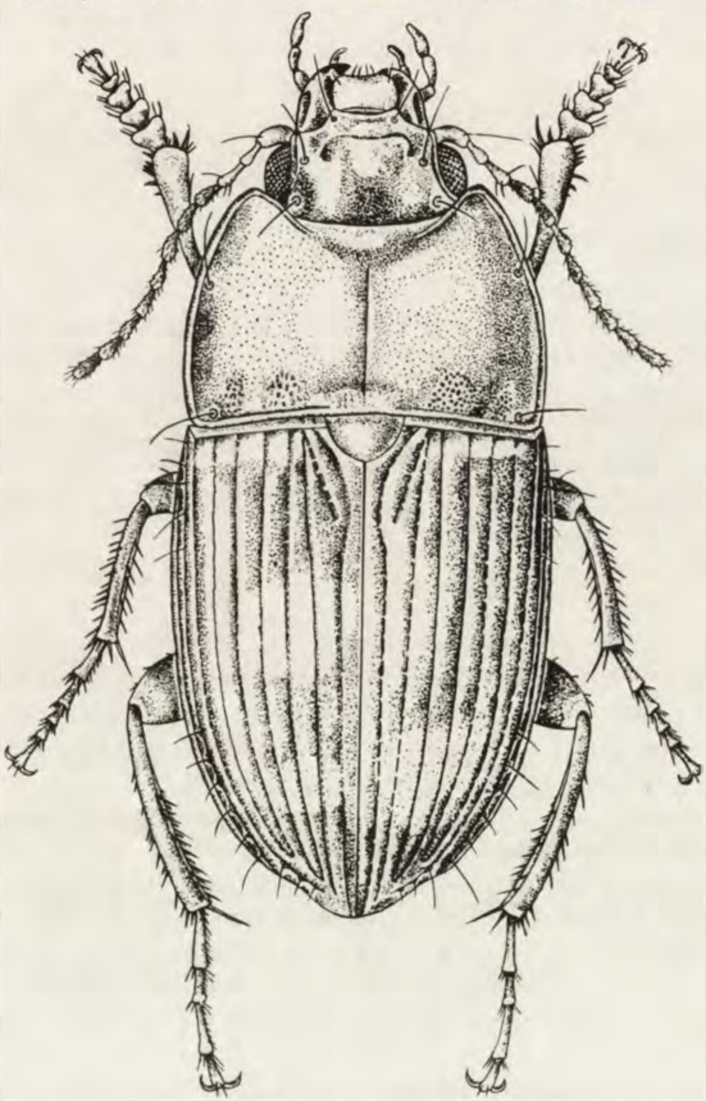


Fig. 41. *Amara pseudocommunis* BURAK., male, dorsal wiev.

—. Seventh stria with 2 setigerous punctures at elytron apex. Basal part of pronotum without punctures or with sparse, barely distinct punctures. Antennae with only first two joints and a half of a third one (rarely either two or three). Tibiae pitchy-black or almost black.

Body length 6.1–7.2 mm. Impressions at pronotum base barely visible. Proepisterna unpunctured, metaepisterna and sides of metasterna with punctures. In dry soils with heath overgrowth, often in mountainous regions. The species only recently described. Its distribution is not sufficiently known. So far recorded from Czechoslovakia, Ukrainian S. S. R, France, central Germany. No records from Poland, it may yet turn up in southern part of the country.

. . . . *A. pulpani* Kult.

3. Proepisterna unpunctured; metaepisterna and sides of metasterna feebly puntured. Apex of penis narrower.

Body larger, narrower and more convex; length of males 6.4–7.0 mm, that of females 6.6–7.7 mm. Dorsal side bronze, less shiny. Common in lowlands in wet swampy meadows and fields. Most frequent in river flood debris. Reproduction in spring; larvae occur from May to July. Recorded almost from whole Palearctic region. Distribution insufficiently known, and the species frequently confused with *A. convexior* Steph.; some of the records also may refer to *A. pulpani* Kult and *A. pseudocommunis* Burak. Distributed certainly in whole central Europe. In Poland recorded from several dozen localities.

. . . . *A. communis* (Panz.).

—. Proepisterna punctured; metaepisterna and sides of metasternum distinctly punctured. Apex of penis broader.

Smaller, broader and less convex species; body length of males 5.6-6.7 mm (85% of specimens measured 5.9–6.4 mm), that of females 6.1–7.2 mm (80% of specimens measured 6.5–6.9 mm). Dorsal side of body bronze-black, shining, with a faint metallic, violaceous tinge. Occurs in lowlands in mixed forest stands with birches as necessary component. Local but often very common. Summer-species. Larvae encountered from July until November. In Poland recorded from many localities. Also known from Czechoslovakia, Germany, Lithuanian and Ukrainian SSR.

. . . . *A. pseudocommunis* Burak.

Ecology. *A. pseudocommunis* Burak. (= *A. mülleri* Mak. i. l.) occurs in birch - including mixed - forest stands, which was already indicated by late J. Makólski and born out by my own observations. Numerous field investigations provided a rich material, which permitted to clear out a biological dependence of the species on the biotop mentioned.

A thin sandy soil layer covered by rotten leaves or moss, seems to be a proper habitat of both early instars and imagines. The species turned out to be particularly common in those part of the forest which adjoined alder stands (station in Kampinoska Forest). In Czechoslovakia the species has been collected not only on sandy soils but also on peaty ones (Hůrka, 1961). In Germany the species has been found in highland moors (Gersdorf, Kuntze, 1957b). The existence of the species depends upon the presence of old seed-bearing birches. The seeds of the trees mentioned constitute an important, supplementary food component for the imagines necessary in attaining sexual maturity mating and oviposition. In pine forests with a birch admixture, *A. pseudocommunis*

Burak. occurs often together with *A. brunnea* (Gyll.). My observations (Burakowski, 1957) with regard to the ecology of the species in question are confirmed by those made by Hůrka (1961) in Czechoslovakia.

By contrast to *A. communis* (Panz.) which has been collected during floods, I could not find *A. pseudocommunis* Burak. in flood debris, and I presume that this species does not inhabit periodically overflown lowland areas. Although the species is associated with sandy soils, I did not find it on mobile dunes, or those recently forested; nor was I able to find the species in sandy river beaches. *A. pseudocommunis* Burak. is certainly at home in humid, overshadowed places, and it seems to avoid dry, sandy sites typical of pure pine forest stands.

Biology of imago. A freshly emerged imago is totally white except for black eyes, brown inner edge of mandibles, yellowish first antennal joints and brown tarsi. Its soft epidermis is yet to be sclerotized, the elytra are easily deformed. The dorsal side acquires pigment earlier than the ventral one. Roughly six hours after emergence the dorsum acquires a greyish colour, whereas the ventral side becomes pale yellowish. During the following two days dorsal side, legs and appendages of head become fully pigmented, whereas on the ventral side this process is yet not complete. The sides are blackish, but the middle part is still brownish. A full pigmentation of specimens emerged in early autumn is not acquired until after a week. In specimens which emerge later the pigmentation process lasts longer, and those found in winter or early spring show often a brownish underside. They acquire additional pigment later after having left their winter quarters, and from May on only fully pigmented individuals can be encountered. It is probable that the pigmentation process is influenced by the food taken by the immature adult. I observed the feeding of a young adult already 2 days after emergence. Freshly emerged imagines remain in its pupal cell at most a couple of days. After leaving them they become dispersed in the surrounding area and hide in lower, more humide sites, under fallen, rotting birch leaves or under heath stems, their favourite feeding grounds. After emergence the imagines display a considerable activity and they are very agile and rapacious. In this period they may not even shy from devouring one another; their dispersal after emergence does not only play a vital edaphic role, but also constitutes an important factor in the survival of the population. The quick leaving of pupal cells by the adults is also not without a certain significance for an indisturbed metamorphosis of remaining pupae as well as pupating larvae.

Wintering. Intensive feeding during autumn helps to store a sufficient amount of fats within the adult body before wintering. All the specimens which I found in their pupal chambers were dead indicating that the beetles do not winter in their pupal chambers. Imagines winter in special shallow earth-chambers dug at most up to 3 cm below the surface – a depth which certainly facilitate a quick getting out in spring. These winter cells are of spherical shape, with smooth, well rammed walls. Special odors or substances secreted by the adults may keep *Acarina* away and prevent fungi to grow out in this rather humid environment. Those imagines which did not seem to have evolved any particular odors, were, as I was able to observe in late autumn, more frequently attacked by *Acarina* and fungi, which would confirm that this kind of secretion may play a certain defensive role.

There are usually several cells near one another, but I never found several specimens in one chamber. The position of adult during wintering is somewhat oblique, the head and dorsum directed upward. In places where groups of wintering adults were found, no other species were collected. These places are usually somewhat elevated in relation to the surrounding area. Margins of ditches, an old molehill, an earth bulge of an uprooted tree or place near elevated trunc base are favourite sites. Such places are devoid of any vegetation, at most are provided with clusters of grass or moss. The chambers are either dug in a sandy soil or in a layer of dry humus, free of roots of either shrubs or trees.

With the onsetting of warmer spring weather, usually in April, the imagines leave their winter quarters and disperse searching for food. In May and June the congregation of individuals are not any more found; only old specimens were collected in this period. About a mid July both males and females congregate in a shallow, flat ground-depressions hiding under a layer of humus and a birch leaves cover. In such places 79 fully mature specimens were taken on a single day (July 22, 1947, leg. Z. Wierzbicki) and later, on Aug. 15, 1956, I personally found 50 specimens (23 males and 27 females). I succeeded in observing the copulation process in the field on July 18 and Aug. 1, 1957. Eggs are laid singly in humus, which I was able to watch in the field on Aug. 21, 1960 as well as in laboratory in the period of July 20–30 and Aug. 2–4, 1960. A large larval material collected in the autumn may suggest an even later oviposition.

The above observation leave no doubt that the distribution of adults is not a stable feature, but changes as the beetles concentrate and disperse alternatively in their biotope. The adults congregate during their breeding period and to spent the winter, whereas they disperse in search for food, which occurs after emergence and after wintering. They have well developed wings, but, I have never witnessed a flight. Most probably the beetles take to their wings in search of new breeding and feeding grounds in of older birch groves which gradually become available as the younger ones grow up. I was able to state a complete absence of the species in the younger birch stands, but, later, as soon as the trees have sufficiently grown up and yielded seeds, and a sufficient humus layer of rotting leaves appeared, the beetles turned up. The imagines lead a hidden life, under humus and among the birch leaves. They shy away from light; I have never succeeded in taking a single specimen using an artificial light.

The phenomenon of migration of *A. pseudocommunis* Burak. is, of course, not unique among *Coleoptera*, nevertheless, since the observation in this respect has rarily been made, I think it worthwhile to give details of my investigations, and to compare them with records already published. The seasonal migration was for the first time observed in *Lepidoptera*, which owing often to their conspicuousness, could be observed and studied more easily. A thorough study on the migrations of *Lepidoptera* in Poland is already initiated (ADAMCZEWSKI, 1962). Among *Coleoptera*, *Carabidae* seems to be the group most thoroughly studied in this respect. The migration of certain species of this family was described by MAKÓLSKI (1929), and apparently due, as the author writes, "to the fact that their breeding grounds were not suitable for wintering." Seasonal migrations of *Coccinellidae* due to lack of food and of suitable sites for wintering, were observed by BIELAWSKI (1961). GALEWSKI (1964) records autumn migrations of some species of *Dytiscidae* from water to land for wintering.

Feeding. The majority of species of *Carabidae* are carnivorous. The species of *Amara* BON. take both animal and plant food (MJÖBERG, 1906; ZNOJKO, 1929; GERSDORF, 1937; LARSSON, 1940; LINDROTH, 1945). Adults of *A. pseudocommunis* BURAK. although they take mainly plant food prefer freshly after emergence small insects. In the postemergence period I was able to observe, both in the field and in laboratory, cannibalism of certain specimens of thir species mentioned. On Oct. 18, 1956 in Nowe Budy distr. Nowy Dwór Maz. I watched two newly emerged imagines as they attacked a third specimen; in several minutes they menaged to devour a whole abdomen content of their pray. Similarly in laboratory pupae left with newly emerged adults were often attacked. Therefore a proper care should be taken when the larvae are reared, and the best solution seems to be a separate rearing of specimens of both larvae and pupae. Those imagines which were fully pigmented and sclerotized did not show any cannibalistic inclination. The animal food taken by the adults enables them to overwinter. When reared the adults devoured pieces of rainworms and fragmentated adults or larvae of *Diptera*.

Although the species of *Amara* BON. may take both animal and plant food, they are mainly phytophagous (ZIMMERMAN, 1832; GERSDORF, 1937). Particularly corn seeds belong to a favourite diet of *A. tricuspidata* DEJ., *A. trivialis* (GYLL.) (= *A. aenea* DEG.), *A. communis* (PANZ.) and *A. familiaris* (DUFT.) (ZIMMERMAN, 1832). Seeds of *Capsella bursa pastoris* (L.) are often devoured by *A. aulica* (PANZ.) (GERSDORF, 1937). Corn products such as corn flakes and farina were used as bait in collecting various *Carabidae* among others *A. fulva* (DEG.) (BŁAŻEJEWSKI, 1959). During field investigations I was able to observe one specimen of *A. pseudocommunis* BURAK. running away with a hard-shell seed hold in their mandibles. Despite being netted the beetle did not loose hold of its pray, and kept holding it several minutes even after being placed in a glass tube. In September and August I often ecountered old, overwintered, imagines in the course of feeding in places abounding in seeds of *Betula verrucosa* EHRH. In my laboratory I was often able to watch, too, feeding of many specimens which devoured not only the seed contents, but also contents of seed "wings" (fig. 42). Birch seeds are of particular importance as supplementary food enabling copulation and oviposition. Therefore a clear phenological correlation of sexual activity of the species with the ripening and falling of seeds mentioned in late summer. In my laboratory also seeds of *Alnus incana* (L.) Mnch. were given as food in March and April. The adults were observed to devour the inner part of seeds, leaving a thick exterior layer intact, and they devoured content of wings less readily (fig. 43). I also observed feeding on seeds of common wheat (*Triticum vulgare* Vill.). Dry contents of hard seeds which were given as food, were gradually eaten away, usually starting from the germ

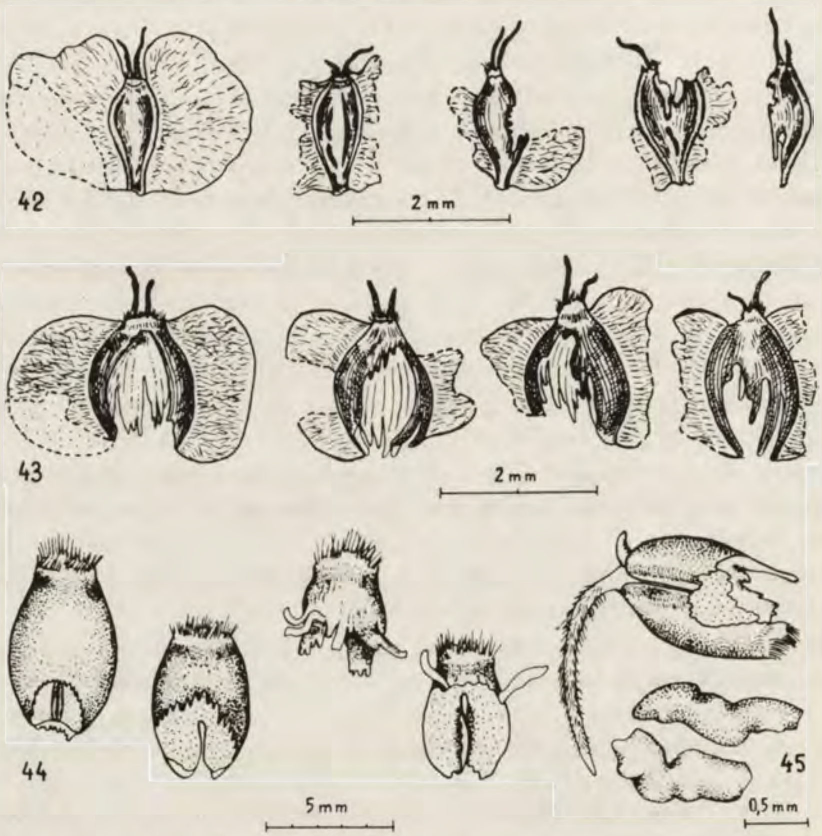


Fig. 42–44. Seeds eaten partly by imago of *Amara pseudocommunis* Burak.
Fig. 45. Excrements. 42 – *Betula verrucosa* Ehrh. 43 – *Alnus incana* (L.) Mnch. 44 – *Triticum vulgare* Vill. 45 – Excrements of imago of *Amara pseudocommunis* Burak.

pole. Only exceptionally were the seeds eaten through their whole length up to the opposite pole; in this case they usually produced much weaker, lower plants when planted into the soil (fig. 44). Tender, moisted seeds or with visible well developed germs, were not consumed. The beetles left after meals somehow irregular roll-shaped excrements (fig. 45).

Phenology. There is a controversy concerning the number of generations in a year which the species of *Amara* BON. may produce. Some authors (BURMEISTER, 1939) believed that there are two generations a year, others (LARSSON, 1939) argued that only one generation occurs. BURMEISTER based its opinion on the number of collected adults in particular months only, whereas LARSSON took also the frequency of capture of larvae, pupae and young, freshly emerged adults, into account. The latter author describes two phenological types among *Carabidae* — the spring and autumn type. Both phenological types are recorded by LINDROTH (1945). The species of a spring type overwinter in adult form and breed in the spring, whereas those of autumn type copulate and oviposit in the autumn and the grown larvae overwinter. LARSSON (1939: 538) regards all species of subgenus *Amara* s. str. as belonging to spring phenological type, and LINDROTH (1945) voices the same opinion with respect to Scandinavian species of the subgenus mentioned. However, my data with regard to *A. pseudocommunis* BURAK. do not agree with those so far published. The most numerous specimens were collected in July, the copulation and oviposition were observed in July and in the autumn, wheras the larvae were collected from July to November, pupae from August to November and the freshly emerged, soft imagines from August to December. Not fully pigmented specimens were found in the spring (14 and 25 March, 5 and 27 of April); they emerged most probably in late autumn and did not have enough time to acquire a full pigmentation before onsetting of winter. A considerably diminished number of mature specimens found in August and September indicate a gradual dying out of the old generation.

On the basis of an analysis of collecting data of all developmental stages, the capture of most numerous mature specimens in July, the copulation in July and autumn, the overwintering of imagines and the lack of immature specimens from May to July, it seems to me justified to conclude that *A. pseudocommunis* BURAK. belongs to a summer phenological type which hitherto has not been described as far as this subgenus is concerned, and that the species has only one generation in a year.

Factors which impede development

Of anorganic factors a sudden frost in the late autumn period should be mentioned. A sudden temperature change also infavourably influence larvae, pupae and young imagines of late emergence. During my field investigation from October to December, I have often found dead specimens in their pupal chambers, particularly in humide places. They were unpigmented and not fully sclerotized, and they probably emerged after onsetting of frost and hardening of the soil, and could not get out from their cells for feeding. Autumn feeding is a precondition of overwintering of adults. The beetles can survive the winter only after having taken a certain amount of food and they usually menage to get out of their pupal cell before freezing of soil.

To organic factors controlling the survival rate belong bacteria, fungi, mites, predatory larvae of *Carabidae*, *Staphylinidae* and *Elateridae*, as well as parasiting insects. The pertaining observations were made both in laboratory and in the field. The beetles are particularly vulnerable during periods of relative immobility: moulting, pupation or emergence, often in the late autumn.

The mortality rate due to parasiting insects is not particularly conspicuous. Out of several dozens of larvae of *A. pseudocommunis* BURAK. I have been able to rear only two specimens of *Hymenoptera*. One larva taken at Zaborówek, distr. Pruszków, on Sept. 16, 1956 gave out a parasiting larva on Oct. 2, 1956 which after two days pupated, and on Oct. 20 emerged a female, determined by dr. H. SZCZEPAŃSKI (I take this opportunity to extend my warmest thanks to him) as *Proctotrupes collaris* SZEPL. I also obtained a pupa of the parasite mentioned (fig. 46) of a larva of *A. pseudocommunis* BURAK. found at Chotomów, distr. Nowy Dwór Maz., on Sept. 23, 1956. The abdomen apex of the pupa

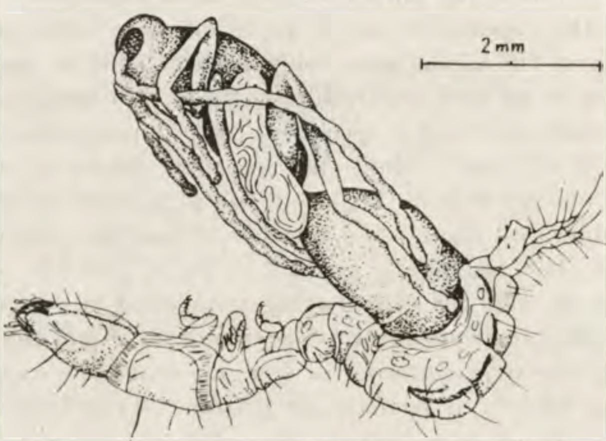


Fig. 46. Pupa of a parasiting hymenopteron — *Proctotrupes collaris* SZEPL. on third stage larva of *Amara pseudocommunis* BURAK.

was attached to the ventral side of the posterior part of abdomen of the host. When at rest the body of the pupa was situated somewhat obliquely and now and then the ventrodorsal movements towards the larva skin could be observed. The rearing of the larva of *A. pseudocommunis* BURAK. took place in a glass tube filled with sand in which the larva constructed an oval chamber.

Distribution

The description of the imago of *A. pseudocommunis* BURAK. is based upon 764 specimens collected in localities given below.

The types are preserved in the collection of the Institute of Zoology of the Polish Academy of Sciences in Warszawa. They are labelled as follow:

Holotype male and allotype female — Central Poland, Chojnów, distr. Grójec, July 22, 1947, leg. Z. Wierzbicki.

680 paratypes — Poland: Bór, distr. Wejherowo, 1933, 1 specimen, leg. S. Jaczewski; Koszalin, 4 specimens, ex coll. A. Lüllwitz; Kramarka, distr. Reszel, 2 specimens, ex coll. F. Kessel; Toruń, Sept. 20, 1956, 1 specimen, 7 specimens reared from larvae and pupae — Oct. 12, 1956, leg. B. Burakowski; Kiekrz, distr. Poznań, Sept. 19, 1956, 4 specimens reared from larvae and pupae — Oct. 12, 1956, leg. B. Burakowski; Władysławów, distr. Biała Podlaska, May 27, 1947, 7 specimens, leg. Z. Wierzbicki; Białowieża, distr. Hajnówka March 27, 1921, 1 specimens, ex coll. S. Tenenbaum; Sept. 26–27, 1950, 6 specimens, leg. B. Burakowski; Pomiechówek, distr. Nowy Dwór Mazowiecki, Oct. 30, 1927, 2 specimens; Nov. 6, 1927, 1 specimen, ex coll. A. Bartoszyński; Chotomów, distr. Nowy Dwór Mazowiecki, Sept. 23, 1956, 12 specimens reared from larvae and pupae — Oct. 13–15, 1956, leg. B. Burakowski; Zielonka, distr. Wołomin, May 3, 1936, 1 specimen, ex coll. S. Tenenbaum; Czarna Struga, distr. Wołomin, April 27, 1930, 1 specimen, ex coll. S. Tenenbaum; Warszawa-Anin, June 26, 1947, 1 specimen, leg. K. Galewski; April 30, 1949, 1 specimen, leg. P. Doliński; Warszawa-Pyry, May 3, 1910, 10 specimens, April 5, 1934, 30 specimens, April 23, 1935, 1 specimen, ex coll. S. Tenenbaum; May 18, 1947, 1 specimen, April 16, 1950, 1 specimen, leg. Z. Wierzbicki; Warszawa-Bielany, July 5, 1933, 1 specimen, ex coll. S. Tenenbaum; Jan. 13, 1957, 2 specimens, leg. B. Burakowski; Kampinos Forest: Leszno, April 27, 1952, 2 specimens; Zaborówek, Aug. 30, 1956, 4 specimens, 3 specimens reared from larvae — Aug. 14–18, 1956; Sept. 4, 1956, 1 specimen; Sept. 15, 16, 1956, 12 specimens, 42 specimens reared from larvae and pupae — Sept. 26 — Oct. 20, 1956; Rózin, Sept. 16, 1956, 25 specimens reared from larvae and pupae — Oct. 2–15, 1956; Cegielnisko, Sept. 16, 1956, 2 specimens, 17 specimens reared from larvae and pupae — Oct. 13–16, 1956; Nowe Budy, Oct. 18, 1956, 11 specimens, 16 specimens reared from pupae — Oct. 25 — Nov. 9, 1956; Sieraków, Jan. 27, 1957, 9 specimens; Febr. 10, 1957, 11 specimens; April 14, 1957, 20 specimens; Dziekanów Leśny, Oct. 23, 1956, 10 specimens, 13 specimens reared from larvae and pupae — Nov. 3–12, 1956; Nov. 4, 1956, 2 specimens, 1 specimen reared from pupa on Nov. 12, 1956; Nov. 11, 1956, 5 specimens; Nov. 18, 1956, 7 specimens, 2 specimens reared from pupae — Nov. 29, 1956; Dec. 2, 1956, 1 specimen; Palmiry, Dec. 23, 1956, 9 specimens — leg. B. Burakowski. Brwinów, distr. Pruszków, May 1, 1952, 1 specimen, leg. A. Riedel; Podkowa Leśna, distr. Pruszków, May 23, 1949, 1 specimen, leg. S. Adamczewski; Otrębusy, distr. Pruszków, Sept. 18, 1934, 3 specimens; Oct. 2, 1934, 3 specimens, ex coll. S. Tenenbaum; Oct. 13, 1956, 8 specimens, 18 specimens reared from pupae — Oct. 18–20, 1956, leg. B. Burakowski; Obory, distr. Piaseczno, April 20, 1947, 6 specimens, leg. J. Makólski; Konstancin, distr. Piaseczno, May 1, 1947, 1 specimen, leg. Z. Wierzbicki; Zalesie, distr. Piaseczno, June 22, 1947, 5 specimens; Sept. 21, 1947, 18 specimens, leg. Z. Wierzbicki; Sept. 28, 1947, 6 specimens, leg. R. Bielawski; Stefanów, distr. Piaseczno, May 17, 1937, 1 specimen, ex coll. S. Tenenbaum; April 22, 1956, 1 specimen, leg. B. Burakowski; Chojnów, distr. Grójec, Sept. 29, 1933, 1 specimen, ex coll. S. Tenenbaum; April 14, 1934, 6 specimens, ex coll. S. Tenenbaum; May 15, 1947, 15 specimens, leg. J. Makólski; July 22, 1947, 77 specimens, leg. Z. Wierzbicki; March 14, 1948, 24 specimens, leg. Z. Wierzbicki; May 16, 1948, 8 specimens, leg. R, Bielawski, 1 specimen, leg. J. Makólski; April 30, 1950, 8 specimens, leg. B. Burakowski; June 5, 1951, 34 specimens leg. J. Makólski; Łoś, distr. Grójec, Dec. 16, 1956, 6 specimens, leg. B. Burakowski; Celestynów, distr. Otwock, July, 3, 1932, 2 specimens, leg. J. Makólski; Oct. 14, 1956, 2 specimens, leg. B. Burakowski; Sulejówek, distr. Otwock, June 12, 1947, 1 specimen, leg. Z. Wierzbicki; Dembe Wielkie, distr. Mińsk Mazowiecki, April 22, 1916, 1 specimen; April 30, 1916, 1 specimen; July 14, 1916, 2 specimens; April 12, 1917, 5 specimens; July 9, 1918, 1 specimen; June 25, 1919, 1 specimen, ex coll. S. Tenenbaum; Siennica, distr. Mińsk Mazowiecki, Oct. 22, 1932, 1 specimen; Nov. 28, 1932, 1 specimen, leg. A. Bartoszyński; Justynów, distr. Łódź, Sept.

29, 1956, 22 specimens, 21 specimens reared from larvae and pupae — Oct. 13–25, 1956, leg. B. Burakowski; Kielce-Ameliówka, March 25, 1912, 2 specimens, ex coll. S. Tenenbaum; Dobroszyce, distr. Oleśnica, Oct. 8, 1956, 6 specimens, 9 specimens reared from larvae and pupae — Oct. 10–18, 1956, leg. B. Burakowski; Bukowiec, distr. Wołów, 1923, 1 specimen, ex coll. A. Lanzke; Zagórze, distr. Chrzanów, April 5, 1914, 3 specimens, leg. E. Mazur; Chełmek, distr. Chrzanów, June 6, 1917, 5 specimens, leg. S. Smreczyński; Bobrek, distr. Chrzanów, April 18, 1922, 8 specimens, leg. E. Mazur.

Germany: Berlin-Finkenkrug, 2 specimens; Berlin-Machnow, 1 specimen, ex coll. P. Franck.

Lithuanian SSR.: Wilno, May 3, 1911, 1 specimen, ex coll. S. Tenenbaum.

Ukrainian SSR.: Wołczków, Aug. 15, 1935, 1 specimen; Borszczów, Aug. 17, 1938, 5 specimens, ex coll. S. Tenenbaum.

There are 82 paratypes in the collection of the Institute of Systematic Zoology of the Polish Academy of Sciences in Kraków:

Poland: Bobrek, distr. Chrzanów, May 31, 1884, 4 specimens; March 25, 1898, 4 specimens; May 5, 1898, 4 specimens; June 5, 1917, 2 specimens; June 20, 1920, 8 specimens; May 1, 1921, 5 specimens, June 4, 1923, 1 specimen; Aug. 22, 1923, 5 specimens; Chełmek, distr. Chrzanów, May 15, 1895, 1 specimen; May 15, 1898, 4 specimens; May 3, 1901, 1 specimen; June 3, 1901, 1 specimen; Sept. 13, 1901, 5 specimens; July 13, 1902, 2 specimens; July 13, 1903, 1 specimen; Sept. 3, 1921, 2 specimens; Kraków-Wola Justowska, May 29, 1902, 1 specimen; July 7, 1911, 1 specimen; Kraków-Bielany, May 24, 1914, 1 specimens; June 1, 1919, 1 specimen; Tomice, distr. Wadowice, May 10, 1902, 1 specimen; Wierzchosławice, distr. Tarnów, Aug. 30, 1917, 1 specimen; Celestynów, distr. Otwock, July 3, 1932, 6 specimens; Żwir, distr. Otwock, May 14, 1931, 1 specimen — all leg. S. Stobiecki. Rózin, distr. Pruszków, Sept. 16, 1956, 6 specimens, leg. B. Burakowski.

Ukrainian SSR. : Lwów-Łyczaków, Krzywczyce, April 23, 1884, 1 specimen; Biłohorszcze, distr. Lwów, May 20, 1902, 12 specimens, leg. S. Stobiecki.

Apart from the localities mentioned above, I have the following new finding data, from Poland, all from the period 1957–1965:

Jaczno, distr. Suwałki, Oct. 12, 1957, 2 specimens; Dziaduszyn, distr. Węgorzewo, Aug. 10, 1958, 3 specimens; Woszczele, distr. Ełk, Aug. 1, 1960, 4 specimens; Olsztyn-Kortowo, Sept. 9, 1965, 5 specimens; Ławy, distr. Pruszków, Oct. 23, 1960, 2 specimens; Zaborów, distr. Pruszków, Oct. 25, 1959, 38 specimens.

From the given map (fig. 47) it is clear that the species occurs everywhere in Poland in lowland area, of course in those habitats which enable its existence. Its association with the birch stands and sandy soils, may indicate a fairly wide distribution. It has been so far recorded from Czechoslovakia (Gersdorf, Kuntze, 1957; Hůrka, 1961), from Germany (Gersdorf, Kuntze, 1957; Korge, 1958; Koch, 1961) and from the European part of the USSR (Kryžanovskij, 1965).

The development of immature stages in autumn, the association with birch and its occurrence on sandy soils allow a suggestion that *Amara pseudocommunis* Burak. is a north species of origin which has gradually been driven south in glacial periods; as the glaciers retreated the species maintained its south "colonies".

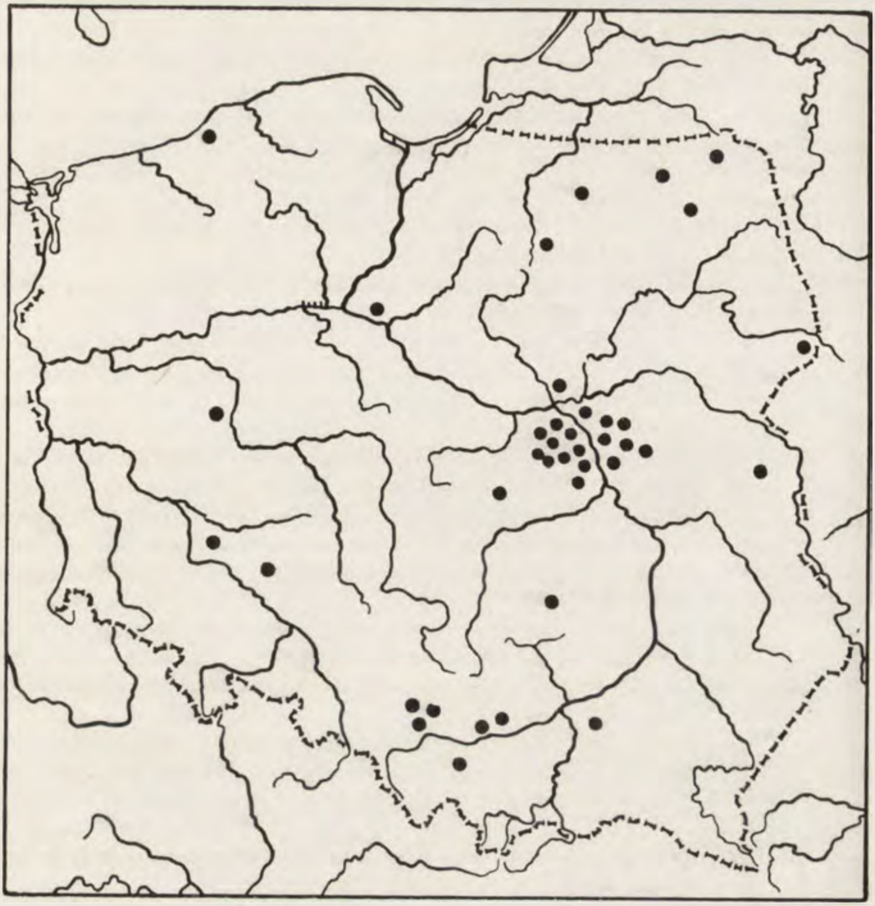


Fig. 47. *Amara pseudocommunis* Burak. finding places in Poland verified by the author.

LITERATURE

Adamczewski S. F. 1962. Materiały do poznania wędrówek motyli w Polsce. I. Fragm. faun., Warszawa, **9**: 373–389.

Bielawski R. 1961. *Coccinellidae* (*Coleoptera*) w zbiorowisku roślin zielnych i młodnika sosnowego w Warszawie na Bielanach. Fragm. faun., Warszawa, **8**: 485–525, 2 fot., 12 ff., 6 tab.

Błażejewski F. 1959. Próby zastosowania płatków owsianych jako przynęty w badaniach faunistycznych. Stud. Soc. Sci. tor., Toruń, Sectio E, **5**, No 2, 10 pp.

Burakowski B. 1957. *Amara* (*Amara*) *pseudocommunis* sp. n. from Central Europe (*Coleoptera, Carabidae*). Ann. zool., Warszawa, **16**: 343–348.

Burmeister F. 1939. Biologie, Ökologie und Verbreitung der europäischen Käfer auf systematischer Grundlage. I. Band: *Adephaga*. I. Familiengruppe: *Caraboidea*. Krefeld, 307 pp., 43 ff.

EMDEN F. I. 1942. A key to the genera of larval *Carabidae* (*Col.*). Trans. roy. ent. Soc., London, **1942**: 1–99, 100 ff.

FASSATI M. 1952. The origin of the holartic species of the genus *Amara* BON. Sborn. nár. Mus. Praha, Praha, **8** B, No. 4, 23 pp., 18 ff.

GALEWSKI K. 1964. The hibernation of the adults of the European species of *Dytiscidae* (*Coleoptera*) out of water. Pol. Pismo ent., Wrocław, **34**: 25–40.

GERSDORF E. 1937. Ökologisch-faunistische Untersuchungen über die Carabiden der mecklenburgischen Landschaft. Zool. Jb. Syst., Jena, **70**: 17–86, 1 f.

GERSDORF E., KUNTZE K. 1957 a. Bestimmungstabelle der *Amara*-Arten (*Col. Car.*) Deutschlands. Ent. Bl., Krefeld, **53**: 3–21, 1 f.

GERSDORF E., KUNTZE K. 1957 b. Zur Faunistik der Carabiden Niedersachsens. Ber. naturh. Ges. Hannover, Hannover, **103**: 101–136, 1 mapa.

HAGEN H. 1852. Die Entwicklung und innere Bau von *Osmylus*. Linn. ent., Berlin, **7**: 368–418, tt. III, IV.

HEYMONS R. 1906. Über einen Apparat zum Öffnen der Eischale bei den Pentatomiden. Z. wiss. Ins. biol., Husum, **2**: 73–82, 2 ff.

HŮRKA K. 1961. Die Carabidenfauna des Sooser Moores in Westböhmen (*Col. Carabidae*). Acta Univ. Car. Praha, Praha, Biol. Suppl. **1960**: 59–82, 1 tab.

KARPIŃSKI J. J., MAKÓLSKI J. 1954. Biegaczowate (*Carabidae, Coleoptera*) w biocenozie lasu Białowieskiego Parku Narodowego. Roczn. Nauk. leśn., Warszawa, **5**: 105–136, 2 tab.

KOCH K. 1961. Seltenheiten der rheinischen Käferfauna aus der Umgebung Düsseldorfs. Ent. Bl., Krefeld, **57**: 103–118.

KORGE H. 1958. Beiträge zur Koleopterenfauna der Mark Brandenburg (Teil XXIII). Mitt. dtsch. ent. Ges., Berlin, **17**: 98–104, 3 ff.

KORGE H. 1961. Beiträge zur Koleopterenfauna der Mark Brandenburg (Teil XXV). Mitt. dtsch. ent. Ges., Berlin, **20**: 21–27, 5 ff.

KRYŽANOVSKIJ O. L. 1965. *Carabidae*–Žuželicy. W: „Opredelitel′ nasekomyh evropejskoj časti SSSR" pod redakcją G. Ja. BEJ-BIENKO, II, Moskva–Leningrad: 29–77, ff. 16–29.

KULT K. 1947. Klíč k určování brouků čeledi *Carabidae* Československé republiky. Ent. Příručky, Praha, č. 20, 199 pp., 11 tt., 2 ff.

LARSSON S. G. 1939. Entwicklungstypen und Entwicklungszeiten der dänischen Carabiden. Ent. Medd., København, **20**: 277–560, 39 ff. XI tab.

LARSSON S. G. 1947. Biller XI. Sandspringere og Lobebiller (*Cicindelidae* og *Carabidae*). Larver. W: „Danmarks Fauna", 47, København: 243–360, 371–372, 377–380, 70 ff.

LINDROTH C. H. 1943. Zur Systematik fennoskandischer Carabiden. 13–33. *Dyschirius, Bembidion, Trechus, Patrobus, Badister, Harpalus, Bradycellus, Trichocellus, Amara, Calathus, Agonum*. Ent. Tidskr., Stockholm, **63**: 1–68, 29 ff., 1 tab.

LINDROTH G. H. 1945. Die fennoskandischen *Carabidae*. I. Spezieller Teil. Göteborgs Vetensk. Samh. Handl., Göteborg, (B) **4**, 1, 709 pp., 1 mapa.

MAKÓLSKI J. 1929. *Amara Roubali* sp. nov. (*Col., Carabidae*), wraz z przeglądem środkowoeuropejskich gatunków podrodzaju *Celia* ZIMM. Pol. Pismo ent., Lwów, **7**: 280–296.

MAKÓLSKI J. 1949. Sprawozdanie z subwencji na badania fizjograficzne przeprowadzone w r. 1947. Sprawozdanie Komitetu Badań Fizjograficznych Wydziału Matematyczno-Przyrodniczego Polskiej Akademii Umiejętności za lata 1946 i 1947. Kraków, PAU, 50 pp.

MJÖBERG E. 1906. Om några svenska insekters biologi och utveckling. Ark. Zool., Stockholm, **3**, No 6: 1–20, 1 t.

PALM T. 1964. Skalbaggar i och under växttäcket pa stenar och berghällar i Uppsalatrakten. En utvecklingsbiologisk undersökning. Opusc. ent., Lund, **29**: 221–247, 5 ff.

ROUBAL J. 1941. Katalog Coleopter (Brouků) Slovenska a Východních Karpat na zakladê bionomickém a zoogeografickém a spolu systematický doplnék Gangelbauerových „Die

Käfer von Mitteleuropa" a Reitterovy „Fauna germanica". Díl III. Praha, 363 pp.

ŠAROVA I. H. 1958. Ličinki žukov-žuželic (*Carabidae*), poleznyh i vrednyh v sel'skom hozjastve. Učen. Zap. mosk. pedag. Inst., Moskva, **124**, Zool. Vyp. 7: 4–165, 142 ff.

ŠAROVA I. H. 1964. Semejstvo *Carabidae* — Žuželicy. W: „Opredelitel' obitajuščih v počve ličinok nasekomyh" pod redakcją M. S. GILJAROVA. Moskva, pp. 112–195, ff. 86–169.

ZIMMERMAN C. 1832. Ueber die bisherige Gattung *Amara*. Ein Beitrag zu einer künstigen Monographie der hieher gehörigen Thiere. Faunus, München, **1**: 5–40.

ZNOJKO D. V. 1929. Opyt kratkogo opredelitelja ličinok rodov žuželic, vstrečajuščihsja v SSSR, i opisanija ličinok *Zabrus tenebrioides* GOEZE, *Harpalus pubescens* MÜLL. i *Amara equestris* DUFT. (*Coleoptera, Carabidae*). Zašč. Rast. Vred., Leningrad, **6**: 335–360, 30 ff.

STRESZCZENIE

Praca jest oparta na materiałach zebranych przez autora oraz obserwacjach przeprowadzonych w Polsce w latach 1956–1964.

Podano dokładne opisy wszystkich stadiów rozwojowych, biologię, ekologię i rozmieszczenie *Amara pseudocommunis* BURAK. Szczegółowo omówiono odżywianie, wędrówki, zimowanie, fenologię oraz czynniki nie sprzyjające rozwojowi.

Dla odróżnienia larw i postaci dorosłych tego gatunku od gatunków pokrewnych, *A. communis* (PANZ.) i *A. convexior* STEPH., podano klucz do oznaczania.

Stwierdzono, że larwa III stadium jest żywicielem pasożyta *Proctotrupes collaris* SZEPL. (*Insecta, Hymenoptera*).

РЕЗЮМЕ

В настоящей работе рассмотрено подробно все стадии развития вида *Amara pseudocommunis* BURAK. описанного автором в 1957 г. Морфологические структуры отдельных стадий были подробно илюстрированны.

Яйца (рис. 1) длиной 1,3–1,5 мм, шириной 0,7-0,8 мм откладывались поодиночно в землю в июле—сентябре. Эмбриональное развитие длится 8–15 дней.

Личинка I стадии (рис. 3, 10) длиной 3,2–3,8 мм и шириной головы 0,62-0,75 мм характерна двумя продольными зубчатыми пластинками на голове, служащими для разрывания яйцевой оболочки во время вылупливания. Кроме того гипоплевриты лишены щетинок, а церки имеют только шесть щетин, ноги имеют меньшее количество шипов, чем личинки II и III стадий, а именно бедро снабжено 4, а голень 6 шипами. Период длительности I стадии равняется около 10 дней.

Личинка II стадии (рис. 11) длиной 4,8–6,1 мм и шириной головы 0,85–0,93 мм лишена зубчатых пластинок на голове на гипоплевритах имеет по 2 щетинки, церки снабжены 10 щетинами, бедра и голени имеют по 8 шипов. Коэффициент роста головы в отношении к I стадии представляет число 1,29. Период этой стадии длится 10–15 дней.

Личинка III стадии (рис. 12–14) длиной 7,2–9,0 мм и шириной головы 1,13–1,30 мм характерна бедрами снабженными 9–11 шипами, коэффициент роста головы в отношении к II стадии является 1,42. В описании личинки III стадии учтено всесторонне морфологию ротовых придатков и внутренней полости рта (рис. 19–21, 25–32). Обращено внимание что многочисленные щетины, нитевидные филаменты на ротовых придатках и в преоральной полости, зубчики и бугорки на субназале имеют большое значение во время корма. Эти эпидермальные отростки направлены к передине и заходящие на себя распределяют, процеживают и фильтруют пищу во время ее хода к дальнейшей пищеварительной системе.

Учитывая диагностические признаки приведены Шаровой (1958, 1964) для личинок III стадии автор дает определитель личинок родственных видов.

1. Промежуток между срединными зубцами назале равен ширине зубца при его основании. Голова очень широкая при основании. Длина тела 8,0–9,5 мм.

. . . . *L. communis* (Panz.)

—. Промежуток между срединными зубцами назале равен ширине зубца при его основании. Голова легко сужена при основании . . . . 2.

2. Тергиты I–VI сегмента только с двумя парами щетин в задней части тергита. Эпиплевриты брюшка с двумя щетинами. Другой сегмент антены немного длиннее четвертого сегмента. Длина тела 10 мм. Голова желтая, остальные сегменты беловатые,

. . . . *A. convexior* Steph.

—. Тергиты I–VI сегмента брюшка с тремя парами щетин в задней части тергита и двумя парами щетин в передней части. Эпиплевриты брюшка с тремя более длинными щетинами и одной очень короткой. Второй и четвертый сегмент антен одинаковой длины. Длина тела 7–9 мм. Голова и переднеспинка желтые, остальные сегменты желтоватые.

. . . . *A. pseudocommunis* Burak.

Личинки III стадии были найдены от августа до начала декабря. Период длительности этой стадии от 10 дней до нескольких недель. Период этот зависит от срока в каком яйца были отложены самкой, от микроклиматических условий и обилия корма. Личинки ведут скрытую жизнь, двигаясь в поверхностном слое почвы, углубляясь наиболее до трех см, или мигрируют по поверхности почвы прикрытой старыми тлелыми березовыми листями. Личинки хищные, кормятся личинками и куколками мелких насекомых, проявляют тоже канибалистические склонности.

Личинки перед окукливанием мигрируют на более сухие места легко возвышены в отношении к местам в которых они кормились. Личинка строит для будущей куколки яйцевидную камеру в земле размерами 10–15 мм (продольная ось) и 4–7 мм (поперечная ось).

Куколка (рис. 35-37) имеет длину 4,8-6,0 мм и наибольшую ширину 2,3–2,6 мм. В стадии личинки можно различить пол, так как куколки самцов меньшие, передние лапки расширены, отличаются значительно формой 7 и 8 стернита и гонотеками (рис. 38-40). Куколка лежит в камере на спине покрытой многочисленными щетинами, которые имеют большое значение для существования вида. Изолируют они нежное тело куколки опеспечивая перед вредящими факторами, как непосредственная влажность почвы, механические повреждения песком во время движений куколки при помощи брюшка и уменьшают заражения микроорганизмами. Период продолжительности куколки варирует от 5–8 дней в первой половине сентября и протягивается до 13–20 дней в октябре и ноябре.

Имаго (рис. 41) описано автором в 1957 помещено в определителях (GERSDORF, KUNTZE, 1957; KRYŽANOVSKIJ, 1965);рисунки концов пенисов *A. pseudocommunis* BURAK. и родственных видов даны Корге (KORGE, 1961).

Отродившийся жук почти целиком белый, окраска последует в продолжении недели у особей вылупившихся ранней осенью. Особи появившиеся позже не успеют окраситься целиком особенно на нижней части тела. Полная окраска следует тогда в марте или в апреле после зимовки. Жуки по отрождению оставляют коморку по 2–3 днях и расходятся проявляя большую подвижность и хищную прожорливость. Питаясь звериным кормом жук интенсивно строит жировую ткань позволяющую ему перезимовать. Жуки зимуют часто массово, но в отдельных коморках в земле на глубине до трех см.

Рассматриваемый жук принадлежит к фауне лесной, заселят только леса с добавкой березы с которой он биологически связан. Весь жизненный цикл происходит в поверхностном слое почвы покрытом тлеющими листьями или низким мхом, преимущественно на легких пропускаемых почвах. Автор находил его главным образом в лесах типа груда соседующего с ольсом. Иностранными исследователями этот жук был приводим из торфяников в Чехословакии (HŮRKA, 1961) и из высоких торфяников в Германии (GERSDORF, KUNTZE, 1957). Существование вида зависит от семенных берез. Семена берез в период зрелости имагинес являются необходимым составом пищи, помогающим в произхождении копуляции и отложении яиц самками.

Копуляция была наблюдаема в поле 18 июля и 1 августа, а отложение яиц 21 августа, а в лабораторном выращивании 20–30 июля и 2–4 августа.

Имагинес проводят местные миграции в лесном биотопе, в котором они скопляются потом снова расходятся. Имагинес образуют скопления на зимовках и в местах размножения, они расходятся по одиночке во время интенсивного корма по отрождению, перед зимовкой и после зимовки.

Пища имагинес состоит из мелких насекомых, главным образом их личинок и куколок и молодых имагинес. Из растительного корма они питаются семенами растений, главным образом берез. В лабораторном выращивании, имагинес кормились семенами серой ольхи *Alnus incana* (L.) MNCH. и обыкновенной пшеницы *Triticum vulgare* VILL.

Вид принадлежит к летнему фенологическому типу характерному тем, что копуляция происходит летом, а жук зимует в виде имагинес. Вид имеет только одно поколение в протяжение года.

Размножение ограничивают постиглые морозы в период поздней осени. С органических факторов, численность встречаемости ограничивают бактерии, грибы, клещи, хищные личинки насекомых главным образом из семейства *Carabidae*, *Staphylinidae* и *Elateridae*. Констатировано, что личинка III стадии является хозяином паразита *Proctotrupes collaris* SZEPL. (*Insecta*, *Hymenoptera*).

Концевая часть работы посвящена встречаемости и известному до сих пор распространению *A. pseudocommunis* BURAK. Кроме многочисленных обнаруженных автором стаций в Польше (рис. 47) вид этот был до сих пор указан из Германии (GERSDORF, KUNTZE, 1957; KORGE, 1958; KOCH, 1961), из Чехословакии (GERSDORF, KUNTZE, 1957; HŮRKA, 1961) и Европейской части СССР Крыжановским (KRYŽANOVSKIJ, 1965).

Redaktor pracy — prof. dr J. Nast

Państwowe Wydawnictwo Naukowe — Warszawa 1967
Nakład 1425+100 egz. Ark. wyd. 3.5, druk. 2³/₄. Papier druk. sat. kl. III, 80 g. Cena zł 14
Nr zam. 1014/67 — Wrocławska Drukarnia Naukowa