

**STUDIES ON THE METATHORACIC FURCA
OF THE PALEARCTIC DYTISCIDAE
(COLEOPTERA).**

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With 14 Plates.

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I. Introduction

Whereas the scientific workers and private collectors have paid great attention to the systematic entomology already since the time of Linné, the anatomy and morphology of the insects have remained little studied and offer to the entomologists a number of interesting questions and unsolved problems. Thus e. g. the number of species described of the *Coleoptera* has more than multiplied by four in the last hundred years, but more accurate details concerning the structure of the body of the beetles are even today known only for a few species used mostly for laboratory tests. Of the anatomy of the insects the branch best studied is the morphology of the chitinous integument, as this can be studied relatively easily without any complicated methods and because of its considerable firmness. It is interesting that the endoskeleton

of the insects, though it forms also part of the body wall, escaped the attention of the entomologists and only few works deal with it. And yet the endoskeleton is a very grateful object for morphological study; it is morphologically very manifold, and last not least its study contributes considerably to the elucidation of the mechanics of movement of the individual parts of the chitinous skeleton of insects, and thus also to the elucidation of some complicated functions as e. g. creeping, flight and swimming. As the subject of the present study I have chosen the metathoracic furca of the *Dytiscidae*, partly because this family interested me also from a systematic, bionomic and ecological point of view, and partly because compared with the other insects the metathoracic furca is especially strongly developed in the diving beetles, a consequence of their aquatic mode of life and the strong development of the posterior swimming legs of these beetles, of which more below in the chapter on the importance of the furca.

The following general chapters concern the literature, the methods, further the organs closely connected with the furca, and finally the topography and importance of the furca. In the chapter giving a historical survey of the literature the works are recorded which deal specially with the endoskeleton and further those treatises which though not focussing directly on the endoskeleton give at least a brief description or figuring of one of the genera or species of the *Coleoptera*. Thus those works are not included in which there is a remark or a schematised figuring of the furca of a generalised type (e. g. many text-books of entomology). In the chapter on the position of the metathoracic furca in the body of the *Dytiscidae* I base myself partly on the data in Korschelt's monograph of the species *Dytiscus marginalis* (see Bibliography). The gist of the present study is the comparative morphology of the furca of the individual species of the four subfamilies of the palearctic *Dytiscidae* (the subfamily *Methlinae* which in north Africa and Mesopotamia encroaches with three species upon the palearctic region has not been included in this treatise).

I wish to take this opportunity to thank PhDr Jan Obenberger, Professor of Entomology of the Charles University and Director of the Entomological Department of the National Museum, Prague, for his never failing interest in my work as well as for placing at my disposal material from the entomological collections of the National Museum, without which I could not have carried out this study of the metathoracic furca of the *Dytiscidae*.

I wish to acknowledge my gratitude and indebtedness also to † Dr Julie Moschelesová, Docent of the Charles University, Prague, for her kind help in translating the manuscript of this article into English.

II. Historical Survey

I found the first remark on the metathoracic furca of the *Coleoptera* in Cuvier's work (1799), in the chapter on the locomotory organs of the imagoes. Here he briefly speaks on pp. 458 and 459 of the furca and of some muscles attached to it; he calls it "une pièce écailleuse en forme d'Y". The first more detailed work devoted exclusively to the endoskeleton of the insects is Eschscholtz's study of 1820. The author discovered the endoskeleton of the insects by chance when he wished to glue together a damaged mole cricket. These inner chitinous organs revivited his attention so that he devoted to them an entire separate work. He describes the endoskeleton of the mole cricket (*Gryllotalpa vulgaris* Latr.), further of the species *Gryllus migratorius* L. and *Gryllus succinctus* L. He studied and figured also the endoskeleton and thus also the metathoracic furca of two species of beetles, *Geotrupes nasicornis* F. and *Hydrophilus caraboides* F. He described also the endoskeleton of insects of other orders: *Eristalis tenax* F., *Musca mortuorum* F., *Aeshna grandis* F., *Bombus terrestris* F., and *Noctua bubo* F. His view on these endoskeletons is interesting. He calls them cartilage ("Knorpel") and regards them as homologous to the bones of the Vertebrata. Thus e. g. he compares part of the anterior arm of the tentorium to the ala magna ossis sphenoides, another part to the ala parva ossis sphen., the endoskeleton of the thorax to the scapula, clavicula, sternum etc. In the conclusion of his work he concludes on the basis on these views that the term of invertebrate animals should be changed into spineless animals (in the original "rückgrathslose"). This work was reprinted in 1822 in an abbreviated form in the journal Isis. A further description of the metathoracic furca is in Chabrier's work (1822), which solves the problems of the flight of the insects. The author describes in fairly great detail the furca and its muscles in the cockchafer, and briefly mentions also the furca of the rose chafers, rhinoceros-beetles, buprestids, and stag beetles (in the original cétoines, capricornes, buprestes, lucanes). This furca is figured in pls. II, III and IV either separately or together with the muscles attached to it. The fundamental work on the morphology of the thorax is Audouin's study of 1824. But it gives only a general remark on the metathoracic furca as well as on its importance for the nervous, digestive and circulatory system. As an example of the division of the thorax he figures on pl. VIII the thorax of the species *Dytiscus circumflexus* Fabr., showing also the metathoracic furca. Baer's published letter to Professor Heusinger (1826) deals with general considerations on the exo- and endoskeleton of animals and does not contain the description of any particular endoskeletal organ of the insects. Nevertheless this work deserves mentioning, as its author showed that the endoskeleton of the insects is not an inner skeleton in the true sense of the word (as in the Vertebrates) but only a continuation of the exoskeleton. He also correctly recognised that the first trace of a true endoskeleton is the chorda dorsalis of *Branchiostoma*. Kirby and Spence (1827) described in their exhaustive and for its time very modern textbook of entomology in vol. III on pp. 621—622 the metathoracic furca of the *Lamellicornia* and of the diving beetle *Dytiscus marginalis*. This work was accessible

to me only in its German translation. Also the work of Strauss-Dürckheim (1828) is important, which gives a very detailed description of the morphology and anatomy of the cockchafer as an example of the organisation of the *Coleoptera*. The chapter on the thorax contains the description of the furca of the cockchafer, and this furca is figured in the atlas on pls. II and III (median section of the thorax). In the first volume of Burmeister's entomology (1832) a separate chapter is devoted to the endoskeleton of the thorax, and there is here the description of the furca of the genera *Dyticus*, *Oryctes*, *Hydrophilus*, *Callichroma*. In the chapter on the muscles mention is made of the muscles attaching to the furca, and on p. 282 the author draws attention to the big muscles in *Dyticus* running from the lateral branch of the furca to the trochanter. The metathoracic furca of the species *Dyticus*, *Buprestis mariana*, *Geotrupes nasicornis*, *Cetonia aurata*, and *Hydrophilus piceus* is figured on pl. V. All figurings are rather inaccurate. Lacordaire describes in the first volume of the Introduction to Entomology (1834) the metathoracic furca of *Cerambycidae* and of the diving beetle *Dytiscus marginalis*. In the second volume (1838) on pl. IX is the median section of a cockchafer, and here the furca is also visible; this figure was taken over from Strauss-Dürckheim. Graber's book on the insects (1877) is less important; it contains a remark on the metathoracic furca of the genus *Dytiscus* (in the original "Schwimmkäfer"). Fig. 59 shows the dissected imago of *Dytiscus marginalis*, and here too the furca is visible. This figure is very primitive and inaccurate. Also Camerano's anatomy of the insects (1882) belong to the less important entomological works. The text contains only a general remark on the endothorax of the insects, and on pls. II and III is a length section through the thorax with the furca of the cockchafer. All plates of this book were taken over from the atlas of Strauss-Dürckheim. Kleuker's doctor's thesis (1883) is important, whose subject was specially the endoskeleton of the insects. He dealt with the endoskeleton of head and thorax in the representatives of different insect orders. Of the *Coleoptera* he describes on pp. 32—40 the metathoracic furca of 19 species, among them also *Dytiscus marginalis* L. He mentions also the importance of the furca for the muscles and ventral nerve cord. Unfortunately this thorough work is without illustrations. In Kolbe's text-book of entomology (1893) a separate chapter is devoted to the endoskeleton, but there is only a general remark on the furca of the *Coleoptera*. Fig. 245 represents a schematic drawing of a view into the metathorax of *Goliathus druryi*, and here too the furca is shown. Packard writes in his entomology (1898) only briefly in three lines about the metathoracic furca of *Dytiscus* and the muscles of the hind legs attached to it. In fig. 100 this furca is figured after Audouin's original illustration, and fig. 101 shows the whole endoskeleton of the stag beetle *Lucanus cervus*. In the chapter on the muscles there is on p. 213 a length section through the body of the cockchafer (after Strauss-Dürckheim), where the metathoracic furca is shown distinctly. In the thorough work of Berlese, of 1909, there is a figure of the furca of *Lucanus cervus* L., and on p. 375 a brief description of the furca of *Hydrophilus piceus*. Further the furca of this species is figured

schematically in connection with the muscles in figs. 453, 467, and 469. Euscher's doctor's thesis (1910) is a monograph on the chitinous skeleton of *Dytiscus marginalis* L. and gives a detailed description of the metathoracic furca of this species on p. 29; besides the furca is figured in several clear, shaded figures (figs. 3, 4, 24). The same year Bauer (1910) published his detailed study on the muscles of *Dytiscus marginalis*, accompanied by numerous illustrations drawn faithfully from reality. The furca is shown in figs. 8, 11, and 19. Böving's work of 1913 deals exclusively with the morphology of the ovipositor of the females of different species of *Dytiscidae*, and in the text there is no remark whatever on the metathoracic furca. On pl. I a median section through the meso-, metathorax and the first three abdominal segments is, however, figured, and here also the furca of the species *Dytiscus marginalis* is roughly indicated. We find figurings of the metathoracic furca of *Lucanus cervus* and *Melolontha melolontha* also in Stellwaag's study (1914) on the mechanism of the flight in *Lamellicornia*, but in the text it is not mentioned at all. Also Verhoeff's work (1916) partly touches upon my subject with a brief remark on the relation of the metathoracic furca of the *Coleoptera* to the jointing of the posterior coxae. A short description of the furca of *Dytiscus marginalis* L. is found also in Schoenichen's manual for practical exercises in entomology (1921) on p. 49. In Korschelt's detailed monograph of the species *Dytiscus marginalis* L. (1924) the furca of the metathorax is described and figured once in the chapter on the chitinous skeleton and once in the chapter on the muscles. Text and illustrations in both these chapters were taken over from Euscher's and Bauer's works mentioned above. In 1926 Hatch published his detailed study on the morphology of *Gyrinidae* and here he described shortly on p. 326 the metathoracic furca of this family; the furca of *Aulonogyrus* sp. is figured in fig. 48 (pl. XXII). In the first part of Schröder's comprehensive textbook of entomology (1928) *Dytiscus marginalis* L. is taken as example in the chapter on the muscles and endoskeleton. The furca of this species is figured together with the muscles attached to it in figs. 324 and 327; both these illustrations were taken over from Bauer's study mentioned above of the muscles of the diving beetle. The same chapter gives also an enumeration and brief description of the muscles of the furca. In Handschin's book on the morphology of the insects (1928) the interior of the meso- and metathorax of the stag beetle *Lucanus cervus* L. with the metathoracic furca are figured in pl. XXI; this figure was drawn after Berlese. In the volume *Insecta* of Kükenthal's zoology, written by Handlirsch (1930) the metathoracic furca of *Dytiscus marginalis* L. covered for the largest part by the muscles is figured in the section on the muscles of insects, on p. 474. In Richmond's treatise dealing with the external morphology of *Hydrophilus obtusatus* Say (1931) a description of the metathoracic furca is given on p. 217; this furca is figured in fig. 21 (pl. X). The whole endoskeleton of the thorax and abdomen of the beetle *Creophilus villosus* Grav., and therefore also its metathoracic furca, is figured and described in Blackwelder's study on the morphology of *Staphylinidae* (1936) in pp. 28—31. The most important modern work

on the furca of the metathorax of *Coleoptera* is Crowson's comparative studies. The first was published in 1938; the author investigated some 350 species of *Coleoptera* from widely different families, but he does not describe and figure all of them. The furcae of 138 species of beetles are figured on thirteen plates. The descriptions are, however, rather brief and superficial, and the author restricted himself mainly to a mutual comparison and to ascertaining similarities. For the family *Dytiscidae* there is on p. 409 a brief remark on the furca of the genera *Dytiscus*, *Hydroporus*, *Copelatus* and *Laccophilus*; the furca of *Hydroporus* sp. is figured on pl. XII (fig. 11). In his second study Crowson (1944) established as basic type the cupeid and hylecoetoid furca. Then he described the metathoracic furcae of further 93 species of *Coleoptera* of 55 different families. The work is accompanied by ten plates figuring the furcae of 82 species of beetles. No representative of the family *Dytiscidae* is given either in the text or in the plates. In the conclusion of this study the author draws the phylogenetic conclusions on the basis of his study of the furcae, taking into consideration also the other morphological characters of the *Coleoptera*. Campau (1940) gave in his work a survey of the morphology of the beetle *Chauliognathus pennsylvanicus* (De Geer), which contains also a brief remark on the metathoracic furca of this species; it is figured in figs. 28 and 32. In the first volume of Obenberger's detailed Entomology (1952) the furca of *Dytiscus marginalis* L. is figured from different sides in the chapter on the endoskeleton of the insect, on p. 415.

In addition to the literature mentioned above we find descriptions and figurings of a generalised type of the endoskeleton of the insects in many entomological text-books. These sources which do not deal with the metathoracic furca of definite concrete *Coleoptera* are not included in this survey, as was emphasised already in the Introduction.

It follows from this historical survey that in the family *Dytiscidae* attention was paid most to the furca of the species *Dytiscus marginalis* L. All in all the metathoracic furcae of six genera or species of this family were described or figured; they are: *Dytiscus circumflexus* Fabr. (Audouin 1824, Packard 1898), *Dytiscus marginalis* L. (Kirby & Spence 1827, Lacordaire 1834, Graber 1877, Kleuker 1883, Euscher 1910, Bauer 1910, Böving 1913, Schönichen 1921, Korschelt 1924, Schröder 1928, Handlirsch 1930, Obenberger 1952), *Dytiscus* sp. (Burmeister 1832, Crowson 1938), *Copelatus* sp. (Crowson 1938), *Hydroporus* sp. (Crowson 1938), *Laccophilus* sp. (Crowson 1938).

III. Material and Methods

I used as material dry beetles partly from my own collection and partly from the collections of the Entomological Department of the National Museum in Prague. Material fixed in liquids (80 per cent alcohol, 4 per cent formaldehyde) did not prove suitable, as in specimens fixed in this way the muscles adhere very firmly to the chitinous integument and thus also to the furca, so that they cannot be removed well even by boiling in diluted

sodium hydroxide. Only specimens for the study of the muscles and other organs, which are in close connection with the furca, were fixed and kept in 80 per cent alcohol.

The dry beetle was detached from the pasting plate or removed from the insect pin and by means of a pincer the head, prothorax, elytra, wings and legs were broken off. The remaining meso-, metathorax and abdomen were boiled a short time in a test-tube with clear water. The further working differs according to the size of the specimen. Fairly large beetles (*Colymbetinae*, *Dytiscinae*) were prepared in the following way: meso- and metathorax were separated from the abdomen, and the tergal part of the two thoracic portions was cut off by means of fine scissors. Thus the cavity of the thorax is opened, and it is possible to remove the muscles by pincer or preparation needle. The iris pincer used in ophthalmology is best suited for this purpose. The preparation can be a dry process, and the object can be attached as required to a wax or cork plate by means of insect pins (000). We boil the thus roughly cleaned pleural and sternal part of the thorax with the furca a short time in diluted (3%) NaOH and then wash it in clear water. In small species (*Hydroporinae*, *Laccophilinae*) we proceeded as follows: meso-, metathorax and abdomen were left together, and by means of two minute steel needles they were fixed to the bottom of a flat dish covered with a wax layer. The two minute needles are here stuck through the abdomen. Now we pour water on the object and remove the tergal part of the thorax by making a cut between the tergites and the pleurites with a sharp lancet. The best suited for this purpose are lancets which we make by soldering small fragments of the edge of a razor blade to a piece of hard wire inserted into a handle. After opening the thorax the muscles were removed by means of minute needles inserted into a handle as because of the small size of the objects a pincer cannot be used. It is best to remove the muscles completely by means of these minute needles and to avoid the use of sodium hydroxide; only when a complete removal cannot be achieved in this way we place the object for a short time in hot 1% NaOH. The whole preparation has absolutely to be carried out in water as by drying the thin processes of the furca twist and change their shape very essentially. The preparations thus made were kept in test-tubes in water with a few drops of a phenol solution. The preparations cannot be kept in alcohol as they twist; in pure water they very often turn mouldy when kept for any length of time.

In his investigation of the metathoracic furca Crows on boiled the beetles in a solution of K_2CO_3 , decolorated them in H_2O_2 , and lit them up in xylen. Then he removed the tergal sclerites, expanded the elytra sideways, and directly figured these objects. The smaller species thus prepared he mounted whole in Canada balsam. This method does not, however, answer in every respect, as it is not possible to observe the furca and its processes in every respect where it is not completely exposed.

The objects were traced by means of Abbe's tracing apparatus. As these preparations are rather spacial and the penetration faculty is on the whole small even in the weakest objectives a certain incorrectness of the tracing is unavoidable. After making a rough sketch by means of the mono-

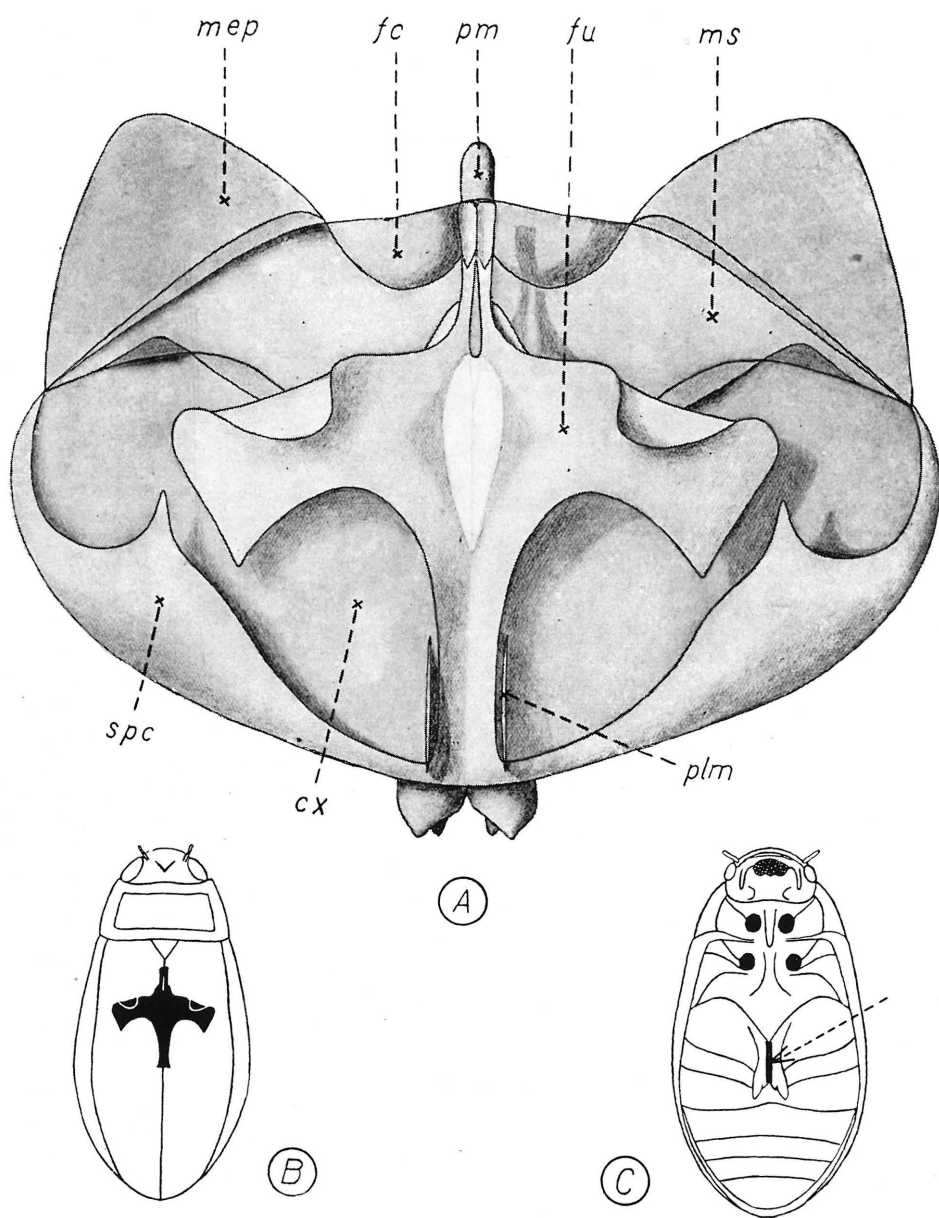
cular microscope and Abbe's tracing apparatus the object was therefore observed under a stereoscopic binocular microscope and the original sketch was corrected. All figurings were traced in a view from above (with the exception of figs. B, C on pl. IV), i. e. perpendicular to the length axis of the body of the beetle (not perpendicular to the length axis of the furca, which is inclined from the front backwards). Most figures were drawn schematically by pen and ink, some were shaded by different charcoal pencils and with diluted Indian ink or coloured with water-colours. An ocular micrometer was used for measuring the objects. During drawing and measuring the preparations have to be constantly in water so as not to dry and in order to remove disturbing lustres.

IV. Position of the Metathoracic Furca in the Body of the Dytiscidae.

The metathoracic furca lies in the body of the *Dytiscidae* in the thorax, as already the name implies, in its third portion, the metathorax. If we were to boil the whole beetle in sodium hydroxide, decolorate it and observe it in transmitted light, we should see that this furca is situated in the middle of the body, approximately in its centre of gravity (pl. I, B). This is not mere chance, as the furca with the strong metathoracic muscles attached to it is a rather heavy organ, and therefore it is necessary that it should be placed in the point of gravity of the body in view of maintaining the equilibrium in swimming in water; otherwise the continuous swimming motion would be made impossible by the sinking of the anterior or posterior part of the body in consequence of the unequal load of one or the other part. The metathoracic furca is with its basal part firmly connected with the integument as it is formed as an invagination of this body wall, and therefore we turn our attention first to the sclerites of the ventral exoskeleton and their mutual position.

The species *Dytiscus marginalis* L. may serve as an example. The ventral side of the metathorax is formed by four components: the metepisterna, the metasternum,¹⁾ the metasternellum and the coxae of the third pair of legs. The metepisterna are developed as two sclerites which have an approximately triangular shape and form the anterior corners of the ventral surface of the metathorax (pl. I, A, mep). Each metepisternum adjoins anteriorly the mesepimeron, laterally the parapleura and metepimeron, and finally posteriorly the metasternum. The limit between the metepisternum and the metasternum is formed by a suture to which corresponds inside a low chitinous comb projecting into the thoracic cavity. The metasternum (pl. I, A, ms) has a winged shape and its lateral wedge shaped parts penetrate between the metepisternum and the coxae of the posterior pair of legs. Anteriorly it forms two hemispheric depressions—foveae coxales metasterni (pl. I, A, fc) which are open on the ventral side and into which fit the mobile spherical coxae of the middle legs. Between the two

⁴⁾ According to some more recent authors (e. g. Campau, *Microentomology* 5: 57-85; Ferris, *Microent.* 5: 87-90) metathoracic sternites proper are not developed in the *Coleoptera*, and these organs are really metathoracic pre-episterna. As this problem is not yet finally solved, I follow the customary nomenclature of the thoracic sclerites.



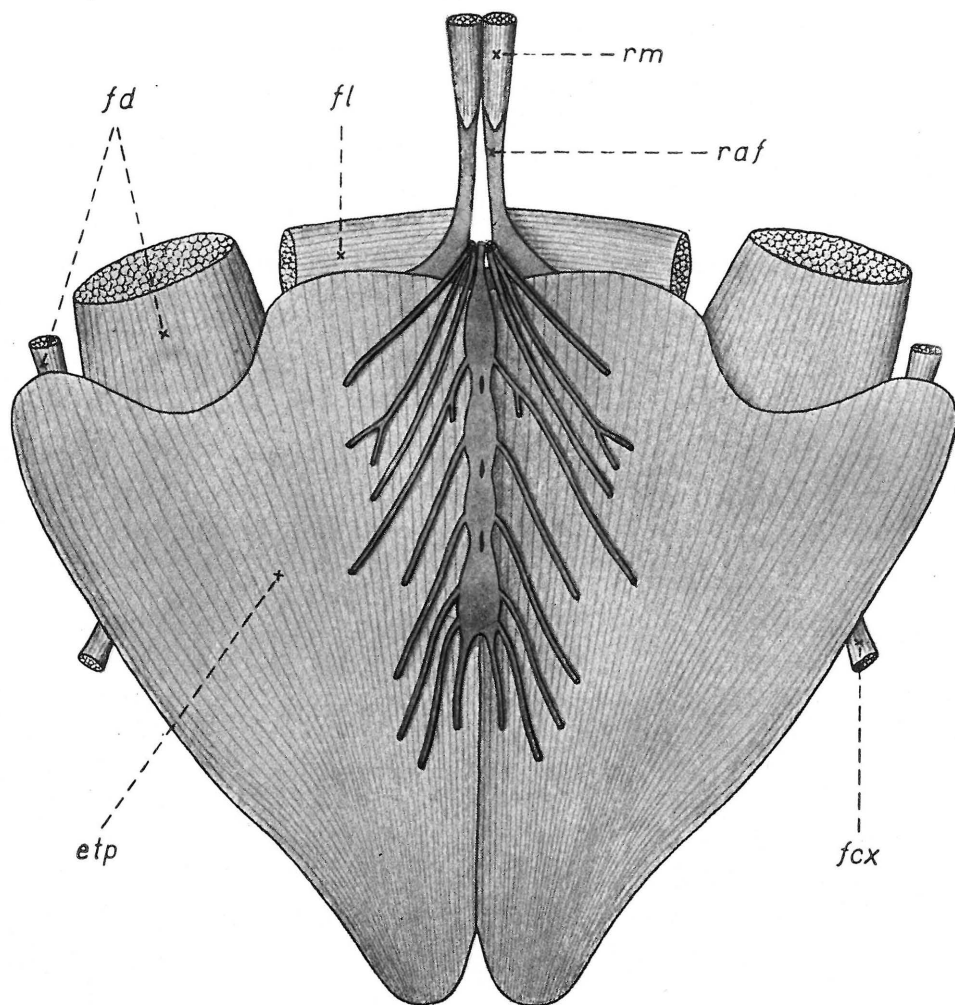
Pl. I. Position of the metathoracic furca in the body of *Dytiscus marginalis* L. A — view from above into the open metathorax; the tergal sclerites, metepimera and parapleurae have been removed; cx — coxa metathoracis, fc — fovea coxalis, fu — furca metathoracis, mep — metepisternum, ms — metasternum, plm — placula muscularis, pm — processus metasterni, spc — sinus posterior coxae. B — dorsal view of the imago of *Dytiscus marginalis* L.; the metathoracic furca is traced black. C — imago of the same species from the ventral side; the thick line to which the interrupted arrow points indicates the place of connection of the metathoracic furca with the exoskeleton.

coxal depressions a process of the metasternum—processus metasterni (pl. I, A, pm) projects forward; it is below depressed in a furrow. The processus prosterni fits into this furrow, and thus a firm connection between prothorax and mesothorax is made possible. The metasternum is lengthwise divided by a median suture into two symmetrical halves, and a fairly high vertical lamella—carina sagittalis—corresponds to this suture inside the thoracic cavity; it is connected with the basal part of the furca. The third component of the ventral side of the metathorax is the metasternellum which is placed between the coxae of the posterior pair of legs. In the literature sometimes the metasternellum is not distinguished from the coxae and it is usually misquoted that the post-coxae touch themselves in a median suture. On these grounds the posterior processes of the metasternellum are usually regarded as the processes of the coxae (“Hinterhüftenfortsätze”), which is a quite erroneous opinion indeed. This metasternellum is elongated, in the anterior direction it broadens and here it touches the metasternum, whereas the caudal end runs out into a pairy processus directed backwards, which is important for the articulation of the mobile part of the swimming legs. It is lengthwise divided by a median suture into two symmetrical parts; in the places of this suture, which is well visible on the surface of the ventral side of the metathorax (pl. I, C) and which is the continuation of the median suture of the metasternum, there is the basal part of the furca inside the thoracic cavity (on these grounds sometimes the term furcasternum instead of sternellum is used). The fourth and last component of the ventral side of the metathorax are the coxae of the posterior pair of legs (pl. I, A, cx). In the *Dytiscidae* these coxae are immovable, they are firmly connected with the metathorax and they are separated from each other by the mentioned metasternellum. At the limit between the anterior margin of the coxa and the posterior margin of the metasternum a relatively high chitinous comb (sinus anterior coxae) projects into the inside of the thoracic cavity, similarly as between the metepisternum and metasternum. Also the posterior margin of the coxa forms in the direction into the interior of the body a large bend—sinus posterior coxae (pl. I, A, spc) which partly separates the thoracic cavity from the cavity of the abdomen; it is directed obliquely forward and its margin runs out in a point directed towards the lateral branch of the furca. The base of the furca has the shape of a vertical chitinous plate, which is thus firmly connected with the exoskeleton in the places of the suture of the metasternellum, and whose anterior margin passes into the carina sagittalis metasterni. The upper margin of this basal lamella becomes lower in a posterior direction and is broadened so that in a vertical cross section it is T-shaped. This broadened margin then passes in an anterior direction into the two large lateral branches and the two much weaker anterior branches of the furca. The whole metathoracic furca (pl. I, A, fu) is thus a large and striking endoskeletal organ which fills almost the whole metathorax and extends in an anterior direction as far as to the metathorax. A vertical and very thin chitinous plate—placula muscularis (pl. I, A, plm)—lies on each side of the base of the furca; it is connected with the trochanter of the hind legs and strong muscles are attached to it. Having elucidated the position of the furca with regard to the ventral

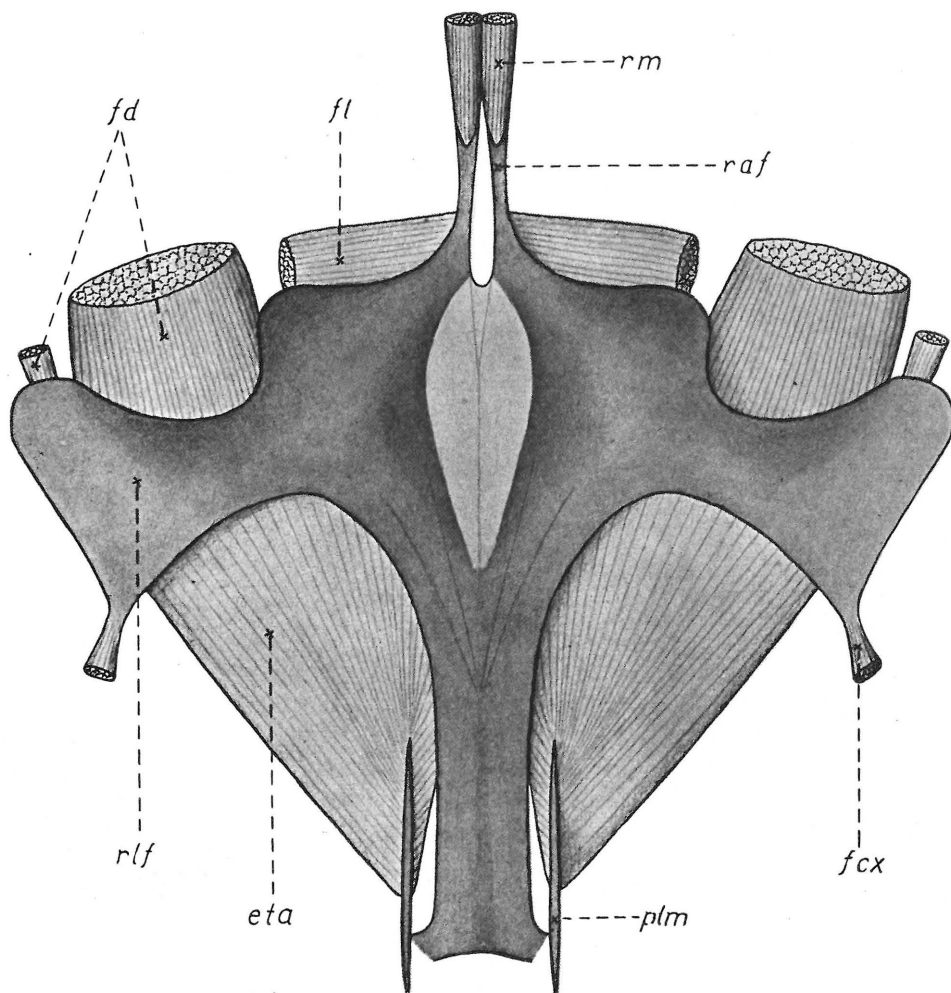
sclerites it still remains to speak of the organs of the metathoracic cavity to which the furca gives support, especially of the muscles.

When dissecting the diving beetle we remove the tergal part of the metathorax together with the dorsal vessel and some muscles there appears the alimentary canal surrounded by the fat-body (*corpus adiposum*). Part of the anterior ectodermal section of the alimentary canal, the so-called stomodaeum, rests on the furca; between the anterior branches of the furca lies the terminal part of the oesophagus, which then passes into the ingluvies lying above its basal part. When we remove the alimentary canal together with the fat-body the ventral nerve cord and the muscle layer adjoining the furca are exposed (pl. II). This nerve cord starts from the suboesophageal ganglion, continues on the ventral side of pro- and mesothorax, then rises upwards in the metathorax and passes through the fissure between the anterior branches of the furca to above the muscles adjoining this furca from above; in the abdomen it descends again to the ventral side. In the metathorax the nerve cord (i. e. ganglion abdominis II.—VI.) is thus, in contradistinction to the other sections of the body, nearer to the tergites than to the sternites in consequence of its position above the furca.

The most striking of the muscles is the pairy, flat and roughly triangular *musculus extensor trochanteris metathoracis posterior* (pl. II, etp). It attaches with its broad basis to the lateral branch of the furca, and its other end is connected with the *placula muscularis*. When we remove both these muscles there appear the metathoracic furca (pl. III) and two other muscles which adjoin it from below. They are the pairy *musculus extensor trochanteris metathoracis anterior* (pl. III, eta) corresponding in shape to the muscle *m. ext. troch. metathor. posterior*; it attaches similarly to the lateral branch of the furca (pl. III, rlf), but from below, and at the other end to the *placula muscularis* (pl. III, plm). Both these extensors are the strongest muscles in the body of the diving beetle and make possible the swimming motion. In addition to them there attaches to the metathoracic furca still the very small *musculus extensor trochanteris metathoracis medius*, which with its other end is again connected with the *placula muscularis*. The fourth and last extensor (*musculus ext. troch. metathor. inferior*) and the three much weaker flexors are not in connection with the furca. In addition to these muscles governing the motion of the hind legs there are firmly connected with the furca still the metathoracic muscles proper which attach to the body wall with their other end; they do not execute any motion, and their purpose is to strengthen the metathorax and especially to fix the furca which is under a considerable strain. The largest of them is the *musculus furcodorsalis metathoracis* (pls. II, III, fd); this muscle is formed on each side by two bundles of muscle fibres which start from the lateral branch of the furca. The place of insertion of the stronger bundle is the depression at the anterior margin of the lateral branch of the furca, and the insertion of the weaker bundle is directly the lateral rounded part of the anterior margin of this branch. The *musculus furcolateralis metathoracis* (pls. II, III, fl) is stretched roughly horizontally between the furca and the place where the metepisternum touches the coxa of the hind leg. These muscles safeguard the furca on the one hand against tension in the direction



Pl. II. The muscles of the metathoracic furca of *Dytiscus marginalis* L. and the ventral nerve cord. Furca brown, muscles yellow, nerve cord blue. *etp* — musculus extensor trochanteris metathoracis posterior, *fcx* — musc. furcocoaxialis metathor., *fd* — musc. furco-dorsalis metathor., *fl* — musc. furcolateralis metathor., *raf* — ramus anterior furcae, *rm* — musc. retractor mesothoracis.



Pl. III. The same as in the preceding plate, but the ventral nerve cord and the musc. ext. troch metathor. posterior have been removed. *eta* — musc. extensor trochanteris metathor. anterior, *fcx* — musc. furcocalis metathor., *fd* — musc. furcodorsalis metathor., *fl* — musc. furcolateralis metathor., *plm* — placula muscularis, *raf* — ramus anterior furcae, *rlf* — ramus lateralis furcae, *rm* — musc. retractor mesothoracis.

obliquely downwards (*m. furcodorsalis*), and on the other hand against deviation sideways (*m. furcolateralis*). The *musculus retractor mesothoracis* (pls. II, III, *rm*) connects the anterior branch of the metathoracic furca (pls. II, III, *raf*) with the mesothoracic furca. The last muscle which comes into consideration is the small *musculus furcocalis metathoracis* (pls. II, III, *fcx*), connecting the posterior margin of the lateral branch of the furca with the posterior coxal bend (*sinus posterior coxae*). Both these muscles safeguard the furca against tension in a posterior and anterior direction. Thus it is obvious that the metathoracic furca is an important organ to which a large part of the muscles moving the hind legs and most of the muscles of the metathorax proper are attached.

V. Topography of the Furca

The metathoracic furca of the *Dytiscidae* is a considerably articulated chitinous organ in which we can distinguish various processes and sharply defined areas which are the places of insertion of the muscles. As it is necessary to designate these individual parts for a morphological description of the furcae of different species and their mutual comparison, I give here the nomenclature of these individual organs which up till now have not been given a name in any work on the endoskeleton of the insects. All terms are in the present chapter elucidated on the basis of the metathoracic furca of the species *Dytiscus marginulis* L. The basal part of the furca—*corpus basillare furcae metathoracis* (pl. IV, A, B, *cbf*)—is a thin, translucent chitinous plate placed perpendicularly to the metasternellum, and has roughly the shape of an irregular quadrangle. Its anterior margin is strongly thickened and pigmented and is connected with the *carina sagittalis metasterni*. The upper margin descends from the front backwards, is likewise thickened and besides enlarged sideways so that this *corpus basillare* is T-shaped in a vertical cross section. The thickened anterior and upper margins meet in its anterior upper corner and thence pass obliquely upwards in two large lateral and two smaller anterior branches. Each lateral branch—*ramus lateralis furcae metathor.* (pl. IV, A, B, C, *rlf*)—is a flat, in an anterior view slightly arcuately bent organ (pl. IV, C, *rlf*). Both these branches are rounded on the sides, their posterior margin is arcuately indented and runs out in a rather sharp tip directed backwards and obliquely downwards. At their anterior margin are two roomy cavities (pl. IV, A, B, C, *ifd*) open forwards and obliquely upwards. This lower surface is almost even, the upper surface is convex and at the same time indented. The end of the muscle *musc. furcodorsalis metathor.* is inserted into these cavities. The large lateral branches pass in a cranial direction into the two much weaker anterior branches—*rami anteriores furcae metathor.* (pl. IV, A, B, C, *raf*), directed forwards. They are narrow, slightly expand in a distal direction, and are separated from each other by a narrow fissure. At the end of them is an elongated and shallow dish-shaped depression—*insertio musc. retractoris mesothoracis* (pl. IV, A, C, *irm*), to which the muscle *musc. retractor mesothor.* connecting the meso- and metathoracic furca

attaches. In the middle between the lateral branches of the furca an elongated area extends from the anterior branches in the direction towards the corpus basillare. This area is drop-shaped, its rounded end directed cranially, the other, pointed end in caudal direction. This area is even, translucent, and formed by a thin, little pigmented chitinous plate; on its sides are two indistinctly defined, roughly triangular districts which are strongly pigmented (see pl. IV, A). At the limit between the ramus anterior and the r. lateralis furcae there is on the underside of the furca a pair of processes—insertio musc. furcolateralis metathoracis (pl. IV, A, B, C, ifl), which are directed obliquely downward and backward. Each of them is hollowed out into a roomy cavity open in a cranial direction, in which is the place of insertion of the muscle musc. furcolateralis metathor. Sometimes these processes have been called the third pair of branches of the furca, but the furca has really only two pairs of branches (r. anterior and r. lateralis), whereas these processes are the place of insertion of muscles just as the ins. m. retr. mesothor. and the ins. m. furcodorsalis metathor.

VI. Importance of the Furca

The metathoracic furca of the *Dytiscidae* is of considerable importance as supporting organ for some organs of the thoracic cavity and especially as firm foundation for the insertion of many muscles. We can summarise its importance in the following points:

The metathoracic furca

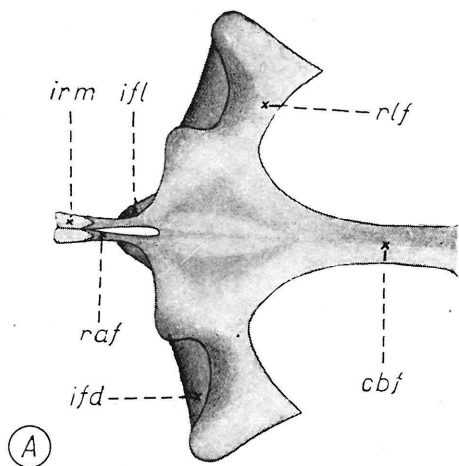
(1) gives support to the ventral nerve cord, i. e. to five abdominal ganglia (gangl. abdominis II.—VI.), which in consequence of the concentration of the nervous system in the *Coleoptera* are shifted into the thorax;

(2) gives support to part of the alimentary canal, chiefly to the large ingluvies, and simultaneously to the fat-body which closely adjoins the alimentary canal;

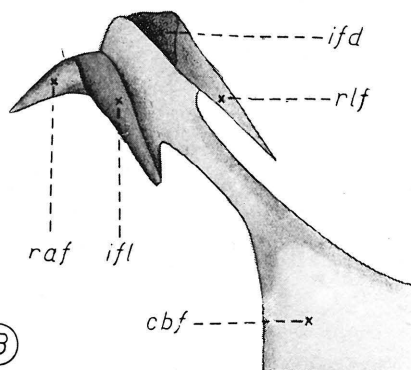
(3) is the foundation for the insertion of the thoracic muscles proper which are stretched between the furca and the body wall and thus strengthen the whole metathorax;

(4) is the firm foundation for the insertion of the extensors of the posterior swimming legs, which are really the only locomotory organ of the diving beetles in water.

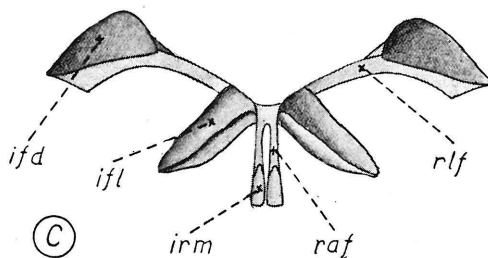
The most important of these four points is the last one. In beetles moving on dry land in a gressorial or cursorial manner all six legs are locomotory organs; consequently also the muscles governing them are more equally distributed in all three parts of the thorax. In the *Dytiscidae*, which live in water, the posterior pair of legs alone has taken over the locomotory function, whereas the anterior and middle legs are only of quite subordinate importance for the swimming movement. The natural consequence of this adaptation to an aquatic environment is the strong development of the legs of the third pair and thus also of their extensors, which are the largest of all muscles in the body of the *Dytiscidae*. These extensors in their turn need within the metathorax a firm organ to which they can attach with their base,



(A)



(B)



(C)

Pl. IV. Topography of the metathoracic furca of *Dytiscus marginalis* L. A — view of the furca from above, perpendicular to the length axis of the body. B — side view. C — anterior view in the direction of the length axis of the furca (not in the direction of the length axis of the body); corpus basillare not shown, *cbf* — corpus basillare furcae metathor., *ifd* — insertio musc. furcodorsalis metathor., *ifl* — insertio musc. furcolateralis metathor., *irm* — insertio musc. retractoris mesothoracis, *raf* — ramus anterior furcae, *rlf* — ramus lateralis furcae.

and this is just the metathoracic furca. The fact that the metathoracic furca of the diving beetles is such a remarkably large endoskeletal organ is thus chiefly due to ecological adaptation to an aquatic mode of life. Consequently shape and size of the furca of the *Dytiscidae* (and probably also of the other beetles) are a predominately adaptive character, i. e. a phylogenetically young character, and thus it is very difficult to draw on the basis of the study of its morphology in different species of the *Coleoptera* phylogenetic conclusions as e. g. C r o w s o n does. Though this author emphasises that the mutual affinity of the species of beetles studied by him cannot be elucidated on the basis of the shape of the furca alone, yet he believes that this is possible on the basis of a comparative morphology of the furca by taking simultaneously into consideration also the other characters. In my opinion even this is not quite suitable, as the configuration of the metathoracic furca in the *Coleoptera* developed in the individual species under the influence of equal or similar living conditions analogously, even when the phylogenetic origin of these species was different. In taxonomy this character may thus be utilised rather for distinguishing the individual species, but not for solving the questions of their phylogenetic affinities.

VII. Morphology of the Furca of the Different Species

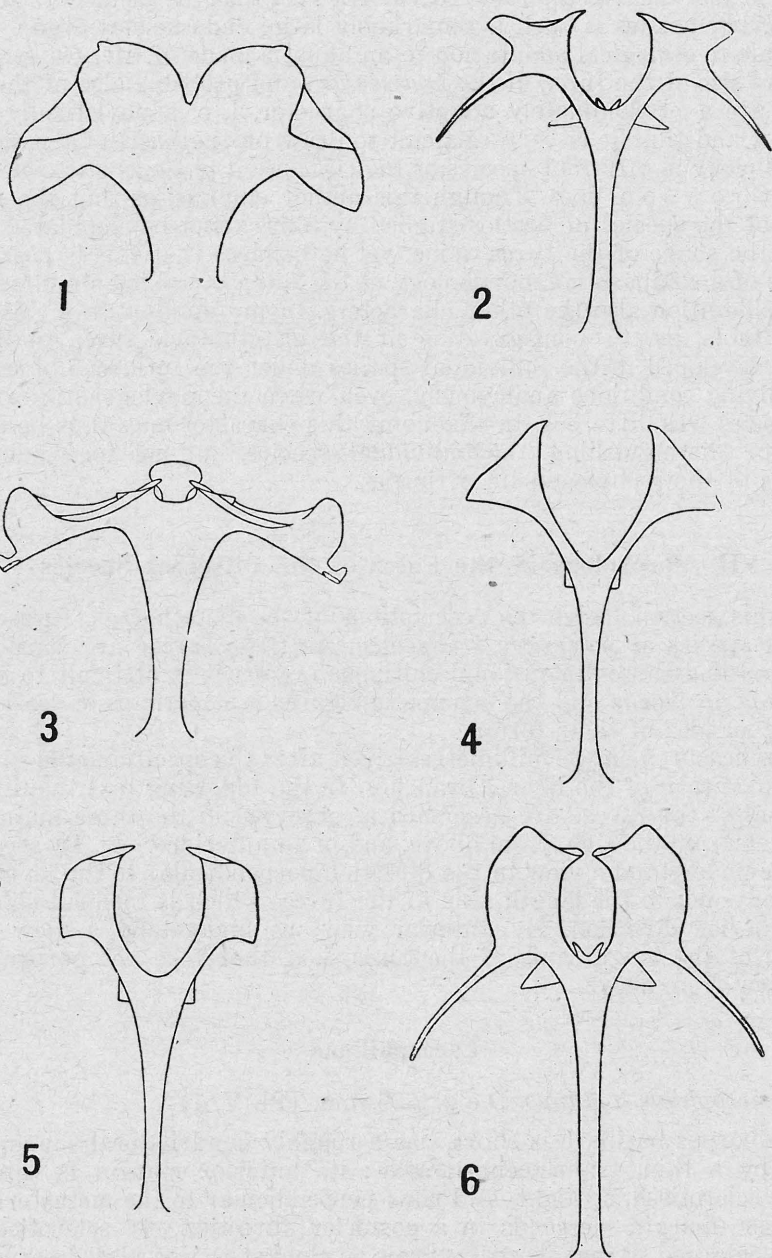
In this section I give the descriptions of the metathoracic furcae of 56 different species of palearctic *Dytiscidae*. As these furcae are considerably articulated and three-dimensional chitinous organs it is difficult to express their shape in words and the schematic figures will perhaps at least partly facilitate an idea of their form.

The measurement in millimetres given after the specific name gives the maximum spread of the lateral branches. In the following text the different characters of the furcae are described as observed in the three main directions: seen from the side, from above, and in an anterior view. By seen from above we understand a view in the direction perpendicular to the length axis of the body, not to the length axis of the furca, which is inclined slantingly in a posterior direction. By anterior view we understand a view in the direction of the length axis of the furca, i. e. therefore not perpendicular to the view from above.

Laccophilinae

1. *Laccophilus hyalinus* D e g. 2.05 mm. (Pl. V, 1).

The corpus basillare is short, has a roughly quadrilateral shape, and is formed by a thin, translucent lamella; its anterior margin is thickened, strongly sclerotised, straight, and runs perpendicular to the metasternum. The upper margin descends in a posterior direction, is sclerotised and strongly enlarged so that it really forms an elongated area placed perpendicularly to the basal lamella passing into the lateral branch. The ramus anterior and r. lateralis are not distinctly separated from each other as e. g. in *Dytiscus marginalis*, so that together they form a flat lobate organ running



Pl. V. 1 — *Laccophilus hyalinus* Deg. 2 — *Hydrovatus cuspidatus* Kunze. 3 — *Hyp-hydrus ovatus* L. 4 — *Bidessus unistriatus* Schrk. 5 — *Guignotus pusillus* F. 6 — *Coel-lambus impressopunctatus* Schall.

out the sides in a blunt point directed backwards. In an anterior view both these lateral lobes are broadly opened, only the marginal parts at the anterior median indentation between the primary rami anteriores bent downwards so that together they form an acute angle. The insertio musc. furcodorsalis is large, considerably high and deep; in an anterior view it has roughly a triangular shape, in a top view it is deeply angularly indented; its lower surface is practically level with the ramus lateralis so that this whole cavity rises markedly above the surface of the lateral branch. The insertio musc. retractoris mesothoracis is not visible. At the anterior margin of each lobate organ is a small processus which is the continuation of a fairly high rib which runs on the underside of the furca in the direction towards the thickened upper margin of the corpus basillare. This rib represents the cavity ins. musc. furcolateralis and the musc. furcolateralis metathoracis attaches to it approximately in the anterior third of it.

Hydroporinae

2. *Hydrovatus cuspidatus* Kunze. 0.72 mm. (Pl. V, 2).

The corpus basillare furcae is low, elongated, posteriorly much lower than in front. The anterior margin is sclerotised and runs obliquely backwards with an inclination inferior to 45° . Besides this anterior margin is split in its whole length as can be seen in a view from above between the anterior branches. The ramus anterior is very short and broad, in the anterior margin shallowly, on the side more deeply indented; the area between the anterior branches is ovoid. It has at its anterior margin a cavity depressed in cornet-shape, whose mouth is tear-shaped; the musc. retractor mesothoracis apparently reaches into it. The insertio musc. furcodorsalis is lacking. The ramus lateralis is very thin, bent in sabre-shape, and narrows towards the end into a sharp tip directed obliquely backwards and sideways. Both branches are rather widely open. The insertio musc. furcolateralis is well visible in a view from above as a horn-shaped formation on each side of the furca. Their posterior margins are not in one plane, but are directed obliquely backwards and at the same time downwards. These processes are hollow and flat and seen from below they have the form of a low triangle; they are isolated from each other and thus are not in contact in the median plane. Their lower surface is in consequence of the deeper indentation smaller than the upper one.

3. *Hyphydrus ovatus* L. 1.92 mm. (Pl. V, 3).

The metathoracic furca of this species is by its shape entirely different from that of all other *Dytiscidae*. The corpus basillare is low and very long, and its upper margin is slightly sinuate; the anterior margin runs out into a broadly rounded, semicircular formation which projects far forward above the metasternum and which is deeply cleft in its upper part. This cleft is broadly open and is well visible in a view from above between the two branches of the furca as a rounded tongue-shaped formation expanding in an anterior direction. From here the anterior margin of the corpus basillare is directed

obliquely backwards to the limit between the coxae and the metasternum under an angle of less than 20° . In its lower part this anterior margin is again cleft and the carina sagittalis metasterni is wedged into this cleft. The ramus anterior is much reduced and indistinguishable from the ramus lateralis. The anterior margin of this lateral branch is connected with an elongated plate placed perpendicularly to this branch. Its origin may be explained so that the anterior margin of the ramus lateralis is divided and drawn back upwards and downwards. This surface is the place of insertion of the muscles musc. retractor mesothoracis and musc. furcodorsalis. The ins. musc. retr. mesothor. (and at the same time also the reduced ramus anterior) is distinguished only by the fact that it is delimited on the periphery by a thickening and that it is depressed in dish-shape, whereas the ins. musc. furcodorsalis is completely flat. Its lateral margin is at the distal end of the ramus lateralis posteriorly deeply indented and thus a hook-shaped process is formed, provided at the posterior margin with a shallow, groove-like depression. Under the furca a rather strong ledge runs on each side from the ins. musc. retract. mesothor. in the direction towards the upper enlarged margin of the corpus basillare. In the anterior part this ledge is recurved and again bent forward as a spiral, and thus a pit is formed which is the insertio musc. furcolateralis.

4. *Bidessus unistriatus* Schrk. 0.38 mm. (Pl. V, 4).

The furca of this and of the following species is very primitive. The corpus basillare has its upper margin thickened and slightly sinuate, the anterior margin faintly indented, shallowly cleft and running towards the coxae under an angle of about 60° . The ramus anterior and the r. lateralis are indistinguishable from each other and form on each side a flat, triangular formation; between these two formations, which are roughly in one plane, is a broad gap. In the anterior corner there is the broad and fairly deep insertio musc. retractoris mesothoracis, which in an anterior view has the shape of a drop whose rounded end is directed proximally and the pointed end distally. In the outer apical corner of the triangular lateral formation a muscle attaches to its margin, which for lack of alcohol material I could not identify accurately. It is probably neither the musc. furcodorsalis nor the musc. furcocoaxalis. The insertio musc. furcodorsalis thus seems not to be developed. The insertio musc. furcolateralis projects on each side of the furca; its upper surface lies in the same plane as the enlarged upper margin of the corpus basillare, passing anteriorly into the triangular lateral formations mentioned above; this upper surface is shorter and broader than the lower one, which is narrower, longer and reaches to the margin of the oval indentation between the branches.

5. *Guignotus pusillus* F. 0.32 mm. (Pl. V, 5).

The corpus basillare extends rather far forwards above the metasternum whose upper margin becomes lower in a backward direction and is thickened and arcuately sinuate. The anterior margin is faintly indented, in the upper part only slightly cleft, and runs downward under an angle of a little more

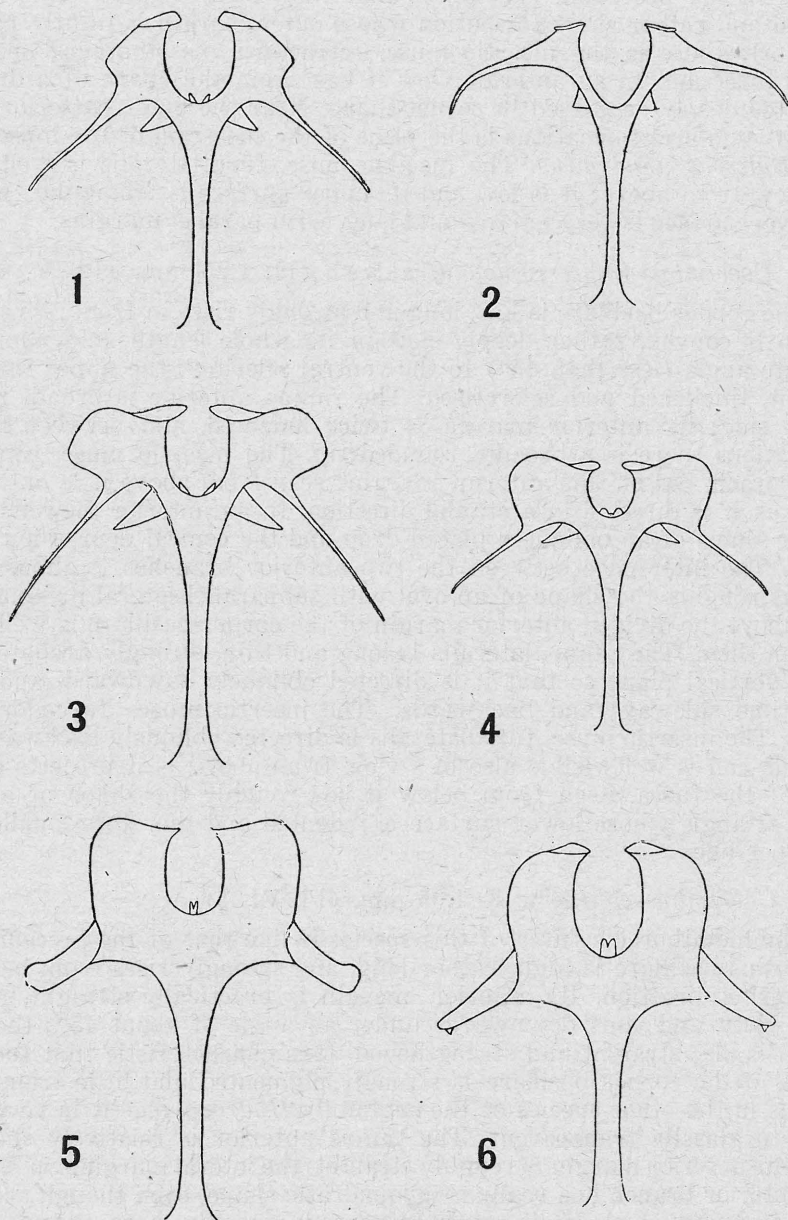
than 45° . The ramus anterior and the r. lateralis are not distinguished at all, just as in the preceding species, so that they form together on each side a broad and rather short formation whose outer margin is faintly rounded. Anteriorly there is the insertio musc. retractoris mesothoracis, open in a cranial direction. In an anterior view it has again the shape of a drop and is not too deeply depressed in cornet-shape. Near the outer posterior corner of the two lateral formations is the place of the insertion of the muscle, just as in *Bidessus unistriatus*. The insertio musc. furcolateralis is well visible in a view from above; it is low and its upper surface is triangular, whereas the lower surface is very narrow and long, with parallel margins.

6. *Coelambus impressopunctatus* Schall. 1.25 mm. (Pl. V, 6).

The corpus basillare is low, long and strongly rises in front; its anterior margin is convex, rather deeply cleft in its whole length, and runs under an acute angle (less than 45°) to the ventral sclerites; the upper margin is straight, thickened and sclerotised. The ramus anterior is broad, rounded on the side; its anterior margin is twice indented, and between the two indentations there is a broadly rounded tip. The insertio musc. retractoris mesothoracis lies on this anterior margin; seen from above it is only partly visible as it is directed in a cranial direction. In an anterior view its mouth has the shape of an obliquely placed drop and the conical depression is well visible. The interspace between the two anterior branches is almost closed and has roughly the shape of an oval with subparallel lateral margins; seen from above the divided anterior margin of the corpus basillare is well visible between them. The ramus lateralis is long and thin, strongly arcuately bent in the vertical plane so that it is directed obliquely downward, and at the same time sideways and backwards. The insertio musc. furcodorsalis is absent. The insertio musc. furcolateralis is directed obliquely backwards and upwards and is well visible also in a view from above as it projects on both sides of the furca. Seen from below it has roughly the shape of an equilateral triangle whose lower surface is indented and therefore smaller than the upper one.

7. *Coelambus confluens* F. 1.05 mm. (Pl. VI, 1).

The metathoracic furca of this species is like that of the preceding one. The corpus basillare is high, rather long, and strongly rises from behind in an anterior direction. Its anterior margin is practically straight, not too deeply cleft, and runs downwards under an angle of about 45° ; the upper margin is also straight and strengthened. It is characteristic that the whole surface of the corpus basillare is strongly pigmented and little transparent, whereas in the other species of the subfamily *Hydroporinae* it is very translucent to glassily transparent. The ramus anterior is relatively short and broad; its anterior margin is roughly straight, the lateral margin is indented. This anterior branch has really a subquadratic shape, even though according to the figuring on pl. VI it seems to narrow strongly in an anterior direction; this is due to its inclination and at the same time also to the inclination of the furca. The insertio musc. retractoris mesothoracis lies on its anterior margin; it is depressed in cornet-shape and its mouth has the shape of a



Pl. VI. 1 — *Coelambus confluens* F. 2 — *Hygrotus inaequalis* F. 3 — *Hygrotus versicolor* Schall. 4 — *Herophydrus guineensis* Aubé. 5 — *Hydroporus dorsalis* F. 6 — *Hydroporus angustatus* Sturm.

broad drop. The rami anteriores are rather distant from each other and between them is a broadly oval space. The ramus lateralis is very thin and long and is arcuately bent in the vertical plane so that it is directed obliquely downwards and backwards with its apical end. The insertio musc. furcodorsalis is not developed. The insertio musc. furcolateralis projects on both sides of the furca and is directed obliquely sideways and backwards. Its upper surface is triangular, the lower surface is deeply indented and thus much smaller.

8. *Hygrotus inaequalis* F. 1.02 mm. (Pl. VI, 2).

The corpus basillare is relatively high and not too long; its upper margin is thickened, almost straight, only quite faintly sinuate; the anterior margin runs in the direction from above downward under an angle of slightly more than 45°, and is very faintly bent in S-shape so that its upper part is slightly convex, whereas the lower part is faintly indented. This anterior margin is on the whole shallowly cleft; below it passes into the sinus anterior coxae and the carina sagittalis is wedged into it. The anterior and lateral branches are so widely open that they are in one plane. The ramus anterior is broad and short; it strongly narrows forwards and is not distinctly separated from the ramus lateralis so that its lateral margin passes imperceptibly into the anterior margin of the lateral branch. The insertio musc. retractoris mesothoracis lies in front, and opens in a cranial direction; in an anterior view it is drop-shaped, and the cornet-shaped depression is well perceptible. Between the anterior branches is an oval space, broadly open anteriorly. The ramus lateralis is long, relatively strongly curved, so that its apical part is directed backwards and at the same time obliquely downwards. This lateral branch is not rod-shaped, but is thin and plate-like. The insertio musc. furcodorsalis is lacking. The insertio musc. furcolateralis projects on each side of the furca; it is low and seen from below it has a triangular shape. Its upper surface is not indented at all, but the lower surface is very deeply indented in a right angle, so that there remains of it only a narrow border along the inner and posterior margin of the insertion.

9. *Hygrotus versicolor* Schall. 1.09 mm. (Pl. VI, 3).

The metathoracic furca of this species is very different from that of the preceding species and resembles more the furca of the genus *Coelambus*, even though *Hygrotus inaequalis* and *Hygr. versicolor* are indubitably two very closely related species. The corpus basillare is fairly high and long; its upper margin is straight and thickened, the anterior margin is also almost straight and forms with the ventral surface of the metathorax an angle of about 45°. This anterior margin is divided, but the cleft is not in its whole length and is restricted to its upper part only. The ramus anterior is short, but very broad and its inner margin is almost straight, whereas the outer one is rounded. It is distinctly separated from the ramus lateralis by a deep lateral indentation. At its anterior margin is the roomy insertio musc. retractoris mesothoracis, open in an anterior and upward direction, which in an anterior view has roughly a broadly oval shape and which is rather deeply conically depressed. A broad gap is between the anterior branches; in

front it is partly closed by the insertions, and the two branches enclose together an angle of about 90° , so that in an anterior view they have the shape of a broadly open V. The ramus lateralis is very long and extremely thin, and is slightly arcuately bent in the vertical plane so that with its end it is directed obliquely downward and at the same time sideways; in its middle part it is only $13\ \mu$ thick. The insertio musc. furcodorsalis is lacking. The insertio musc. furcolateralis projects on each side of the furca as a horn-shaped, slightly bent formation directed obliquely backwards. Its lower surface is much smaller than the upper one and is restricted to a small triangular area only, situated in the posterior inner corner of the insertion. The whole furca of this species is almost translucent, only slightly pigmented.

10. *Herophydrus guineensis* Aubé. 1.46 mm. (Pl. VI, 4).

The corpus basillare is high and not too long; its upper margin is thickened, slightly bent, and rises strongly in an anterior direction. The anterior margin is almost straight, runs downward under an angle of a little less than 45° , and is rather deeply cleft. This cleft is broadly open as can be seen distinctly in a view from above between the anterior branches of the furca, and it occupies about three fourths of the anterior margin of the corpus basillare, while the remaining lowest fourth is not divided. The ramus anterior is considerably broad; its inner margin is arcuately indented, the anterior margin is undulate, and the lateral margin broadly rounded. It carries in front the insertio musc. retractoris mesothoracis, which is depressed in funnel-shape and is in an anterior view broadly tear-shaped. Though the lateral branch is clearly distinguished, there is not between it and the anterior branch a deep indentation as in *Hygrotus versicolor* Schall. Between the rami anteriores is a broadly oval gap, partly closed anteriorly. Ramus lateralis very thin, slightly sinuate, but much shorter than in the preceding species. The insertio musc. furcodorsalis is lacking. Seen from above the insertio musc. furcolateralis is distinctly visible on each side of the furca; it has approximately the shape of a low triangle. Its lower surface is more deeply indented and therefore smaller than the upper one. The metathoracic furcae of the species *Hygrotus versicolor* Schall. and *Herophydrus guineensis* Aubé are rather similar in shape, but they can be distinguished from each other at first glance because in the former there is a deep indentation between the r. anterior and the r. lateralis and the whole lateral branch is much longer.

11. *Hydroporus dorsalis* F. 1.21 mm. (Pl. VI, 5).

The corpus basillare is not too long and rather high. The anterior margin is in the upper part almost semicircularly convex and then runs from this rounded processus in a downward direction to the limit between the metasternum and the metasternellum in an angle of about 30° ; it is deeply cleft in its whole length, but this cleft of the anterior margin attains its maximum depth in its upper third. The ramus anterior is broad, rounded in the anterior outer corner, with subparallel lateral margins. The insertio musc. retractoris mesothoracis is directed cranially and is hidden in a view from above as its upper margin overlaps a little the lower one. In an anterior view it has the

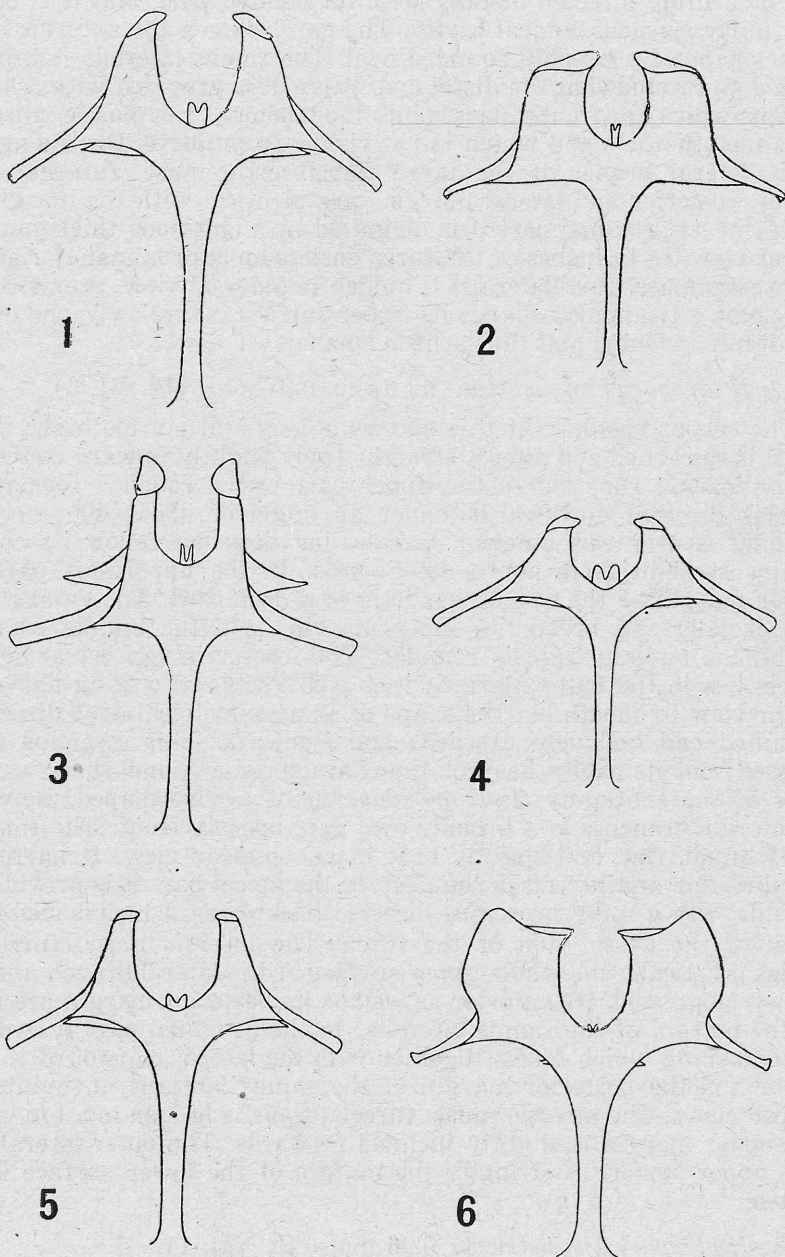
shape of a drop, directed distally with its pointed part, and it is depressed into a fairly spacious conical cavity. The gap between the anterior branches has the shape of a broadly rounded oval. The ramus lateralis is broad, flat, enlarged and rounded at the distal end. Below it is provided with a low spiny processus which apparently passes into the tendon of the muscle *musc. furco-coxalis metathoracis* and which is not visible from above. On the upper side of this lateral branch is the large flat insertio *musc. furcodorsalis*; its anterior, posterior and lateral margins are identical with the margin of the branch, in its proximal part it is delimited by a chitinous thickening. In an anterior view the branches of the furca enclose an approximately right angle. The insertio *musc. furcolateralis* is hidden in a dorsal view; seen from below it has again a triangular shape; its upper surface is shallowly, the lower one more deeply indented and thus a little smaller.

12. *Hydroporus angustatus* Sturm. 0.87 mm. (Pl. VI, 6).

The corpus basillare of this species is long and not too high; its upper margin is thickened and almost straight (only slightly upward convex). The anterior margin runs out in the upper part into a rounded formation and thence is directed downwards under an angle of about 40°; a chitinous thickening is near this anterior margin, but does not follow its curvature, but runs straight from above downwards. In the uppermost part of the anterior margin of the corpus basillare is a deep cleft. The ramus anterior is rather long and broad, its inner margin is in the middle part almost straight, the outer margin is rounded. The insertio *musc. retractoris mesothoracis* lies in the outer margin; it is well visible also from above. In an anterior view its mouth has the shape of an asymmetrical drop directed with its pointed end obliquely upwards and sideways. This insertion is again depressed; but its cavity has not the characteristic funnel-shape as in most species of the subfamily *Hydroporinae*, but is groove-shaped. Between the two anterior branches is a broadly oval gap, open in front. The ramus lateralis is broad, flat, and slightly bent in an anterior view. It narrows in a distal direction and its end is rounded; in the apical part it is provided on its underside with a spiny processus directed backwards, which is visible also in a view of the dorsal side of the furca. The insertio *musc. furcodorsalis* occupies practically the whole upper surface of the lateral branch and is very shallowly depressed. Its anterior as well as its posterior margin are identical with the margin of the ramus lateralis; in the proximal part it is delimited by a thickening which forms together with the lateral margin of the ramus anterior and the posterior margin of the ramus lateralis an uninterrupted S-shaped curve. The insertio *musc. furcolateralis* is hidden in a top view, and its posterior margin is slightly inclined forwards. The outer lateral margin of the upper surface is straight, the margin of the lower surface is deeply indented.

13. *Hydroporus palustris* L. 0.96 mm. (Pl. VII, 1).

The corpus basillare furcae is long, slightly rising anteriorly; its upper margin is thickened and roughly straight; the anterior margin is rounded, divided, and runs downward under an angle slightly inferior to 45°. The



Pl. VII. 1 — *Hydroporus palustris* L. 2 — *Hydroporus erythrocephalus* L. 3 — *Hydroporus planus* F. 4 — *Hydroporus discretus* Fairm. 5 — *Hydroporus nigrita* F. 6 — *Porhydrus lineatus* F.

ramus anterior is fairly long and broad; its lateral margins are almost straight and converge in an anterior direction. The insertio musc. retractoris mesothoracis is at the distal end of this branch; it is open in a cranial direction and at the same time obliquely upwards so that it can be seen distinctly also from above. In an anterior view its mouth is broadly tear-shaped, and the cavity of this insertion has the characteristic funnel-shape. Between the anterior branches is a gap, broadly open in front, which resembles an open letter U. In a view from above the anterior part of the corpus basillare projects into this gap. The ramus lateralis is flattened, slightly arcuately bent, and its margins are roughly parallel; it is rounded at the end and passes into a low pointed processus directed backwards. The insertio musc. furcodorsalis occupies the whole upper surface of the lateral branch, reaches to the ramus anterior, and narrows in a proximal direction. The posterior margin of this insertion and simultaneously also of the lateral branch passes in an uninterrupted curve into the lateral margin of the ramus anterior. The branches of the metathoracic furca of this species are mutually rather strongly inclined so that in an anterior view they form an acute angle with the vertex directed downward. The insertio musc. furcolateralis is in a view from above for the most part hidden and its posterior margin is not perpendicular to the length axis of the furca, but is somewhat inclined forwards. Seen from below this insertion is of triangular shape and its lower surface is a little smaller than the upper one because of its deeper indentation.

14. *Hydroporus erythrocephalus* L. 1.25 mm. (Pl. VII, 2).

The corpus basillare is low and long; it becomes lower from the front to the back. Its anterior margin is in the upper part strongly convex, in the lower part inclined under an angle of 45° to the ventral sclerites of the metathorax, and cleft in its whole length; the upper margin is straight and thickened. The ramus anterior is broad and its lateral margins are almost straight and subparallel. In front this anterior branch carries the insertio musc. retractoris mesothoracis, which has the shape of an elongated and at the same time bent droplet; it is depressed in cornet-shape and directed cranially. Between the rami anteriores is a roughly oval gap, open in front. The ramus lateralis is flat, narrows in a distal direction and is rounded at the end; on the underside of the apical part there is at the posterior margin a low conical processus. The insertio musc. furcodorsalis is very shallowly groove-like depressed and occupies almost the whole upper surface of the lateral branch; in the proximal half its posterior margin is delimited by an arcuately curved thickening. The posterior margin of this insertion forms together with the lateral margin of the ramus anterior an uninterrupted line as in the preceding species. The insertio musc. furcolateralis are not visible from above; seen from below they have the shape of triangles and their posterior margins are perpendicular to the length axis of the furca. The lower surface of each of these insertions is somewhat more deeply indented than the upper one and therefore smaller. Characteristic for the furca of this species is that the ramus anterior and the r. lateralis are not in one plane; the anterior branches are inclined towards each other so that in an anterior view they form a V, whereas the lateral branches are in one plane.

15. *Hydroporus planus* F. 1.07 mm. (Pl. VII, 3).

The metathoracic furca of this species is by some features considerably distinguished from those of the preceding ones. The corpus basillare is rather high and very long, much higher in front than behind. The upper margin is thickened and practically straight. The anterior margin is in the upper part strongly convex and then runs downward under an angle of not quite 45°; it is deeply cleft in its whole length and this cleft has its maximum depth in the upper part of the anterior margin as a view from above shows distinctly between the anterior branches. The ramus anterior is not too long and is also relatively narrow; its lateral margins are practically straight and parallel. It carries in front the insertio musc. retractoris mesothoracis which is directed cranially and at the same time moderately obliquely upwards. This insertion is again depressed and its mouth is—in contradistinction to the preceding species—not tear-shaped, but reniform. Between the anterior branches is a broad gap which is U-shaped. The ramus lateralis is narrower and longer than the ramus anterior, it is flat and with its end it is directed obliquely sideways; at the same time it is slightly arcuately bent. Its end is truncated, with the anterior apical corner of this branch rounded and the posterior one pointed. The insertio musc. furcodorsalis is depressed in the form of a shallow groove and occupies almost the whole upper surface of the ramus lateralis, similarly as in the preceding species. Its posterior margin is in the proximal part again characterised by a low ridge. A special feature of the metathoracic furca of this species is the position of the insertio musc. furcolateralis. This insertion does not project behind the ramus lateralis, nor is it hidden under it as in the other species of the subfamily *Hydroporinae*, but can well be seen from above far in front of the lateral branch. Seen from below it has a triangular shape and its lower surface is much more deeply indented than the upper one.

16. *Hydroporus discretus* Fairm. 0.98 mm. (Pl. VII, 4).

The corpus basillare is in this species relatively low and long, and becomes gradually lower from the front backwards. Its upper margin is thickened and straight. The anterior margin is directed obliquely downwards under an angle of about 45°, and in the upper part it is strongly convex in a cranial direction; it is deeply cleft in its whole length. The ramus lateralis is short and relatively broad; its lateral margins are roughly straight and converge in a distal direction. At the apical end of this branch is the shallowly depressed insertio musc. retractoris mesothoracis, directed forwards; in an anterior view its mouth is oviform, with the more rounded part directed proximally, the more pointed one distally. Between the two anterior branches is a broad gap which has the shape of part of a hexagon, as its posterior margin is broken and has the shape of a broadly open letter V and the lateral margins are parallel. The ramus lateralis is flat, much longer and narrower than the ramus anterior, and it is slightly bent in the vertical plane. Its anterior and its posterior margin are roughly parallel, and the distal end has a similar shape as in the species *Hydroporus planus* F. The insertio musc. furcodorsalis is depressed in the form of a shallow groove

and its anterior margin and part of the posterior one are identical with the margin of the ramus lateralis. The proximal half of the posterior margin of this insertion is characterised by a chitinous thickening, which, however, does not form together with the lateral margin of the ramus anterior and the posterior margin of the ramus lateralis a continuous line as in the preceding four species. The insertio musc. furcolateralis projects when seen from above slightly under the basal part of the lateral branch, and seen from below it has the shape of an almost equilateral triangle. The anterior margin of its upper surface is slightly arcuately indented, the margin of the lower surface is much more deeply indented.

17. *Hydroporus nigrita* F. 0.78 mm. (Pl. VII, 5).

This and the preceding species show a considerable resemblance, and therefore I selected these two species for the study of the metathoracic furca in order to ascertain to what an extent their furcae differ. Roughly the metathoracic furcae of the two species are very similar, though they can be quite safely distinguished on the basis of certain characters. *Hydroporus nigrita* F. has the corpus basillare somewhat shorter so that seen from above it does not project between the anterior branches so far forward as in *H. discretus* Fairm. At the same time its anterior margin is far more shallowly cleft. The ramus anterior is a little narrower, much longer, and thus also the gap between these anterior branches is relatively narrower and has the shape of the letter U. The insertio musc. retractoris mesothoracis though also oval in an anterior view, is much higher and more rounded. The ramus lateralis is roughly as broad as in *Hydroporus discretus*, but is somewhat shorter. This is especially striking when seen from above, as the two lateral branches are inclined towards each other under a more acute angle and as they are more strongly bent in the vertical plane. The insertio musc. furcodorsalis is consequently also shorter, but otherwise it agrees in the two species. The insertio musc. furcolateralis does not differ any more essentially in *Hydroporus discretus* Fairm. and *Hydr. nigrita* F.

18. *Porhydrus lineatus* F. 0.98 mm. (Pl. VII, 6).

The corpus basillare is relatively short and high, anteriorly about twice as high as posteriorly. Its upper margin is thickened and straight, the anterior margin is also almost straight and runs downward under an angle of about 45°; it is cleft in its uppermost part. The ramus anterior is very broad, its inner lateral margin is shallowly indented, the outer one is rounded, and the anterior margin is obliquely arcuately indented. In front is the large insertio musc. retractoris mesothoracis, which is partly visible from above, and in an anterior view its mouth is tear-shaped; this insertion is depressed in a funnel-shaped, fairly spacious cavity. Between the anterior branches is a gap, broadly open in front, which has roughly an oval shape. The rami anteriores are broadly open so that they are almost in one plane. Between the anterior and the lateral branch there is a fairly deep indentation. The ramus lateralis is relatively short and narrow; it broadens at the end so that it forms one rounded processus directed anteriorly and at the same time one rectangular corner directed backwards and downwards. The insertio musc. furcodorsalis

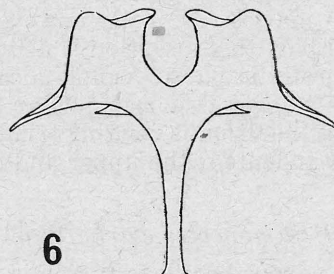
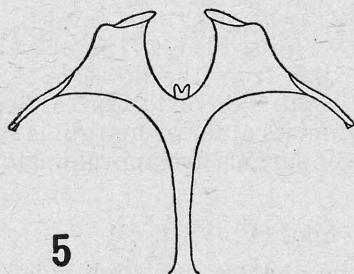
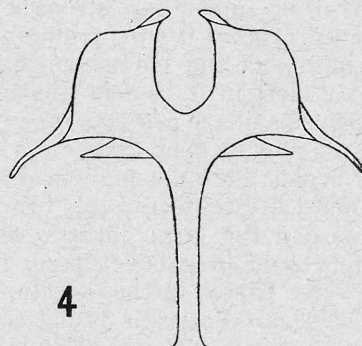
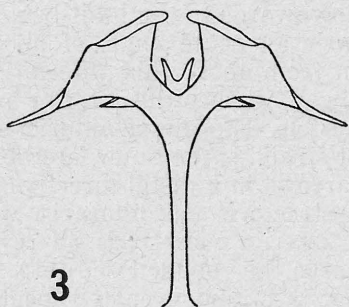
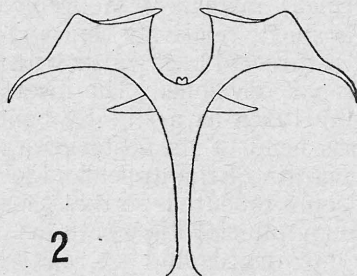
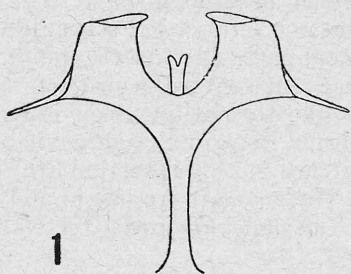
is in the proximal part very shallowly depressed and in a distal direction this depression passes into a straight plane. The anterior margin and the larger part of the posterior margin of this insertion are identical with the margin of the ramus lateralis; in the proximal part the depression of this insertion is marked by a low ridge which forms with the lateral margin of the ramus anterior and the posterior margin of the ramus lateralis an unbroken, strongly curved line. Seen from above the insertio musc. furcolateralis projects only slightly with its apical part on both sides of the furca and is relatively small. Seen from below it has roughly a triangular shape, and the posterior margins of these insertions do not lie in one straight line, but are slightly inclined forwards.

19. *Graptodytes bilineatus* Sturm. 0.69 mm. (Pl. VIII, 1).

The corpus basillare furcae is rather high and long, its upper margin is straight and thickened. The anterior margin runs out far in a cranial direction so that seen from above it projects between the anterior branches of the furca to the middle of their length. This processus of the anterior margin is, however, not broadly rounded as in most of the other *Hydroporinae*, but is bluntly pointed (in a lateral view); then the anterior margin of the corpus basillare runs downwards under an angle of about 45° and is in its whole length not too deeply cleft. The ramus anterior is broad, narrows slightly in an anterior direction, and its inner lateral margin is shallowly indented, whereas the outer one is almost straight. The insertio musc. retractoris mesothoracis lies in front; it is depressed in cornet-shape and has in an anterior view the shape of an elongated droplet. Between the anterior branches is a broadly oviform gap open in front. These branches are very broadly open so that they are almost in one plane. The ramus lateralis is thin, rod-shaped and at the same time slightly arcuately bent in the vertical plane so that it is directed obliquely downwards with its end. The insertio musc. furcodorsalis occupies almost its whole upper side; it is depressed in the form of a shallow groove. In the distal part it is narrow, with parallel anterior and posterior margins, in the proximal part it is somewhat broader and curved in sickle-shape; its posterior margin is indicated in the places by a narrow ledge-like elevation which attaches itself anteriorly to the outer lateral margin of the ramus anterior. The insertio musc. furcolateralis is not visible from above; seen from below it has a triangular shape.

20. *Deronectes platynotus* Germ. 1.44 mm. (Pl. VIII, 2).

The corpus basillare of this species is high and fairly long; its upper margin is thickened, faintly convex and becomes lower in the direction from front to back. The anterior margin is in the upper part only little convex, runs from above downwards under an angle a little smaller than 45° , and is shallowly cleft in its whole length. The ramus anterior is short and very broad; its inner lateral margin is almost straight, the outer one is also straight and besides slanting so that in front this branch is considerably narrower than behind. The two anterior branches are broadly open and between them



Pl. VIII. 1 — *Graptodytes bilineatus* Sturm. 2 — *Deronectes platymotus* Germ.
3 — *Stictotarsus duodecimpustulatus* F. 4 — *Potamonectes clarki* Woll. 5 — *Oreodytes septentrionalis* Gyll. 6 — *Scarodytes halensis* F.

is a gap which has roughly the shape of the letter U. The insertio musc. retractoris mesothoracis lies in front; it is partly visible also in a dorsal view. In an anterior view it has the shape of a very long, elongated droplet, but is not depressed in funnel-shape as in most of the other species of the subfamily *Hydroporinae*; instead it is deeply depressed in groove-shape. The ramus lateralis is short, relatively thin and at the same time rather strongly curved, so that it is directed backwards with its apical part. The insertio musc. furcodorsalis is not developed. The insertio musc. furcolateralis projects on both sides of the furca as a slightly bent horn-like formation. Seen from below the arcuate bend of its posterior and anterior margin is again visible; the anterior margin of the upper and lower surface of this insertion are roughly equally deeply indented, so that these two surfaces are approximately equal in size. In an anterior view both ins. musc. furcolateralis are directed slightly obliquely downwards and are relatively low.

21. *Stictotarsus duodecimpustulatus* F. 1.55 mm. (Pl. VIII, 3).

The corpus basillare is relatively low and very long; its upper margin slopes from the front backwards, is thickened and almost straight. The anterior margin is in its upper part strongly convex in a cranial direction, and from this rounded process it runs from above downwards to the limit between the metasternum and the metasternellum under an acute angle of about 40° ; it is deeply cleft in its whole length. Seen from above this anterior margin of the corpus basillare projects far into the gap between the anterior branches of the furca and its deep division is well visible. The ramus anterior is short and very broad; its inner margin is almost straight; the outer lateral margin is also almost straight, and this branch narrows in a distal direction. It carries at its end the large insertio musc. retractoris mesothoracis, which is deeply depressed in groove-shape. In an anterior view it is narrow, long, and its cavity passes in the direction towards the rounded end into an even plane. The ramus lateralis is not too long, thin, and arcuately bent in the vertical plane; it narrows slightly in a distal direction and ends in a rounded tip. This branch is directed with its apical part sideways and at the same time obliquely downwards. The insertio musc. furcodorsalis occupies almost its whole upper surface; it is depressed in the form of a shallow groove. Its anterior margin is identical with the margin of the lateral branch, the posterior margin projects, however, moderately over this branch. In the proximal part this insertion is delimited by a raised ledge. The insertio musc. furcolateralis is partly visible also in a view from the dorsal side, and its posterior margin is perpendicular to the length axis of the furca. Seen from below this insertion is roughly triangular, and its anterior margin is shallowly arcuately indented; the upper and the lower surface are approximately equal in size.

22. *Potamonectes clarki* Woll. 1.30 mm. (Pl. VIII, 4).

The corpus basillare furcae is low, long and becomes slightly lower from the front backwards. Its upper margin is straight and thickened; the anterior margin is also straight, runs straight from above downwards under an angle exceeding a little 45° , and is therefore not visible between the

anterior branches of the furca in a view of the dorsal side. In the uppermost part it is slightly cleft for a very short distance, for the rest it is whole in its whole length. The ramus anterior is of medium length and very broad, its inner margin is slightly indented, the outer margin rounded. The insertio musc. retractoris mesothoracis lies at its apical end; viewed from above it is only partly visible as its lateral part is turned obliquely downwards and thus hidden under the anterior margin of the ramus anterior. In an anterior view this insertion is depressed in funnel-shape, and its margin is tear-shaped. The two anterior branches are mutually inclined under an acute angle; and the gap between them is oval. The ramus lateralis is thin, rod-shaped and strongly arcuately bent in the vertical plane, so that with its apical part it is directed obliquely backwards and downwards. In the basal part it narrows in a distal direction, then its anterior and posterior margin are parallel, and it ends in a blunt rounded tip. The insertio musc. furcodorsalis is narrow, long and depressed in the form of a shallow groove, and occupies almost the whole upper surface of the lateral branch. Its anterior and partly its posterior margin are identical with the margin of the ramus lateralis; part of the posterior margin is characterised by a bent raised ledge which in front attaches directly to the outer lateral margin of the ramus anterior. The insertio musc. furcolateralis projects when seen from above on both sides of the furca, and the posterior margins of these insertions are in one straight line. Seen from below they have a roughly triangular shape, and their lower surface is more deeply indented than the upper one and therefore also smaller.

23. *Oreodytes septentrionalis* Gyll. 1.19 mm. (Pl. VIII, 5).

The corpus basillare is in this species rather high and long; its upper margin is thickened and straight. The anterior margin is in its upper part convex in a cranial direction, and then runs obliquely downwards under an angle slightly exceeding 45° ; it is not too deeply cleft in its whole length, and this division is distinctly visible between the anterior branches when seen from above. The ramus anterior is relatively short and broad; it narrows in a distal direction. Its inner margin is slightly arcuately indented; the outer lateral margin is S-shaped, convex in its distal part, concave in its proximal part. The anterior branch carries in front the insertio musc. retractoris mesothoracis, which is rather deeply depressed in funnel-shape. In an anterior view its margin has the shape of an elongated droplet. A broadly oviform gap, open in front, lies between the rami anteriores. The ramus lateralis is rather long and besides arcuately bent; it is directed with its end obliquely downwards and sideways. Its margins are practically parallel so that it is equally thick in its whole length, and it ends in a blunt rounded tip. In the apical part it is provided on the underside with a low spiny processus directed downward and backward. The insertio musc. furcodorsalis is narrow, long, depressed as a shallow groove, and roughly equally wide in its whole length. Its anterior and for the major part also the posterior margin coincide with the margin of the ramus lateralis; in the proximal part its posterior margin is characterised by a thickening. The insertio musc. furcolateralis is hidden in a dorsal view; seen from below it has roughly the shape of an equilateral

triangle; its lower surface is but little more deeply indented than the upper surface, and both are thus almost equal in size.

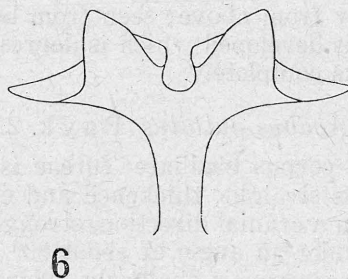
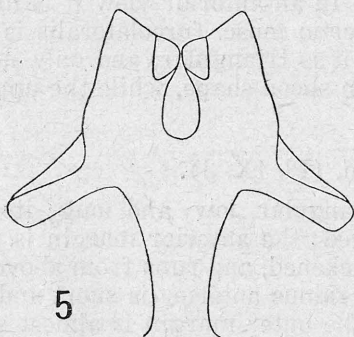
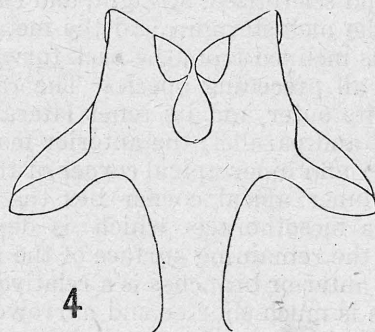
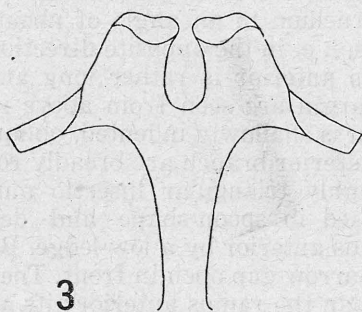
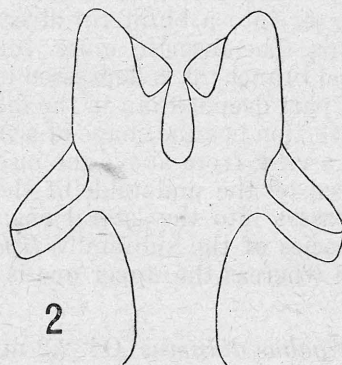
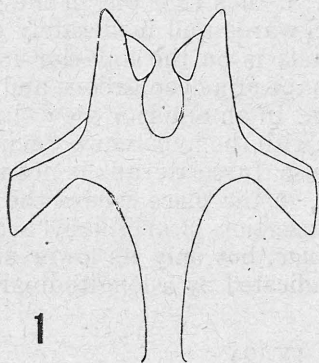
24. *Scarodytes halensis* F. 1.19 mm. (Pl. VIII, 6).

The corpus basillare furcae is rather short and high, strongly lowering itself from the front backwards. The upper margin is thickened and almost straight; the anterior margin is in the upper part only slightly convex anteriorly so that in a dorsal view it is not visible between the anterior branches of the furca. It encloses with the ventral surface of the metathorax an angle of about 45° and is in the uppermost part shallowly cleft. The ramus anterior is relatively short and broad; its lateral margins are roughly straight and parallel; the anterior margin is indented. The insertio musc. retractoris mesothoracis lies in the apical part; it is depressed in funnel-shape and is in an anterior view tear-shaped. Both these branches are widely open in an anterior view, and seen from above there is a broad gap between them. The ramus lateralis is relatively short, rod-shaped, and slightly bent in the vertical plane; it narrows in a distal direction and ends in a blunt rounded tip. On the upper side of this lateral branch lies the insertio musc. furcodorsalis, which is depressed in the shape of a shallow groove. It is relatively narrow, bent in sickle-shape, and does not reach to the end of the ramus lateralis as in the preceding species. Its anterior margin is identical with the margin of the branch, but the posterior margin is characterised in its whole length by a ledge-like elevation which forms an unbroken curve together with the outer lateral margin of the ramus anterior and with the apical part of the anterior margin of the ramus lateralis. The insertio musc. furcolateralis is partly visible in a view from above; seen from below it is triangular and its lower surface is deeply angularly indented and thus smaller than the upper surface. Both these insertions are mutually in contact in the median plane of the furca.

Colymbetinae

25. *Copelatus haemorrhoidalis* F. 2.0 mm. (Pl. IX, 1).

The corpus basillare is low and relatively short, and becomes slightly lower in the direction from the front backwards. Its upper margin is thickened and enlarged; the anterior margin is strongly sclerotised, thickened, and roughly perpendicular to the ventral surface of the metathorax. The ramus anterior is fairly long and not too broad; its outer lateral margin is almost straight, the inner one is shallowly indented. In a distal direction this branch broadens and is at the end obliquely truncated; its outer anterior corner is bluntly pointed the inner one is broadly rounded and in it lies the insertio musc. retractoris mesothoracis, which is depressed in the shape of a shallow dish. Seen from above it has the shape of a triangle with blunt corners and against the adjoining surface of the anterior branch it is indistinctly delimited by a narrow and low ledge. In an anterior view the two anterior branches are inclined towards each other in an acute angle so that they form the letter V. Seen from above there is between them an elliptic



Pl. IX. 1 — *Copelatus haemorrhoidalis* F. 2 — *Agabus didymus* Ol. 3 — *Agabus guttatus* Payk. 4 — *Agabus paludosus* F. 5 — *Agabus bipustulatus* L. 6 — *Platambus maculatus* L.

gap which is in front incompletely closed by the insertions. The ramus lateralis is roughly as broad and long as the ramus anterior, it enlarges in a distal direction and is truncated at the end; it thus runs out in the posterior apical corner into a blunt tip directed backwards and moderately obliquely downwards. The insertio musc. furcodorsalis is on the anterior margin of this lateral branch; it is depressed in the shape of a deep groove and is in the proximal part deeper than in the distal part. In an anterior view the margin of this insertion has the shape of a triangle with the hypotenuse facing downward. In a view from above the insertio musc. furcolateralis is not visible as it is placed on the underside of the furca, in the place where the anterior branch passes into the lateral one. This insertion is originally a cavity as in the species of the subfamily *Hydroporinae*, but only its lower surface is developed whereas the upper one is only indicated by a longitudinal thickening.

26. *Agabus didymus* O l. 2.2 mm. (Pl. IX, 2).

The corpus basillare is very low and short. Its upper margin is strongly thickened, enlarged and straight; the anterior margin is also strongly thickened and sclerotised, straight, and runs obliquely downwards to the limit between the metasternum and the metasternellum in an angle of about 130° ; thus it is inclined from the back forwards, i. e. in the opposite direction from that of all preceding species. The ramus anterior is rather long and very broad; its outer and its inner lateral margin are seen from above roughly straight and parallel; the anterior margin is shallowly indented, oblique, and the outer and inner apical corner of the anterior branch are broadly rounded. In the inner apical corner lies the roughly triangular insertio musc. retractoris mesothoracis which is depressed in spoon-shape and delimited against the remaining surface of the ramus anterior by a low ledge. Between the two anterior branches is a relatively narrow gap open in front. The ramus lateralis is much shorter and narrower than the ramus anterior; its anterior and posterior margins are slightly convex, and in the apical part it ends in a blunt, broadly rounded tip directed backwards. The large insertio musc. furcodorsalis lies on the anterior margin of this branch; it is open anteriorly and at the same time obliquely upwards. In an anterior view it is high and its spatial cavity is well visible. The insertio musc. furcolateralis is hidden in a view from above; seen from below it is triangular, and only its lower surface is developed which is depressed in spoon-shape, while the upper surface lacks completely.

27. *Agabus guttatus* P a y k. 2.3 mm. (Pl. IX, 3).

The corpus basillare furcae is rectangular, low and long; its upper margin is straight, thickened and enlarged; the anterior margin is slightly convex in a cranial direction, strongly thickened, and runs from above downwards under an angle of about 80° . The ramus anterior is short and broad, its inner margin is shallowly indented, the outer margin is almost straight and both converge in a distal direction; the anterior margin is wavily indented. The insertio musc. retractoris mesothoracis is in contradistinction to the other species of the genus *Agabus* depressed in funnel-shape, is open

in a cranical direction, and in an anterior view its mouth is droplet-shaped by which it resembles the species of the subfamily *Hydroporinae*. Between the rami anteriores lies the elongated oval gap, open in front. The ramus lateralis is relatively narrow, slightly widens in a distal direction, and is at the end straightly truncated. The insertio musc. furcodorsalis is directed forwards and at the same time obliquely upwards, and is depressed in the shape of a deep groove. In the figure on pl. IX it looks as if the posterior margin of this insertion were identical with the posterior margin of the ramus lateralis, but in reality the lateral branch is inclined in a posterior direction and the insertion is directed upwards so as to cover this posterior margin. The insertio musc. furcolateralis is not visible in a dorsal view; seen from below it lies under the ramus anterior nearer its inner margin and reaches in a posterior direction to the posterior margin of the indentation between the anterior branches. The lower and the upper surface are developed, but the latter is smaller.

28. *Agabus paludosus* F. 2.5 mm. (Pl. IX, 4).

The corpus basillare is low and not too long, its upper margin is slightly indented and lowers itself from the front backwards, and becomes strongly thickened and enlarged; the anterior margin is sclerotised and thickened, practically straight, and runs downwards under an angle of about 110° , thus it is forward inclined as in the species *Agabus didymus* Ol. The ramus anterior is medium long, very broad and enlarges in a distal direction. Its outer lateral margin is slightly, the inner one more deeply indented; the anterior margin is obliquely truncated, the outer and the inner apical corner of this branch are rounded. In the inner apical corner lies the insertio musc. retractoris mesothoracis which is seen from above roughly triangular. It is shallowly spoon-shaped depressed and is delimited against the adjoining surface of the anterior branch by a low thickening. Between the two anterior branches is a tear-shaped gap which is anteriorly almost entirely closed by the insertions. The ramus lateralis is rather long and broad and narrows at the end into a blunt rounded tip directed obliquely downwards and sideways. The anterior margin of this branch is convex, the posterior margin is in the proximal part indented and in the distal part convex so that it is bent in S-shape. The insertio musc. furcodorsalis is open in a forward and upward direction; it is deeply groove-like depressed and reaches to the ramus anterior; in an anterior view it becomes lower towards both ends. Its anterior and posterior (in an anterior view lower and upper) margin form with the outer lateral margin of the ramus anterior an unbroken line. The insertio musc. furcolateralis is visible for the lesser part also in a dorsal view, beside the outer apical corner of the ramus anterior; whence it continues to below the basal part of the ramus lateralis as a rather high chitinous comb, which is really the lower surface of the insertion; the upper surface is lacking, only indicated by a narrow ledge.

29. *Agabus bipustulatus* L. 3.1 mm. (Pl. IX, 5).

The corpus basillare becomes lower from the front to the back and is relatively low and short. Its anterior margin is strongly thickened, roughly

straight; and runs down to the sternal sclerites under an angle exceeding slightly 90° ; the upper margin is thickened, enlarged, and only slightly indented. The ramus anterior is rather long and broad, its inner and outer lateral margin are very shallowly indented. The inner apical corner of this branch is bluntly pointed, the inner corner is broadly rounded and the insertio musc. retractoris mesothoracis lies in it. This insertion is of an irregular shape, is shallowly spoon-shaped depressed, and is delimited against the remaining surface of the ramus anterior in the distal part by an indistinct, in the proximal part by a raised ledge. In an anterior view the two anterior branches are inclined towards each other under an acute angle so that they form the letter V; seen from above there is between them a gap which narrows in a distal direction and which anteriorly is entirely closed by the insertions, which are mutually in contact. The ramus lateralis is shorter and narrower than the ramus anterior; its anterior and posterior margin are almost straight and slightly converge in a distal direction; the anterior and the posterior apical corner are rounded. In the anterior margin is the insertio musc. furcodorsalis which is open in front and at the same time obliquely upwards, and is depressed into a spacial cavity. The posterior (upper in an anterior view) margin forms with the lateral margin of the ramus anterior a continuous curve bent several times. The insertio musc. furcolateralis is not visible at all in a dorsal view; seen from below it lies under the ramus anterior and reaches as far as under the basal part of the ramus lateralis. This insertion begins already in the outer apical corner of the anterior branch as a low ledge, which then rises in a posterior direction as a comb-like formation, which is the underside of the insertion. The upper surface is lacking and is only indicated by a low ledge.

30. *Platambus maculatus* L. 2.7 mm. (Pl. IX, 6).

The corpus basillare is low and relatively long, becoming rather strongly lower in the direction from the front backwards. Its anterior margin passes into the carina sagittalis metasterni, but is distinctly distinguished from it by being strongly thickened; it runs downwards under an angle of about 80° . The upper margin is also thickened and besides enlarged and slightly bent. The ramus anterior is very short and broad, its inner margin is indented, the outer one moderately rounded; the anterior margin is slanting when seen from above. The outer and the inner apical corner of the ramus anterior are rounded. In the inner corner lies the insertio musc. retractoris mesothoracis which in a dorsal view has the shape of a triangle with rounded corners; this insertion is, however, really—in a view perpendicular to the surface of the anterior branch—much more elongated than is shown in the appended figure. From the remaining surface of the anterior branch this insertion is delimited at its posterior margin by a narrow and raised ledge. In an anterior view the two anterior branches are wide open so that they enclose together an obtuse angle; seen from above there is between them a gap broadly open anteriorly, which is rounded and broader than long. The ramus lateralis is much narrower and at the same time longer than the ramus anterior; its anterior margin is very shallowly indented, the posterior margin is slightly convex; in a distal direction this branch narrows strongly and is terminated

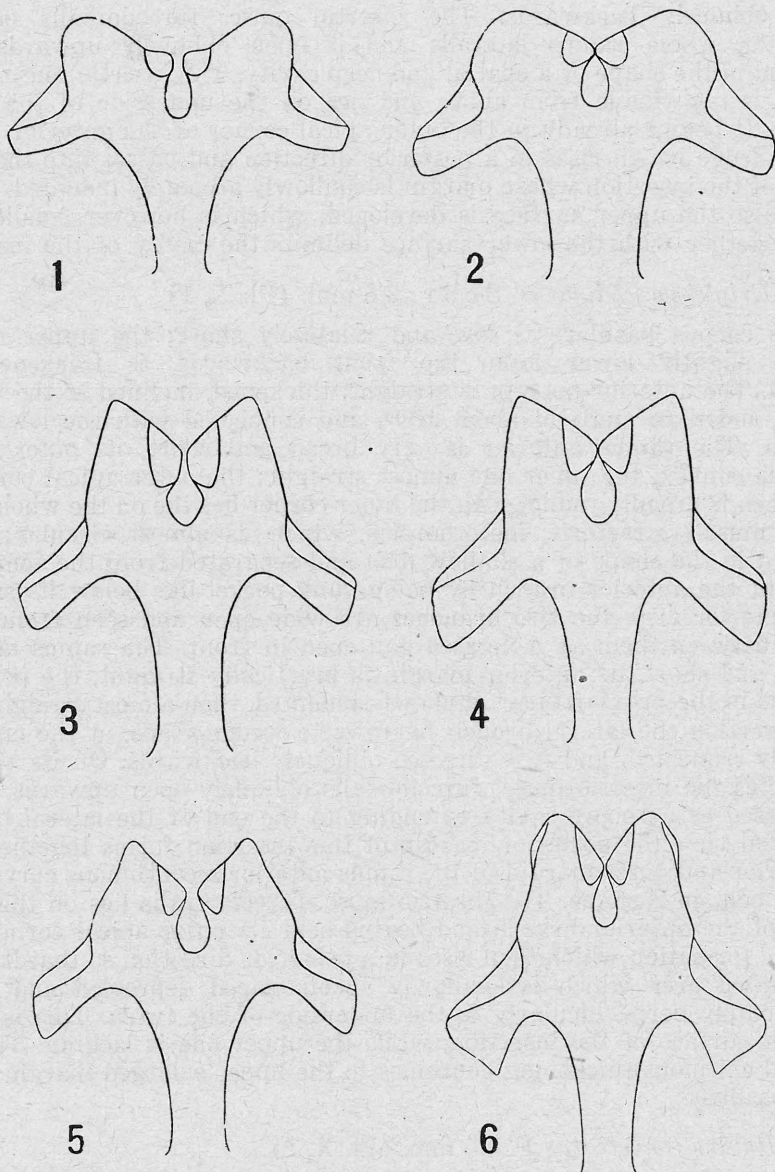
by a blunt rounded tip. Seen from above the two lateral branches lie in one straight line, so that they are directed to the sides in contradistinction to the other species where the lateral branches are directed with the apical part always obliquely backwards. The insertio musc. furcodorsalis occupies almost the whole ramus lateralis and is open obliquely upwards; it is depressed in the shape of a spatial and deep cavity. The insertio musc. furcolateralis is not visible from above and lies on the underside of the ramus anterior. It begins already in the outer apical corner of the anterior branch as a low ledge which rises in a posterior direction and passes into the lower surface of the insertion whose margin is shallowly arcuately indented. In this species also the upper surface is developed, which is however smaller, and which together with the lower surface delimits the cavity of the insertion.

31. *Eriglenus undulatus* S c h r. 2.6 mm. (Pl. X, 1).

The corpus basillare is low and relatively short; the upper margin becomes slightly lower from the front backwards, is thickened and enlarged. The anterior margin is straight, thickened, inclined to the ventral sclerites under an angle of about 100°, and connected with the low carina sagittalis. The ramus anterior is very broad and short, its outer lateral margin is convex, the inner one almost straight; the outer apical corner of this branch is broadly rounded. In the inner corner lies the on the whole small insertio musc. retractoris mesothoracis, which is almost circular; it is depressed in the shape of a shallow dish and separated from the remaining surface of the anterior branch by being sunk pocket-like below its surface. In an anterior view the two branches are wide open and seen from above there is between them an elongated gap open in front. The ramus lateralis is broad and short, its anterior margin is practically straight, the posterior margin is in the proximal part shallowly indented, then almost straight. In a distal direction the lateral branch narrows in wedge-shape, at the end it is straightly truncated, and it is directed obliquely backwards. On its anterior margin lies the insertio musc. furcodorsalis obliquely open upwards, which is depressed as a roomy cavity extending to the end of the lateral branch. In a dorsal view the posterior margin of this insertion forms together with the anterior and outer margin of the ramus anterior a continuous curve twice strongly bent in S-shape. The insertio musc. furcolateralis lies on the lower surface of the anterior branch and begins near its outer apical corner as a comb-like formation which then rises in a posterior direction so that it forms an elongated area which is shallowly spoon-shaped depressed and placed approximately perpendicularly to the underside of the furca. This is really the lower surface of the insertion, while the upper one is lacking. Then an elongated chitinous thickening continues to the upper enlarged margin of the corpus basillare.

32. *Ilybius fenestratus* F. 4.3 mm. (Pl. X, 2).

The metathoracic furca of this species is more like the furca of *Eriglenus undulatus* S c h r k. than like the furca of the following species of the genus *Ilybius*. The corpus basillare furcae is rather short, not too high, and becomes lower in a posterior direction. Its upper margin is very strongly thickened



Pl. X. 1 — *Eriglenus undulatus* Schrk. 2 — *Ilybius fenestratus* F. 3 — *Ilybius ater* Deg. 4 — *Ilybius fuliginosus* F. 5 — *Ilybius quadriguttatus* Boisd. et Lac. 6 — *Rhantus pulverosus* Steph.

and enlarged, so that it forms a thin plate placed perpendicularly to the corpus basillare. Also the anterior margin is thickened; it runs approximately perpendicularly to the ventral sclerites of the metathorax and is connected anteriorly with the low carina sagittalis metasterni. The ramus anterior is short and very broad, its inner margin is indented, the outer margin slightly convex, and the anterior margin roughly straight. The outer apical corner is broadly rounded, and in the inner one lies the small insertio musc. retractoris mesothoracis. Seen from above this insertion has an irregular shape, is shallowly depressed in spoon-shape, and in the posterior part continues still under the surface of the anterior branch as in the preceding species. In an anterior view the two anterior arms are wide open so that they enclose an obtuse angle; only their inner apical corners with the insertions are bent downwards so that they are inclined to each other in an acute angle. Seen from above there is between them a tear-shaped gap which in front is closed by the insertions. The ramus lateralis is broad, narrows in a distal direction, and its anterior and posterior margin are practically straight. It ends in a blunt rounded tip directed backwards. The insertio musc. furcodorsalis is open obliquely upwards and forwards, it is depressed in a spacious cavity and in an anterior view is considerably high. The middle part of the furca from the gap between the anterior branches backwards to the enlarged upper margin of the corpus basillare is flat and translucent. Seen from above the insertio musc. furcolateralis is hidden, seen from below it lies under the ramus anterior. Only its lower surface is developed, which has the shape of an elongated triangle; the upper surface is lacking. A raised ledge continues from this insertion in a posterior direction to the enlarged upper margin of the corpus basillare.

33. *Ilybius ater* Deg. 3.8 mm. (Pl. X, 3).

The corpus basillare is rectangular, its upper margin is subhorizontal, thickened and enlarged. The anterior margin is also thickened, straight, and runs downward under a right angle, i. e. perpendicularly to the ventral metathoracic sclerites; anteriorly it passes into the low carina sagittalis. The ramus anterior is rather long and broad; its outer lateral margin is almost straight, the inner one indented; seen from above the anterior margin is slanting and slightly convex. The outer apical corner of the anterior branch is pointed, the inner one is blunt and there lies in it the large insertio musc. retractoris mesothoracis. This insertion has seen from above an irregular shape, is scarcely depressed at all, and is indistinctly delimited against the adjoining surface of the ramus anterior; only in its posterior part it is more markedly distinguished by a chitinous elevation. In an anterior view the anterior branches are inclined towards each other under an acute angle, seen from above there lies between them a rounded gap which is almost closed anteriorly. The ramus lateralis is a little shorter and much narrower than the ramus anterior, its anterior and posterior margin are subparallel, and this branch is thus roughly equally wide in its whole length; its posterior apical corner forms a rounded tip directed backwards. In its outer margin is the not too high (in an anterior view) insertio musc. furcodorsalis, whose cavity is deep and groove-shaped. The insertio musc. furcolateralis lies on the underside

of the ramus anterior, and only its lower surface is developed, which has the shape of an elongated triangle; the upper side is indicated only by a narrow longitudinal ledge. A raised thickening continues from this insertion in the direction towards the upper enlarged margin of the corpus basillare.

34. *Ilybius fuliginosus* F. 2.9 mm. (Pl. X, 4).

The corpus basillare is in this species rather long and high; its upper margin is enlarged and lowers itself from the front backwards. The anterior margin is thickened, straight, runs downward under an angle slightly exceeding 90°, and passes into the relatively low carina sagittalis. The ramus anterior is rather long and broad; its outer lateral margin is almost straight, the inner one indented; seen from above the anterior margin is slanting, slightly convex, and the outer and inner apical corner of the anterior branch are bluntly pointed. In an anterior view the two anterior branches are inclined towards each other under a more acute angle than in the preceding species, and seen from above there is between them a broad and short gap which is anteriorly completely closed by the insertions. The ramus lateralis is directed obliquely backwards; it is equally broad in its whole length; its anterior margin is slightly indented, the posterior one faintly convex; it ends in a broadly rounded tip directed caudally. The insertio musc. furcodorsalis is in its anterior margin; it is depressed into a spacial groove-shaped cavity and is in an anterior view somewhat higher than in *Ilybius ater* De g. Seen from above the posterior margin of this insertion forms a continuous and little bent line together with the outer lateral margin of the ramus anterior. The insertio musc. furcolateralis lies on the underside of the ramus anterior, near its inner margin, and has only the lower surface developed. This surface has the shape of an elongated triangle which rises backwards; the upper surface of the insertion is only indicated by a ledge. A raised thickening continues from this insertion in a posterior direction to the enlarged upper margin of the corpus basillare.

35. *Ilybius quadriguttatus* Bois d. et Lac. 3.4 mm. (Pl. X, 5).

The corpus basillare furcae has a roughly rectangular shape. Its upper margin is enlarged, strengthened and becomes only slightly lower in a caudal direction; the anterior margin is little thickened, runs downwards under an angle of about 115°, and passes anteriorly into the carina sagittalis metasterni. The ramus anterior is broad and rather short; its outer lateral margin is roughly straight, the inner one is arcuately indented, the anterior one slightly convex. The outer and the inner apical corner of the anterior branch are rounded and in the inner one lies the insertio musc. retractoris mesothoracis. This insertion has seen from above a roughly triangular shape, is shallowly depressed in spoon-shape, and is rather indistinctly delimited. Between the anterior branches is an oval gap which is anteriorly partly closed by the insertions. The ramus lateralis is considerably narrower than the ramus anterior; its anterior and posterior margin are shallowly indented, and this branch slightly broadens in a distal direction. Its whole anterior margin is occupied by the insertio musc. furcodorsalis, which is open obliquely upwards and is rather deeply depressed in groove-shape. The

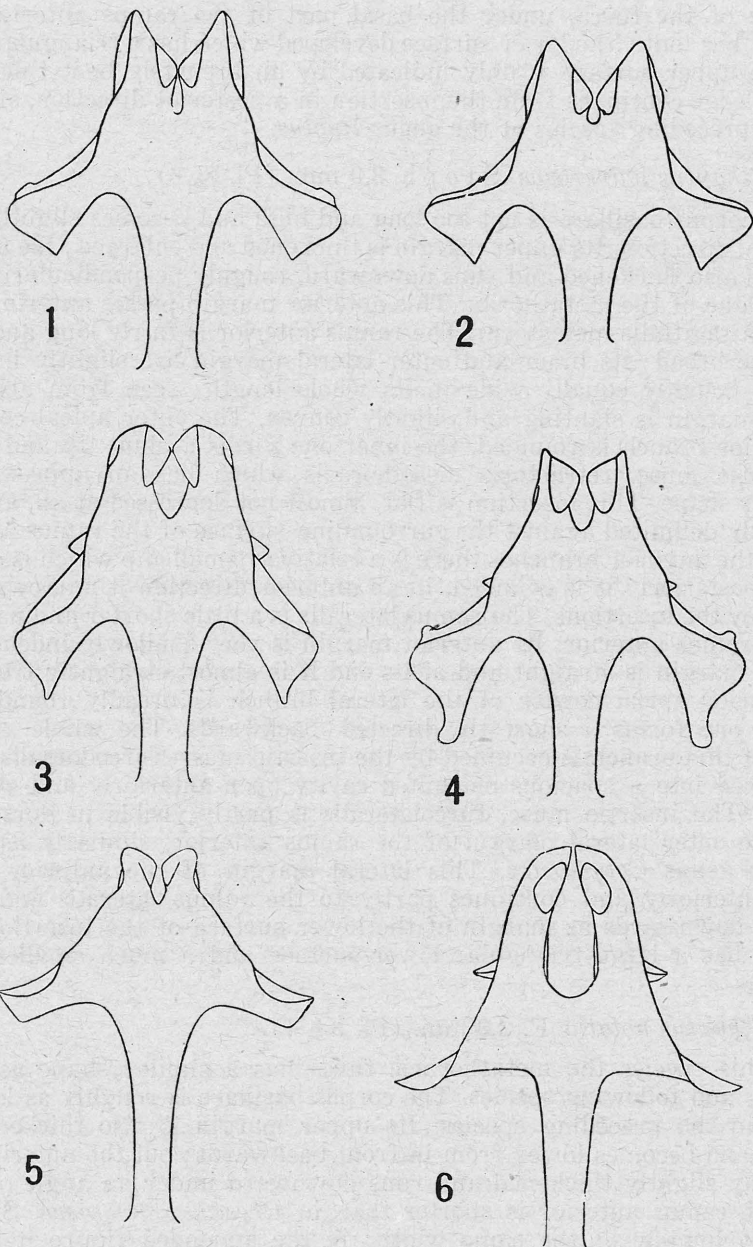
insertio musc. furcolateralis is hidden in a dorsal view as it lies on the underside of the furca, under the basal part of the ramus anterior. This insertion has only the lower surface developed which has a triangular shape. while the upper surface is only indicated by an arcuately bent thickening. A raised ledge continues from the insertion in a posterior direction, similarly as in the preceding species of the genus *Ilybius*.

36. *Rhantus pulverosus* Steph. 3.0 mm. (Pl. X, 6).

The corpus basillare is not too long and high and becomes slightly lower in a caudal direction. Its upper margin is thickened and enlarged; the anterior margin is also thickened and runs downward, roughly perpendicularly to the ventral plane of the metathorax. This anterior margin passes anteriorly into the carina sagittalis metasterni. The ramus anterior is fairly long and at the same time broad; its inner and outer lateral margin are slightly indented, and it is roughly equally wide in its whole length; seen from above the anterior margin is slanting and slightly convex. The outer apical corner of the anterior branch is rounded, the inner one forms a blunt tip and carries the insertio musc. retractoris mesothoracis which has an approximately triangular shape. This insertion is flat, almost not depressed at all, and very indistinctly delimited against the surrounding surface of the ramus anterior. Between the anterior branches there is a relatively small gap which is droplet-shaped; posteriorly it is rounded, in an anterior direction it narrows and it is closed by the insertions. The ramus lateralis is a little shorter and narrower than the ramus anterior. Its anterior margin is very shallowly indented, the posterior margin is straight and at its end it is almost straightly truncated. The anterior apical corner of the lateral branch is broadly rounded, the posterior one forms a short tip directed backwards. The whole anterior margin of this branch is occupied by the insertio musc. furcodorsalis, which is depressed into a spacious elongated cavity open anteriorly and obliquely upwards. The insertio musc. furcolateralis is partly visible in dorsal view beside the outer lateral margin of the ramus anterior, similarly as in the following genus *Colymbetes*. This lateral margin of the anterior branch divides anteriorly and continues partly to the ramus lateralis and partly obliquely downwards as margin of the lower surface of the insertion. This insertion has a large triangular lower surface and a much smaller upper surface.

37. *Rhantus notatus* F. 2.9 mm. (Pl. XI, 1).

In this species the metathoracic furca has a similar shape as in the preceding and following species. The corpus basillare is roughly as long and high as in the preceding species. Its upper margin is also thickened and enlarged and becomes lower from in front backwards; but the anterior margin is only slightly thickened and runs downward under an angle of about 100°. The ramus anterior is shorter than in *Rhantus pulverosus* Steph., but approximately of the same width; in the appended figure it appears narrower because it is more inclined than in *Rhantus pulverosus*. Seen from above its outer and its inner margin are shallowly indented, the anterior margin is slanting and also faintly indented. The outer and the inner apical



Pl. XI. 1 — *Rhantus notatus* F. 2 — *Rhantus exoletus* Forst. 3 — *Colymbetes striatus* L. 4 — *Colymbetes fuscus* L. 5 — *Meladema coriaceum* Cast. 6 — *Eretes sticticus* Er.

corner of the anterior branch are rounded, and in the inner one lies the triangular insertio musc. retractoris mesothoracis which is only indistinctly indicated similarly as in the preceding species. Seen from above there is between the anterior branches a short, narrow gap completely closed anteriorly. The ramus lateralis is fairly long; it is directed obliquely backwards and enlarges in a distal direction. Its anterior and posterior margin are roughly straight and this lateral arm is straightly truncated at the end. The anterior margin forms a low processus in the apical part. The insertio musc. furcodorsalis lies in this anterior margin of the lateral branch; it is much narrower than in the preceding species and is deeply depressed in groove-shape. From above a large part of the insertio musc. furcolateralis is visible beside the outer margin of the anterior branch. Morphologically this insertion is similar as in the species *Rhantus pulverosus* Steph., but it is rather narrower and the upper surface is formed only by a low ledge.

38. *Rhantus exoletus* Forst. 3.1 mm. (Pl. XI, 2).

The corpus basillare is roughly as high as in *Rhantus notatus* F., but it is markedly longer. Its upper margin is strengthened and enlarged and becomes lower in a posterior direction. The anterior margin is slightly thickened and runs obliquely downward from behind forward under an angle of less than 110° . The ramus anterior is the shortest one of the three species examined of the genus *Rhantus*, and it is considerably broad. Its outer lateral margin is almost straight, the inner one is indented. Seen from above this branch is bevelled in front, and outer and inner apical corner are rounded. The insertio musc. retractoris mesothoracis is of triangular shape, very shallowly depressed, and rather indistinctly distinguished from the surrounding surface of the anterior branch. The gap between the anterior branches is very short and relatively broad, roughly oval. The ramus lateralis is directed obliquely backwards and sideways, is narrowed in the basal part and strongly enlarged in a distal direction, and differs in this from that of the preceding two species. Its anterior margin is shallowly indented, the posterior margin is roughly straight. The anterior apical corner is rounded and the posterior one runs out in a blunt tip. The insertio musc. furcodorsalis is depressed in groove-shape and its mouth has a similar shape as in *Rhantus notatus*, but is wider. The insertio musc. furcolateralis does not differ essentially from that of the preceding species.

39. *Colymbetes striatus* L. 3.3 mm. (Pl. XI, 3).

The corpus basillare furcae is relatively long and high and becomes strongly lower in a posterior direction. Its upper margin is thickened and enlarged, the anterior margin is also thickened, straight, and encloses with the ventral plane of the metathorax an angle of about 80° ; the lower part of this anterior margin is connected with the very low carina sagittalis. The ramus anterior is short and not too broad; in a distal direction it first narrows and then enlarges; its outer lateral margin is shallowly indented and in the anterior part interrupted, the inner one is more deeply indented. The insertio musc. retractoris mesothoracis lies in the apical part of the anterior branch at its inner margin; it is very indistinctly distinguished from the

surrounding surface of the ramus anterior and is longitudinally depressed in trough-shape. In an anterior view the anterior branches are inclined to each other in an acute angle so that they form the letter V; seen from above there is between them a short and broad gap which is closed anteriorly by the insertions and has roughly a rhombic shape. The ramus lateralis is a little longer than the ramus anterior and is roughly equally wide in its whole length; its anterior margin is almost straight, the posterior margin is arcuately indented. The anterior apical corner is broadly rounded, the posterior one runs out in a blunt tip directed backwards and obliquely downwards. The rather deep insertio musc. furcodorsalis is on the anterior margin; it is open obliquely upwards. In a dorsal view the apical part of the insertio musc. furcolateralis projects on both sides of the furca anterior to the lateral branches; it lies on the underside of the furca below the ramus anterior. In the distal part the lateral margin of the anterior branch passes downwards directly into the lower surface of the insertion which is deeply angularly indented. Besides also the upper surface of the insertion is developed, but it is much smaller; in the anterior part it begins as a chitinous ledge which gradually rises in a posterior direction so that it forms a relatively low comb.

40. *Colymbetes fuscus* L. 4.3 mm. (Pl. XI, 4).

The metathoracic furca of this species resembles that of the preceding species. The corpus basillare becomes lower from the front backwards and is fairly high and long. The anterior margin is straight, thickened, and runs downwards roughly under a right angle; the upper margin is also thickened and besides enlarged. Anteriorly the corpus basillare passes into the low carina sagittalis metasterni. The ramus anterior is still shorter than in the preceding species, and is rather broad; its inner and its outer lateral margin are indented, and the anterior margin is bevelled. In the apical part of this branch lies the large insertio musc. retractoris mesothoracis, which seen from above has a roughly triangular shape. It is shallowly longitudinally depressed and is rather indistinctly delimited against the surrounding surface of the ramus anterior; only in the posterior part the margin of this insertion is raised. Seen from above there is a gap between the anterior branches which is in front almost entirely closed; in an anterior view these branches are inclined towards each other under an acute angle. The ramus lateralis is directed obliquely backwards and in contradistinction to *Colymbetes striatus* L. it is strongly enlarged in a distal direction; its anterior and its posterior margin are shallowly indented; its end is S-shaped, in the anterior part rounded, in the posterior part deeply indented so that the anterior apical corner is rounded, the posterior one elongated in a rather broad tongue-shaped formation directed backwards and obliquely downwards. The anterior margin of the ramus lateralis forms in the distal part a low and flat processus. The insertio musc. furcodorsalis is directed obliquely forwards and upwards, and in an anterior view it is relatively lower and shallower than in the preceding species. The insertio musc. furcolateralis lies for the major part on the underside of the ramus anterior, and the lateral margin of this branch passes uninterruptedly into the lower surface of the insertion.

This lower surface of the insertion is approximately triangular, and its outer margin is shallowly arcuately indented, just as is the margin of the upper surface, which, however, is much smaller.

41. *Meladema coriaceum* Cast. 3.9 mm. (Pl. XI, 5).

The corpus basillare furcae is relatively short and high. Its upper margin is enlarged, slightly thickened, straight, and becomes lower in a posterior direction; the anterior margin is straight, slightly thickened, and runs downward perpendicularly to the ventral plane of the metathorax; its lower two thirds are connected with the carina sagittalis metasterni. The ramus anterior is very short and fairly broad, and its outer and inner lateral margin are indented so that it is narrowed in the middle. The outer apical corner of the anterior branch is broadly rounded, the inner one is bluntly pointed and in it lies the insertio musc. retractoris mesothoracis. This insertion is flat and very indistinctly delimited, only in its posterior part it is somewhat more perceptibly marked by a slight thickening. Seen from above there is a gap between the anterior branches, which narrows in an anterior direction; both these branches are in an anterior view widely open. The outer margin of the anterior branch passes uninterruptedly into the anterior margin of the lateral branch so that there is no indentation at all between these branches. The ramus lateralis is longer and almost as broad as the ramus anterior; it is roughly equally broad in its whole length and is obliquely truncated at the end. Its anterior apical corner is sharp, the posterior one is rounded. In the anterior margin of this branch is the insertio musc. furcodorsalis which is fairly deeply depressed and whose mouth is sickle-shaped when seen from above. The insertio musc. furcolateralis is visible from above beside the outer lateral margin of the ramus anterior. This anterior margin of the branch divides namely and continues partly backwards to the lateral branch and partly obliquely downwards so as to form the margin of the lower surface of the insertion. This insertion is large and deep, and its cavity is delimited by a large lower and much smaller upper surface.

Dytiscinae

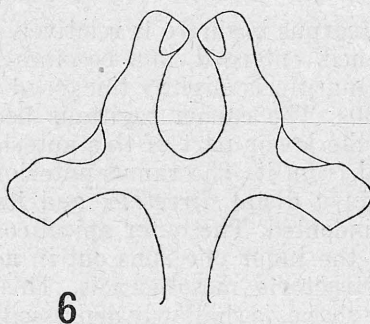
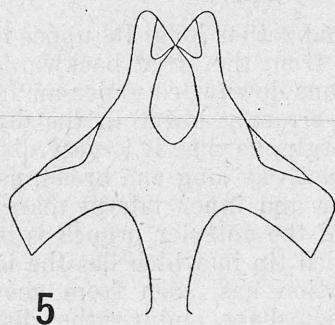
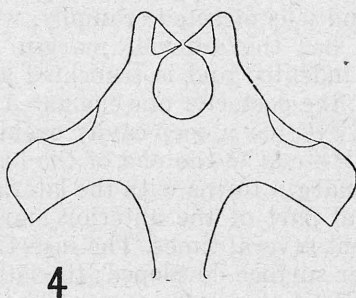
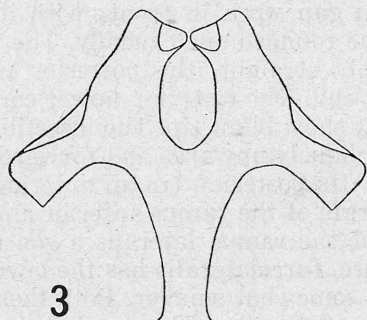
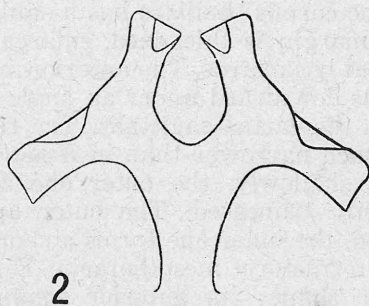
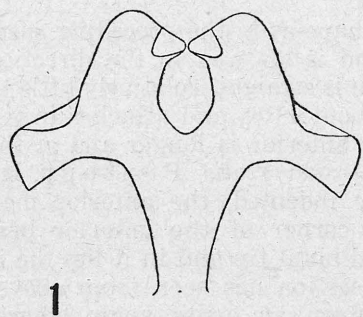
42. *Eretes sticticus* Er. 3.8 mm. (Pl. XI, 6).

The corpus basillare furcae is not too high and long; its upper margin is thickened and relatively little enlarged; it becomes strongly lower in a posterior direction. The anterior margin is thickened, indented, and encloses with the ventral sclerites of the metathorax an angle of about 120° ; it is thus inclined from the back forwards. The ramus anterior is long and narrow; its outer lateral margin is convex and passes uninterruptedly into the anterior margin of the lateral branch, the inner one is shallowly indented; in the apical part the anterior branch ends in a blunt tip. Near this tip lies the insertio musc. retractoris mesothoracis which has an irregular elongated shape. It is in contact with the inner margin of the anterior branch, but in contradistinction to all the other species of the family *Dytiscidae* it does not extend to its tip. This insertion is not depressed at all; it is flat and is

indistinctly distinguished from the adjoining surface of the ramus anterior by a low thickening. A longitudinal ledge runs on the underside of the furca from the insertio musc. retractoris mesothor. to the upper part of the anterior margin of the corpus basillare; seen from above it is partly visible between the rami anteriores. Between the two anterior branches lies an elongated gap which is rounded behind and gradually narrows in an anterior direction; in an anterior view the anterior branches are widely open and thus enclose an obtuse angle. The ramus lateralis is shorter than the ramus anterior and strongly narrows in a distal direction; it is directed obliquely upwards and at the same time sideways. In its apical part lies the insertio musc. furcodorsalis which is open anteriorly and obliquely upwards. It is sickle-shaped; its anterior margin is identical with the margin of the ramus lateralis, the posterior margin projects, however, beyond this branch; this insertion is very shallowly depressed. Seen from above the insertio musc. furcolateralis projects on both sides of the furca; it lies on the underside of the ramus anterior and has a well developed lower and upper surface. The lower surface is deeply arcuately indented; the outer margin of the upper one is straight. Both these surfaces delimit the spacious cavity of the insertion, which opens forwards and obliquely upwards.

43. *Hydaticus transversalis* Pontopp. 4.4 mm. (Pl. XII, 1).

The metathoracic furca of this species differs by the shape of the anterior branch from all the following species of the genus *Hydaticus*. The corpus basillare is rather high and not too long. The anterior margin is straight, thickened, and inclined under an angle of about 115° ; in its lower part it passes into the carina sagittalis metasterni. The upper margin is thickened and enlarged and becomes lower in a caudal direction. The ramus anterior is relatively long and broad, its outer lateral margin is roughly straight, the inner one indented. The outer apical corner is broadly rounded; the inner apical corners of the anterior branches are elongated into short blunt tips which are directed against each other and touch in the median plane of the furca. Here lies the insertio musc. retractoris mesothoracis, which is shallowly depressed; in the posterior part it is delimited by a chitinous elevation, whereas in the anterior part its margin is indistinct. Between the anterior branches is a wide gap which is completely closed anteriorly. In an anterior view the two anterior branches are wide open so that they enclose an obtuse angle. The ramus lateralis is a little narrower than the ramus anterior, and its anterior and posterior margin are subparallel so that this branch is in its whole length roughly equally broad. Its end is straightly truncated, the anterior apical corner is rounded and the posterior one forms a short tip directed backwards and obliquely downwards. On the anterior margin of the lateral branch lies the insertio musc. furcodorsalis which extends almost to its end. It is depressed into a spacious cavity open forwards and upwards. The insertio musc. furcolateralis is hidden in a top view and lies on the underside of the ramus anterior. The lower surface of this insertion is triangular and its outer margin is roughly straight; the upper surface is smaller and is developed in the posterior part only, while in the anterior part it is only indicated by a low ledge.



Pl. XII. 1 — *Hydaticus transversalis* Pontopp. 2 — *Hydaticus seminiger* Deg.
3 — *Hydaticus stagnalis* F. 4 — *Hydaticus dorsiger* Aubé. 5 — *Hydaticus vittatus* F.
6 — *Graphoderus austriacus* Sturm.

44. *Hydaticus seminiger* Deg. 5.0 mm. (Pl. XII, 2).

The corpus basillare has a similar shape as in the preceding species. Its upper margin is thickened, enlarged, and is lowered in the direction from the front backwards. The anterior margin is straight, relatively little thickened, runs downward under an angle of about 110° , and attaches in its lower part to the carina sagittalis. The ramus anterior is longer and at the same time much narrower than in *Hydaticus transversalis* Pontopp. Its inner side is shallowly, the outer one deeply indented, the anterior margin is straightly truncated. The outer apical corner of the anterior branch is rounded, the inner one forms a short and blunt tip and in it lies the insertio musc. retractoris mesothoracis. This insertion has seen from above a triangular shape; its anterior summits form an acute angle whereas the posteriorly directed summit is broadly rounded. The insertion is shallowly depressed and continues in the posterior part still under the surface of the anterior branch; on the exterior side it is only very indistinctly distinguished from the surrounding surface. Seen from above there is between the anterior branches a broad, approximately oviform gap, open in front; with its narrowed end it is directed cranially, with the rounded one caudally. The ramus lateralis has the anterior margin roughly straight, the posterior margin slightly indented and is truncated at the end. The anterior apical corner is rounded, the posterior one elongated into a short blunt tip. The insertio musc. furcodorsalis has a deep cavity opening obliquely upwards and forwards, and does not extend to the end of the branch. Its posterior (in an anterior view upper) margin forms with the lateral margin of the ramus anterior and with the apical part of the anterior margin of the ramus lateralis a continuous curve bent several times. The insertio musc. furcolateralis has the lower and the upper surface developed; the latter is somewhat smaller. Both these surfaces delimit the deep groove-like cavity of the insertion, and their outer lateral margin is almost straight. A relatively low ledge continues from this insertion in a posterior direction towards the corpus basillare.

45. *Hydaticus stagnalis* F. 4.5 mm. (Pl. XII, 3).

The corpus basillare is relatively low and rather long. Its upper margin is thickened, enlarged, and becomes lower from the front backwards. The anterior margin is slightly thickened and runs downward under an angle of about 100° . The carina sagittalis becomes strongly lower in the direction towards the lower part of this anterior margin, so that it is very distinctly separated from it. The ramus anterior is relatively long and broad, narrows slightly in a distal direction, and its outer and inner lateral margin are slightly indented. The outer apical corner of the anterior branch is broadly rounded, the inner one runs out in a rounded tip in which lies the insertio musc. retractoris mesothoracis. This insertion has, seen from above, an irregular shape, is shallowly depressed in spoon-shape, and is rather distinctly distinguished from the adjoining surface of the ramus anterior; in its posterior part it continues still under the surface of the anterior branch, just as in the preceding species. In a dorsal view there is an elongatedly oval gap between the anterior branches; its lateral margins are subparallel and in

front it is almost completely closed by the insertions. In an anterior view these branches are widely open and enclose a roughly right angle. The ramus lateralis is directed obliquely backwards and sideways, slightly enlarges in a distal direction, and its anterior and posterior margin are almost imperceptibly indented. It is straightly truncated at the end; the anterior apical corner is rounded, the posterior one forms a right angle, i. e. a blunt tip directed obliquely backwards and downwards. In the anterior margin of this lateral branch lies the insertio musc. furcodorsalis which does not extend, however to its end. It is not too deeply depressed and in an anterior view the lower margin of its mouth is straight, the upper margin arcuate, so that the contour of this mouth has a semicircular shape. The insertio musc. furcolateralis lies on the underside of the furca and thus is not visible at all in a view from above. It is depressed into a longitudinal cavity which enlarges in a posterior direction. This depression is delimited by the well developed upper and lower surface of the insertion; the outer margin of the lower surface is slightly convex, whereas the margin of the upper one is slightly indented; this lower surface is thus somewhat smaller. In an anterior view both insertions are directed obliquely sideways and downwards.

46. *Hydaticus dorsiger* Aubé. 5.0 mm. (Pl. XII, 4).

The metathoracic furcae of this and the following species are similar, but are distinguished by the shape of the anterior branches and by the shape of the gap between them. The corpus basillare is rather low and not too long, its upper margin is thickened, strongly enlarged, and becomes lower in a caudal direction. The anterior margin is only slightly thickened and runs downwards under an angle of a little more than 120° , therefore obliquely from back to front. This anterior margin is straight and in its uppermost part moderately indented; anteriorly it is almost completely isolated from the carina sagittalis metasterni. The ramus anterior seen from above has the outer and the inner lateral margin fairly deeply indented, the anterior margin bevelled and roughly straight. The outer apical corner of the anterior branch is rounded, the inner one lengthened into a relatively sharp tip which is directed towards the tip of the opposite branch. The insertio musc. retractoris mesothoracis lies in this inner corner; seen from above it is roughly triangular in shape. The anterior margin of this triangle is identical with the margin of the branch, the outer margin is indistinct, and the posterior margin is indicated by a narrow raised ledge. In a dorsal view there is between the anterior branches a broad rounded gap, and in an anterior view both these branches are inclined towards each other under an acute angle. The ramus lateralis is longer and much broader than the ramus anterior; its anterior margin is in the proximal part slightly indented, in the distal part slightly convex, the posterior margin is almost straight. This branch is in its whole length roughly equally broad and is almost straightly truncated at the end. The insertio musc. furcodorsalis lies in its anterior margin in the proximal part so that it is far from reaching its end. The insertio musc. furcolateralis lies on the underside of the ramus anterior and has a deep groove-shaped depression which is delimited by the lower and the slightly smaller upper surface. A narrow raised ledge continues from this insertion on the one

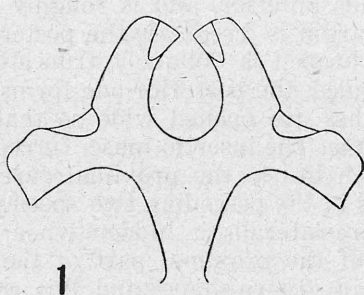
hand in an anterior direction to the outer apical corner of the ramus anterior and on the other hand in the opposite direction, backwards to the upper part of the anterior margin of the corpus basillare.

47. *Hydaticus vittatus* F. 4.8 mm. (Pl. XII, 5).

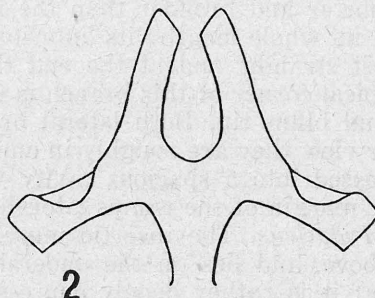
The corpus basillare furcae has a similar shape as in the preceding species; its upper margin is thickened and runs in the direction downwards to the sternal surface of the metathorax under an angle of about 110° , i. e. under a somewhat smaller angle than in the preceding species. The ramus anterior seen from above is much longer and narrower than in *Hydaticus dorsiger* A u b é, and its outer and inner lateral margin are shallowly indented, the anterior margin is bevelled and only very slightly convex. The outer apical corner of the anterior branch is rounded, the inner one forms a very blunt tip and in it lies the insertio musc. retractoris mesothoracis which has an approximately triangular shape. The anterior two corners of this triangle are pointed, the corner directed posteriorly is rounded. The posterior margin of this insertion is characterised by a chitinous elevation. In a dorsal view there is between the anterior branches an elongated, roughly oval gap which is anteriorly almost completely closed by the insertions; in an anterior view the two branches enclose an acute angle. The ramus lateralis is approximately as long as the ramus anterior, but is much broader; its anterior margin is undulate, the posterior one very shallowly indented. At the end this branch is straightly truncated, its anterior apical corner is rounded, and the posterior one is lengthened into a short tip directed in a caudal direction. The insertio musc. furcodorsalis lies in the anterior margin of the lateral branch; it is a spacious depression, open obliquely upwards, whose mouth becomes gradually lower on both sides. The insertio musc. furcolateralis is on the underside of the anterior branch, and has a well-developed large lower surface and a much smaller upper surface. A raised ledge continues from this insertion in a posterior as well as in an anterior direction, similarly as in the preceding species. The metathoracic furcae of *Hydaticus dorsiger* A u b é and of *Hyd. vittatus* F. thus differ chiefly by the fact that in the former the anterior branches are much shorter and that in consequence also the gap between them is relatively broader and more rounded.

48. *Graphoderus austriacus* S t u r m. 4.6 mm. (Pl. XII, 6).

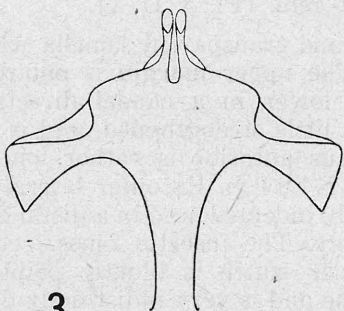
The corpus basillare is low and relatively short; its upper margin is thickened, enlarged, and becomes strongly lower in a posterior direction. The anterior margin is not too strongly thickened, and runs downward under an angle of almost 140° , so that it is obliquely inclined from back to front. The ramus anterior is fairly long and at the same time narrow, and its outer as well as its inner lateral margin are shallowly indented when viewed from above. Outer and inner apical corner are rounded, and in the inner one lies the insertio musc. retractoris mesothoracis, which has an irregular shape and is indistinctly distinguished from the surrounding surface of the anterior branch. Seen from above there is between the anterior branches a fairly



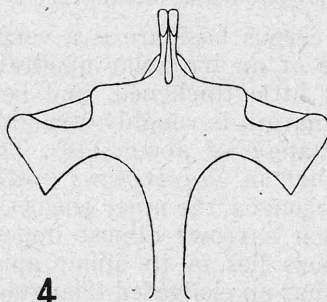
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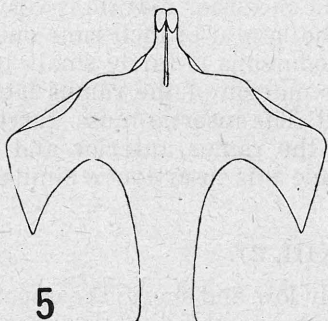
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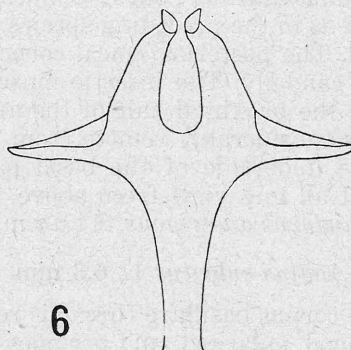
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4



5



6

Pl. XIII. 1 — *Graphoderus bilineatus* Deg. 2 — *Acilius sulcatus* L. 3 — *Dytiscus latissimus* L. 4 — *Dytiscus marginalis* L. 5 — *Dytiscus circumcinctus* Ahr. 6 — *Cybister tripunctatus asiaticus* Sharp.

broad elongated gap which is posteriorly rounded, narrows in an anterior direction, and is almost completely closed in front. The ramus lateralis is a little shorter and broader than the ramus anterior, and is roughly equally wide in its whole length; its anterior margin is irregular, the posterior one is almost straight and at the end this branch is obliquely truncated. The outer apical corner of this branch is rounded, the posterior one forms a very short and blunt tip. Both lateral branches are opened wide so that in an anterior view they are roughly in one plane. The insertio musc. furcodorsalis is depressed into a spacious cavity which lies in the proximal part of the anterior margin of the ramus lateralis as in the preceding two species of the genus *Hydaticus*. The insertio musc. furcolateralis is hidden when viewed from above, and lies on the underside of the proximal part of the ramus anterior; it is rather deeply depressed in groove-shape, and this cavity is delimited by a larger lower and a smaller upper surface. An elevated ledge runs from this insertion in an anterior as well as in a posterior direction, just as in the preceding two species.

49. *Graphoderus bilineatus* D eg. 6.0 mm. (Pl. XIII, 1).

The corpus basillare is a very thin and transparent lamella which has the shape of an irregular quadrangle. The upper margin is enlarged and relatively little thickened, and becomes lower in a caudal direction; the anterior margin is roughly straight, only little strengthened, and is inclined under an angle of about 140° . The ramus anterior is rather long and is broader than in *Graphoderus austriacus* Sturm. Its outer lateral margin is slightly convex, the inner one is shallowly indented, and in a distal direction this branch narrows almost imperceptibly. The insertio musc. retractoris mesothoracis lies in its inner apical corner which is bluntly pointed. The insertion has an elongated triangular shape and is very indistinctly delimited against the surrounding surface. A broadly oviform gap is between the anterior branches; in an anterior view these two branches are very widely open under an obtuse angle. The ramus lateralis is approximately as long as the ramus anterior, but it is much broader; its anterior margin is undulate similarly as in the preceding species, and the posterior margin is very slightly indented. The posterior apical corner of the lateral branch runs out in a tip directed caudally. The insertio musc. furcodorsalis is fairly small, but deep; it lies in the proximal half of the anterior margin of the ramus lateralis, so that it is considerably remote from its end. The insertio musc. furcolateralis is on the underside of the basal part of the ramus anterior and thus not visible at all in a view from above. In shape this insertion is similar to that in *Graphoderus austriacus* Sturm.

50. *Acilius sulcatus* L. 6.3 mm. (Pl. XIII, 2).

The corpus basillare furcae is relatively low and short; the upper margin is thickened, enlarged, and becomes lower in a caudal direction; the anterior margin is slightly thickened, straight, and runs obliquely downwards from front to back under an angle of about 120° , and is almost entirely isolated from the carina sagittalis. The ramus anterior is long and narrow and moderately narrows in a distal direction; its outer and its inner lateral

margin are roughly straight and subparallel. It is obliquely truncated at the end, and outer and inner apical corner are rounded; the insertio musc. retractoris mesothoracis is not marked at all. Seen from above there is between the anterior branches a broad and long gap, open in front, which is rounded posteriorly and gradually narrows in an anterior direction. In an anterior view the rami anteriores are inclined towards each other in an acute angle. The ramus lateralis is long and rather narrow, slightly enlarges in a distal direction, and its end is straightly truncate. Its anterior and its posterior margin are not too deeply indented, and the two apical corners form roughly a right angle, with the anterior apical corner rounded and the posterior one pointed. In the proximal part of the anterior margin of the lateral branch lies the relatively deep insertio musc. furcodorsalis which is directed obliquely upwards and forwards. In a dorsal view the apical part of the insertio musc. furcolateralis projects on both sides of the furca. This insertion is depressed as a longitudinal depression delimited by a larger lower and a smaller upper surface. A raised ledge continues from this insertion forwards in the direction towards the end of the ramus anterior and backwards in the direction towards the upper margin of the corpus basillare. The whole metathoracic furca of this species is intensively coloured dark.

51. *Dytiscus latissimus* L. 10.8 mm. (Pl. XIII, 3).

The corpus basillare is high and fairly long; its upper margin is thickened, relatively strongly enlarged, and becomes lower from front to back. The anterior margin is strongly thickened, shallowly indented, and runs from above downwards almost perpendicularly to the ventral metathoracic sclerites. The ramus anterior is very short, narrow, and rounded at the end; in a distal direction it enlarges only slightly so that it is almost equally wide in its whole length. In its apical part lies the elongated insertio musc. retractoris mesothoracis, which is delimited posteriorly by a low thickening which has the shape of the letter V. Between the two anterior branches is a very narrow gap which enlarges in a posterior direction. The ramus lateralis is long and many times broader than the ramus anterior, and its anterior margin is convex in the proximal part, whereas it is indented in the distal half; also the posterior margin is rather deeply arcuately indented. In the basal part this branch is very wide, then it narrows in the direction towards the end and enlarges again. At the end the ramus lateralis is roughly straightly truncated; its anterior apical corner is rounded, the posterior one forms an acute angle, i. e. a relatively long tip directed caudally and at the same time obliquely downwards. In the distal part of the anterior margin of the lateral branch lies the deep insertio musc. furcodorsalis which reaches to its end and which is open anteriorly and obliquely upwards. The insertio musc. furcolateralis viewed from above is partly visible between the anterior and lateral branches. The outer lateral margin of the ramus anterior divides namely, and on the one hand passes in a posterior direction into the anterior margin of the ramus lateralis, while on the other hand it continues obliquely downwards as the lateral margin of the lower surface of this insertion. The lower and the somewhat smaller upper surface of the insertion delimit a deep elongated depression.

52. *Dytiscus marginalis* L. 9.7 mm. (Pl. XIII, 4).

The corpus basillare becomes lower in a posterior direction. Its upper margin is thickened and enlarged; the anterior margin is also thickened, straight, runs downwards under an angle of about 80°, and is connected in its lower part with the high carina sagittalis metasterni. The ramus anterior is short and slightly enlarges in a distal direction. It is rounded at the end, and in its apical part lies the insertio musc. retractoris mesothoracis, which is shallowly longitudinally depressed and is in the posterior part delimited by a thickening. Seen from above there is between the anterior branches a narrow gap which has a similar shape as in the preceding species. The ramus lateralis is long and in an anterior view it is slightly arcuately sinuate. Its anterior and its posterior margin are shallowly indented, and at the end it is straightly truncated. The anterior apical corner of this branch is rounded, the posterior one lengthened into a short pointed tip directed backwards and obliquely downwards. In the distal part of the anterior margin of the lateral branch lies the insertio musc. furcodorsalis which is depressed into a spacious cavity open anteriorly and obliquely upwards. The lower surface of this insertion is almost straight, the upper one is convex and at the same time indented. In the middle between the lateral branches of the furca a surface extends from the anterior branches in the direction towards the corpus basillare, which is droplet-shaped and is formed by an even, translucent chitinous plate. Seen from above the insertio musc. furcolateralis projects partly on each side of the furca between the anterior and the lateral branch.

53. *Dytiscus circumcinctus* A h r. 7,2 mm. (Pl. XIII, 5).

The metathoracic furca of this species resembles in shape that of the preceding two. The corpus basillare is high and relatively short, and becomes strongly lower in a caudal direction. Its upper margin is almost straight and is thickened and expanded. The anterior margin is also roughly straight, strongly sclerotised, and in its lower half it is connected with the high carina sagittalis metasterni; it runs in a downward direction obliquely from front to back under an angle of less than 90°. The ramus anterior is very short and narrow and is distinctly distinguished from the lateral branch. Its outer lateral margin is shallowly indented, the inner one is straight, so that this branch is narrowed in the middle. It is rounded at the end, and carries in the apical part the insertio musc. retractoris mesothoracis which is shallowly longitudinally depressed and delimited in the posterior part by a narrow elevation as in the preceding species. Seen from above there is a narrow gap between the anterior branches, which slightly narrows in a cranial direction. The ramus lateralis is considerably long and broad, its anterior margin is convex in the proximal part, roughly straight in the distal part, and the posterior margin is arcuately indented. This branch thus first narrows and then expands again; at the end it is almost straightly truncated. The anterior apical corner of the lateral branch is blunt and rounded, the posterior one is lengthened into a long sharp tip directed caudally and at the same time obliquely downwards. A large part of the anterior margin carries the insertio musc. furcodorsalis which opens forwards and obliquely upwards. It is

depressed into a spacious depression whose mouth when seen from above is sickle-shaped. The insertio musc. furcolateralis viewed from above is partly visible between the anterior and the lateral branch. The margin of its lower surface attaches to the lateral margin of the anterior branch, and also the upper surface of this insertion extends as far as to the margin of the basal part of the ramus lateralis. Both surfaces, the upper and the lower one, are roughly equally large and delimit the elongated depression of this insertion.

54. *Cybister tripunctatus asiaticus* Sharp. 8.6 mm. (Pl. XIII, 6).

The corpus basillare furcae is very long and relatively low and becomes only slightly lower in the direction from front to back. Its upper margin is shallowly indented, thickened and enlarged; the anterior margin is roughly straight, strongly thickened and sclerotised, and encloses with the ventral plane of the metathorax an angle of about 80° ; in its lower half it is connected with the strong carina sagittalis metasterni. The ramus anterior is fairly long and narrow; its outer margin is roughly straight and broken in the anterior part, the inner margin is slightly indented. In a distal direction it narrows gradually and in the apical part it carries the small insertio musc. retractoris mesothoracis. This insertion is shallowly depressed in spoon-shape and seen from above it is tear-shaped with the pointed end directed outwards. In an anterior view the two anterior branches are inclined towards each other under an acute angle, and in a dorsal view there is between them a fairly broad and long gap which is posteriorly broadly rounded and narrows in a cranial direction. The ramus lateralis is a little shorter and narrower than the ramus anterior; its anterior margin is roughly straight and the posterior margin is somewhat convex. In a distal direction it strongly narrows so that it runs out in a blunt tip. Both lateral branches are when seen from above directed directly to the sides so that they lie in one straight line perpendicular to the length axis of the furca, similarly as in the species *Platambus maculatus* L. The whole anterior margin of the ramus lateralis is occupied by the insertio musc. furcodorsalis which is depressed into a spacious cavity open obliquely upwards and forwards. The upper (seen from above posterior) margin of the mouth of this insertion is convex and at the same time indented, while the lower one is roughly straight and not indented. The insertio musc. furcolateralis is in a view from above not visible at all, in contradistinction to the genus *Dytiscus*; it lies on the underside of the basal part of the ramus anterior and ramus lateralis. This insertion has a well developed upper as well as lower surface; both surfaces are approximately equally large and delimit the elongated depression.

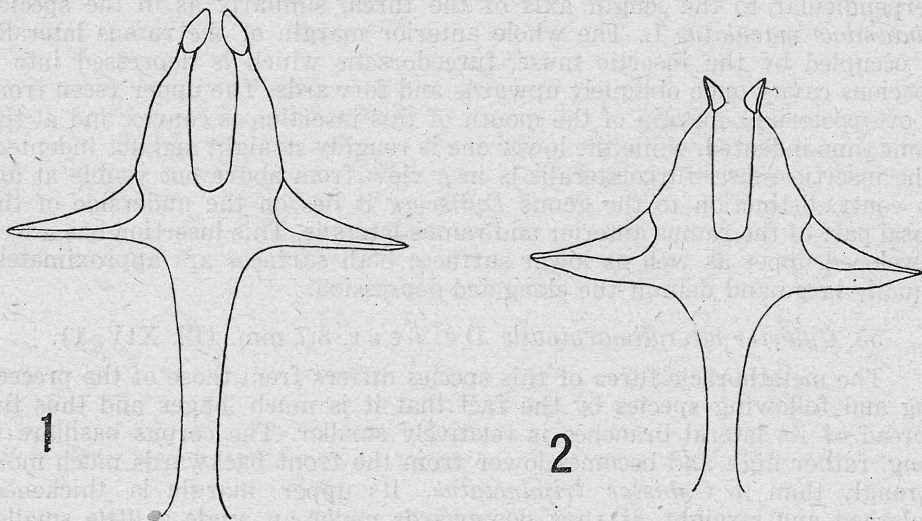
55. *Cybister lateralimarginalis* De Geer. 8.7 mm. (Pl. XIV, 1).

The metathoracic furca of this species differs from those of the preceding and following species by the fact that it is much longer and thus the spread of its lateral branches is relatively smaller. The corpus basillare is long, rather high and becomes lower from the front backwards much more strongly than in *Cybister tripunctatus*. Its upper margin is thickened, enlarged and straight. It runs downwards under an angle a little smaller than 90° , and in the lower part it is connected with the carina sagittalis;

besides this anterior margin enlarges in its lower half to the sides and thus passes into the sinus anterior coxae. The ramus lateralis is long and narrow and narrows in the distal direction. Its outer lateral margin is undulate, the inner one is almost straight. In the apical part of the anterior branch lies the insertio musc. retractoris mesothoracis which is roughly elongated oval and shallowly depressed in spoon-shape. Seen from above there is between the anterior branches a long and not too broad gap which in contradistinction to the preceding species enlarges in a cranial direction and is closed anteriorly by the insertions for its major part. The ramus lateralis is somewhat shorter than the ramus anterior; its anterior margin is shallowly arcuately indented and the posterior one almost straight. In the direction towards the end it narrows strongly and runs out in a blunt tip. Its anterior margin carries the insertio musc. furcodorsalis which is depressed into a spacious depression open obliquely upwards and forwards. The upper margin of this insertion is bent upwards and at the same time indented. The insertio musc. furcolateralis is in a top view hidden and lies on the underside of the furca where the ramus anterior passes into the ramus lateralis. This insertion is depressed into a longitudinal open cavity which is delimited by the roughly equally large upper and lower surface.

56. *Cybister japonicus* Sharp. 10.4 mm. (Pl. XIV, 2).

The corpus basillare furcae is long, but lower than in the preceding two species and also becomes much less strongly lower in a posterior direction. The upper margin is thickened, enlarged, and shallowly indented; the anterior margin is roughly straight, is connected in front with the carina sagittalis metasterni, and runs downwards under an angle of almost 90°. The ramus anterior is fairly long; its outer lateral margin is undulate and



Pl. XIV. 1 — *Cybister lateralimarginalis* Deg. 2 — *Cybister japonicus* Sharp.

the inner one straight. In a distal direction it narrows strongly and just before the end enlarges again so that it is here constricted. The small insertio musc. retractoris mesothoracis lies in the apical part; it is of a roughly triangular shape and is shallowly depressed. Its outer lateral margin is not identical with the margin of the ramus anterior as it is in the preceding two species of the genus *Cybister*, but is isolated from it. Seen from above there is between the anterior branches an elongated gap which slightly enlarges in an anterior direction. Anterior and lateral branches are not so well distinguished as in the preceding two species as the lateral margin of the ramus anterior and the anterior margin of the ramus lateralis form a continuous, only slightly bent line. The ramus lateralis is broad in the basal part; in a distal direction it strongly narrows and ends in a blunt tip. Its anterior margin is slightly indented, the posterior one slightly convex. The anterior margin of the ramus lateralis carries the insertio musc. furco-dorsalis which is deeply depressed. Its upper margin is bent and more deeply indented than in *Cybister lateralimarginalis* De Geer. The insertio musc. furcolateralis has roughly the same shape and lies similarly as in the preceding two species.

VIII. Summary

The corpus basillare of the metathoracic furca of the *Dytiscidae* is always developed as a thin, vertical chitinous lamella. In the subfamily *Laccophilinae* this basal part of the furca has roughly a quadrangular shape, the anterior and the upper margin are thickened, and the anterior margin runs straight downwards under an angle of 90° . In the subfamily *Hydroporinae* the corpus basillare furcae has an entirely different shape. It is always elongated and considerably longer than high; only the upper margin is thickened and enlarged, whereas the anterior one is cleft and is in most species in the upper part convex in a cranial direction so that it projects between the anterior branches. Besides this anterior margin is always obliquely inclined from front to back under an angle of about 45° ; only in the species *Hyphydrus ovatus* L. it runs under an angle of 20° , and in the species *Bidessus unistriatus* Schrk. under an angle of 60° . The subfamily *Colymbetinae* has a corpus basillare of similar shape as the *Laccophilinae*. It is thickened at the anterior and upper margins, is usually a little longer than high, and the anterior margin is straight and runs downward roughly perpendicularly or slightly obliquely, but in the direction from back to front, i. e. opposite to the preceding subfamily; the angle of inclination is 80° — 115° , only in the species *Agabus didymus* Ol. up to 130° . In the subfamily *Dytiscinae* the corpus basillare furcae resembles that of the *Colymbetinae*. In the tribes *Eretini* and *Hydaticini* its anterior margin is always inclined obliquely from back to front under an angle of 100° — 120° . Also in the tribe *Thermonectini* the anterior margin runs obliquely from back to front, but under a greater angle (120° — 140°). The last tribes *Dytiscini* and *Cybisterini* differ from the other representatives of the subfamily *Dytiscinae* by the fact that the anterior margin of the corpus basillare runs approximately vertically downwards (under an angle of 80° — 90°).

The ramus anterior and the ramus lateralis are almost always clearly distinguished from each other. Only in the species *Laccophilus hyalinus* Deg., *Hyphydrus ovatus* L., *Bidessus unistriatus* Schrk., *Guignotus pusillus* F., and *Ilybius fenestratus* F. these two branches form a compact pairy formation. The ramus anterior is in the subfamily *Hydroporinae* mostly very broad (e. g. the genera *Coelambus*, *Hygrotus*, *Herophydrus*, *Porhydrus*, *Graptodytes* etc.), only in some species of the genus *Hydroporus* (e. g. *Hydr. planus* F.) it is rather narrow. In the subfamily *Colymbetinae* the anterior branch is usually fairly broad and narrows only slightly in an anterior direction or is subparallel. In the species of the subfamily *Dytiscinae* the ramus anterior has different shapes: the tribes *Eretini*, *Hydaticini* and *Thermonectini* have the anterior branch relatively long and narrower than the species of the subfamily *Colymbetinae*; in the tribe *Dytiscini* on the contrary the ramus anterior is very short and narrow; in the *Cybisterini* it is rather long and narrow and strongly narrows in a distal direction. The insertio musc. retractoris mesothoracis is not marked at all only in two of the species studied, *Laccophilus hyalinus* Deg. and *Acilius sulcatus* L. In the subfamily *Hydroporinae* this insertion is depressed into a spacious cavity which is almost always funnel-shaped and whose mouth has in almost all species tear-shape. In contradistinction to this this insertio is in the other *Dytiscidae* (*Colymbetinae*, *Dytiscinae*) superficial, only very shallowly depressed in dish-shape, or entirely flat, and is delimited by a low thickening.

The ramus lateralis is in the *Hydroporinae* of two types. In the species in which the anterior branch is considerably broad this lateral branch is on the contrary very narrow, long, and usually arcuately bent. Where the ramus anterior is relatively narrow (e. g. *Hydroporus planus* F.) the ramus lateralis is much broader and flattened. In the subfamily *Colymbetinae* the lateral branch is broad, flat, and its posterior apical corner is mostly rounded. In the subfamily *Dytiscinae* we meet different types. The tribe *Eretini* is characterised by a very short and rather narrow lateral branch. The tribes *Hydaticini*, *Thermonectini* and *Dytiscini* have a ramus lateralis similar to that of the subfamily *Colymbetinae*, but the posterior apical corner is always lengthened into a tip directed caudally. In the *Cybisterini* the lateral branch is rather narrow, narrows in a distal direction and ends in a tip directed sideways; thus no anterior and posterior apical corners are formed in the apical part. Characteristic is the position of these branches: they lie in one straight line perpendicular to the length axis of the furca and thus are not directed obliquely backwards as in the other species of the subfamily *Dytiscinae*. The insertio musc. furcodorsalis is lacking in some *Hydroporinae* (e. g. *Coelambus*, *Hygrotus*), in others it is flat and its anterior as well as its posterior margin are identical with the margin of the ramus lateralis (the only exception is *Scarodytes halensis* F.). In the other *Dytiscidae* on the contrary this insertion is almost always depressed into a spacious depression, and is isolated from the posterior margin of the lateral branch.

The insertio musc. furcolateralis is developed in the *Hydroporinae* as a flattened pairy processus of triangular shape, which is depressed into

a cavity. The lower surface of this insertion is usually more deeply indented and therefore smaller than the upper surface. In the other *Dytiscidae* just the contrary is the case: the lower surface of the insertion is much larger than the upper surface which is often only indicated by a ledge, or both surfaces are approximately of equal size.

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