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**Post-embryonic development and bionomics of *Quasimus minutissimus*
(GERMAR) (Coleoptera, Elateridae)**

[With 38 figures in the text]

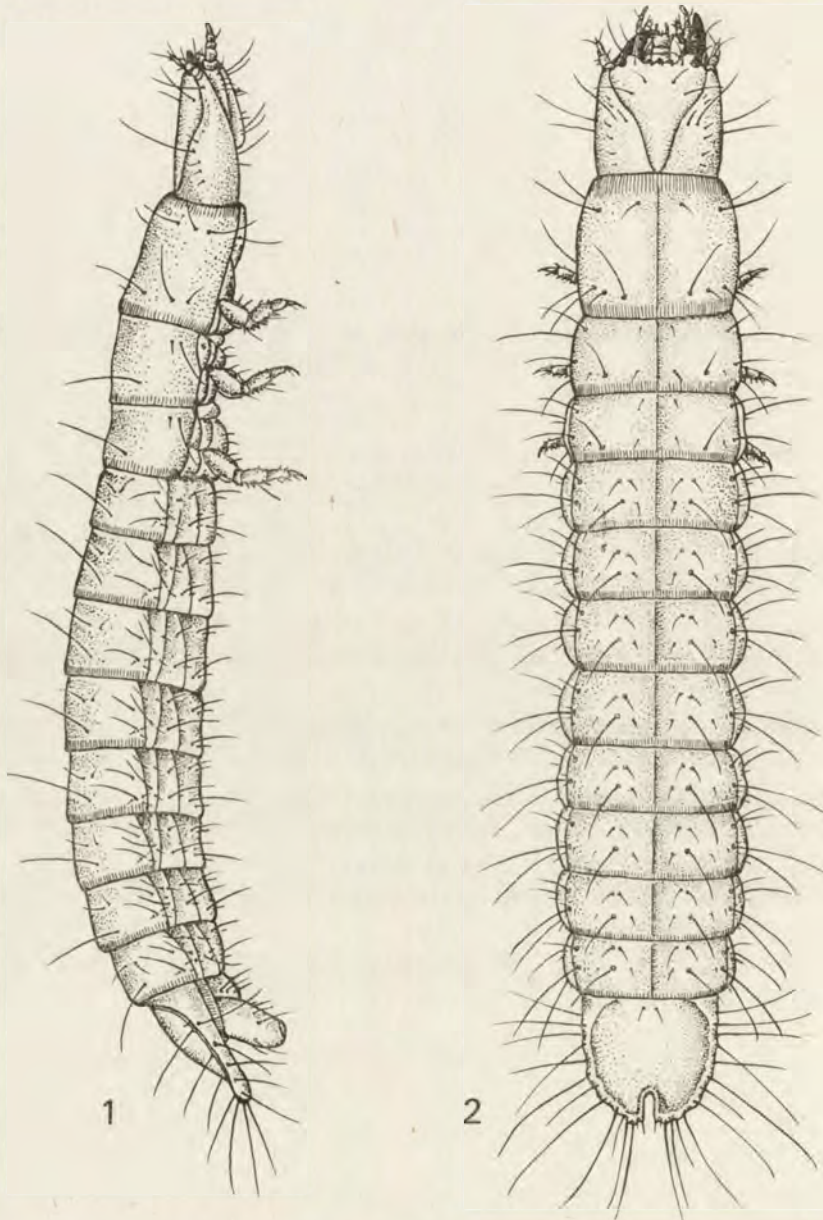
A fairly large genus, *Quasimus* DES GOZIS, comprises 23 species; however, the immature stages of any species were hitherto unknown. The majority — 21 of them — occur in the Palaearctic and Oriental Regions, only two species are known from the Australian Region. Eight species inhabit the Palaearctic Region, the majority of which are distributed in Japan, and only one — *Q. minutissimus* (GERMAR) — ranging from South and Central Europe (except their northern parts) to Caucasus and Asia Minor. In Poland this species as mature specimens has been recorded from only southern part of the country: Pieniny Mts., Beskid Zachodni, Śląsk Dolny and Sudety Zachodnie. In the Pieniny Mts. during 1971–1974 I was lucky to come across the larvae and pupae in company with the adults. Now I am able to present detailed descriptions of all stages of *Q. minutissimus* (GERMAR) together with the bionomics of this species. All material is kept in the collection of the Institute of Zoology of the Polish Academy of Sciences in Warszawa.

DESCRIPTION OF THE MATURE LARVA (Figs. 1–16)

General: the larva (Fig. 1 and 2) is well characterized by its soft body, very long penicillus of mandible, sensory appendix on labial palpus, and narrow almost parallel caudal notch.

Body shape: elongate, almost cylindrical of subequal width, constricted between segments which are broader than long; dorsum more convex than

venter, feebly sclerotized, with small membraneous areas in lateral view. Colouring: dorsal side shiny, light yellow, distinctly darker on head, pronotum and setae, apical part of mandible and nasale are brown; venter slightly yellowish. Dimensions: fully distended, the largest larva examined in the present study



Figs. 1, 2. *Quasimus minutissimus* (GERMAR), mature larva: 1 - lateral view; 2 - dorsal view.

measured up to 3.5 mm in length and about 0.55 mm in width on 2-7 abdominal segments; head width about 0.35 mm.

Head capsule (Figs. 1-4): in dorsal view (Fig. 3) subquadrangular, with feebly arcuate sides, longer than broad, flattened above and below, covered by prothorax as far anteriorly as the bifurcation of frontal suture. In lateral view (Fig. 1) tapered for one-half its length to base of mandible. In ventral view (Fig. 4) concave for reception the ventral mouth parts.

Frontoclypeal region (Fig. 3) defined by feebly visible frontal sutures. Anterior part transverse, at each side of frons with one long and two shorter setae; posterior part elongate, subtriangular, extending backward almost to foramen magnum, acute posteriorly. Median epicranial suture very short. Paranasal lobes strongly produced anteriorly, inner margin moderately to strongly convex, outer margin slightly concave, anterior ventral margin densely pilose; dorsal surface bearing two setae. Nasale (Fig. 7) well developed, tridentate, strongly sclerotized, blunt teeth are almost equal in length. Subnasale ventral to nasale, consisting of 5 strongly sclerotized, subequal, short, forward-projecting denticles; the most lateral ones slightly larger.

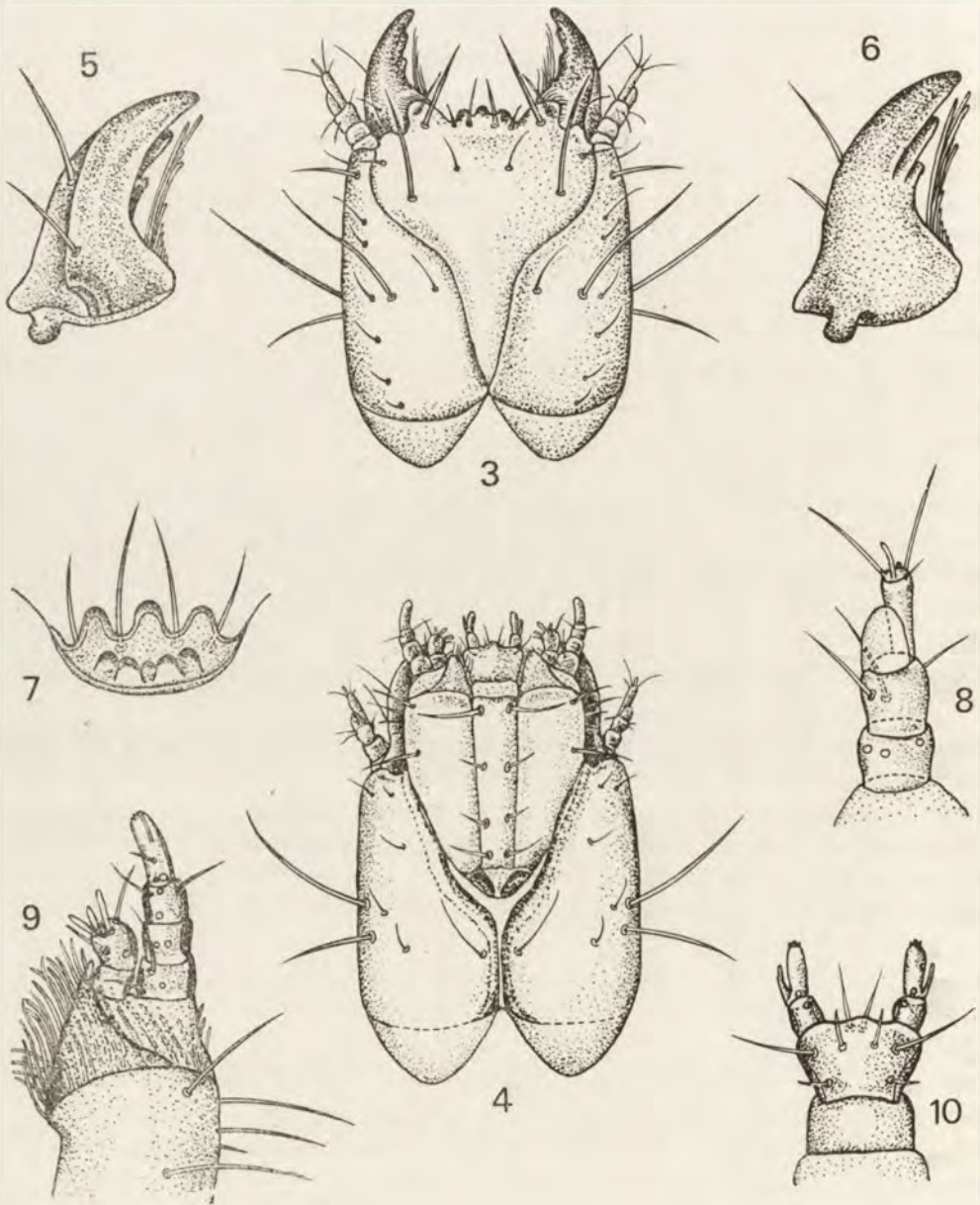
Epicranial plates (Figs. 3, 4) large, covering posterodorsal, lateral and posteroventral parts of head capsule. Dorsal surface with two long and two shorter setae. Laterally with two long lateroepicranial setae and 6 or 7 short setae subequally spaced; the most anterior seta being very long. Ventrally, on each side with five short setae. Hypostoma with sclerotized mesal margins. Gula elongate, narrow, invaginated, defined laterally by postoccipital sutures, widened anteriorly. Eye-spot or ocelli lacking.

Antennae (Fig. 8) three-segmented; first joint clavate, almost two-thirds as long as wide, with three small pores, setae lacking; second joint subcylindrical, almost as wide as long, with three long setae, distally bearing one medium-sized conical sensory appendix, just ventral to base of terminal joint. Third joint narrow, cylindrical, almost as long as second joint and one-third as wide as first joint, its apex provided with two long setae and three small sensory setae.

Mandibles (Figs. 5, 6) very characteristic, about three-fourths as broad as long; outer side convex, with profound antennal fossa and one seta; dorsal surface slightly convex, with one seta, and with a socket for reception the mandibular condyle on frontoclypeus; ventral surface flat, with well developed condyle for articulation with epicranial plate; inner face concave with small, obtuse retinaculum at about half its length, and with additional tooth between retinaculum and top of mandible; penicillus well developed, with tuft of long hairs reaching additional tooth of mandible.

Ventral mouthparts (Fig. 4), excluding appendages, almost as long as wide, moving as a unit forward and backward, with cardines acting as hinges. Maxillae slender, well developed. Cardines short, well separated, with one arcuate brace, obliquely situated. Stipes large, lateral sides arcuate and inner

sides almost straight, posteriorly attenuate, with two prominent and three shorter setae on antero-lateroventral aspect; anterior dorsal surface bearing numerous hair-like filaments. Lacinia (Fig. 9) reduced, triangular, densely



Figs. 3-10. *Quasimus minutissimus* (GERMAR), larva: 3 - head, dorsal view; 4 - head, ventral view; 5 - left mandible, dorsal view; 6 - right mandible, ventral view; 7 - nasale and subnasale; 8 - right antenna, ventral view; 9 - left maxilla, ventral view; 10 - first prementum and second prementum, ventral view.

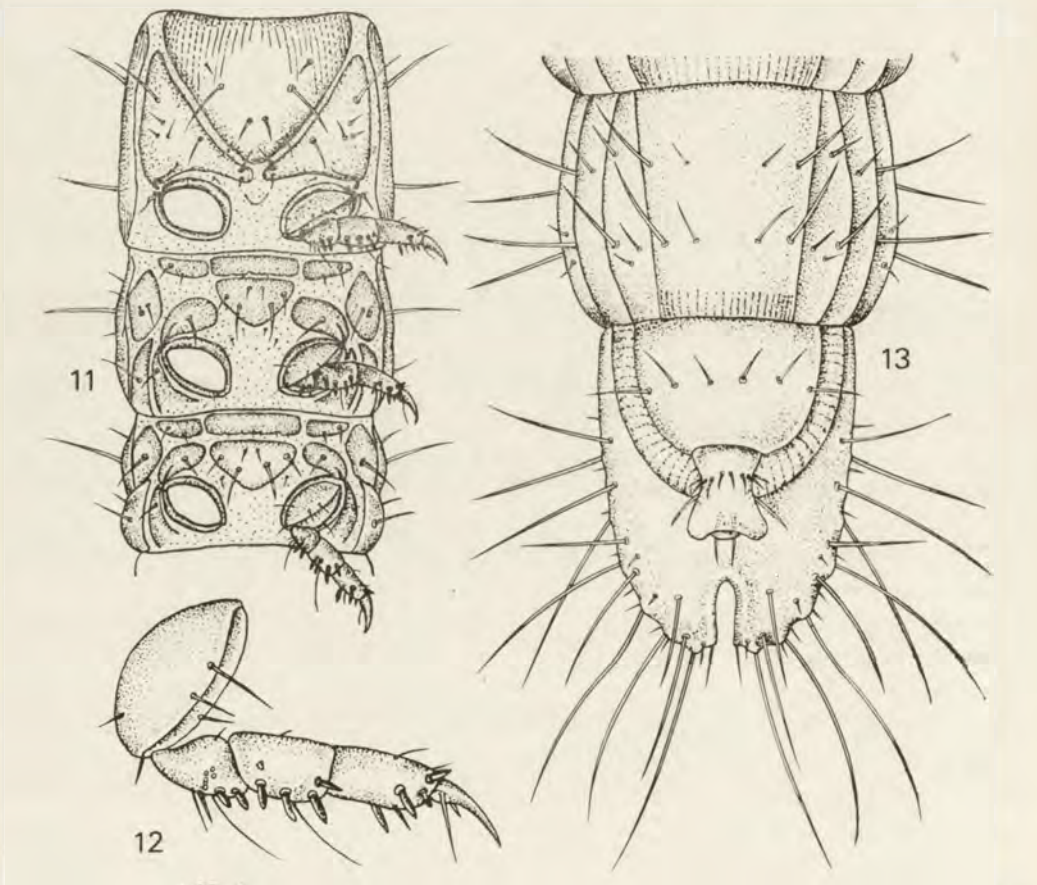
clothed with seta-like filaments projecting into preoral cavity. Galea (Fig. 9) two-jointed, situated somewhat ventral to lacinia, basal joint ring-shaped, partially sclerotized, slightly wider than long; terminal joint thimble-shaped, with the outer margin longer than the inner one, bearing one pore and two long setae, the shorter sensory pegs placed distally. Maxillary palpi four-jointed. The first joint wider than long, with one pore and two setae; the second joint at least as long as wide, with two pores; the third one with two pores and two apical setae; the terminal joint nearly twice as long as second joint, with one minute seta and two pores, and with a group of minute sensory papillae on apex.

Labium (Fig. 9) composed of postmentum and first and second prementum. Postmentum elongate, subquadrangular, the sides subparallel, bearing one long seta at each corner and two more tiny setae along lateral margins. Second prementum subtrapezoidal, transverse, without setae. First prementum (Fig. 10) almost pentagonal, with two prominent setae caudad to base of each palpus, and one seta at posterior angle on each side. Labial palpi two-jointed; basal joint cylindrical, about as long as wide, with one pore; terminal joint slender, twice length of basal joint, with one pore and a group of minute papillae on apex; finger-shaped sensory appendix attached laterally to near base of terminal joint. This accessory segment well characteristic, till now in other groups of *Elateridae* unknown. Ligula small, semicircular, membranous, bearing a pair of forward projecting setae on its upper side.

Thorax (Figs. 1, 2) length equalling about one fourth of the total body length. Prothorax nearly as long as mesothorax and metathorax combined; tergites not divided into medial and lateral sclerites, with anterior and posterior margins membranous and longitudinally striated; sides of pronotum strongly upturned; each half of pronotum with three setae on each anterior and posterior margins; prosternal area (Fig. 11) large, subtriangular, striate on anterolateral aspect, with three setae on each side. Episternum subtriangular, anteriorly reaching sides of presternum, bearing two prominent setae and five smaller ones; posterolateral angle with a condyle for articulation with coxa. Eusternum small, membranous, with two minute setae. Epimeron reduced, membranous, with one minute seta. Eusternum, sternella and poststernella small, indefinite, membranous. Mesothorax (Figs. 2, 11) about twice broader than long; mediotergite with posterior margin longitudinally striate, anterior part with one conspicuous and two minute setae, posterior part with two long setae and two small ones. Anterior laterotergite subrhomboidal, bearing a spiracle and one seta; posterior laterotergite arcuate, with two setae. Presternal area transverse, consisting of four sclerites as follows: proximally, medial piece, triangular, with three pairs of minute setae; distally, a narrow medial piece, subrectangular, without setae; two smaller lateral sclerites subtriangular, each bearing two minute setae. Eusternum membranous, with four fine setae. Episternum arcuate, anteriorly reaching presternal area, posterior part forming

a joint with coxa and epimeron. Epimeron semicircular, surrounding coxae exteriorly, each with one seta in the anterior part. Sternella and poststernella membranous, indefinite and glabrous. The mesothoracic spiracles (Fig. 15) are easily visible; there are bifore, broadest posteriorly, larger than that of other segments; approximate measurement of spiracle of the mature larva is in length and breadth 0.017 mm. The number of teeth at each side of the spiracular opening is five. Metathorax similarly developed as mesothorax, its anterior laterotergite, however, without spiracle.

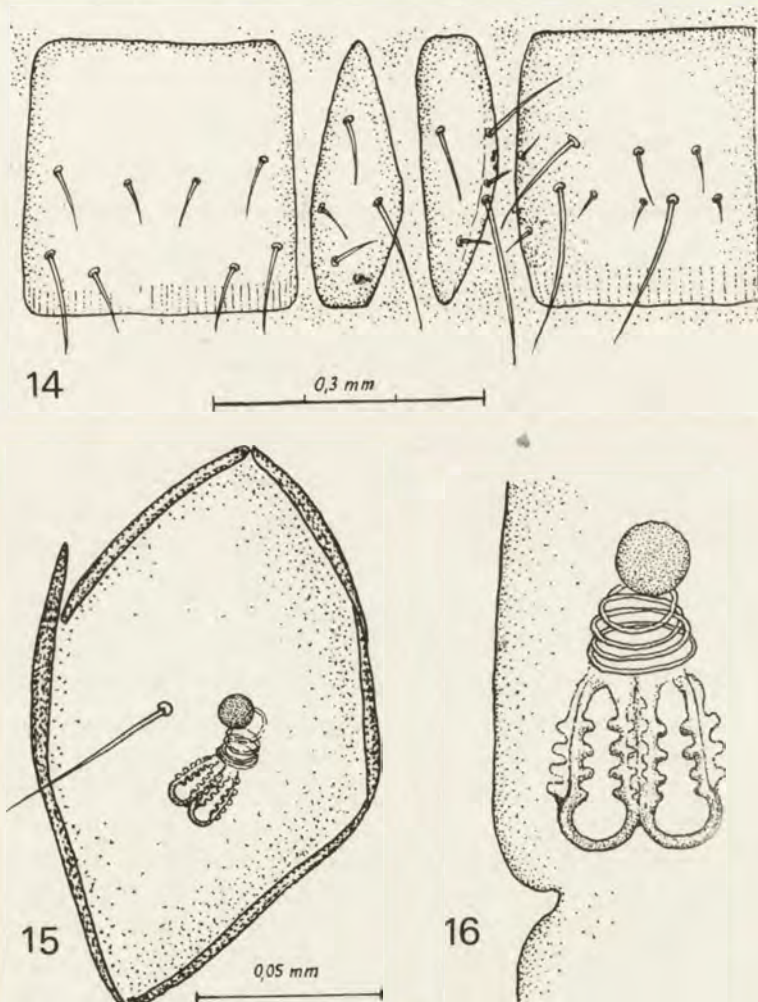
Legs (Fig. 12) well developed, rather widely separated, five-segmented, similar to each other. Coxa sessile, suboval, broadest and longest of all leg parts, excavated on outer surface for reception the trochanter and femur; anterior edge of coxa with two setae and posterior one with one seta, while its posterior part provided with two tine setae. Trochanter, femur and tibio-tarsus almost



Figs. 11-13. *Quasimus minutissimus* (GERMAR), larva: 11 - thorax, ventral view, right legs removed; 12 - left leg, anterior aspect; 13 - eighth and ninth abdominal segments, ventral view.

of equal length. Trochanter upper surface with one short seta, its lower one with two setae and one spine-like seta, and shorter two stiff spines along its anterior margin. Femur lower surface with four stiff spines and one long seta, and with one tiny seta on its upper surface. Tibio-tarsus slender, with two tiny setae on upper surface, and four stiff spines and one spine-like seta along its distal part. Ungula slightly curved, rather long, acuminate and with two setae at base.

First to eight abdominal segments (Fig. 1, 2) subequal, similar to each other. Mediotergites with posterior margin longitudinally striated; posteriorly on each mediotergite (Fig. 14) there are two long setae and three minute one



Figs. 14-16. *Quasimus minutissimus* (GERMAR), larva: 14 - sternum, laterotergites and left mediotergite of fourth abdominal segment; 15 - spiracular sclerite and spiracle of mesothorax; 16 - spiracle of fourth abdominal segment.

forming a transverse row; laterally, with two very small setae; anteriorly, with one long and two shorter setae. First laterotergite elongate, extending the length of segment, bearing three long and two fine setae. The hyposternite large, with one long and three shorter setae. Sternum (Fig. 14) large, subquadrate; feebly sclerotized, pale posterior margin faintly longitudinally striated; anteriorly and posteriorly with four pair of setae. The abdominal spiracles (Fig. 16) resemble those of the thorax but are somewhat smaller; they are almost colourless, feebly visible and situated in the middle of laterodorsal margin on first laterotergite. The two chambers elongate-oval. The number of supporting teeth at either side of the respiratory orifice is four. Approximate measurement is in length and maximum breadth 0.015 mm. The scar yellowish, situated anteriorly to the chambers.

Ninth abdominal segment (Figs. 1, 2, 13) slightly longer than eight abdominal segment and at least three-fourth as wide, more flattened than the rest, but slightly convex, its upper surface almost without sculpture. Sides of anterior half subparallel, posterior half tapering caudally. Dorsum with minute swellings on the lateral margins, and only two minute setae on the anterior part, usually with seven long and six minute setae on each side. Urogomphi short and stout, separate, projecting caudad, with four long and six minute setae from lateral aspect, and one short seta ventrally near base. Caudal notch narrow, U-shaped, about three times as long as wide, about one-third length of ninth tergite (exclusive of urogomphi). Ventrally, the pleura (Fig. 13) arch-shaped, transversely striate, surrounding the ninth sternite and tenth segment, the ninth tergite extending laterally to their margins. The sternum undivided, medially with six setae forming a transverse row. Tenth abdominal segment short, directed caudoventral, with the whorl of eight minute setae, and two setae on dorsocaudal surface and one seta at each lateral side. Distance between anterior margin of caudal notch and posterior margin of pleural area approximates one-fourth of total length of ninth segment.

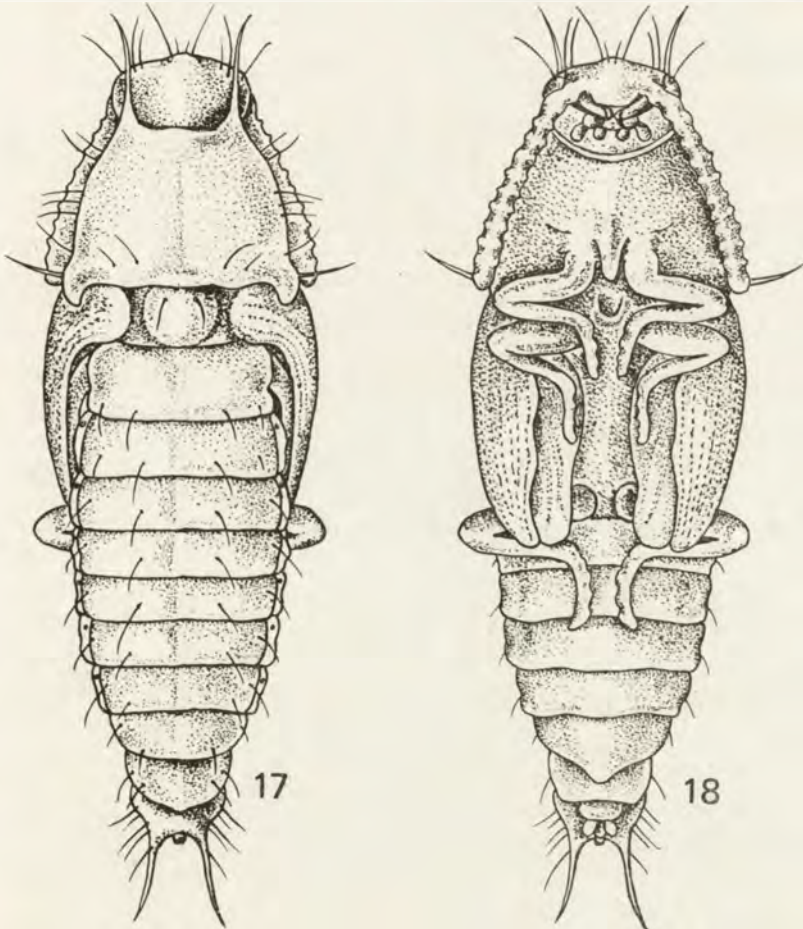
According to LESEIGNEUR (1972) the genus *Quasimus* DES GOZIS is placed at the beginning of the subfamily *Negastrinae* NAKANE, 1953. The knowledge of larvae of this subfamily (RUDOLPH 1974) is based upon an examination of larvae of only six species belonging to three genera: *Fleutiauxellus* MÉQUIGNON, *Negastrius* C. G. THOMSON, and *Zorochrus* C. G. THOMSON. According to RUDOLPH (1974) the known present larvae of *Negastrinae* show the following features: head flat, quadrangular or lightly tapered anteriorly, angles are rounded; mandibles sickle-shaped, with retinaculum; nasale tridentate; frontoclypeal area V-shaped, narrow; postmentum oblong quadrangular; stipes not met together at base; galea one-jointed. Abdominal segments: tergites without right-angled impressions; hyposternites well developed, they have a length of the segment. Ninth abdominal segment: dorsum not hollowed, with 1 or 2 pairs of setae; sides with narrow listel and long setae; urogomphi undivided. Tenth abdominal segment without thorns or hooks. The larva of *Quasimus* DES GOZIS

differs from larvae of the above genera in possessing the following characters, and being of primary significance: the long penicillus; two-jointed galea; finger-shaped sensory appendix on labial palpus; and narrow, U-shaped caudal notch on ninth abdominal segment.

DESCRIPTION OF THE PUPA (Figs. 17, 18)

The pupa has not been described so far. Generally similar to the pupa of other species of the family *Elateridae*.

Body longitudinally oval with abdomen tapering posteriorly, about 2.7 mm long, greatest width about 0.9 mm. Body whitish with somewhat yellowish tinge, covered with sparse, both shorter and longer setae. Body epidermis very feebly sclerotized.



Figs. 17, 18. *Quasimus minutissimus* (GERMAR), pupa: 17 — dorsal view; 18 — ventral view.

Head subglobular and bent beneath the prothorax. Front of head with one pair of short setae and one pair of long setae. On each side of head there are 3 temporal setae. Antennae short, moniliform, fitting the pronotum sides, with apices extending to posterior angles of prothorax. Labrum transverse, subtrapezoidal, mandibles stout, maxillary palpi fairly long, cylindrical, incurved and rounded apically.

Pronotum almost trapezoidal, with obtuse posterior angles projecting posteriorly along the anterior margin of elytra. Disc of pronotum feebly convex, its width to length ratio is 4 : 3. There are two styli at its anterior angles, and two styli at posterior ones. Setae at each side of pronotum 8 in number: two setae along posterior edge, and six setae along lateral margin. Mesonotum almost trapezoid in shape, with slightly concave lateral sides, about one third as long as pronotum. There is one fine, pale seta on each side of scutellum. Metanotum a little longer than mesonotum, with two setae on each half.

Anterior and posterior wings fitting obliquely at both sides of body and passing to the underside; elytral sheaths just reaching the third abdominal sternum.

Abdomen composed of 9 segments, anal cone and gonopods. Abdominal terga I-VI almost equal in width, subsequent terga gradually tapering toward apex. Ist-VIIIth abdominal terga bearing two setae at each side. IXth segment provided posteriorly with two cerci, which are very peculiar, strikingly long, four times longer than last abdominal sternum. Each cercus with one seta situated at its outer edge. Lateral margin of IXth tergum bearing 5 setae.

Spiracles annular, in number of 9 pairs, situated on antero-lateral surface of mesothorax and each of Ist-VIIIth abdominal segment.

Prosternum broad, lobed in front, with a prominent process produced posteriorly between the fore coxae. Mesonotum and metanotum partly visible between legs and wings.

Legs clinging to the underside of body. Anterior and middle legs perfectly visible, posterior ones partly covered with wings. Femora subparallel-sided. Apex of hind tarsi extending to fifth abdominal sternum.

Underside of body (Fig. 18) with only seven abdominal sterna visible. Sterna I-III fused in one unit, sterna III-VI semirectangular, sternum VII is longer than the others and is produced posteriorly, so as partly to cover the next sternum. In male specimens sternum VIII with shallowly excised posterior margin. Posteriorly to IXth sternum, of semicircular shape, are three rounded lobes. Probably these represent the median and lateral lobes of the male external genital organs. Anal cone situated between posterior part of IXth tergum and gonotheca.

IMAGO (Figs. 19–36)

Quasimus minutissimus (GERMAR) is the type-species of the genus *Quasimus* DES GOZIS. The characteristic features of this species, by which it can be easily distinguished from all other *Elateridae* in European area, are the presence of a long carina on the prothoracic hind angles reaching to anterior angles, and by non-striated elytra.

Body (Fig. 19) robust, elliptical, moderately elongate and somewhat convex above; length from 1.8 to 2.3 mm, greatest breadth about 0.9 mm; shiny, entirely black except tarsi which are brown; on the whole surface covered with short, fine, decumbent greyish pubescence.

Head gently convex above with frons flattened and weakly concaved between antennae, sparsely punctured and setose; clypeal margin well ridged.

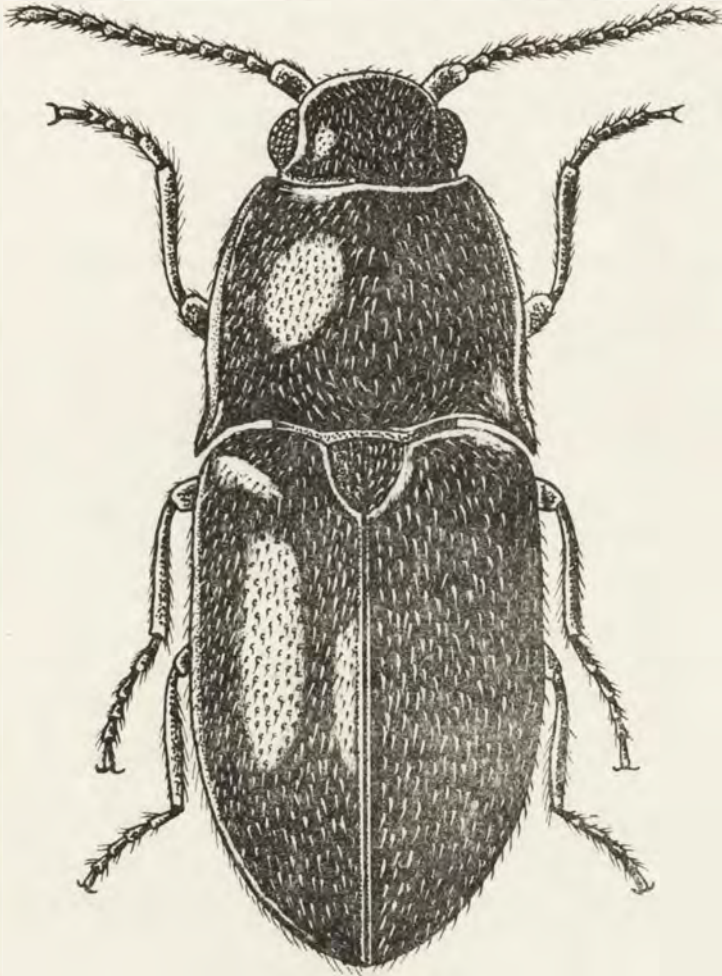
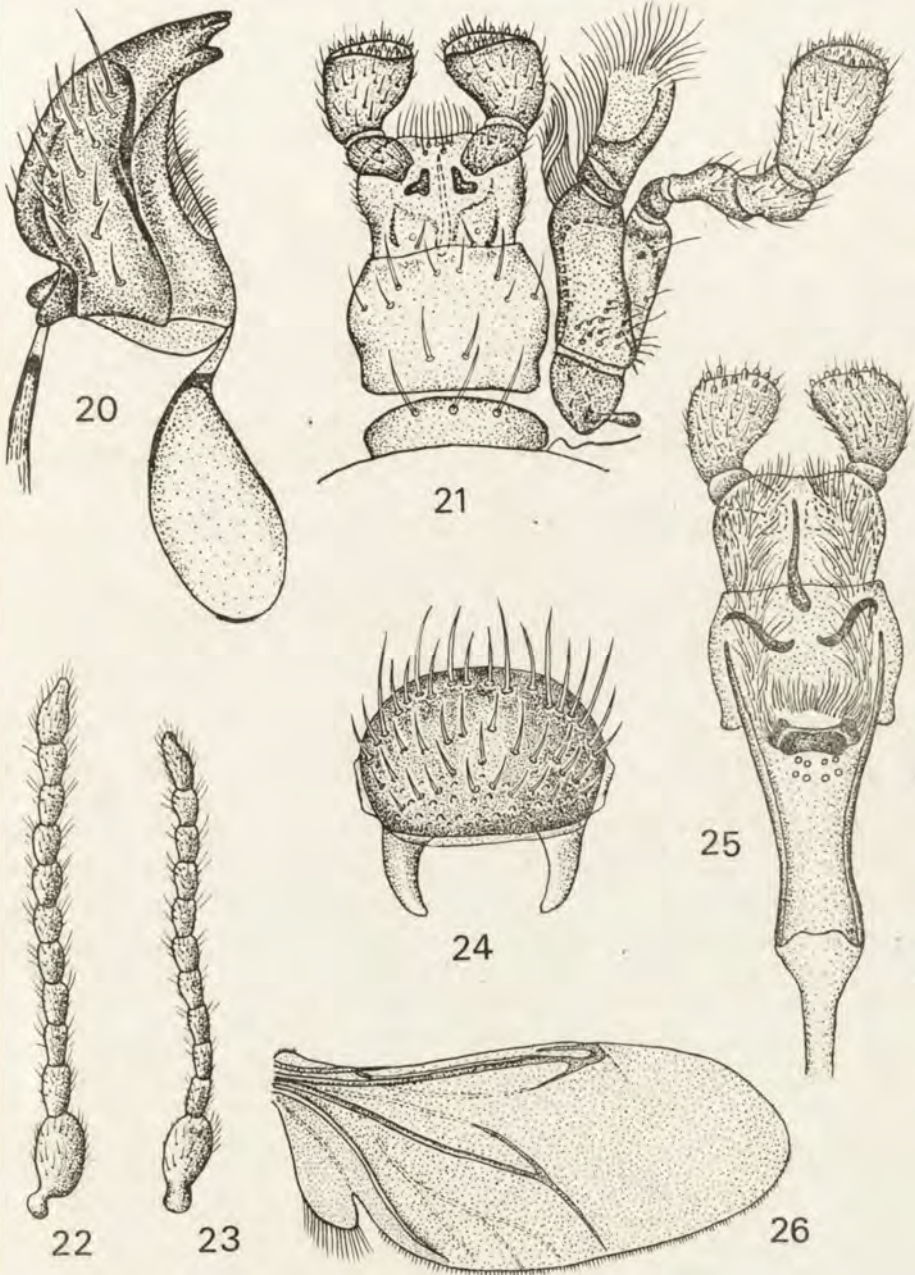


Fig. 19. *Quasimus minutissimus* (GERMAR), imago, dorsal view.

Antennae (Figs. 22, 23) slender, reach to about tips of prothoracic angles (male) or less (female); segments subclavate; the basal joint is about 1.5 times the length of the second, with outer margin weakly arcuate; 3rd to 10th are subequal in length and clearly longer than wide in each; apical joint is elongate oval, about 1.5 times the length of the 10th, with the apex rather acutely rounded. Labrum (Fig. 24) transverse, convex and coarsely punctate and setose; its superior margin straight, the sides and lower margin broadly rounded; on its inner face is the membranous epipharynx, which is partly visible below the lateral margin of the labrum. Mandible (Fig. 20) robust, its external part strongly curved, sparsely setose, with one long seta on distal part, and with double acuminate apex; fovea enters sideways the external face near its base; prosthema slightly rounded, pubescent along its free margin; flexor muscle strongly developed, retractor muscle weaker. Labium (Figs. 21, 25) consisting of submentum and mentum. Submentum subquadrangular with sinuate and arcuate sides, bearing five pairs of anteriorly directed setae, and its upper surface with two sclerotized sinuate listels. Mentum semi-membranous, its sides anteriorly divergent, and with anterior and lateral margins setose, upper surface with median, narrow sclerotized listel. Ligula membranous, broadly semi-circular, its anterior margin covered with short bristly hairs. There is no trace of the paraglossae. Labial palpi three-jointed; the first joint short, subtriangular; the second slightly arcuate, about three times as long as the first joint; the terminal joint axe-shaped, setose, curved at its base, its internal and anterior margins subequal, with a group of short sensory processes on apex. Gula subovate with three long setae. Maxillae (Fig. 21) well developed. Cardines subtriangular, articulated with one-jointed stipes, located in a depression of the gena and separated from submentum and gula by a carina. The subquadrangular stipes is not differentiated into a basistipes and mediostipes, and is confluent with the semi-membranous lacinia which bears a thick cluster of long filaments on its apex. The galea is more highly specialized, it is indicated by the division into a ring-like basigalea and a long distinct distigalea, which is covered with filaments at anterior and interior edges. Lacinial and galeal filaments curve upward toward the buccal cavity. Palpifer elongate, subtriangular, bears few setae on its exterior face. Maxillary palpi four-jointed; first joint small, subspherical, attached to the oblique palpifer; second and third joints elongate, obconical and distinctly arcuate, subequal its exterior margin the longest; apical joint axe-shaped, as long as both two preceding ones, with a group of short sensory processes at apex. Hypopharynx (Fig. 25) composed of a transverse sclerotized plate with suspensories at sides; anterior part of hypopharynx fitting to upper and posterior edges of labium, and its posterior part passing gradually into pharynx. Anterior and lateral parts of hypopharynx with fine, long filaments; they cover also upper surface of labium. Pharynx (Fig. 25) tube-shaped, its ventral side anteriorly provided with four pairs of gustatory sensillae in form of round plates.



Figs. 20–26. *Quasimus minutissimus* (GERMAR), imago: 20 – left mandible, dorsal view; 21 – labium and left maxilla, ventral view; 22 – antenna of male; 23 – antenna of female; 24 – labrum, dorsal view; 25 – pharynx, hypopharyngeal sclerome and labium, dorsal view; 26 – right wing.

Prothorax (Fig. 19) three-fourths as long as wide, except hind angles, widest at about basal one-third. Disc moderately convex, without median carina. Anterior margin weakly sinuate, slightly bordered by a fine impression. Sides feebly arcuate along hind angles. Lateral carina fine, long, extending from hind angles nearly to anterior margin. Base sloping moderately, impressed either side of middle. Posterior margin strongly arched and very sinuate. Anterior angles are somewhat produced, posterior angles very prominent, diverging slightly, prolonged and acute, incurved at tip. Punctures on disc moderately large, dense, setae directed obliquely caudad.

Elytra (Fig. 19) about one and half times as long as breadth, with the sides almost parallel from base to apical one-half, thence rounded and gradually tapering to the extremities, anterior margin of the elytron is transverse and sinuate, and deeply emarginate to receive the scutellum; it is strongly deflexed along its anterior third and at the humeral angle which is strongly carinate. The disc is flat to feebly convex anteriorly, and distinctly convex posteriorly, finely and closely punctate and setose. Scutellum subtriangular, as broad as long, flattened, its surface densely, finely punctate and pubescent.

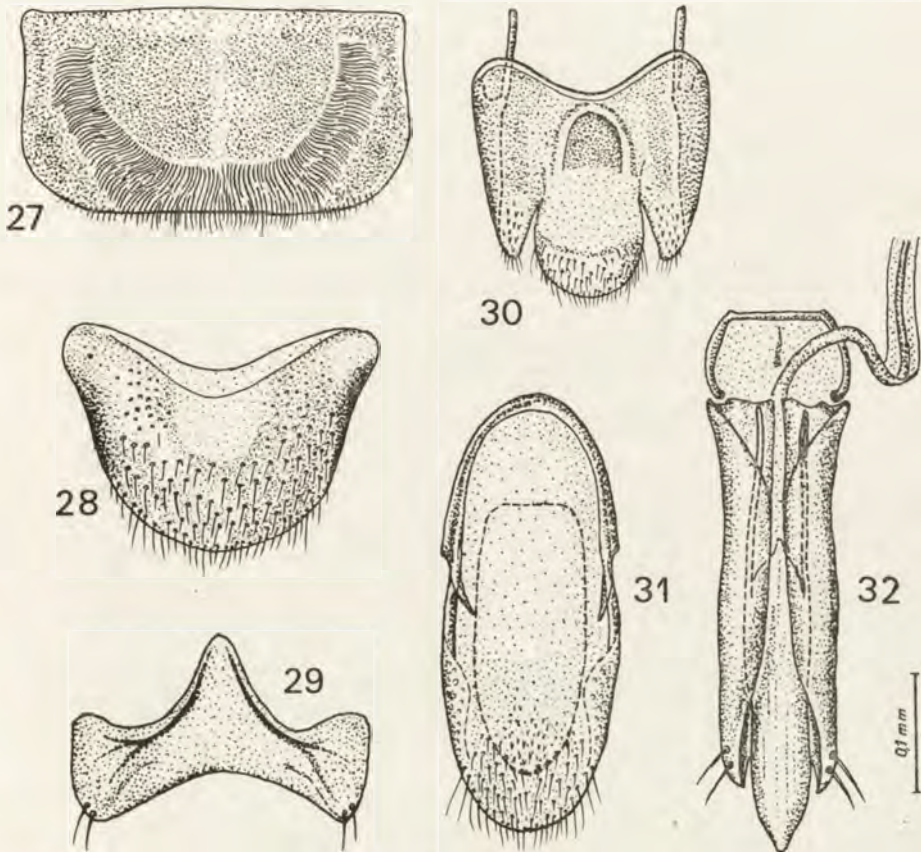
Wings (Fig. 26) very characteristic, although the venation faintly represented. The distal one-third part of wing without visible venation. The wing venation of *Quasimus minutissimus* (GERMAR) differing from the several schemes of others genera of *Elateridae*. Second radius and first media strongly reduced. Closed radial cell and radio-medial cross-vein, lacking. Cubital veins very indistinct. Strongly represented the second anal vein, reaching margin, suggests it may be a fusion of first three anal. Fourth anal vein rudimentary. On the posterior margin of the wing, near the base, there is a free lobe (alula) with long bristles; the remainder posterior margin covered densely with short fine bristles.

Prosternum tumid, convex, subquadrate, anteriorly it is broadly rounded, slightly depressed, free margin is finely bordered. On either side the sternum is bounded by externally convex double sterno-pleural sutures, which are somewhat widened and excavate anteriorly; posteriorly these sutures curve inward and end near the anterior edge of the coxal cavity. Tergo-pleural area is nearly flat except a shallow excavation near the posterior angle; its posterior margin is oblique and sinuate. Prosternal process, or mucro, elongate, subtriangular, sharply narrowed and slightly concave between the coxae, with its lateral margins somewhat rolled. Mesosternum narrow, with a prominent fossa for the prosternal process, occupies the entire length of the sclerite. Metasternum subpentagonal, slightly convex, its anterior margin roundly emarginate by the coxal cavities of the mesothorax; its lateral margins are straight and lightly divergent posteriorly; the posterior margin slightly sinuate. The sternum, posteriorly to coxal cavity, bears an obliquely parabolic, shallow impression.

Legs are not remarkable. Coxae of the metathorax are flat, strongly transverse, gradually narrowed outward and separated along their inner margin;

the posterior margin is strongly excavate for the reception of the femora. Coxae of the mesothorax are subspherical, but not protruding; anterior coxae are subglobular and prominent.

Abdomen (Fig. 33); only five abdominal segments are visible ventrally, while seven are visible dorsally. The outline of the abdomen is elongate triangular, with the sides gently arcuate, especially on the apical third. The first six tergites are membraneous and hardly distinguishable from the tergo-pleural



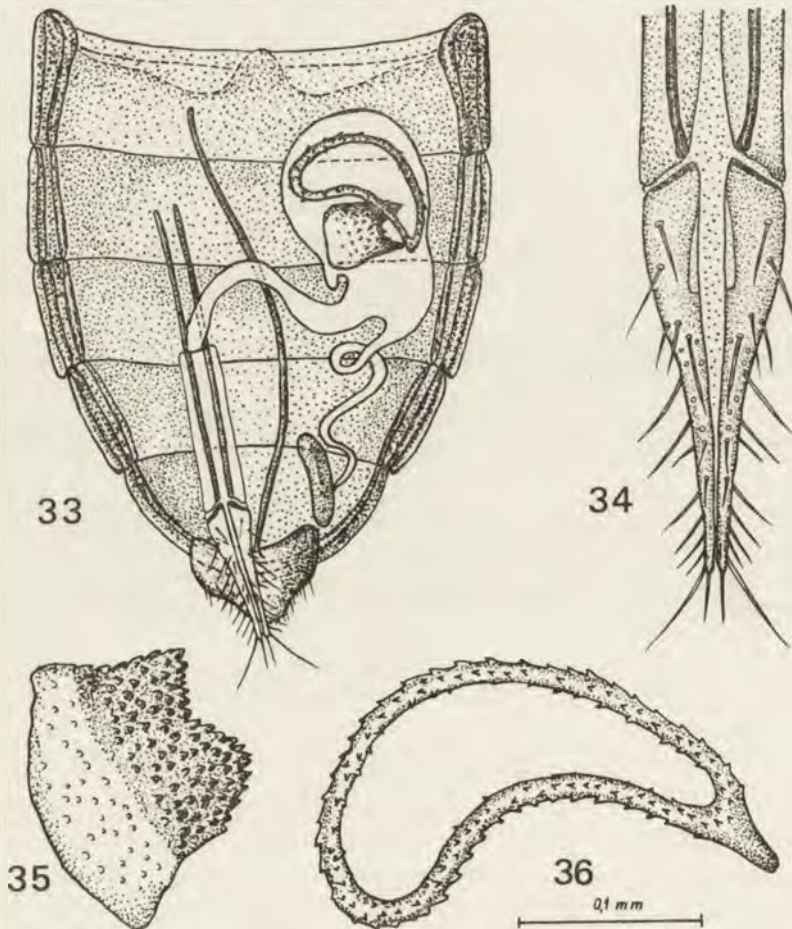
Figs. 27-32. *Quasimus minutissimus* (GERMAR), imago, male: 27 - VIIth abdominal tergum; 28 - VIIIth abdominal tergum; 29 - VIIIth abdominal sternum; 30 - IXth and Xth abdominal terga; 31 - IXth abdominal sternum; 32 - aedeagus, dorsal view.

membrane on either side. The seventh tergite (Fig. 27) is similar in both sexes; it is subquadrangular with broadly rounded posterior angles, narrower than the preceding segment, slightly longer and moderately sclerotized; its outline is roughly parabolic, setose posteriorly; lateral and posterior parts with semi-circular fimbriate girdle. Sternites of the abdomen (Fig. 33) are heavily sclerotized and convex. Sternites I-III fused into a unit, with a rudimentary suture,

cleft by the hind coxae. The last visible, VIIIth sternite, is subtriangular, about one-third longer than preceding one, its sides arcuate and its apex acutely rounded.

Abdominal spiracles oval, subequal in size, situated in a fold of the membrane about the lateral ridge of tergites I-III.

Retractile segments of the male (Figs. 27-31). Tergite VIII subtriangular, one-fourth shorter than preceding one, its sides arcuate and the apex broadly rounded, and posterior part clothed with short setae. Tergite IX slightly broader than long, with posterior margin deeply emarginate and sides arcuate; the outer part on either side is free and inflected, while the inner part fused with tergite X; the median part well sclerotized and pigmented; its anterior corners connected by long processes with sides of sternite IX. Tergite X tongue-



Figs. 33-36. *Quasimus minutissimus* (GERMAR), imago, female: 33 - position of VIIIth abdominal sternum and genital organ in abdomen; 34 - IXth abdominal segment; 35, 36 - processes in bursa copulatrix.

like, well setose on posterior part, it is about one-half the length and breadth of the tergite IX. Sternite VIII narrow, transverse, its posterior margin shallowly emarginate, anterior part with well produced median process, posterior corner on each side bears two short setae. Sternite IX is slender and suboval, about two and one-half times as long as median width; its basal part membranous and flexible, but towards its ridges it becomes well sclerotized, posterior part clothed with short and minute setae. Sternite X hardly visible, elongate, tongue-shaped, flat, about two-thirds the length of the sternite IX, finely setose on apical part.

External genitalia of male (Fig. 32) are depressed, bilaterally symmetrical, it consists of basal piece, aedeagus and parameres. The basal piece appears a U-shaped band of which the arms are directed dorsad, and well sclerotized; the remainder part is membranous, and encloses within its posterior margin the bases of a slender aedeagus and two lateral lobes (parameres). The ejaculatory duct leads through the dorsal face of the basal piece to the interior of the aedeagus. Apex of aedeagus exceeding parameres. Median strut short, lateral struts longer, heavily sclerotized, elongate, nearly straight, reaching to base of parameres. Parameres with strong lateral lobes, its outer side posteriorly arcuate, acute at apex, with two setae on ventral side of lobe.

Retractile segments of the female (Figs. 33-36). Tergite VIII is subogive, membranous at the base, but well sclerotized and setose apically, similar to those of male. Sternite VIII is subtriangular, about two-thirds the length of the seventh, it is narrower and shorter, and more heavily sclerotized than the tergite VIII, and with a median process prolonged in a well sclerotized rod of about six times of sternite length. The ninth urosegment (Fig. 34) is membranous, and is not differentiated into tergite, sternite or pleurites; it encloses the ovipositor.

External genitalia of female (Figs. 33, 34). The ovipositor is slender, depressed, bears the two genital valves, which are finely and sparsely haired, its base articulating with narrow, elongate, flexible sclerotized baculi about twice longer than length of valves. The terminal styli lacking. Bursa copulatrix with two well pigmented and sclerotized processes (Figs. 33, 35, 36), their outer face densely covered by small, short spines. One accessory gland, club-shaped, with lateral duct of gland, which opens into the median portion of the bursa copulatrix.

GEOGRAPHIC DISTRIBUTION ,

Quasimus minutissimus (GERMAR) is well known from the lowland and highland areas of South and Central Europe (except its northern parts), and noted from the Caucasus, Asia Minor and Japan. The species in Central Europe seems to be everywhere fairly rare and very local and has been collected in general sporadically; in South Europe it was found more frequently and commonly.

In Poland it has been reported from a few localities only. Its occurrence in Śląsk (without locality) has been recorded for the first time by BACH (1852), later this country was repeated by others authors. From Sudety Zachodnie the species has been noted by ZEBE, 1852 (Kłodzko), by LETZNER, 1871 (Lwówek Śląski), and 1889 (Świeradów Zdrój, distr. Lwówek Śląski). From Śląsk Dolny it has been reported by SCHOLZ, 1927 (Dunino, distr. Legnica), and by HORION, 1953 (Legnica). I have seen specimens in numbers taken by R. SCHOLZ in Śląsk Dolny (distr. Legnica: Dunino), and five specimens (coll. W. KOLBE) in Sudety Zachodnie (Lwówek Śląski), all preserved in the collection of the Institute of Zoology of the University in Wrocław. Also it has been noted more than 100 years ago, from Beskidy Zachodnie (distr. Cieszyn: Ustroń) by LETZNER (1871), however this species has not been found in that locality since then. KUNTZE (1936) and ROUBAL (1936a) noted the species from Pieniny Mountains (distr. Nowy Targ: Czorsztyn), without localities from this country it has been mentioned by KUNTZE (1934), KUNTZE and NOSKIEWICZ (1938), and URBAŃSKI (1939). This report presents more detailed information on the distribution in the Pieniny Mountains. I have also myself collected a fair number of specimens of the species in question. A list of the investigated material is given at the end of this paper. From the distribution of the localities mentioned above it is clear that the species occurs in South Poland in lowland area and in lower situation of mountains (about up to 950 m above sea level), and indicates the subcarpathian disjunction in distribution in this country. I found it in Poland only in the picturesque country — the Pieniny Mts. The species confined to limestone soil of richly carved group of rocks. This region was not covered by glaciers and represented a tertiary refugium. *Quasimus minutissimus* (GERMAR) is probably one of the oldest species of the Polish fauna, and represented here as a relic of the tertiary age; it is a mediterranean element in our fauna.

BIONOMICS

Sparse and fragmentary observations are related only to mature stage, and are limited to the date and place of finding.

According to GERHARDT (1910) the species occurs in Śląsk up to 1300 m above sea level, and is characteristic of dry and sandy grounds in river valleys, but according to my opinion it is not the natural habitat of the species. In France PATER (1941) collected it in number during successive four years in June and July on twigs of older leafless or diseased *Prunus* L. and *Cerasus* MILL.; LESEIGNEUR (1972) likewise reports it from various plants, as *Genista* L., *Castanea* MILL., *Crataegus* L., *Abies* MILL., *Carduus* L., and others. ROUBAL (1936b) reports finding the adults in Slovakia on sunny places, frequently on the most warm slopes; according to him, the species is characteristic element for xerophil formation of pontic thicket plants, and for the rocky declivities,

where it appears abundantly on *Vincetoxicum officinale* MNCH. HORION (1953) found them many a year on same location near Kreuzberg (Federal Republic of Germany), always in a few numbers of specimens; he collected it by sweeping on shrubs of oak (*Quercus* L.) and furze (*Genista* L.), also on grasses. In Poland (in the Pieniny Mts.) KUNTZE (1936) gives sunny rocky-wall sparse covered with vegetation as being particularly characteristic habitat; according to him, the species is found in the Pieniny Mts., however, in the lower situation. In Śląsk Dolny near Legnica according to SCHOLZ (1934) the adults inhabit the southern slopes of hills, which are well warmed by sunshine.

I have found *Quasimus minutissimus* (GERMAR) in the Pieniny Mts. likewise in higher areas (up to about 950 m above sea level), usually on dry, sunny exposed places of rocky-ground, also adults by sweeping low vegetation, and by beating the foliage of bushes and trees with a strong insect net, or by sifting leaf mould from around the plants. These beetles are difficult to see because of their small size. The sample contents must be sorted over carefully. In the Pieniny area, the time of first emerge of adult in the spring ranged from the middle April to about the middle of May. In the field the beetles were most active during warm and sunny days, they were hiding under the low plants or in litter during bad weather. They crawled for short distances and eventually entered into the soil up to the depth of about 5 centimeters. The dirtied body, the more so antennae, were careful cleaned from lime powder by appendages of mouth and tarsi of fore and middle legs. These small beetles are also perfect flyers, and possess a remarkable capacity for leaping when lying on their back. They lived until about the middle of August. In the laboratory they were observed to feed on strawberries and shreds of apple and peach; to suck out fragments of killed ants which were given as food, as well as taking of the water by the adults. The structure and location of the head appendages, even adults as larvae, and a very small mouth opening indicate to the intake of fluid food. Numerous setae and processes around the mouth opening as well as in the mouth cavity percolate and filter the already sucked out food. I have not reared successive generations of this species. The narrow and elongate ovipositor suggests an adaptation to lay down eggs in soil close to litter.

The larvae lead a hidden life. In the Pieniny Mts. I was lucky to see the larvae and pupae in company of adults. These larvae inhabit the sunny exposed place on slope of rock, among limestone gravel mixed with light-grey soil, beneath or alongside low vegetation, as *Teucrium montanum* L., *Thymus* L., also tufts of grasses. These larvae were taken from shallow limestone soil, called the rendzina, at depths between 3 and 5 centimeters. They apparently prefer relative moist, but well-drained situation, which supports a rich and varied natural vegetation. They are perfectly able to bore into earth. The small, soft, elongate and depressed form of the larva body is adapted for tunnelling in ground between granules of limestone soil or between roots.

This species apparently requires two or three years to be mature, as in

the summer I have taken larvae of different sizes and pupae in the same place. Pupation takes place in the loose, relatively dry soil, within a cell prepared beforehand by the larva. The depth of pupation varied from usual 2 to 4 cm. So far as my observations extend, the pupa is placed horizontally in the cell, and lies on its back; the body is flexed ventrally, its rigid setae preventing contact with a damp bottom of its pupal chamber. Under laboratory conditions the pupal period lasted about ten days. Pupation usually started during the later part of July and was completed early in August, but the beetle remains in its pupal chamber and does not emerge until the following spring. In the Pieniny Mts. were observed other associated larvae of beetles: *Idolus picipennis* (BACH) and *Hymenalia rufipes* (F.). The rapacious wireworms of *Ctenicera purpurea* (PODA) and *Agrypnus murinus* (L.) were stated as principal predators of larvae and pupae of the discussed species.

COLLECTING AND REARING DATA

Immature stages. Pieniny Mts.: Grabczycha, July 1, 1971, south rocky slope, in a sunny exposed place, on subsoil of consolidated rubbish, in limestone soil, called the rendzina, at a depth from two to five centimeters, near rots of *Teucrium montanum* L., in company with the adults on this plant, two larvae. Same locality and place, July 26, 1971, with larvae of *Idolus picipennis* (BACH), one larva and two pupae, one of them preserved in alcohol was used for this study, and second of them reared in laboratory, one adult emerging on August



37

38

Figs. 37, 38. The typical habitat of *Quasimus minutissimus* (GERMAR) in the Pieniny Mts: 37 - small limestone rock in the Białe Skały range; 38 - limestone precipice in the Trzy Korony.

4, 1971. Same locality, June 18, 1972, on limestone precipice, in soil under tuft of grass, two larvae, one specimen pupated on July 25, and the adult emerged on August 4, 1972. Same locality, July 1, 1974, in limestone soil, at a depth about 3 cm., between two tufts of *Teucrium montanum* L. and *Thymus* L., in the neighbour of nest of ants, two larvae, one of them in laboratory moulted on July 27, 1974, and second of them was found dead on August 15, 1974. Białe Skąły range, June 9, 1972, small limestone rock, the place as on Fig. 37, in dry, loose soil, associated with larvae of *Hymenalia rufipes* F. (Coleoptera, Alleculidae), two larvae, one of them reared in laboratory; pupated on July 22, 1972; unfortunately, I did not succeed in rearing and this pupa died on August 1, 1972. All material was collected and reared by the author.

Adult. Pieniny Mts.: Czorsztyn, August 16, 1928, 11 specimens, Sz. TENENBAUM; June 29, 1971, on flowers of *Thymus* L., 6 specimens, B. BURAKOWSKI. Valley of the river Potok Pieniński, August 20, 1928, 4 specimens, Kras near Krościenko, August 20, 1953, on sunny exposed small limestone rock, among small stalks of *Thymus* L., 4 specimens, B. BURAKOWSKI. Trzy Korony, about 950 m above sea level, May 22, 1955, 1 specimen, R. BIELAWSKI; same locality, June 17, 1972, the place as on Fig. 38, sifted from litter, 3 specimens, B. BURAKOWSKI. Grabczycha, the south part of Facimiech Mt., in the years 1971-1974, the time of first catching on beginning of May, the latest time of observation on July 26, in great numbers of specimens by sweeping on low vegetation, the more so from flowers of *Cornus sanguinea* L., *Vincetoxicum officinale* Mnch., and from various *Umbelliferae*, frequently in association with beetles: *Idolus picipennis* (BACH), *Adrastus montanus* (L.) and *Danacaea morosa* KIESW., B. BURAKOWSKI and A. GRABOWSKA. Wąwóz Sobczański, June 22, 1973, the slope of the gorge, by sweeping on xerothermic grassplot, 4 specimens, K. WINNIK. Małe Pieniny Mts.: Wąwóz Homole, July 7, 1972, 2 specimens, I. DWORAKOWSKA. Valley of the river Biała Woda, July 9, 1974, near limestone rock, on flowers of umbelliferes, 10 specimens, in captivity the beetles lived to middle of August 1974, B. BURAKOWSKI.

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STRESZCZENIE

[Tytuł: Rozwój postembrionalny i bionomia *Quasimus minutissimus* (GERMAR) (*Coleoptera, Elateridae*)]

Praca zawiera omówienie wyników badań nad morfologią młodszych postaci rozwojowych oraz bionomią *Quasimus minutissimus* (GERMAR), lokalnie i rzadko spotykanego chrząszcza w południowej części Polski. Przeważająca część materiału do pracy została zebrana przez autora w Pieninach.

Podano dokładne opisy larwy i poczwarki, dotychczas w ogóle nie znanych w omawianym rodzaju mającym na świecie 23 znane gatunki. Uwzględniając dymorfizm płciowy, omówiono zewnętrzną morfologię postaci dojrzalej oraz aparaty genitalne. Wymienione opisy zilustrowano oryginalnymi rysunkami. Nadto, na podstawie dotychczasowego piśmiennictwa i materiałów muzealnych, przedstawiono rozmieszczenie w Polsce. W części bionomicznej omówiono ekologię oraz cykl rozwojowy zbadanego gatunku. W końcowej części pracy przedstawiono wykaz użytego do badań materiału, przechowywanego w Instytucie Zoologii PAN w Warszawie.

РЕЗЮМЕ

(Заглавие: Постэмбриональное развитие и биономия *Quasimus minutissimus* (GERMAR) [Coleoptera, Elateridae])

В настоящей работе рассмотрено результаты исследований над морфологией стадий развития, распространением и бионимией *Quasimus minutissimus* (GERMAR), самого малого вида средневропейских *Elateridae*. Работа опирается на материалах собранных главным образом автором в польских Пенинах.

Автор дает точные описания личинки и куколки, неизвестных до сих пор в роде *Quasimus* DES GOZIS, засчитываемого сейчас к подсемейству *Negastrinae* NAKANE (LESEIGNEUR 1972). Личинки рассматриваемого рода отличаются значительно от известных до сих пор личинок трех родов этого подсемейства, а рассмотренных в работе К. Рудольфа (K. RUDOLPH 1974).

Взрослая личинка *Quasimus minutissimus* (GERMER) перед окукливанием имеет около 3,5 мм длины, а голова имеет 0,35 мм ширины. Тело мягкое, слабо ошетиненное в общем желтовато окрашено. Характерными признаками личинки являются: очень длинная кисточка волосков достигающих почти до верхушки мандибул. Мандибулы с двумя отростками на внутреннем краю. Задняя часть лобной пластинки клинообразная. Назале трезубное, субназале пятизубное. Лабильные шупики с длинным пальчатым боковым отростком. Лациния рудиментарная, галера двучленистая, ее верховый член, снабжен четырьмя чувствительными отростками и двумя щетинками. Второй член усиков с тремя щетинками и куполообразным отростком находящимся на верхушке от нижней стороны, последний с четырьмя длинными щетинами на одной очень короткой. Ноги сильные, служащие для рытья в почве, покрытые щетинками и сильно склеритизированными короткими шипами. Дыхальца двудырчатые, продолбные боки дыхальцевых пластинок с четырьмя или пятью отростками. Задняя часть IX тергита брюшка с узким параллельным вырезом. Длинная анальная трубка окружена венцом щетинок.

Куколка кремовая, слабо ошетиненная, длины около 2,7 мм и ширины около 1,0 мм. Голова первдней части с 8 длинными и 2 короткими щетинками. Переднеспинка с двумя длинными тонкими отростками в передних углах, с двумя короткими в задних углах. На каждой стороне переднеспинки на боковом краю находится 6 щетинок, а на заднем краю две. Задние углы переднеспинки, вытянутые кзади, лежат на основной части надкрылий. Каждый тергит I—VIII сегмента брюшка с четырьмя щетинами. Девятый тергит брюшка с двумя длинными отростками и 10 щетинками.

Учитывая половой диморфизм, автор рассматривает наружную морфологию зрелой особи и генитальные аппараты. Приведенные описания всех стадий развития иллюстрированы оригинальными рисунками, личинки — на рис. 1—16, куколки — на рис. 17 и 18, а взрослые особи — на рис. 19—36.

Биономическая часть работы содержит экологическую характеристику вида и обсуждение его цикла развития. *Quasimus minutissimus* (GERMAR) размещён главным образом в южной и центральной Европе кроме того обнаружен из Голландии, Кавказа, Малой Азии и Японии. В Польше известен до сих пор из Западных Судетов, Нижней Силезии, Западных Бескидов и Пенин. Этот вид заселяет инсоляционные открытые места, с редко поросшими травами и низкой развительностью на низинных местах и погорьях до высоты около 950 м над ур. м. Через Польшу пробегает северная граница распространения этого вида. Взрослые особи после зимовки появляются в мае и живут до августа. Во время солнечной погоды можно их встретить на многолетниках, кустах и на низких ветвях деревьев. Во время плохих атмосферических условий они прячутся среди стелящихся по земле растений, под свободно лежащими камнями, в щелинах комкообразной почвы в которую они влезают иногда до глубины около 5 см. Жуки проявляют значительную подвижность, они способны до быстро лётать и пригания вверх таким способом как и другие виды щелкунов. Потревожены на растениях они стремительно падают на землю, а в случае падения на спину они прыгают так долго пока не приобретут нормального положения и стараются скоро спрятаться. Во время протискивания в щелинах почвы они загрязняют свое тело; после выхода на поверхность земли старательно чистят свои усики при помощи лапок первой и второй пары ног, которые раньше были очищены губовыми придатками.

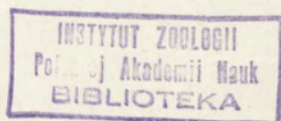
В выращивании жуки высасывали воду из влажной почвы, пили сок из кусков фруктов (яблоки, персики) и лимфу из убитых муравьёв.

Период полного развития вида не менее двухлетний. Яйца вероятно откладывались в почву весной или ранним летом. В Пенинах были найдены личинки на инсоляционных местах поросших редкой травой и низкой растительностью. Личинки заселяют умеренно влажную карбонатную почву на субстрате рухляковой известковой породе. Они встречались на глубине до 5 см под кучкой травы на известковой скале и между кучками стелящихся растений (*Teucrium montanum* L. и *Thymus* L.).

Во второй половине июля личинка строит кукольную камеру в почве на глубине около 2—3 см. Куколка лежит на спине подпираемая торчащими щетинками

и таким образом изолирована от непосредственной влажности почвы. Стадия куколки длится около двух недель. Вылупленные взрослые особи зимуют в кукольных камерах, иногда только некоторые особи опускают свое помещение. В Пенинах констатировано, что главными врагами личинок и куколок являются личинки хищных видов из семейства *Elateridae*, а именно: *Agrypnus murinus* (L.) и *Ctenicera purpurea* (PODA).

В концевой части работы представлено список использованного для исследования материала хранящегося в Институте Зоологии ПАН в Варшаве.



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