A Comparative Morphological Study of the Proventriculus in the Adult of the Superfamily Scolytoidea (Coleoptera)

By

Akira NOBUCHI[1]

Contents

Received April 23, 1969.

(1) Chief, Forest Insect Unit II, Forest Insect Section, Forest Protection Division. Dr.

Introduction

Scolytoidea, a large superfamily of the suborder Rhynchophora, is world-wide in distribution. It contains a great number of species which are more destructive to the forest trees than any other group of insect pests. In general the adults are known as the bark beetles, timber beetles and ambrosia beetles, though they attack all parts, namely root, seed, twig, bark, cambium and wood, of trees, herbaceous plants and shrubs.

Our knowledge on the Japanese fauna of this superfamily has been established since 1875 by Eichhoff, Chapuis, Blandford, Niijima, Weichmann, Eggers, Murayama, Sawamoto, Kôno, Inouye and the present author. This superfamily, in Japan, consists of two families, Scolytidae and Platypoeidae; the former is comprised of fourty-nine genera and more than two hundred and seventy species, and the latter three genera and sixteen species.

Some insects in such as Formicidae, Blattidae, Curculionidae, etc., had been admitted by

several entomologists as being of an interesting character from the viewpoint of classification. On the family Scolytidae, LINDEMANN[80)81)82)] (1875 & 1876～1879) seems to be the first entomologist to describe it. A phylogenetic arrangement of the genera was also presented by him to indicate certain relationships found within the European species, with emphasis on the proventriculus. NÜSSLIN[162)] (1911～1912) proposed a new system of classification of the European Scolytidae based on both external and internal features, with the keys to the genera, the species of *Hylesinus* and the tribe Ipini by the proventriculus. And he[164)] (1912) also reported details on the proventricular characters of *Lymantor* and *Dryocoetes*. A series of his work is very suggestive to us in that it may be possible to judge the taxonomic importance of the proventriculus. FUCHS[51)] (1911) reported on the same organ of the subfamily Hylesininae. STROHMEYER[227)] (1914) illustrated the proventriculus of the family Platypodidae in his "Genera Insectorum". HOPKINS[59)] (1915) made mention of the importance of this organ in the classification of the Scolytoidea and he, on the other hand, pointed out the danger of classification based on the proventricular character alone. SPESSIVTZEFF[221)] (1926) gave a key to some species of *Orthotomicus* by the proventricular feature. BEAL[4)] (1927) published a paper on the development of this organ through the whole stage of *Pityogenes hopkinsi* SWAINE. A report on *Scolytus* by BUTOVITSCH[21)] (1929) is an excellent one of this group. SCHEDL[187)] (1931) published a paper on morphology of *Gnathotrichus* with description of the proventriculus. KRIVOLUTZKAJA[79)] (1958) described the bark beetles from Saghalien, with an interesting discussion on the group relationships within the tribe Cryphalini using the characteristics of the male genitalia and proventriculus, and also provided a key to species of *Dryocoetes* by the proventriculus. CHARARAS[27)] (1956) noted that this organ was useful since it shows the differences between the Scolytoidea and xylophagous Curculionidae. Many figures of the proventriculi were shown to distinguish the species of the coniferous *Cryphalus* from Hokkaido by INOUYE and the present author[63)] (1958). The following authors also described the new species or new genera with the illustration of this organ: BERGER[6)] (1916), NIIJIMA[143)] (1917), PJATNITZKY[171)] (1930), MURAYAMA[94)115)123)127)] (1930, 1951, 1955 & 1957), SAWAMOTO[184)] (1942), INOUYE and NOBUCHI[64)] (1959), NOBUCHI[148)150)151)155)] (1959, 1964 & 1966), NOBUCHI and TAKAHASHI[156)] (1965), BROWNE[18)] (1962) and TSAI and LI[232)] (1963).

Since 1952, the author has been studying the classification of this group. In the present paper, he intends to report the results of comparative study of the proventriculus observed in about one hundred genera of the Scolytoidea and a phylogenetic conclusion.

Acknowledgments

Before going further, the present author expresses his hearty thanks to Prof. Dr. Keizô YASUMATSU of Kyushu University, Dr. Motonori INOUYE of Ebetsu City, Prof. Dr. Mitsuhiro SASAKAWA of Kyoto Prefectural University, Dr. Masaaki TOKUNAGA of Kyoto, Dr. Takehiko NAKANE of National Science Museum, Dr. Kazuo ITO, Dr. Sukehisa AINO and Mr. Kyugo ODA of Government Forest Experiment Station and Professor Masatoshi NITTO of University of Tokyo, for their kind guidance in the course of the present study.

Prof. Dr. Chihisa WATANABE of Hokkaido University, Mr. Hitoshi HASEGAWA of National Institute of Agricultural Sciences, Dr. Kenji UMEYA of Exported and Imported Plant Quarantine and Mr. H. KORGE of Berlin were greatly helpful to the author in making valuable literature available.

Also he is indebted to the following entomologists for the gift of material: Dr. M. NUNBERG

of Hochschule für Bordenkultur, Warszawa, Dr. S. L. Wood of Brigham Young University, Dr. G. O. Krivolutzkaja of Institute of Biology and Pedology, Vladivostok, Dr. F. G. Browne of Middlesex, Dr. D. E. Bright, jr. of Entomology Research Institute of Central Experimental Farm, Ottawa, Mr. Kaku Sato of Tokyo, Mr. Seiho Kuniyoshi of Ryukyu Forest Experiment Station, Mr. Shizuo Ohno of Bonin Branch Office of Tokyo Metropolis and Mr. Keijiro Takahashi of Agricultural University of Tokyo.

General structure

(Plate 1)

Firstly, Lindemann[81] described the German terms of individual parts of the proventriculus. Subsequently, various differentiations of the proventriculus have been named by Nüsslin[162], Hopkins[59], Beal[4], Schedl[186] and Balachowsky[2], as shown in Table 1. The terminology used by Hopkins (1915) is accepted in this paper, with minor exception dercribed below.

The proventriculus (Pv) is the terminal part of the fore intestine and situated between the crop and cardia of the ventriculus. The inner lining is highly specialized and consists of eight sclerotized plates arranged in a circle forming a tube. Each plate is furnished with many spines, bristle-like spines or teeth, teeth, pubescence and other grinding surface. The function of the proventriculus is probably masticating and straining of the food.

Nüsslin[162] (1911～1912) observed that it is produced in eight longitudinal elevations in the

Table 1. A comparison of main terms used by different authors

Lindemann (1875)	Nüsslin (1911～1912)	Hopkins (1915)	Beal (1927)	Schedl (1931)	Balachowsky (1949)
Kauplatte	Plattenteil	Anterior plate	Chewing plate	Anterior plate	Diaphragme
	Ersatzsperr-borsten	Marginal bristles or fringe		Marginal bristles	Spicules latérales
	Hakenzähne	Transverse or apical teeth of anterior plate	Cutting teeth	Apical teeth of anterior plate	Denticules basilaires
	Kreulinie			A row of short stout teeth arising from lateral margin	
	Zähne am medianen Kauplattenrand	Sutural teeth	Cutting teeth		Denticules médians
Vorderer unpaarer Ansatz	Zahnreihe in unpaaren Ansatz				
Kaulade	Ladenteil	Posterior or masticatory plate		Masticatory plate	Plaque basale
Kaubürsten	Bürsten	Masticatory brush			
Abdachung	Abdachung	Femora of masticatory teeth	Sloping teeth	Femora of masticatory teeth	
	Abdachungs-zähne	Femoral teeth or ridge			
	Sperrborsten	Closing teeth	Obstructing bristles	Closing teeth	Soies d'arrêt

prepupal stage, and the sclerotization takes place in the pupal stage on two European species of *Ips*. Beal[4] (1927) stated that the wall of the proventriculus is divided into eight corrugations of epitherial layer in the fifth larval stadium and the complicated sclerotized structures of the intima are developed during the last few days of the pupal stage.

The primitive type of sclerotized proventriculus is seen in the Curculionidae, which has been known as a more primitive family than the Scolytoidea. In *Paroplapoderus* (Fig. 9), for example, it has only eight rows of long bristle-like spines and rather short rows of long spines, without any trace of the sclerotized plate. However, in *Niphades* (Fig. 10), *Pissodes* (Fig. 11) and *Sitopilus* (Fig. 12) they have eight sclerotized plates which are provided with the distinct masticatory brush and closing teeth, such as in the Scolytoidea. In the Cossoninae, the proventriculus is remarkably sclerotized, and is closely allied to those of the Scolytoidea in the structures.

The general type of each proventricular plate of the Scolytoidea may be separated into two regions; the anterior plate (Ap, Figs. 6～7) and posterior or masticatory plate (Pp). The former is connected with the crop in the anterior margin, strongly or weakly sclerotized, and is armed with teeth, long bristle-like spines, tubercles or processes and sutures. It is the most distingishable part of the proventricular apparatus for taxonomic use. In the ambrosia beetles it is quite absent or very small in size. The presence or absence of the anterior plate is highly significant, in the point of phylogenetic view. The latter is the posterior or caudal part of the proventricular plate and is armed with the closing teeth, masticatory brush and masticatory teeth.

As shown in the figures of plate 1, the proventricular plate of this superfamily may be divided into the following four types in the structures:

1. *Scolytine*-type (Fig. 5): The type is distinctly differentiated from other types in the following points: the proventricular plate is wide and well sclerotized; anterior plate is strongly sclerotized, divided longitudinally into two parts only scarcely united with each other in the middle, and densely covered with minute tubercles; posterior plate with apical laminate teeth and masticatory teeth.

2. *Hylastine-Hylurgine*-type (Fig. 6): The type is particularly specialized in the anterior plate, which is usually rather weakly sclerotized in the cephalic portion, indistinctly bordered on the crop, and has curved transverse sutures and dense rows of fine tubercles.

3. *Ipine*-type (Fig. 7): The anterior plate is strongly sclerotized, usually divided into two parts by a median longitudinal suture, bearing with the distinct sutural and apical teeth. The marginal bristles are often present.

4. *Scolytoplatypine*-type (Fig. 8): The proventriculus is very small and narrow. The anterior plate is nearly obsolete or quite absent. This type is only observed in the xylomycetophagous Scolytoidea.

The technical terms used in this paper are enumerated below, with a commentary.

Anterior plate (Ap): The anterior or cephalic part of the proventricular plate described above.

Apical laminate teeth (Al): The long teeth on the posterior plate as seen in *Scolytus*, corresponding to the closing teeth or masticatory brush in the other genera.

Apical teeth (At): The strong teeth on the caudal margin of the anterior plate, usually curved outwardly and arranged in V-shape.

Closing teeth (Ct): The fringe of bristle-like teeth arranged in a tuft on the cephalic portion of the masticatory brush.

Femoral teeth (Ft): The minute tubercles on the masticatory teeth.

Lateral teeth of serration (Lt): A row of minutely or distinctly serrated teeth on the anterior plate, extending anteriorly in V-form from the growing area of closing teeth; found in the tribes Hylastini and Hylurgini.

Marginal bristles or fringe (Mbl): A longitudinal row of very narrow and long spines on the lateral sides of the anterior plate, the number, length and growing area of these bristles are of remarkable value in the subfamily Ipinae.

Masticatory teeth (Mt): The narrow teeth on the lateral sides of the posterior plate. They usually connect with each other, crenulate nearby apices and make the masticatory brush (Mb) at tips.

Median longitudinal suture (Ms): A suture along the median longitudinal line of the anterior plate.

Posterior plate or masticatory plate (Pp): The posterior or caudal part of the proventricular plate described already.

Sutural teeth (St): The teeth along the median longitudinal suture.

Materials and methods

The majority of the Japanese species used in this study were collected by the author. The foreign species were sent to him by several entomologists.

Specimens examined were mostly in dried condition, but some were preserved in 75% alcohol. In order to remove all cellular tissues from the proventricular plates, the whole beetles are boiled in about 10% potassium hydroxide for several minutes until the proper clearing has taken place. The cleared specimen is then washed several times in distilled water to remove the alkali. Then the body is cut off between the head and pronotum or pronotum and mesonotum. The exposed proventriculus and crop separated from the pronotum are transferred to acetic acid solution containing a few drops of carbolate acid. Finally the proventriculus and crop are cut off longitudinally by a sharp needle or knife under the binocular microscope. For the detailed observation they are mounted on a slide. The "Zeichen Apparat" was used in making the figures.

Descriptions

Family Scolytidae

Subfamily Scolytinae

Genus *Scolytus* GEOFFROY

(Figs. 5 & 13)

Species examined: *S. claviger* BLANDFORD, *S. dahricus* CHAPUIS, *S. frontalis* BLANDFORD and *S. japonicus* BLANDFORD from Japan, *S. ratzeburgi* JANSON from Siberia, *S. scolytus* FABRICIUS (type-species) from Europe.

Wide, parallel-sided. Anterior plate sclerotized, with a deep cleft in middle of anterior margin and numerous denticles on posterior area, denser in middle. Posterior plate nearly as

long as the anterior, excepting distinctly shorter plate in *scolytus*, distinctly separated into two parts posteriorly, with slender laminate teeth, which taper apically and curved outwardly; in *japonicus* the laminate teeth shorter and not distinctly curved; closing and femoral teeth absent. Crop without both spine and tubercle.

Subfamily Hylesininae

Tribe Bothrosternini

Genus *Bothrosternus* EICHHOFF

(Fig. 14)

Species examined: *B. cancellatus* SCHEDL from South America.

Very narrow and small, almost parallel-sided. Anterior plate obsolete. Posterior plate very long; each closing tooth short, narrow and not serrated. Masticatory teeth accompanied with irregular rows of fine tubercles just laterad base of masticatory brush. Crop covered with pubescence.

Tribe Sphaerotrypini

Genus *Sphaerotrypes* BLANDFORD

(Fig. 15)

Species examined: *S. pila* BLANDFORD (type-species) from Japan.

Wide, slightly narrowing posteriorly. Anterior plate rather strongly sclerotized on lateral sides but nearly membraneous in middle, indistinctly bordered on crop, rather densely and irregularly covered with blunt tubercles, which are sparser on antero-lateral sides but become larger anteriorly; median longitudinal suture and apical tooth absent. Posterior plate nearly equal in length to the anterior; closing teeth longer, extending to posterior five-sixths of masticatory brush, each tooth simple and shortened anteriorly; femoral tooth lacking. Crop with fine and blunt tubercles.

Tribe Hyorrhynchini

Genus *Hyorrhynchus* BLANDFORD

(Fig. 16)

Species examined: *H. lewisi* BLANDFORD (type-species) from Japan.

Small, very narrow, parallel-sided. Anterior plate completely degenerate. Posterior plate slender; closing teeth short, narrow and simple; femoral tooth absent. Crop covered with long pubescence.

Genus *Pseudohyorrhynchus* MURAYAMA

(Fig. 17)

Species examined: *P. wadai* MURAYAMA (type-species) from Japan.

The proventriculus is very similar to that of the preceding genus.

Genus *Neohyorrhynchus* SCHEDL

(Fig. 18)

Species examined: *N. niisimai* (EGGERS) (type-species) from Japan.

It is hardly distinguished from the preceding two genera, by having the serrated closing teeth.

Genus *Sueus* MURAYAMA

This was already illustrated in the original description of *S. sphaerotrypoides* by MURAYAMA[115]

(1951). The structure of the proventriculus is very similar to that of *Hyorrhynchus*.

Tribe Strombophorini

Genus *Strombophorus* HAGEDORN

(Fig. 19)

Species examined: *S. ericeus* SCHAUFUSS from West Africa.

Wide, nearly parallel-sided. Anterior plate moderate in size, strongly sclerotized laterally but membraneous in triangular area of middle, indistinctly bordered on crop, covered with ten or more arcuate rows of minute tubercles, which almost connect with each other and become finer posteriorly; median longitudinal suture and lateral teeth of serration absent. Posterior plate nearly twice as long as the anterior; closing teeth extending just behind middle of masticatory brush, of which anterior ones long, slender and gradually tapering apically; the others shorter, strong, finely and sparsely serrated outside; femoral tooth absent. Crop closely covered with long pubescence, which are replaced by spines on tubercles in anterior areas.

Genus *Peronophorus* STROHMEYER

(Fig. 20)

Species examined: *P. adhorrens* EGGERS from Central Africa.

Wide, weakly narrowing posteriorly. Anterior plate about one and three-fifths as long as the posterior, almost membraneous, narrowly sclerotized laterally, indistinctly bordered on crop but distinctly separated by distinct semicircular suture from posterior plate, without median longitudinal suture, closely covered with fine tubercle; lateral teeth of serration absent. Posterior plate rather short; closing teeth long, each tooth gradually tapering apically, not serrated, extending to posterior end of masticatory brush, anterior ones of the teeth shorter; femoral tooth absent. Crop covered with dense tubercles.

Genus *Rhopalopselion* HAGEDORN

(Fig. 21)

Species examined: *R. thompsoni* SCHEDL from West Africa.

Narrow, nearly parallel-sided. Anterior plate short, moderately sclerotized on lateral sides but membraneous in middle, indistinctly bordered on crop, with posteriorly about nine strongly arcuate transverse rows of fine and blunt tubercles and anteriorly isolated spinose tubercles; median longitudinal suture and lateral teeth of serration absent. Posterior plate about two and one-third times as long as sclerotized part of anterior plate; closing teeth extending to middle of masticatory brush, anterior ones of them slender, tapering apically and slightly serrated inside, the others stout and with dense teeth of serrations of apices but sparsely serrated outside; anterior masticatory teeth with some strongly pointed spines; femoral tooth absent. Crop closely pubescent.

Tribe Diamerini

Genus *Diamerus* ERICHSON

(Fig. 22)

Species examined: *D. impar* CHAPUIS and *D. inperfectus* EGGERS from West Africa.

Wide, narrowing posteriorly. Anterior plate strongly sclerotized but membraneous in semicircle on antero-median part, indistinctly bordered on crop, finely with undulate transverse sutures, which are somewhat curved posteriorly and replaced by rows of granules and spines on anterior area, microscopically granulate on interstices between sutures on postero-median

portion; in *impar* an indistinct median longitudinal suture present; lateral tooth of serration absent. Posterior plate nearly as long as the anterior; closing teeth very long and narrow, almost extending to posterior end of masticatory brush, posteriorly forked; femoral teeth small, knob-like and arranged irregularly. Crop closely covered with fine spines.

Tribe Hylastini

Genus *Hylastes* ERICHSON

(Figs. 6 & 23)

Species examined: *H. parallelus* BLANDFORD and *H. plumbeus* EICHHOFF from Japan, *H. opacus* ERICHSON from Manchuria.

Narrow, gradually narrowing posteriorly. Anterior plate long, usually membraneous but sclerotized on lateral sides, indistinctly bordered on crop, with about twenty-five transverse sutures, which are more or less curved and accompanied with spinulae in middle of anterior portion and replaced by rows of sharp tubercles, which become larger on each lateral side; lateral teeth of serration distinct; median longitudinal suture absent. Posterior plate longer than the anterior, but shorter than anterior plate in *parallelus*; closing teeth narrow and comparatively long, but shorter than masticatory brush, some of them bifurcate at apices; femoral tooth absent. Crop rather closely covered with pubescence.

Genus *Hylurgops* LECONTE

(Fig. 24)

Species examined: *H. glabratus* (ZETTELSTEDT), *H. inouyei* NOBUCHI, *H. interstitialis* (CHAPUIS), *H. longipilis* REITTER, *H. niponicus* MURAYAMA, *H. palliatus* (GYLLENHAL) and *H. transbaicalicus* EGGERS from Japan.

Wide, narrowing posteriorly. Anterior plate moderately sclerotized but weakly in anterior portion, indistinctly bordered on crop, posteriorly with about twenty transverse sutures, which are replaced by rows of minute tubercles in anterior portion (except lateral sides), the tubercles becoming narrower and longer in middle of anterior portion; the transverse sutures accompanied with about fifteen lateral teeth of serration. Posterior plate nearly as long as the anterior; closing teeth rather long, extending beyond middle of masticatory brush, anterior ones of them slender and not furcate at apices, the others furcate at apices; femoral teeth distinct in *interstitialis* and *transbaicalicus*. Crop rather closely covered with long spines.

Tribe Hylurgini

Genus *Pseudohylesinus* SWAINE

(Fig. 25)

Species examined: *P. nebulosus* (LECONTE) from North America.

Wide, narrowing posteriorly. Anterior plate large, sclerotized on posterior halves of lateral sides, indistinctly bordered on crop, with about five transverse sutures posteriorly and five rows of isolated sharp tubercles in antero-median portion; sutures curved posteriorly and with distinctiy lateral teeth of serration. Posterior plate one and a half times longer than the anterior; closing teeth long, bristle-like, extending to anterior two-thirds of masticatory brush and bifurcate apically. Crop closely covered with short spines.

Genus *Hylurgonotus* SCHEDL

(Fig. 26)

Species examined: *H. antipodus* EGGERS from South America.

Narrow, lateral sides weakly narrowing posteriorly. Anterior plate very short, weakly sclerotized but well sclerotized on posterior and lateral areas, indistinctly bordered on crop, with about eight transverse sutures, which are replaced by rows of long spines in anterior portion, posterior ones of sutures incised shallowly in middle; median longitudinal suture and lateral teeth of serration absent. Posterior plate about three times as long as the anterior; closing teeth short, extending to about anterior one-third of masticatory brush, basal teeth of them stronger than apical ones, each tooth gradually narrowing apically and finely serrated outside, basal ones of them with sharply pointed serrated teeth; each masticatory tooth on anterior one-third of posterior plate with about one to five blunt tubercles just laterad base of masticatory brush.

Genus *Tomicus* LATREILLE

(Fig. 29)

Species examined: *T. brevipilosus* (EGGERS), *T. minor* (HARTIG) and *T. piniperda* (LINNÉ) (type-species) from Japan.

Wide, slightly narrowing posteriorly. Anterior plate weakly sclerotized, indistinctly bordered on crop, with about twelve sutures, which are replaced by rows of tubercles but vanished in middle of anterior portion, accompanied with lateral teeth of serration, of which posterior ones strongly curved. Posterior plate nearly as long as the anterior; closing teeth not so long, extending to middle of masticatory brush, anterior ones gradually narrowing at tips, the others not narrowing but bifurcate at tips, each tooth sparsely serrated outside; femoral tooth lacking. Crop covered with rather long spines.

Genus *Hylurgus* LATREILLE

(Fig. 27)

Species examined: *H. ligniperda* (FABRICIUS) (type-species) from Japan.

Wide, slightly narrowing posteriorly. Anterior plate longer, strongly sclerotized, excepting a weakly sclerotized rectangular area on anterior portion, indistinctly bordered on crop, with about twenty transverse sutures, accompanied with about twenty-five lateral teeth of serration, posterior ones of sutures curved and retuse in middle, rows of blunt tubercles arranged in anterior portion. Posterior plate one and two-thirds times as long as the anterior; closing teeth rather long and extending beyond middle of masticatory brush, consist of both bristle-like teeth and apically bifurcate ones, the former longer and narrower than the latter, and the latter slightly serrated outside; femoral tooth lacking. Crop covered with sharply pointed spines.

Genus *Dendroctonus* ERICHSON

(Fig. 28)

Species examined: *D. pseudotsugae* HOPKINS from North America.

Wide, narrowing posteriorly. Anterior plate weakly sclerotized on anterior half, indistinctly bordered on crop, with about eighteen transverse sutures, which are replaced by rows of sharply pointed granules or spinulae in middle of anterior portion, accompanied with about twenty strong lateral teeth of serration. Posterior plate shorter, about one and a half times as long as the anterior; closing teeth rather long, ending before posterior end of masticatory brush, gradually narrowing toward terminal end, with a few large but blunt tubercles beside base, some of them furcate apically; femoral teeth minute and very loosely scattered. Crop closely covered with narrow spines.

Tribe Hylesinini

Genus *Hylesinus* FABRICIUS

(Fig. 30)

Species examined: *H. cingulatus* BLANDFORD, *H. eos* SPESSIVTSEFF and *H. tristis* BLANDFORD from Japan, *H. oleiperda* FABRICIUS from Europe.

Narrow, weakly narrowing posteriorly. Anterior plate short, weakly sclerotized on apical triangular area which is provided with regular rows of blunt but large tubercles, indistinctly bordered on crop, with about ten transverse sutures, posterior ones of them curved and not or slightly retuse in middle; median longitudinal suture and lateral teeth of serration absent. Posterior plate variable in length, one to two times as long as the anterior; closing teeth rather short, not reaching to middle of masticatory brush; numerous minute tubercles growing irregularly just laterad base of masticatory brush, in *cingulatus* but each masticatory tooth only with blunt femoral teeth, of which posterior ones are finer. Crop rather closely covered with long spines.

Genus *Leperisinus* REITTER

(Fig. 31)

Species examined: *L. orni* (FUCHS) from Europe.

The proventriculus is very similar to that of the preceding genus.

Genus *Pteleobius* BEDEL

(Fig. 32)

Species examined: *P. scutulatus* (BLANDFORD) from Japan.

Narrow, almost parallel-sided. Anterior plate short, rather strongly sclerotized on lateral sides but weakly in antero-median part, indistinctly bordered on crop, with a smooth triangular area on each lateral side and some loose rows, which are slightly curved; median longitudinal suture and lateral teeth of serration absent. Posterior plate large, about three times as long as the anterior; closing teeth rather short and extending to middle of masticatory brush, anterior ones of the teeth slender and long, the others wider and with some microscopic teeth outside; femoral teeth distinct, arranged in five irregular rows. Crop rather closely covered with long and sharply pointed spines.

Genus *Alniphagus* SWAINE

(Fig. 33)

Species examined: *A. alni* NIIJIMA from Japan.

Narrow, slightly narrowing posteriorly. Anterior plate strongly sclerotized on lateral sides, excepting triangular area in middle, indistinctly bordered on crop, with many transverse sutures, which are replaced by blunt tubercles on anterior triangular area, posterior ones of the sutures strongly curved and retuse in middle, without distinct tubercles laterally; median longitudinal suture and lateral teeth of serration absent. Posterior plate one and a half times longer than the anterior; closing teeth not reaching to middle of masticatory brush, each not serrated in lateral sides; each masticatory tooth with about six femoral teeth, of which median ones are larger. Crop closely covered with rather sharply pointed tubercles.

Genus *Scierus* LECONTE

(Fig. 34)

Species examined: *S. annectens* LECONTE (type-species) from North America.

Narrow, slightly narrowing posteriorly. Anterior plate rather long, strongly sclerotized but membraneous in anterior semicircular portion, indistinctly bordered on crop, with some transverse sutures on sclerotized portion, the sutures curved posteriorly and emarginated in middle, membraneous portion with transverse rows of spine-like tubercles, which are finer in anterior rows; median longitudinal suture and lateral teeth of serration absent. Posterior plate about one and three-fifths times as long as the anterior; closing teeth hardly extending to middle of masticatory brush, each tooth finely serrated outside, anterior ones of them narrow and the others wider; masticatory teeth with many femoral teeth, which become longer and larger towards base of masticatory brush. Crop closely covered with long pubescence.

Genus *Hylastinus* BEDEL

(Fig. 35)

Species examined: *H. frankhauseri* REITTER from Europe.

Narrow, nearly parallel-sided. Anterior plate moderately sclerotized but weakly on anterior half, indistinctly bordered on crop, with several rows of pointed tubercles and some transverse sutures on posterior half, the sutures curved posteriorly and minutely serrated; median longitudinal suture and lateral teeth of serration absent. Posterior plate about twice as long as the anterior; closing teeth comparatively short, not extending to middle of masticatory brush, some of them stout and serrated outside; femoral teeth distinct and arranged densely. Crop rather closely covered with sharp tubercles.

Genus *Xylechinus* CHAPUIS

(Fig. 36)

Species examined: *X. pilosus* (RATZEBURG) from Europe.

Narrow, slightly narrowing posteriorly. Anterior plate short, weakly sclerotized, indistinctly bordered on crop, with several transverse sutures, of which posterior three curved posteriorly, without median longitudinal suture and lateral teeth of serration. Posterior plate three times as long as the anterior; closing teeth short, not extending to middle of masticatory brush, anterior ones of the teeth narrower than the others; femoral tooth absent. Crop closely covered with spines on posterior portion.

Tribe Phloeotribini

Genus *Phloeotribus* LATREILLE

(Fig. 37)

Species examined: *P. puberulus* LECONTE from North America, *P. rugulosus* EGGERS from South America.

Narrow, lateral sides almost parallel. Anterior plate short, moderately sclerotized, indistinctly bordered on crop, with six to ten transverse sutures, which are curved and minutely undulate, apical three of the sutures emarginated in middle; median longitudinal suture and lateral teeth of serration absent. Posterior plate about three times as long as the anterior; closing teeth narrow and long, two-thirds as long as masticatory brush in *rugulosus* and one-half in *puberulus*, and each tooth with two or three minute teeth outside in *rugulosus*. Crop closely covered with rather long spines on elongate tubercles.

Genus *Phthoropholoeus* REY

(Fig. 38)

Species examined: *P. spinulosus* REY (type-species) from Japan.

Narrow, lateral sides almost parallel. Anterior plate strongly sclerotized on lateral sides, indistinctly bordered on crop, with about ten transverse sutures only in middle, which are curved and minutely serrated, apical four of the sutures emarginated in middle; median longitudinal suture and lateral teeth of serration absent. Posterior plate longer, about three times as long as the anterior; closing teeth moderate, extending to middle of masticatory brush, slightly tapering apically, usually furcate at apices, some of them closely serrated outside and with rather blunt and sparse teeth only outside of base. Crop closely covered with rather long spines.

Tribe Hypoborini

Genus *Hypoborus* ERICHSON

(Fig. 39)

Species examined: *H. ficus* ERICHSON (type-species) from Europe.

Wide, lateral sides almost parallel. Anterior plate moderately sclerotized, with anterior margin almost straight; median longitudinal suture distinct, covered sparsely with blunt and large tubercles, which are arranged somewhat in several irregular rows; apical tooth and marginal bristle absent. Posterior plate moderate in length, about two and a half times as long as the anterior; closing teeth wide, extending to middle of masticatory brush, with a few large serrated teeth outside. Crop rather sparsely covered with bristle-like spines.

Genus *Renocis* CASEY

(Fig. 40)

Species examined: *R. heterodoxus* CASEY (type-species) from North America.

Wide, almost parallel-sided. Anterior plate weakly sclerotized, indistinctly bordered on crop, with several rows of fine tubercles on postero-lateral sides, tubercles distinctly larger in middle and arranged in loose lines; median longitudinal suture and lateral teeth of serration absent. Posterior plate nearly as long as the anterior; closing teeth moderate in length, extending to middle of masticatory brush, not serrated, narrowing apically; femoral tooth absent. Crop closely covered with fine tubercles, which are sharply pointed at apices.

Tribe Phloeosinini

Genus *Phloeosinus* CHAPUIS

(Fig. 41)

Species examined: *P. izuensis* NOBUCHI, *P. kiushuensis* MURAYAMA, *P. perlatus* CHAPUIS and *P rudis* BLANDFORD from Japan, *P. henschi* REITTER and *P. thujae* (PERRIS) (type-species) from Europe.

Wide, almost parallel-sided. Anterior plate almost membraneous except for moderately sclerotized postero-lateral area, with twelve rows of tubercles, which become larger anteriorly, posterior rows strongly curved anteriorly in middle, anterior rows irregular; median longitudinal suture and lateral teeth of serration absent. Posterior plate almost as long as the anterior; closing teeth long, extending beyond posterior one-third of masticatory brush, each blunt at apices but some of them indistinctly furcate at apices; femoral teeth arranged in irregular rows, but indistinct in *perlatus*. Crop rather closely covered with fine and blunt tubercles.

Genus *Hylesinopsis* EGGERS

(Fig. 42)

Species examined: *H. dubius* EGGERS (type-species) from West Africa.

Wide, slightly narrowing posteriorly. Anterior plate short, strongly sclerotized on latero-

posterior sides, indistinctly bordered on crop, with about five transverse sutures, which are minutely undulate, vanished in middle and replaced by minute and dense tubercles antero-mesally; median longitudinal suture and lateral teeth of serration absent. Posterior plate about two and four-fifths times as long as the anterior; closing teeth long, bristle-like, hardly reaching to three-fourths of masticatory brush; femoral teeth large, not pointed at apices, and very closely arranged. Crop closely covered with pubescence.

Tribe Polygraphini

Genus *Polygraphus* ERICHSON

(Fig. 43)

Species examined: *P. gracilis* NIIJIMA, *P. horyurensis* MURAYAMA, *P. jezoensis* NIIJIMA, *P. kisoensis* NIIJIMA, *P. nigrielytris* NIIJIMA, *P. proximus* BLANDFORD and *P. parvus* MURAYAMA from Japan, *P. formosanus* NOBUCHI from Formosa.

Wide, narrowing posteriorly. Anterior plate strongly sclerotized but weakly in middle of anterior portion, distinctly emarginated in a trumpet-form in apical margin, usually extending to middle of anterior plate; inner lateral margins of the emargination more strongly sclerotized, bearing a row of some strongly curved teeth along margins; in some species some short sutures on lateral sides of the sclerotized band present; apical tooth and marginal bristle absent. Posterior plate slightly longer than the anterior; closing teeth usually extending beyond middle of masticatory brush, but extending almost to posterior end of masticatory brush in *parvus*; femoral teeth strong and numerous in number. Crop closely pubescent.

Genus *Carphoborus* EICHHOFF

(Fig. 44)

Speices examined: *C. minimus* (FABRICIUS) (type-species) from Europe, *C. swainei* BUNCH from North America.

Wide, parallel-sided. Anterior plate strongly sclerotized, gently round in anterior margin and with a distinct median cleft extending over middle of the plate, transverse sutures consist of seven rows of sharply pointed tubercles, which are sometimes connected with each other; apical tooth and marginal bristle absent. Posterior plate slightly longer than the anterior; closing teeth broad and long, extending to two-thirds of masticatory brush, neither serrated nor furcate, gradually tapering apically; femoral tooth absent. Crop rather closely covered with pubescence.

Subfamily Ipinae

Tribe Micracini

Genus *Micracis* LECONTE

(Fig. 45)

Species examined: *M. hirtellus* LECONTE from North America.

Narrow, almost parallel-sided. Anterior plate rather long, strongly sclerotized on lateral sides but membraneous longitudinally in middle, indistinctly bordered anteriorly, with a tuft of five strong seta-like spines in middle of anterior membraneous area, two or three irregular longitudinal rows of large, bluntly pointed teeth on lateral sclerotizd areas, those rows extending to anterior masticatory teeth. Posterior plate about one and one-fifth times as long as the anterior; closing teeth reaching to middle of masticatory brush, anterior ones of them narrow and tapering apically, the others wide and finely serrated outside; femoral teeth narrow but

long, arranged in two irregular rows. Crop closely covered with pubescence.

Genus *Pseudothysanoes* BLACKMAN

(Fig. 46)

Species examined: *P. rigidus* (LECONTE) from North America.

Narrow, almost parallel-sided. Anterior plate large, strongly sclerotized laterally, indistinctly bordered in anterior margin and with deep membraneous incision in middle, with six to eight spines on membraneous area, lateral sclerotized area with about seven transverse rows of large tubercles and strong spines. Posterior plate nearly as long as the anterior; closing teeth extending to middle of masticatory brush, anterior ones of teeth narrow, the others wider and more or less serrated laterally; femoral teeth not pointed, continued in a row. Crop closely covered with pubescence.

Tribe Xyloctonini

Genus *Cryphalomimus* EGGERS

(Fig. 47)

Species examined: *C. ghanaensis* (SCHEDL) (type-species) from West Africa.

Wide, nearly parallel-sided. Anterior plate very short, almost triangular in shape, weakly sclerotized anteriorly, with fine scattered tubercles and four irregular rows of minute tubercles, of which posterior two strongly angulate in middle, anterior margin almost straight, not emarginated; median longitudinal suture and apical tooth absent. Posterior plate distinctly longer than the anterior; closing teeth very wide, not extending to middle of masticatory brush, minutely sinuous in lateral and apical sides; femoral teeth very sparse, slender and sharply pointed at apices. Crop closely pubescent.

Genus *Ctonoxylon* HAGEDORN

(Fig. 48)

Species examined: *C. camernum* HAGEDORN and *C. nodosum* EGGERS from West Africa.

Wide, slightly narrowing posteriorly. Anterior plate strongly sclerotized, especially along margins of median cleft, which extends from antero-lateral corners to just before base of closing teeth; surface distinctly tuberclate on antero-lateral corners but weakly along inner margin of emargination, in *camernum* conical tubercles arranged closely; apical tooth absent. Posterior plate nearly as long as the anterior, but one-half as long as that in *camernum*; closing teeth very long, extending beyond end of masticatory brush, furcate apically; femoral tooth absent. Crop closely but minutely tuberculate.

Tribe Cryphalini

Genus *Cryphalus* ERICHSON

(Fig. 49)

Species examined: *C. kurenzowi* (SCHEDL) from Japan.

Narrow, slightly narrowing posteriorly. Anterior plate very short, weakly sclerotized, with anterior margin slightly rounded; median longitudinal suture absent. Posterior plate five times as long as the anterior; closing teeth extending beyond middle of masticatory brush, with strong serration at base; femoral teeth distinct. Crop rather sparsely covered with pubescence.

Genus *Ernoporus* THOMSON

(Fig. 50)

Species examined: *E. longus* EGGERS from Japan.

Narrow, slightly narrowing posteriorly. Anterior plate weakly sclerotized, very short, indistinctly bordered on crop, with five transverse sutures, of which basal two or three curved and finely serrated, median longitudinal suture absent. Posterior plate long, five times as long as the anterior; closing teeth rather short, hardly extending to middle of masticatory brush, neither serrated nor furcate; femoral teeth finely but sharply pointed, of which basal ones are the longer, continuous in irregular rows. Crop covered with short but broad spines.

Genus *Ernoporicus* BERGER

(Fig. 51)

Species examined: *E. spessivtzevi* BERGER from Siberia.

Narrow, slightly narrowing posteriorly. Anterior plate short, weakly sclerotized, indistinctly bordered on crop, with some curved transverse rows of minute and pointed tubercles. Posterior plate long, about four times as long as the anterior; closing teeth extending beyond middle of masticatory brush, anterior ones of them narrow and tapering apically, the others broad and with some sharp teeth outside; masticatory teeth with many blunt tubercles just laterad base of masticatory brush on anterior half. Crop closely covered with short but broad spines.

Genus *Margadillius* HOPKINS

(Fig. 52)

Species examined: *M. corpulentus* (SAMPSON) from Ryukyu.

Wide, slightly narrowing posteriorly. Anterior plate small, moderately sclerotized, not or slightly curved in anterior margin, with about five transverse sutures, the sutures with indistinctly fine teeth; median longitudinal suture absent. Posterior plate large, about two and a half times as long as the anterior; masticatory teeth comparatively short, extending just before middle of masticatory brush, anterior two of them narrow and not furcate apically, the others distinctly wider, not pointed at apices; closely serrated outside; femoral tooth absent. Crop closely covered with pubescence.

Genus *Euptilius* SCHEDL

(Fig. 53)

Species examined: *E. thailandicus* SCHEDL from Thailand.

Wide, almost parallel-sided. Anterior plate moderately sclerotized, rounded anteriorly, with about eight arcuate rows of fine tubercles, which are arranged continuously on lateral sides; median longitudinal suture absent. Posterior plate about one and a half times as long as the anterior; closing teeth wide, tapering apically and finely serrated outside, extending beyond middle of masticatory brush; femoral teeth absent. Crop covered with pubescence.

Genus *Phellodendrophagus* KRIVOLUTZKAJA

(Fig. 54)

Species examined: *P. elegans* KRIVOLUTZKAJA (type-species) from Saghalien.

Wide, slightly narrowing posteriorly. Anterior plate short, indistinctly bordered on crop, with about five arcuate rows of fine pointed tubercles; median longitudinal suture absent. Posterior plate about five times as long as the anterior; closing teeth extending to middle of posterior plate, anterior ones of the teeth narrow and short, the others longer and tapering

apically, serrated outside and especially distinct at base; masticatory teeth with a few fine femoral teeth inside. Crop covered with rounded tubercles, which are provided with two or three short spines.

Genus *Cryphalomorphus* SCHAUFUSS

(Fig. 55)

Species examined: *C. birosimensis* (MURAYAMA) from Japan.

Narrow, slightly narrowing posteriorly. Anterior plate very short, weakly sclerotized, indistinctly bordered on crop, with a few curved sutures, which are serrated in middle; median longitudinal suture absent. Posterior plate long, ten or more time as long as the anterior; closing teeth wide but short, extending to anterior third of masticatory brush, each with some blunt processes outside, but anterior two of the teeth narrower and simple; femoral tooth absent. Crop covered with rather strong pubescence, which is somewhat bifurcate at apices.

Genus *Eocryphalus* KURENZOV

(Fig. 56)

Species examined: *E. semenovi* KURENZOV from Siberia.

Narrow, slightly narrowing posteriorly. Anterior plate short, weakly sclerotized, indistinctly bordered on crop, with indistinct transverse sutures and irregular tubercles, which are finer in middle; median longitudinal suture absent. Posterior plate about six times as long as the anterior; closing teeth narrow, not serrated, extending to anterior one-third of masticatory brush; femoral teeth arranged irregularly at lateral sides of brush. Crop rather sparsely covered with short spines.

Genus *Cryptocarenus* EGGERS

(Fig. 57)

Species examined: *C. haveae* (HAGEDORN) from West Africa.

Wide, narrowing posteriorly. Anterior plate short, strongly sclerotized, excepting membraneous median cleft, which is rounded mesally, each lateral sclerotized portion with four or five undulate transverse sutures and somewhat J-shaped sclerotized band at posterior end. Posterior plate about three and a half times as long as the anterior; closing teeth very short, a few in number and tapering apically; femoral tooth absent. Crop closely pubescent.

Genus *Taenioglyptes* BEDEL

(Fig. 58)

Species examined: *T. exiguus* (BLANDFORD), *T. fulvus* (NIIJIMA), *T. jeholensis* (MURAYAMA), *T. jezoensis* (INOUYE et NOBUCHI), *T. kyotoensis* (NOBUCHI), *T. laricis* (NIIJIMA), *T. malus* (NIIJIMA), *T. montanus* (NOBUCHI), *T. niponensis* (INOUYE et NOBUCHI), *T. piceae* (RATZEBURG) (type-species), *T. piceus* (EGGERS), *T. rhusii* (NIIJIMA) and *T. yamaguchii* (INOUYE et NOBUCHI) from Japan, *T. abbreviatus* (SCHEDL) and *T. garciniae* (NOBUCHI) from Ryukyu.

Wide, narrowing posteriorly. Anterior plate strongly sclerotized, almost straight or weakly concave in middle of anterior margin, with distinct median longitudinal suture; sutural teeth large, usually blunt at apices, and arranged in a few rows; apical teeth well developed, closely seriated in two or three transverse rows, becoming finer laterally; marginal bristle absent. Posterior plate nearly equal in length to the anterior; closing teeth long, usually extending over posterior end of masticatory brush, anterior ones of them swollen terminally and strongly

forked at apices and minutely serrated on lateral sides, the others tapering apically and weakly but serrated laterally; femoral tooth absent. Crop closely covered with rather long pubescence.

Genus *Hypocryphalus* HOPKINS

(Fig. 59)

Species examined: *H. mangiferae* STEBBING from West Africa.

Wide, narrowing posteriorly. Anterior plate large, strongly sclerotized, almost straight but slightly produced in middle of anterior margin; median longitudinal suture distinct; sutural teeth large, knob-like and arranged in an irregular row; apical teeth well developed, closely arranged in two or three rows; each tooth blunt or pointed apically, becoming gradually smaller in size laterally. Posterior plate slightly shorter than the anterior; closing teeth rather narrow and forked at apices, of which anterior ones distinctly shorter than the posterior which extend over posterior end of masticatory brush; femoral tooth absent. Crop closely covered with long pubescence.

Genus *Hypothenemus* WESTWOOD

(Figs. 60 & 61)

Species examined: *H. expers* BLANDFORD and *H.* sp. from Japan.

Wide, weakly narrowing posteriorly. Anterior plate moderately sclerotized, rather indistinctly bordered and not or slightly emarginated in anterior margin, with rather indistinct median longitudinal suture and eight to twelve transverse sutures, bearing sharply pointed tubercles, anterior five sutures almost straight but the others produced semicircularly laterad of middle; maginal bristle lacking. Posterior plate about one and one-third times as long as the anterior; closing teeth long, extending to anterior two-thirds of masticatory brush but middle in *H.* sp., anterior ones of the teeth long, slender and tapering apically, the others shorter, wider and serrated on lateral sides; in *H.* sp. each tooth not narrowing apically, with some forks at apices; femoral tooth lacking. Crop closely covered with pubescence.

In *H.* sp. three proventricular plates differ from the others described above in the following points: anterior plate with anterior margin quite indistinct, weakly sclerotized and not having marginal tubercle along margin, one or two anterior transverse rows of triangular tubercles almost extending to lateral margins of plate.

Genus *Stylotentus* SCHEDL

(Fig. 62)

Species examined: *S. concolor* (HAGEDORN) (type-species) from West Africa.

Wide, slightly narrowing posteriorly. Anterior plate moderately sclerotized, with anterior margin distinctry bordered, nearly straight with a shallow emargination in middle; median longitudinal suture distinct; transverse sutures about fifteen and sinuate, of which posterior five produced in semicircle posteriorly laterad of median suture and others oblique. Posterior plate one and one-third times as long as the anterior; closing teeth extending to middle of masticatory brush, anterior ones of them long, slender and tapering apically, the others shorter, wider and finely serrated outside; femoral tooth absent. Crop closely pubescent.

Tribe Xyloterini

Genus *Trypodendron* STEPHEN

(Fig. 63)

Species examined: *T. lineatum* OLIVIER, *T. proximum* (NIIJIMA) and *T. signatum* (FABRICIUS) from

Japan.

Small, very narrow, lateral sides slightly narrowing posterioly. Anterior plate nearly vestigial. Posterior plate slightly rounded, produced in middle of anterior margin; closing teeth short, almost extending to anterior third of masticatory brush, each minutely serrated at apex; masticatory brush narrow but long; femoral teeth fine, pointed at tips and arranged densely, especially distinct in *signatum*. Crop with eight tufts of seta-like spines.

Genus *Dendrotrypum* SCHEDL

(Fig. 64)

Species examined: *D. aceris* (NIIJIMA) and *D. pubipenne* (BLANDFORD) from Japan.

This genus is similar to the preceding genus *Trypodendron* in the structure of the proventriculus, and differs only in the absence of tuft of the crop.

Tribe Crypturgini

Genus *Dolurgus* EICHHOFF

(Fig. 65)

Species examined: *D. pumilus* (MANNERHEIM) (type-species) from North America.

Wide, weakly narrowing posteriorly. Anterior plate rather long, moderately sclerotized, concave in anterior margin, with about seven transverse sutures, which are curved and minutely crenate, posterior sutures of them with a pair of large teeth; median longitudinal suture absent. Posterior plate almost as long as the anterior; closing teeth long, being as long as two-thirds of masticatory brush, anterior ones of them narrow, not dentate, the others wider, with some large teeth of serration outside; femoral teeth arranged in a few rows. Crop covered with long pubescence.

Genus *Crypturgus* ERICHSON

(Fig. 66)

Species examined: *C. pusillus* (GYLLENHAL) (type-species) and *C. tuberosus* NIIJIMA from Japan.

Wide, weakly narrowing posteriorly. Anterior plate short moderately sclerotized, not or slightly concave in anterior margin, with a few rows of tubercles, in *tuberosus* tubercles arranged continuously and a pair of long tubercles in middle of posterior row; median longitudinal suture absent. Posterior plate distinctly longer than the anterior; closing teeth long and extending beyond middle of masticatory brush; femoral teeth arranged in a longitudinal row, those smaller in *pusillus* but in *tuberosus* larger and in an irregular row. Crop pubescent.

Genus *Thamnurgus* EICHHOFF

(Fig. 67)

Species examined: *T. euphorbiae* (KUSTER) (type-species) from Europe.

Narrow, slightly narrowing posteriorly. Anterior plate strongly sclerotized, slightly rounded, with anterior margin weakly emarginated in middle and sparsely serrated; median longitudinal suture distinct, about ten tuberculate transverse sutures curved posteriorly but concave in middle, reaching to each lateral margin, the tubercles triangular and sharply pointed, of which lateral ones become rather blunt and fine; marginal bristle absent. Posterior plate nearly twice as long as the anterior; closing teeth short, not extending to middle of masticatory brush, narrow and simple in anterior ones but broad and serrated in the others; femoral tooth absent. Crop closely covered with narrow and long spines.

Genus *Tiarophorus* SCHREINER

(Fig. 68)

Species examined: *T. elongatus* SCHREINER (type-species) from West Africa.

Wide, slightly narrowing posteriorly. Anterior plate short, strongly sclerotized, with anterior margin bluntly jagged and distincty bordered by crop, and with about six undulate transverse sutures, of which posterior two produced posteriorly and with two distinct teeth in middle, the others bisinuate and slightly rounded posteriorly in middle; median longitudinal suture absent. Posterior plate about two and a half times as long as the anterior; closing teeth short but wide, ending before middle of masticatory brush, each tooth bluntly pointed at apices, with several long spines from base to apical one-third outside, masticatory brush sparsely with large teeth of serration; femoral teeth long, seta-like. Crop rather closely covered with long pubescence.

Genus *Lymator* LOWENDAL

(Fig. 69)

Species examined: *L. coryli* (PERRIS) from Europe.

Wide, slightly narrowing posteriorly. Anterior plate short, strongly sclerotized, weakly emarginated in antero-median margin; median longitudinal suture distinct; tubercles large and blunt at apices, arranged irregularly on mesal part; apical tooth absent. Posterior plate rather wide; closing teeth narrow, extending to middle of masticatory brush, posterior ones of them wide and serrated outside; femoral tooth absent. Crop closely covered with pubescence.

Genus *Xylocleptus* FERRARI

(Fig. 70)

Species examined: *X. bispinosus* (DUFTSCHMIT) (type-species) from Europe.

This genus is closely allied to *Lymantor* in the structure of the proventriculus, but differs in having short transverse rows of minute tubercles on the anterior plate.

Genus *Ozopemon* HAGEDORN

(Fig. 71)

Species examined: *O. obanus* HAGEDORN from West Africa.

Narrow, weakly narrowing posteriorly. Anterior plate short, one-fourth as long as the posterior, strongly sclerotized, with anterior margin strongly emarginated in middle, each side of the emargination roundly produced anteriorly, strongly sclerotized, with blunt teeth sparsely; median longitudinal suture rather distinct; sutural tooth absent but weakly raised along suture; apical tooth and marginal bristle absent. Posterior plate long; closing teeth narrow, not pointed at apices, one-fourth as long as masticatory brush, of which anterior ones are shorter than posterior ones; femoral tooth absent. Crop closely covered with pubescence.

Genus *Taphrorychus* EICHHOFF

(Fig. 72)

Species examined: *T. coffeae* (EGGERS) and *T. striatus* NOBUCHI from Japan.

Narrow, weakly narrowing posteriorly. Anterior plate comparatively short, strongly sclerotized, with a deep median cleft reaching nearly to posterior end and bearing large teeth of serration, and provided with small triangular tubercles along inner margin of cleft; marginal bristles consist of two or three seta-like spines on postero-lateral part in *striatus* but absent in *coffeae;* apical teeth weakly developed. Posterior plate about two to three times as long as the

anterior; closing teeth extending to middle of masticatory brush, anterior ones of teeth slender and not serrated, the others wide and serrated outside, base of closing teeth finely serrated in *striatus*. Crop rather sparsely pubescent.

Genus *Dryocoetes* EICHHOFF

(Figs. 113 & 121)

Species examined: *D. autographus* (RATZEBURG) (type-species), *D. baikalicus* REITTER, *D. cristatus* INOUYE et NOBUCHI, *D. hectographus* REITTER, *D. luteus* BLANDFORD, *D. niijimai* NOBUCHI, *D. pini* NIIJIMA, *D. rugicollis* EGGERS, *D. striatus* EGGERS from Japan.

Narrow, weakly narrowing postriorly. Anterior plate strongly sclerotized, anterior margin with narrow or broad concavity in median portion, bearing a few large teeth, which are slender and not pointed at apices, in *autographus*, *baikalicus hectographus* and *rugicollis* some blunt teeth arranged continuously or scattered inside of concave margin but quite absent in other species; median longitudinal suture distinct; sutural teeth strong, spreading from middle to posterior end of anterior plate, gradually connected with strong apical teeth, which usually become finer in lateral sides and strongly curve outwardly; marginal bristles present in *autographus*, *cristatus*, *luteus*, *niijimai* and *pini*. Posterior plate rather long, distinctly longer than the anterior; closing teeth moderate in length, extending posteriorly over middle of masticatory brush, some of them serrated outside but not serrated in *luteus*; femoral teeth fine but close in anterior portion, absent in *luteus*. Crop irregularly covered with long pubescence.

Genus *Cyrtogenius* STROHMEYER

(Fig. 73)

Species examined: *C. cribricollis* STROHMEYER from West Africa.

Narrow, slightly narrowing posteriorly. Anterior plate short, strongly sclerotized; anterior anterior margin entirely straight; median longitudinal suture distinct; sutural teeth strong, jointed to smaller apical teeth, forming arrangement in inverted Y-shape; marginal bristle absent. Posterior plate about three and a half times as long as the anterior; closing teeth narrow, not reaching to middle of masticatory brush; femoral teeth a few in number, pointed apically. Crop rather sparsely covered with pubescence.

Genus *Carposinus* HOPKINS

(Fig. 74)

Species examined: *C. philippinensis* EGGERS from Ryukyu.

Narrow, narrowing posteriorly. Anterior plate strongly sclerotized, rather strongly produced anteriorly but with a deep median cleft, reaching to apical teeth, each lateral margin of cleft strongly sclerotized in stripe-form; sutural teeth large but blunt, extending from middle of suture to base of apical teeth which are strong, bluntly pointed at apices and almost uniform in size; marginal bristles about eight in number, long, situated on postero-lateral end. Posterior plate one and a half times as long as the anterior; closing teeth extending over middle of masticatory brush, tapering apically, minutely serrated laterally at base. Crop pubescent.

Genus *Orosiotes* NIIJIMA

The structure of the proventriculus of this genus has already been described in the original description of *O. kumamotoensis* NIIJIMA.

Genus *Pseudopoecilips* MURAYAMA

(Figs. 75, 122 & 123)

Species examined: *P. mikuniyamensis* MURAYAMA and *P. pilosus* (BLANDFORD) (type-species) from Japan.

Narrow, narrowing posteriorly. Anterior plate strongly sclerotized, with strong projection in middele of anterior margin and shallow concavities laterad of it; median longitudinal suture distinct; sutural teeth long, sometimes seta-like and arranged closely, posteriorly connected with apical teeth; apical teeth not so large in *mikuniyamensis* but moderate in *pilosus;* marginal bristles consist of a few simple seta-like spines. Posterior plate about one and a half times as long as the anterior; closing teeth extending to middle of masticatory brush, anterior ones of them shorter and the others closely serrated outside; femoral teeth small, arranged irregularly in *pilosus*. Crop closely covered with rather narrow pubescence.

Genus *Dryocoetiops* SCHEDL

(Fig. 76)

Species examined: *D. laevis* (STROHMEYER) (type-species) from the Philippines.

Narrow, narrowing posteriorly. Anterior plate strongly sclerotized; anterior margin strongly produced in middle and narrowly with deep median cleft, strongly sclerotized and bearing about ten teeth of serration along lateral margins, which are connected directly with narrow apical teeth; apical teeth arranged obliquely; marginal bristles slender, strongly curved forward at base, minutely furcate at apices, situated from middle to postero-lateral corners of anterior plate in a row. Posterior plate slightly longer than the anterior, very closely covered with seta-like teeth before closing teeth; closing teeth narrow, tapering apically, extending over middle of masticatory teeth; femoral teeth fine at anterior portin. Crop very closely covered with long pubescence.

Genus *Poecilips* SCHAUFUSS

(Fig. 77, 124 & 125)

Species examined: *P. fagi* NOBUCHI, *P. japonicus* (EGGERS) and *P. nubilis* (BLANDFORD) from Japan,

Narrow, slightly narrowing posteriorly. Anterior plate strongly sclerotized, somewhat produced in anterior margin, emarginated in middle of anterior margin, mesally with some strong but blunt teeth; median longitudinal suture distinct; apical teeth long in *fagi* and *japonicus* but somewhat finer in *nubilis*, strongly curved outwardly and gradually becoming finer laterally; marginal bristles consist of several seta-like spines, usually bifurcate at apices and situated at latero-posterior corners. Posterior plate about twice as long as the anterior; closing teeth moderate in length, extending over middle of masticatory brush, finely serrated outside; femoral teeth fine and numerous. Crop rather closely covered with pubescence.

Genus *Coccotrypes* EICHHOFF

(Fig. 78)

Species examined: *C. pygmaeus* EICHHOFF from North America.

Very narrow, narrowing posteriorly in lateral sides. Anterior plate short, strongly sclerotized, rather widely emarginated in middle of anterior margin, with indistinct teeth of serration along inner margins of concavity; sutural teeth blunt; apical teeth stout, not curved, becoming gradually smaller laterad; marginal bristles long, hair-like, some of them bifurcate and situated from anterior margin of plate to posterior end. Posterior plate long four or more times as long as the anterior; closing teeth hardly extending to middle of masticatory brush, narrow,

but posterior ones become wider and serrated outside; femoral tooth absent. Crop closely pubescent.

Tribe Premnobiini

Genus *Premnobius* EICHHOFF

(Fig. 79)

Species examined: *P. cavipennis* EICHHOFF (type-species) from West Africa.

Narrow, narrowing posteriorly. Anterior plate strongly sclerotized;anterior margin emarginated in triangle and reaching to base of apical teeth; sutural teeth large and strong; apical teeth very small, pointed at apices; marginal bristles consist of about six short seta-like spines. Posterior plate nearly twice as long as the anterior; closing teeth extending to middle of masticatory brush, anterior ones of them narrow but the others wide and serrated outside; femoral tooth absent. Crop closely pubescent.

Tribe Xyleborini

Genus *Xylosandrus* REITTER

(Fig. 80)

Species examined: *X. brevis*(EICHHOFF), *X. compactus* (EICHHOFF) and *X. germanus* (BLANDFORD) from Japan.

Small, narrow, weakly narrowing posteriorly. Anterior plate very short, with shallow concavity in middle of anterior margin. Posterior plate very narrow and long; closing teeth short, not extending to middle of masticatory brush, each minutely serrated on base of outside; femoral tooth absent. Crop covered with seta-like spines.

Genus *Xyleborus* EICHHOFF

(Fig. 81 to 88)

Species examined: *X. adumbratus* BLANDFORD, *X. amputatus* BLANDFORD, *X. apicalis* BLANDFORD, *X. atratus* EICHHOFF, *X. defensus* BLANDFORD, *X. exesus* BLANDFORD, *X. mutilatus* BLANDFORD, *X. rubricollis* EICHHOFF, *X. schaufussi* BLANDFORD, *X. seiryorensis* MURAYAMA, *X. semiopacus* EICHHOFF and *X. seriatus* BLANDFORD from Japan.

Small, narrow, almost parallel-sided. Anterior plate very short or vestigial, moderately sclerotized, variable in shape and length among species. Posterior plate very narrow and long; closing teeth short, less than half the length of masticatory brush; femoral teeth usually present. Crop covered with seta-like spines.

This genus shows considerable differences among species in the structure of the anterior plate, consequently the generic character cannot be admitted easily. But it may be recognized as of the follwing types based on the character of the anterior plate:

Type 1. *X. adumbratus* BLANDFORD.

Anterior plate almost absent; anterior four or five of masticatory teeth with long seta-like and inwardly directed spines. Anterior five of closing teeth very short and bear resemblance somewhat to apical teeth; femoral teeth fine but close at front.

Type 2. *X. apicalis* BLANDFORD, *X. atratus* EICHHOFF, *X. defensus* BLANDFORD, *X. exesus* BLANDFORD, *X. mutilatus* BLANDFORD and *X. seriatus* BLANDFORD.

Anterior plate rather large, with weak or strong sutural teeth; apical teeth distinct in *seriatus*; marginal bristles present in *atratus*, *defensus*, *exesus* and *seriatus*.

Type 3. *X. amputatus* BLANDFORD, *X. schaufussi* BLANDFORD, *X. seiryorensis* MURAYAMA and *X.*

semiopacus EICHHOFF.

Anterior plate very narrow, with fine granules instead of apical or sutural teeth.

X. rubricollis EICHHOFF is somewhat intermediate between Type 2 and 3 in having the apical teeth, very close and minute tubercles on the anterior plate, and the marginal bristles.

Genus *Cnestus* SAMPSON

(Fig. 89)

Species examined: *C. murayamai* SCHEDL from Japan.

Small, narrow, somewhat narrowing posteriorly. Anterior plate very short, sclerotized, anteriorly emarginated in middle, bearing a few teeth along inner margin of concavity. Posterior plate long and rather wide; closing teeth short, as long as one-third of masticatory brush, with indistinct granules at base; femoral tooth absent. Crop with eight tufts of long seta-like teeth.

Genus *Webbia* HOPKINS

(Fig. 90)

Species examined: *W. costulatulus* SCHEDL from Borneo.

Small, nallow and slightly narrowing posteriorly. Anterior plate absent. Posterior plate long; closing teeth extending to about one-third of masticatory brush, anterior ones of them short but stout, and with one or two distinct granules at base, posterior ones long, tapering apically and serrated outside; femoral tooth absent. Crop rather sparsely covered with short pubescence on fine tubercles.

Genus *Arixyleborus* HOPKINS

(Fig. 91)

Species examined: *A. rugosipes* HOPKINS from Borneo.

Small, narrow and slightly narrowing posteriorly. Anterior plate very short, emarginated in middle of anterior margin; marginal bristle absent. Posterior plate narrow and long; closing teeth hardly extending to middle of masticatory brush, anterior ones of them narrow and tapering apically, the others wider and serrated outside; femoral tooth absent. Crop rather sparsely covered with pubescence.

Genus *Eccoptopterus* MOTSCHULSKY

(Fig. 92)

Species examined: *E. sexspinosus* MOTSCHULSKY (type-species) from West Africa.

Small, narrow, not or slighly narrowing posteriorly. Anterior plate very small, emarginated in antero-median margin; marginal bristle absent. Posterior plate narrow, about six times as long as the anterior; closing teeth extending to one-third length of masticatory brush, narrow and tapering apically, with sharp and curved tubercles; femoral tooth absent. Crop with eight tufts of pubescence.

Tribe Ipini

Genus *Mimips* EGGERS

(Fig. 93)

Species examined: *M. pilosellus* BROWNE from West Africa.

Wide, slightly narrowing posteriorly. Anterior plate large, quadrate, strongly sclerotized, distinctly bordered at anterior margin, which is straight and not emarginated; median longitudinal suture distinct, with small blunt teeth of serration; apical teeth large, but lateral

ones smaller, arranged obliquely in a row, becoming sparser laterally; marginal bristles long, situated on postero-lateral corners, furcate at apices. Posterior plate a little longer than the anterior; closing teeth long, extending to two-thirds length of masticatory brush, consist of both narrow teeth and broad ones, the former furcate at apices, the latter strongly serrated outside; femoral teeth blunt, fine, and arranged in a longitudinal row. Crop covered with pubescence.

Genus *Pityogenes* BEDEL

(Figs. 126 to 128)

Species examined: *P. chalcographus* (LINNÉ) (type-species), *P. seirindensis* MURAYAMA and *P. foveolatus* EGGERS from Japan.

Wide, weakly narrowing posteriorly. Anterior plate strongly sclerotized, with median longitudinal suture; anterior margin sinuate and not or slightly emarginated in middle; sutural teeth comparatively large, semicircular to conical in shape, extending from anterior margin to base of apical teeth; marginal bristles consist of three or four seta-like teeth, but absent in *foveolatus*; apical teeth six to nine in an oblique line, large and sharply pointed at apices, curved outwardly, gradually smaller laterally; in *foveolatus* apical teeth smaller as compared with those of other species. Posterior plate nearly as long as the anterior; closing teeth well developed and long, posterior ones of them almost as long as masticatory brush, sometimes serrated outside and furcate at apices; femoral teeth nearly seta-like. Crop closely covered with pubescence.

Genus *Pityokteines* FUCHS

(Fig. 94)

Species examined: *P. spinidens* (REITTER) from Europe.

Wide, narrowing posteriorly. Anterior plate large strongly sclerotized; anterior margin slightly produced in middle, provided with sparsely serrated concavity; median longitudinal suture distinct; sutural teeth almost triangular, rather densely arranged from anterior margin to base of apical teeth; marginal bristles consist of about three long seta-like teeth, bifurcate or not; apical teeth large, arranged in an oblique line and curved outwardly, of which median ones are larger and longer than the others. Posterior plate somewhat longer than the anterior; closing teeth narrow, hardly reaching to posterior end of masticatory brush, anterior ones of them very narrow and long, the others wide, tapering apically and minutely serrated outside; femoral teeth narrow, longitudinally uniseriate. Crop closely pubescent.

Genus *Orthotomicus* FERRARI

(Figs. 129 to 133)

Species examined: *O. angulatus* (EICHHOFF), *O. golovjankoi* PJATNITZKY and *O. laricis* (FABRICIUS) (type-species) from Japan, *O. proximus* (EICHHOFF) from Siberia.

Wide, narrowing posteriorly. Anterior plate strongly sclerotized, with anterior margin slightly curved or slightly produced in middle; median longitudinal suture distinct; sutural teeth distinct and variable in shape among species; marginal bristles seta-like and furcate apically or not; apical teeth strong but smaller in *angulatus* and *proximus*. Posterior plate variable in size; closing teeth uniform in length, one-third to one-fourth as long as masticatory brush, usually serrated outside; femoral teeth long. Crop covered with short pubescence.

Genus *Ips* DEGEER

(Figs. 134 to 138)

Species examined: *I. acuminatus* (GYLLENHAL), *I. cembrae* (HEER), *I. tosaensis* MURAYAMA and *I.*

typographus japonicus NIIJIMA from Japan, *I. kuniyoshii* NOBUCHI from Ryukyu, *I. duplicatus* (SAHLBERG) from Siberia, *I. typographus* (LINNÉ) (type-species) and *I. sexdentatus* (BOERN) from Europe and Siberia.

Wide, usually strongly narrowing posteriorly. Anterior plate strongly sclerotized, slightly produced in middle of anterior margin, with median longitudinal suture and sutural teeth distinct, the latter spreading along anterior half of median longitudinal suture, but through whole length of suture in *tosaensis*, and quite absent in *kuniyoshii*; marginal bristles usually arranged in a long row laterally from anterior corner of plate to posterior end, but only several on postero-lateral corner in *typographus* and *kuniyoshii*, posterior ones of the bristles longer and sometimes weakly furcate at apices; apical teeth well developed, curved outwardly, forming about twenty strong teeth of serration obliquely, and becoming smaller laterally. Posterior plate nearly as long as the anterior; closing teeth not so long, not or hardly reaching to middle of masticatory brush, but distinctly longer in *tosaensis* and *kuniyoshii*; femoral teeth very weak. Crop closely covered with short pubescence.

Genus *Acanthotomicus* BLANDFORD

(Fig. 95)

Species examined: *A. spinosus* BLANDFORD (type-species) from Japan.

Narrow, weakly narrowing anteriorly. Anterior plate strongly sclerotized, weakly concave in middle of anterior margin; median longitudinal suture present; sutural teeth triangular, dense, evenly continuing from anterior margin of plate to base of apical teeth, becoming slightly larger and rather sharp posteriorly; marginal bristles consist of about seven simple seta-like teeth; apical teeth stout, curved outwardly, gradually becoming smaller laterally. Posterior plate somewhat longer than the anterior; closing teeth rather long, extending to middle of masticatory brush, anterior ones of them shorter; femoral teeth rather large and arranged in a longitudinal row. Crop closely pubescent and with a tuft of long seta-like spines before each proventricular plate.

Tribe Pityophthorini

Genus *Pityoborus* BLACKMAN

(Fig. 96)

Species examined: *P. comatus* ZIMMERMAN from North America.

Nerrow, slightly narrowing posteriorly. Anterior plate comparatively short, sclerotized on lateral and posterior sides, distinctly bordered and widely emarginated in anterior margin, with about six transverse rows of tubercles, which become larger on antero-lateral sides. Posterior plate about four times as long as the anterior; closing teeth extending to middle of masticatory brush and distinctly serrated outside; femoral tooth absent. Crop closely covered with long pubescence.

Genus *Conophthorus* HOPKINS

(Fig. 97)

Species examined: *C. lambertiarae* HOPKINS from North America.

Narrow, slightly narrowing posteriorly. Anterior plate rather long, strongly sclerotized, with a deep cleft expanding in triangle anteriorly, about eight transverse rows of tubercles arranged sparsely, tubercles larger and isolated in anterior rows and connected with each other in posterior rows. Posterior plate about one and a half times as long as the anterior; closing teeth extending to middle of masticatory brush, anterior ones of them narrower, the others wide and minutely serrated outside; femoral tooth absent. Crop closely covered

with pubescence.

Genus *Pityophthorus* EICHHOFF

(Fig. 98)

Species examined: *P. jucundus* BLANDFORD from Japan.

Narrow, almost parallel-sided. Anterior plate small, moderately sclerotized, excepting median broad membraneous part, almost straight in anterior margin, with about seven transverse row of tubercles roundly curved but retuse in middle of posterior three rows. Posterior plate about three times as long as the anterior; closing teeth moderate in size, extending to middle of masticatory brush; masticatory teeth minutely serrated laterad base of mastidatory brush; femoral teeth minute, sharp and arranged in a row. Crop closely covered with short pubescence.

Genus *Pseudopityophthorus* SWAINE

(Fig. 99)

Species examined: *P. opacicollis* BLACKMAN and *P. pubipennis* (LECONTE) from North America.

Wide narrowing posteriorly. Anterior plate rather long, strongly sclerotized, with a broad and deep cleft in anterior margin and about ten transverse rows of tubercles, which are isolated anteriorly and connected with each other in posterior half of rows, posterior two or three rows accompanied with a pair of large conical tubercles at both mesal ends. Posterior plate about one and one-third times as long as the anterior; closing teeth narrow and not furcate apically, extending just before end of masticatory brush, posterior ones of them serrated outside; femoral teeth irregularly arranged. Crop closely covered with long pubescence.

Genus *Myeloborus* BLACKMAN

The structure of the proventriculus of this genus has already been described in the original description of *M. arakii* (SAWAMOTO).

Tribe Corthylini

Genus *Gnathotrichus* EICHHOFF

(Fig. 100)

Species examined: *G. sulcatus* (LECONTE) from North America.

Small, very long, not or slightly narrowing posteriorly. Anterior plate nearly vestigial. Posterior plate long; closing teeth short not extending to anterior fourth of masticatory brush, bearing from anterior margin of plate to base of masticatory brush, anterior ones of them seta-like and furcate apically, the others wide and strongly serrated outside; masticatory brush with minute tubercles just laterad of its base; femoral tooth absent. Crop pubescent.

Genus *Monarthrum* KIRSCH

(Fig. 101)

Species examined: *M. fasciatum* (SAY) from North America.

Very small and narrow, almost parallel-sided. Anterior plate completely absent. Posterior plate long; closing teeth short, minutely serrated outside, tapering apically; masticatory brush close with minute tubercles just laterad of its base; femoral tooth absent. Crop rather sparsely covered with pubescence.

Genus *Pterocyclon* EICHHOFF

(Fig. 102)

Species examined: *P. minutum* SCHEDL and *P. plaumanni* SCHEDL from South America.

Very small and narrow, almost parallel-sided. Anterior plate completely degenerate. Post-

erior plate long and narrow; closing teeth short, extending to anterior fourth of masticatory brush, gradually narrowing apically, with fine teeth on outside of base; masticatory brush with minute tubercles just laterad of its base; femoral teeth absent. Crop closely pubescent.

Genus *Corthylus* ERICHSON

(Fig. 103)

Species examined: *C. robustus* EGGERS and *C. schaufussi* EGGERS from South America.

Very small and narrow, parallel-sided. Anterior plate lacking. Posterior plate long; closing teeth rather short, extending to anterior fourth of masticatory brush, tapering apically, finely serrated outside; masticatory brush with minute tubercles just laterad of its base, which are arranged irregularly and increasing in size anteriorly; femoral tooth absent. Crop somewhat closely pubescent before plates.

Genus *Microcorthylus* FERRARI

(Fig. 104)

Species examined: *M. puerulus* SCHEDL from South America.

This is quite similar to the preceding genus in general structure of the proventriculus.

Genus *Tricolus* BLANDFORD

(Fig. 105)

Species examined: *T. senex* SCHEDL from South America.

Very small and narrow, parallel-sided. Anterior plate absent. Posterior plate narrow and long; closing teeth short, extending to anterior third of masticatory brush, finely serrated outside of base; masticatory brush with minute tubercles just laterad of its base; femoral tooth absent. Crop somewhat closely pubescent before ecah plate.

Subfamily Scolytoplatypinae

Genus *Scolytoplatypus* SCHAUFUSS

(Fig. 106)

Species examined: *S. daimio* BLANDFORD, *S. mikado* BLANDFORD, *S. shogun* BLANDFORD and *S. tycon* BLANDFORD from Japan.

Small and narrow, not or slightly narrowing posteriorly, Anterior plate almost vestigial. Posterior plate long; closing teeth short, extending to anterior third of masticatory brush, serrated outside of base; masticatory teeth with a few irregular rows of triangular teeth just laterad base of masticatory brush. Crop with eight tufts of long seta-like spines before plates.

Family Platypodidae

Subfamily Platypinae

Genus *Platypus* HERBST

(Fig. 107)

Species examined: *P. calamus* BLANDFORD, *P. lewisi* BLANDFORD, *P. modestus* BLANDFORD and *P. severini* BLANDFORD from Japan, *P. lepidus* CHAPUIS from the Philippines.

Very small and narrow, not narrowing posteriorly. Anterior plate atrophied. Posterior plate very long; closing teeth short, bearing from anterior margin of plate to base of masticatory brush in an irregular row, each seta-like and furcate apically; masticatory brush with a longitudinal row of minute tubercles just laterad of its base but two rows in *lepidus*. Crop with eight tufts of seta-like spines before plates.

Genus *Trachyostus* SCHEDL

(Fig. 108)

Species examined: *T. schaufussi* (STROHMEYER) from West Africa.

Very small and narrow, not narrowing posteriorly. Anterior plate nearly obsolete. Posterior plate long; closing teeth short, very narrow and tapering apically, bearing from anterior margin to posterior area in an irregular row and nearly extending to apical fifth of masticatory brush; masticatory brush with many tubercles just laterad of its base. Crop pubescent.

Genus *Crossotarsus* CHAPUIS

(Fig. 109)

Species examined: *C. niponicus* BLANDFORD from Japan.

Very small and narrow, not or slightly narrowing posteriorly. Anterior plate nearly vestigial. Posterior plate long; closing teeth short and narrow, bearing from anterior margin of plate; masticatory brush with numerous minute tubercles just laterad of its base.

Genus *Doliopygus* SCHEDL

(Fig. 110)

Species examined: *D. aduncus* SCHEDL from West Africa.

Very small and narrow, almost parallel-sided. Anterior plate nearly vestigial. Posterior plate long; closing teeth short and furcate apically, bearing from anterior margin to posterior area in an irregular row; masticatory brush with many tubercles just laterad of its base. Crop pubescent.

Subfamily Diapinae

Genus *Diapus* CHAPUIS

(Fig. 111)

Species examined: *D. truncatus* NIIJIMA et MURAYAMA from Formosa.

Very small and narrow, almost parallel-sided. Anterior plate obsolete. Posterior plate long; closing teeth short, narrow, furcate at apices; masticatory teeth with many tubercles laterad base of masticatory brush. Crop pubescent.

Genus *Diacavus* SCHEDL

(Fig. 112)

Species examined: *D. serratus* SCHEDL from Borneo.

Very small and narrow, not narrowing posteriorly. Anterior plate absent. Posterior plate wide and short; closing teeth short, narrow, furcate at apices; mesal sides of masticatory teeth indistinctly serrated. Crop pubescent.

Discussion

1. Some remarks on the feeding habits

Before discussing the significance of the proventriculus, it is necessary to investigate the feeding habits. There is a wide range of variations in the habits of the larvae and adults according to the different groups. The Scolytoidea is distinguished into several categories depending on its feeding habits.

Phloeophagy is a common habit in the subfamilies Hylesininae and Ipinae. The larvae and adults feed upon the inner bark and living tissues between the bark and wood. In general,

they are called "bark beetles". In some cases, the larvae shallowly excavate in the wood or directly mine into the wood beyond the apical part of larval tunnels. The gallery wall is not covered with ambrosia fungus.

Xylo-mycetophagy is a highly specialized type in this superfamily and can be seen in the ambrosia beetles. The tunnels of the beetles extend directly through the bark into the sapwood. Both the larvae and adults feed on fungi that are growing on the wall of the burrows. It is prevalent in the subfamilies Scolytoplatypinae, Platypinae, Diapinae and in the tribes Xyloterini, Premnobiini, Xyleborini and Corthylini of the subfamily Ipinae, and it occurs also in the primitive groups, such as the tribes Bothrosternini and Hyorrhynchini of the subfamily Hylesininae.

Xylophagy, feeding on wood as in the family Bostrychidae, is a special case in this superfamily and has been discovered in *Lymantor decipiens* (LECONTE) and some species of *Micracis* and *Thysanoes* in the tribe Micracini. But it is not an uncommon habit in the primitive genera of the subfamily Hylesininae, namely *Strombophorus*, *Rhopalopselion*, *Metahylesinus*, *Dendrosinus* and *Diamerus*. And this feeding habit is also known to occur in *Mimips arundinarius* SCHEDL, *M. kikusuae* SCHEDL and *Micracidendron montanum* SCHEDL of the subfamily Ipinae. NIIJIMA[142](1913) mentioned that *Hyorrhynchus lewisi* BLANDFORD from Japan is truly xylophagous. The author ascertained it on the galleries made in *Fagus crenatus* BLUME. According to this material, a primary tunnel penetrates across the grain of wood, secondary tunnels branch out horizontally and are darkened by ambrosia fungi, the eggs are deposited in both upper and lower sides of the main secondary tunnels, the larval mines diverge from the seconday tunnel and are extended through the inner wood. The tunnels expand as the larvae grow, the newly emerged adults bore through the wood to surface. In Japan, some beetles, like *Pityophthorus jucundus* BLANDFORD, *Taphrorychus coffeae* (EGGERS), *T. striatus* NOBUCHI and *Hypothenemus expers* BLANDFORD, bore through the bark and wood, and moreover construct egg galleries in the pith or heartwood located in the center of twigs. And the hatched larvae feed on the pith or heartwood. They may also be classed in this xylophagy.

Spermatophagy, feeding on and living in seeds or cones, is a habit known to occur in *Hypothenemus* of the tribe Cryphalini, *Poecilips* and *Coccotrypes* of the tribe Crypturgini and *Conophthorus* of the tribe Pityophthorini.

The mode of life in the Scolytoidea discussed above is summarized in Table 2 on the genera examined in this study.

Table 2. The known feeding habits of the genera examined

	Phloeophagy	Xylo-mycetophagy	Xylophagy	Spermato-phagy
Scolytus	+			
Bothrosternus		+		
Sphaerotrypes	+			
Hyorrhynchus			+	
Pseudohyorrhynchus		?	?	
Neohyorrhynchus		+		
Sueus		+		
Strombophorus	+		+	

	Phloeophagy	Xylo-mycetophagy	Xylophagy	Spermato-phagy
Peronophorus	+			
Rhopalopselion	+		+	
Diamerus	+		+	
Hylastes	+			
Hylurgops	+			
Pseudohylesinus	+			
Tomicus	+		+*	
Hylurgus	+			
Dendroctonus	+			
Hylesinus	+			
Leperisinus	+			
Pteleobius	+			
Alniphagus	+			
Scierus	+			
Hylastinus	+			
Xylechinus	+			
Phloeotribus	+			
Phthorophloeus	+			
Hypoborus	+			
Renocis	+			
Phloeosinus	+		+	
Hylesinopsis	+			
Polygraphus	+			
Carphoborus	+			
Micracis			+	
Pseudothysanoes			+	
Cryphalomimus			+	
Ctonoxylon	+			
Cryphalus	+			
Ernoporus	+			
Ernoporicus	+			
Margadillius	+			
Euptilius	+			
Phellodendrophagus	+			
Cryphalomorphus	+		+	
Eocryphalus	+			
Cryptocarenus			+	+
Taenioglyptes	+			
Hypocryphalus	+			
Hypothenemus	+		+	+
Stylotentus			+	
Trypodendron		+		
Dendrotrypum		+		
Dolurgus	+			
Crypturgus	+			

* in the adult stage only.

	Phloeophagy	Hylo-mycetophagy	Xylophagy	Spermato-phagy
Thamnurgus	+			
Lymantor	+		+	
Xylocleptus	+			
Ozopemon	+			
Taphrorychus	+		+	
Dryocoetes	+			
Cyrtogenius	+		+	
Carposinus	+			
Pseudopoecilips	+			
Dryocoetiops	+			
Poecilips	+			+
Coccotrypes	+			+
Premnobius		+		
Xylosandrus		+		
Xyleborus		+		
Cnestus		+		
Webbia		+		
Arixyleborus		+		
Eccoptopterus		+		
Mimips	+		+	
Pityogenes	+			
Pityokteines	+			
Orthotomicus	+			
Ips	+			
Acanthotomicus	+			
Pityoborus	+			
Conophthorus	+			+
Pityophthorus	+		+	
Pseudopityophthorus	+			
Myeloborus	+		+	
Gnathotrichus		+		
Monarthrum		+		
Pterocyclon		+		
Corthylus		+		
Microcorthylus		?		
Tricolus		?		
Scolytoplatypus		+		
Platypus		+		
Trachyostus		+		
Crossotarsus		+		
Doliopygus		+		
Diapus		+		
Diacavus		+		

Feeding habits of *Hylurgonotus*, *Tiarophorus* and *Orosiotes* are unknown at present.

2. **Variation in individual proventricular plate**

The proventriculus consists of eight plates as previously stated. The plates are not variable in general structure, but in a few species they show slight differences among them. Namely, the three plates of *Hypothenemus* differ from the other five by lacking the longitudinal suture and having longer transverse rows of teeth on the anterior plate. In the certain species *Taenioglyptes*, some anterior plates are variable in size. On the other hand, the arrangement of tubercles, teeth and seta-like teeth on the anterior plate is usually not variable in outline, but is in number.

3. **Variability of the proventricular plate among the species**

NÜSSLIN was of the opinion that the proventricular plates are of great value in differentiating the genus and higher group. Generally, the proventricular plates of the species belonging to a single genus closely resemble one another, excepting some cases. Previously, some entomologists had established the various keys to the species of *Scolytus*, *Hylesinus*, *Dryocoetes*, *Pityokteinus*, *Orthotomicus* and *Ips* by the character of the proventricular plate. In general, it appears to him that no clearcut distinction can be made among the species of the ambrosia beetles by their simplification in the structures, but can be easily applicable in the bark beetles which have the teeth and spines in various degrees on the anterior plate. A few keys distinguishing the species of the Scolytoidea will be described below.

Key to the species of the tribe Crypturgini by the proventriculus

1. Anterior plate with strong apical teeth…… 2
- Anterior plate without apical tooth……18
2. Anterior plate emarginated in middle of anterior margin…… 5
- Anterior plate almost straight or produced anteriorly in middle of anterior margin, never emarginated …… 3
3. Anterior plate very short, less than one-third as long as the posterior, with anterior margin almost straight……*Cyrtogenius cribricollis* SCHEDL
- Anterior plate long, more than half as long as the posterior, strongly and roundly produced in middle of anterior margin…… 4
4. Sutural teeth on anterior portion distinctly long and sharply pointed; basal ones of masticatory teeth with larger tubercles……*Pseudopoecilips pilosus* (BLANDFORD)
- Sutural teeth short and rounded at apices; masticatory teeth normal……*Pseudopoecilips mikuniyamensis* MURAYAMA
5. Marginal bristles present…… 6
- Marginal bristles absent but anterior ones of masticatory teeth with a few short seta-like spines near lateral ends……14
6. Marginal teeth on antero-median concavity of anterior plate smaller, not pointed at apices ……7
- Marginal teeth on antero-median concavity of anterior plate larger and usually distinctly pointed…… 9
7. Anterior plate very short, less than one-fourth as long as the posterior, distinctly wider than long……*Coccotrypes pygmaeus* EICHHOFF
- Anterior plate longer than one-third as long as the posterior, not or slightly wider than long …… 8
8. Frontal margin of anterior plate strongly produced anteriorly, marginal teeth on antero-

median concavity of anterior plate distinct but small; emargination of anterior margin extending beyond middle of anterior plate……*Poecilips nubilis* (Blandford)

- Frontal margin of anterior plate not or slightly produced anteriorly; marginal teeth on antero-median concavity of anterior plate indistinct; emargination of anterior margin extending to anterior one-third length of anterior plate……*Dryocoetes luteus* Blandford

9. Masticatory teeth with numerous tubercles……10
- Masticatory teeth without tubercle……11

10. Anterior plate narrowly emarginated in middle of anterior margin; closing teeth short, not extending to posterior two-thirds of masticatory brush……*Poecilips fagi* Nobuchi
- Anterior plate widely emarginated postero-mesally; closing teeth longer, extending beyond posterior two-thirds of masticatory brush ……*Dryocoetes niijimai* Nobuchi

11. Anterior plate with strongly sclerotized stripes along margin of deep cleft; apical teeth not pointed and wide……12
- Anterior plate without sclerotized stripe; apical teeth pointed and narrow……13

12. Anterior plate short, about one-half times as long as the posterior; apical teeth ending anteriorly before middle of anterior plate……*Carposinus pilippinensis* (Eggers)
- Anterior plate long, slightly shorter than the posterior; apical teeth extending anteriorly beyond middle of anterior plate……*Dryocoetiops laevis* (Strohmeyer)

13. Emargination of anterior margin of plate deeper, extending beyond middle of anterior plate; apical teeth small and bluntly pointed……*Taphrorychus striatus* Nobuchi
- Emargination of anterior margin of plate shallow, not extending to middle of anterior plate; apical teeth long, sharply pointed and curved outward……*Poecilips japonicus* Eggers

14. Anterior plate with both marginal teeth on inner margins of concavity and several teeth inside of that……15
- Anterior plate with marginal teeth only……17

15. Posterior ones of sutural teeth distinctly longer than anterior ones……
……*Dryocoetes baikalicus* Reitter
- Posterior ones of sutural teeth equal in length to or slightly shorter than anterior ones…16

16. Emargination in anterior margin of plate deeper, reaching beyond middle of anterior plate
……*Taphrorychus coffeae* (Eggers)
- Emargination in anterior margin of plate shallow, not reaching to middle of anterior plate ……
……*Dryocoetes autographus* Ratzeburg*, *D. hectographus* Reitter and *D. rugicollis* Eggers

17. Anterior plate nearly half as long as the posterior; masticatory teeth with seta-like spines on anterior area; apical teeth arranged almost transversely ……
……*Dryocoetes striatus* Eggers
- Anterior plate less short than half length of the posterior; masticatory teeth with a few bristles on anterior area; apical teeth arranged obliquely ……
……*Dryocoetes cristatus* Inouye et Nobuchi and *D. pini* Niijima

18. Anterior plate with median longitudinal suture ……19

---

* According to Nüsslin[162] (1911～1912) and Krivolutzkaja[79] (1958), who illustrated the proventriculus of this species, the anterior plate has no tooth along margins of the antero-median concavity, but the specimens collected in our country differ from that in the existence of distinct teeth of serration there.

- Anterior plate without median longitudinal suture ..... *Dolurgus pumilus* (Mannerheim), *Crypturgus pusilus* (Gyllenhal), *C. tuberosus* Niijima and *Tiarophorus eleongatus* Schreiner

19. Closing teeth very short, one-fourth length of masticatory brush; anterior plate strongly sclerotized along anterior margin, with longitudinal suture, and without tubercle..... *Ozopemon obanus* Hagedorn
- Closing teeth long, extending near middle of masticatory brush; anterior plate not strongly sclerotized along anterior margin, with fine tubercles on surface, without median longitudinal suture.....20

20. Tubercles on anterior plate large and isolated..... *Lymantor coryli* Lowendal
- Tubercles on anterior plate minute, arranged in some transverse rows.....21

21. Transverse rows of tubercles on anterior plate long, almost reaching to each lateral margin..... *Thamnurgus euphoribiae* (Kuster)
- Transverse rows of tubercles on anterior plate short, only situated in middle..... *Xylocleptus bispinosus* (Duftschmit)

Key to the species of the genera *Xyleborus* Eichhoff and *Xylosandrus* Reitter by the proventriculus

1. Anterior plate very short or nearly vestigial; masticatory teeth without or with fine tubercles 2
- Anterior plate absent; anterior masticatory teeth with three or four long seta-like spines ..... *Xyleborus adumbratus* Blandford

2. Either apical or sutural teeth present..... 3
- Both apical and sutural teeth absent..... 8

3. Sutural teeth on anterior plate quite long, more than four times as long as wide..... *Xyleborus exesus* Blandford
- Sutural teeth on anterior plate short, less than four times as long as wide..... 4

4. Sutural and apical teeth spreaded posteriorly, in connection with femoral teeth of serration; marginal bristle absent..... 5
- Sutural and apical teeth widely spreaded posteriorly, separated from femoral teeth of serration when they are present, marginal bristles present..... 6

5. Sutural teeth of serration reaching to anterior margin of plate and somewhat fine..... *Xyleborus mutilatus* Blandford
- Sutural teeth not reaching anteriorly to anterior margin..... *Xyleborus apicalis* Blandford

6. Femoral teeth present 7
- Femoral teeth absent ..... *Xyleborus seriatus* Blandford

7. Anterior plate almost straight in anterior margin; marginal bristles short; apical teeth minute and arranged obliquely..... *Xyleborus atratus* Eichhoff
- Anterior plate finely but distinctly produced in middle of anterior margin; marginal bristles long; apical teeth long and almost arranged transversely..... *Xyleborus defensus* Blandford

8. Anterior plate weakly serrated along anterior margin of concavity, with four or five rows of tubercles along whole length of median longitudinal suture..... *Xyleborus amputatus* Blandford
- Anterior plate without tooth in anterior margin, with only two or three tubercles on base of closing teeth..... 9

9. Marginal bristles present……10
- Marginal bristle absent…… *Xylosandrus brevis* (EICHHOFF), *X. compactus* (EICHHOFF), *X. germanus* (BLANDFORD) and *Xyleborus semiopacus* EICHHOFF

10. Marginal bristles very fine, nearly spine-like……*Xyleborus seiryorensis* MURAYAMA
- Marginal bristles long (distinctly longer in *rubricollis*)……*Xyleborus rubricollis* BLANDFORD and *X. schaufussi* BLANDFORD

Key to the species of the tribe Ipini by the proventriculus

1. Sutural teeth present…… 2
- Sutural teeth absent ……*Ips kuniyoshii* NOBUCHI

2. Sutural teeth arranged along whole length of median longitudinal suture; marginal bristles situated only on posterior end …… 3
- Sutural teeth arranged on anterior half; marginal bristles usually arranged in a long lateral row, extending from each anterior corner of plate to posterior end……13

3. Closing teeth long, nearly extending to posterior end of masticatory brush; proventricular plate wide …… 4
- Closing teeth short, not extending to posterior end of masticatory brush; proventricular plate usually narrow (except *Mimips*)…… 7

4. Anterior margin of anterior plate weakly produced in middle and with a few teeth, which are somewhat larger than sutural teeth, along margin of small concavity……*Pityokteines spinidens* REITTER
- Anterior margin almost straight and bare …… 5

5. Apical teeth very small and arranged in a transverse line; true marginal bristle absent …… *Pityogenes foveolatus* EGGERS

Apical teeth long, especially in median ones and arranged in shallow, V-formed line; marginal bristles present …… 6

6. Femoral teeth long ……*Pityogenes chalcographus* (LINNÉ)
- Femoral teeth indistinct……*Pityogenes seirindensis* MURAYAMA

7. Apical teeth arranged loosely, lateral ones rounded at apices; closing teeth weakly furcate …… *Mimips pilosellus* BROWNE
- Apical teeth arranged closely, rather sharply pointed; closing teeth usually not furcate apically…… 8

8. Anterior plate short, less than half as long as the posterior……*Orthotomicus golovjankoi* PJATONITZKY
- Anterior plate long, more than half length of the posterior…… 9

9. Closing teeth extending beyond middle of masticatory teeth; apical teeth long and arranged obliquely ……10
- Closing teeth not or hardly extending to middle of masticatory teeth; apical teeth small, arranged transversely ……*Orthotomicus laricis* (FABRICIUS)

10. Apical teeth becoming abruptly smaller laterally……*Orthotomicus angulatus* (EICHHOFF)
- Apical teeth becoming gradually smaller laterally……11

11. Sutural teeth consist of about seven teeth ……*Orthotomicus proximus* (EICHHOFF)
- Sutural teeth consist of ten or more teeth ……12

12. Sutural teeth rather bluntly pointed at tips; anterior plate shorter than the posterior……*Acanthotomicus spinosus* BLANDFORD

- Sutural teeth rounded at tips; anterior plate nearly as long as the posterior····· ····· *Ips tosaensis* Murayama

13. Anterior plate distinctly longer than the posterior; closing teeth extending beyond middle of masticatory brush; marginal bristles very long····· *Ips sexdentatus* (Boern)
- Anterior plate short or moderate, less or nearly as long as the posterior; closing teeth usually not extending beyond middle of masticatory brush; marginal bristles gradually shortening anteriorly·····14

14. Anterior plate small, shorter than the posterior ·····*Ips typographus* (Linné)
- Anterior plate long, nearly equal in length to the posterior·····15

15. Closing teeth extending to middle of masticatory teeth····· ····· *Ips acuminatus* (Gyllenhal) and *I. duplicatus* (Sahlberg)
- Closing teeth not extending to middle of masticatory teeth····· *Ips cembrae* (Heer)

4. Peculiarity of the proventricular plate among the genera and higher categories

Before entering upon the discussion of the relationships among the genera or higher categories, the primitive and specialized characters of the proventriculus on the superfamily Scolytoidea will be summarized in Table 3, and also the main generic characters of the proventriculus in Table 4.

Table 3. A comparison of the primitive and specialized characters of the proventriculus on the Scolytoidea

Primitive	Specialized
Proventriculus larger, as compared with body size.	Proventriculue smaller, as compared with body size.
Proventricular plate wide and narrowing posteriorey.	Proventricular plate narrow and almost parallel-sided.
Anterior plate indistinctly bordered on crop, weakly sclerotized, with many sutures or rows of minute tubercles.	Anterior plate distinctly bordered by crop, strongly sclerotized, with large teeth along median longitudinal suture and at posterior portion or some transverse sutures, or degenerate.
Posterior plate wide but short.	Posterior plate narrow and long.
Masticatory brush absent.	Masticatory brush present.
Closing teeth wide and long.	Closing teeth slender and short.
Crop with fine tubercles.	Crop with long pubescence or seta-like spines.

1. Scolytidae-Scolytinae

Most taxonomists are of the common opinion that the subfamily Scolytinae is highly divergent from all other members of the Scolytidae and the most primitive among the subfamilies, judging from the large incurved denticulation on the outside of all the tibiae, the structure of the antennal clubs and the strongly ridged lateral margins of the pronotum in the external morphology of the adult. And the proventriculus, as previously stated by Nüsslin[162] (1911～1912), is also strikingly unique among those of the subfamilies in the absence of the masticatory brush and in having a deep notch in the middle of the posterior plate. From the present study, it seems to be admissible that the proventriculus of this subfamily is more primitive than that of the rest.

2. Scolytidae-Hylesininae

Table 4. A comparison of some main characters of the proventriculus among the genera

	Anterior plate	Anterior margin	Median longitudinal suture	Sutural teeth	Emargination in anterior margin	Apical teeth	Marginal bristles	Transverse sutures or rows of tubercles	Irregular tubercles	Lateral teeth of serration	Masticatory brush	Closing teeth
Scolytus	+	+	+		+				+			
Bothrosternus											+	+
Sphaerotrypes	+								+		+	+
Hyorrhynchus											+	+
Pseudohyorrhynchus											+	+
Neohyorrhynchus											+	+
Sueus											+	+
Strombophorus	+							+			+	+
Peronophorus	+								+		+	+
Rhopalopselion	+							+			+	+
Diamerus	+		±					+			+	+
Hylastes	+							+		+	+	+
Hylurgops	+							+		+	+	+
Pseudohylesinus	+							+		+	+	+
Hylurgonotus	+							+			+	+
Tomicus	+							+		+	+	+
Hylurgus	+							+		+	+	+
Dendroctonus	+							+		+	+	+
Hylesinus	+							+			+	+
Leperisinus	+							+			+	+
Pteleobius	+							+			+	+
Alniphagus	+							+			+	+
Scierus	+							+			+	+
Hylastinus	+							+			+	+
Xylechinus	+							+			+	+
Phloeotribus	+							+			+	+
Phthorophloeus	+							+			+	+
Hypoborus	+	+	+					+			+	+
Renocis	+							+			+	+
Phloeosinus	+							+			+	+
Hylesinopsis	+							+			+	+
Polygraphus	+	+			+						+	+
Carphoborus	+	+			+			+			+	+
Micracis	+										+	+
Pseudothysanoes	+							+			+	+
Cryphalomimus	+	+						+			+	+
Ctonoxylon	+	+			+						+	+
Cryphalus	+	+									+	+
Ernoporus	+							+			+	+
Ernoporicus	+							+			+	+
Margadillius	+	+						+			+	+
Euptilius	+	+						+			+	+
Phellodendrophagus	+							+			+	+
Cryphalomorphus	+							+			+	+
Eocryphalus	+								+		+	+
Cryptocarenus	+	+	+		+			+			+	+
Taenioglyptes	+	+	+	+		+					+	+
Hypocryphalus	+	+	+	+		+					+	+

+ Present.　　± Present or absent variable within the species or plates.

	Anterior plate	Anterior margin	Median longitudinal suture	Sutural teeth	Emargination in anterior margin	Apical teeth	Marginal bristles	Transverse sutures or rows of tubercles	Irregular tubercles	Lateral teeth of serration	Masticatory brush	Closing teeth
Hypothenemus	+	±	±					+			+	+
Stylotentus	+	+	+					+			+	+
Trypodendron	+	+									+	+
Dendrotrypum	+	+									+	+
Dolurgus	+	+						+			+	+
Crypturgus	+	+						+			+	+
Thamnurgus	+	+	+		+			+			+	+
Tiarophorus	+	+						+			+	+
Lymantor	+	+	+		+				+		+	+
Xylocleptus	+	+	+		+			+			+	+
Ozopemon	+	+	+		+			+			+	+
Taphrorychus	+	+	+		+	+	±				+	+
Dryocoetes	+	+	+	+	+	+	±				+	+
Cyrtogenius	+	+	+	+		+					+	+
Carposinus	+	+	+	+	+	+	+				+	+
Orosiotes	+	+	+	+	+	+					+	+
Pseudopoecilips	+	+	+	+		+	+				+	+
Dryocoetiops	+	+	+	+	+	+	+				+	+
Poecilips	+	+	+		+	+	+				+	+
Coccotrypes	+	+	+	+	+	+	+				+	+
Premnobius	+	+	+	+	+	+	+				+	+
Xylosandrus	+	+			+						+	+
Xyleborus	±	±		±		±	±				+	+
Cnestus	+	+			+						+	+
Webbia											+	+
Arixyleborus	+	+			+						+	+
Eccoptopterus	+	+			+						+	+
Mimips	+	+	+	+		+	+				+	+
Pityogenes	+	+	+	+		+	±				+	+
Pityokteines	+	+	+	+		+	+				+	+
Orthotomicus	+	+	+	+		+	+				+	+
Ips	+	+	+	±		+	+				+	+
Acanthotomicus	+	+	+	+		+	+				+	+
Pityoborus	+	+			+			+			+	+
Conophthorus	+	+	+		+			+			+	+
Pityophthorus	+	+			+			+			+	+
Pseudopityophthorus	+	+			+			+			+	+
Myeloborus	+	+			+			+			+	+
Gnathotrichus	+	+									+	+
Monarthrum											+	+
Pterocyclon											+	+
Corthylus											+	+
Microcorthylus											+	+
Tricolus											+	+
Scolytoplatypus	+	+									+	+
Platypus	+	+									+	+
Trachyostus	+	+									+	+
Crossotarsus	+	+									+	+
Doliopygus	+	+									+	+
Diapus											+	+
Diacavus											+	+

In the external character of the adult, this subfamily is characterized by having the sub-oblong and prominent head, and the elevated and crenate basal margins of the elytra. In the major genera the anterior plates of the proventriculus are usually indistinctly borderd on the crop, with a few exceptions. This subfamily may be divided into the following five types by the proventricular character.

i. *Bothrosternine-Hyorrhynchine*-type

In the xylo-mycetophagus group of the subfamily Hylesininae, the anterior plate is degenerate and the posterior plate is very narrow and long. This type is as common a feature as seen in the other ambrosia beetles belonging to the other subfamilies.

ii. Primitive *Hylesinine*-type

In the primitive Hylesininae, such as *Sphaerotrypes*, *Strombophorus*, *Rhopalopselion*, *Diamerus*, *Renocis* and *Phloeosinus*, the anterior plate is large and has irregular tubercles or rows of minute tubercles. Most of them are phloeophagous in the feeding habit but some are true xylophagous.

iii. *Hylastine-Hylurgine*-type

The proventricular plate is strongly narrow posteriorly; the anterior plate is large, has many transverse sutures and accompanied with lateral teeth of serration on the lateral sides of the sutures. These two latter characters are distinctive in this superfamily.

iv. *Hylesinine-Phloeotribine*-type

The proventricular plate is not so narrow posteriorly as the preceding type; the anterior plate has only transverse sutures and not the lateral teeth of serration. This type is observed in the members of the tribes Hylesinini, Phloeotribini, *Hylesinopsis* of the tribe Phloeosinini and *Hylurgonotus* of the tribe Hylurgini.

v. *Polygraphine*-type

In the tribe Polygraphini and genus *Hypoborus* belonging to the tribe Hypoborini, the anterior plate is distinctly bordered by the crop in its anterior margin and deeply emarginated in the tribe Polygraphini and subdivided into two parts by a median longitudinal suture in *Hypoborus*.

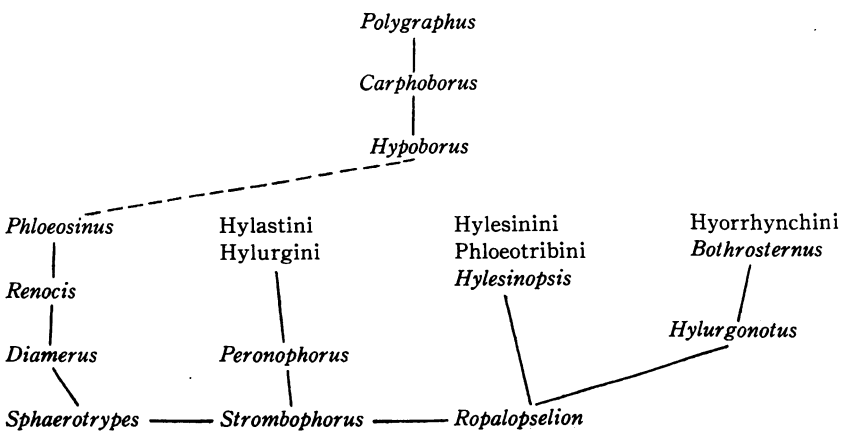
The tribe Hyorrhynchini is composed of four genera and specialized group in that the external appearance shows some similarity to that of the other tribes. Blandford[15] (1894), in his original description of the genus *Hyorrhynchus*, commented as follows: "The one species of this genus has, at least in the male, more the appearance of a Curculionid or an Anthribid, than a Scolytid, owing to the prominent rostrum, the general shape of its body, the vestiture, and the unarmed tibiae. It is, however, a true Scolytid, and either one of the Hylesini, or not remote from them. I know, however, of no described genus with which it is closely allied". Hagedorn[52)53)] (1910) and many authorities followed him to place this genus in the subfamilies Hylesininae or Hyorrhynchinae of the family Scolytidae. On the other hand, Niijima[142)] (1913) transferred *Hyorrhynchus* from the family Scolytidae to the family Curculionidae by its special feeding habit. In the tropical regions, however, it has been known as a common habit in some of the more primitive group of the subfamily Hylesininae. Judging from the gallery of *Hyorrhynchus lewisi* Blandford, it is probably xylo-mycetophagous in the early stage. The author[151)] (1964) illustrated the gallery of *Neohyorrhynchus niisimai* (Eggers) as an example of the xylo-mycetophagous; that is, the primary tunnel penetrates across the grain of wood, the secondary tunnel branches perpendicularly and the mother gallery grows the ambrosia fungi on the wall. And also he observed *Pseudohyorrhynchus wadai* Murayama boring directly into

the wood. The genus *Sueus*, one of the ambrosia beetles, may be ranked an affinitive genus to near *Neohyorrhynchus*, according to the original description and its feeding habit. The proventriculus of this genus, as illustrated by MURAYAMA[116] (1951), has the anterior plate strongly degenerated. According to a private message from WOOD, the habit of *Bothrosternus* is little known, but they are xylo-mycetophagous. On the above-mentioned ambrosia beetles, they are considerably different from the other genera of the subfamily Hylesininae in the proventricular feature. It seems to be admissible that the organ is specially adapted to the xylo-mycetophagous habit by the primitive condition.

Diamerus is characterized by having the forked closing teeth, unlike the other genera of the subfamily Hylesininae. In the tribe Hylesinini the proventriculus is not so variable in the structures among genera. The genera of the tribes Hylastini and Hylurgini bear a close relationship in having the widely separated coxal cavity of the adult. Their proventriculus are fundamentally almost identical with each other, and distinctive from the other tribes of the subfamily Hylesininae in the presence of the lateral teeth of serration excepting *Hylurgonotus*.

In *Renocis* and *Hypoborus* of the tribe Hypoborini, the proventricular feature is quite different one from the other. In the latter genus it is somewhat similar to that of *Hypothenemus* belonging to the subfamily Ipinae in general character. In the external feature of the adult, *Polygraphus* is easily distinguishable from the other genera of this subfamily in having the solid antennal clubs and biparted eyes. And its proventriculus is also peculiar, having a trumpet-formed and strongly serrated median concavity in the anterior margin of the plate and the absence of the transverse sutures. NÜSSLIN[162] (1911～1912) stated that the proventriculus of this genus is somewhat related to that of *Taphrorychus* of the subfamily Ipinae. So far as the author examined the Japanese species, however, the proventriculus of *Polygraphus* is quite different from *Taphrorychus* in the absence of both the apical tooth and marginal bristle. *Carphoborus* are rather slightly similar to the genera of the tribe Pityophthorini in general structure of the proventriculus, but differ from the latter by its simple closing teeth.

It is presumed by the present author that the proventricular features of the genera or tribes of the subfamily Hylesininae are differentiated in the following way:



3. Scolytidae-Ipinae

This subfamily, one of the major group of the family Scolytidae, is more specialized than the subfamily Hylesininae in the following external characters: the head globose and almost entirely concealed by the pronotum; the pronotum usually distinctly roughened, with backwardly directed spines in the front; the basal margins of the elytra simple, etc. In so far as the present study is concerned, the proventriculus of this subfamily is more complicated than are those of the other subfamilies.

The tribe Micracini is distinguishable from the other tribes in the structure of the proventriculus as well as the external characters, especially in the shape of the fore tibiae. The anterior plate is somewhat close to that of the tribe Pityophthorini in general shape, but differs from the latter in having a distinct tuft of seta-like spines on its anterior membraneous emargination.

The tribe Xyloctonini is also highly specialized in the structure of the anterior plate and has no closely related groups in the Scolytoidea.

In the external characters the genera of the tribe Cryphalini appear to possess the closest kinship to each other in having comparatively few, large and isolated asperities and distinctly elevated summit on the pronotum. In the proventricular feature, however, the tribe Cryphalini may be divided into the following four types:

i. *Taenioglyptes*-type

In *Taenioglyptes* and *Hypocryphalus*, the anterior plate is large and strongly sclerotized so that the anterior margin is distinctly bordered by the crop; the apical teeth are present and closing teeth are very long and distinctly forked at the apices. This type is characteristic in the above-mentioned points among the genera, and somewhat similar to those of the members of the tribe Ipini in the structure of the anterior plate, except for the absence of the marginal bristle and femoral tooth.

ii. *Ernoporus*-type

In *Ernoporus*, *Cryphalus*, *Ernoporicus*, *Phellodendrophagus* and *Eocryphalus*, the anterior plate is short, provided usually with transverse sutures or rows of tubercles and indistinctly bordered by the crop in the anterior margin; the apical tooth is absent; the closing teeth are long and simple.

iii. *Hypothenemus*-type

The anterior plate varies in size, has the transverse sutures of tubercles, no apical teeth; the closing teeth are short. This type is somewhat allied to that of *Hylesinine-Phloeotribine* type in the subfamily Hylesininae, and observed in *Margadillius*, *Euptilius*, *Hypothenemus* and *Stylotentus*. In *Hypothenemus* and *Stylotentus*, containing the seed and twig borers, the anterior plate is subdivided into two parts by a median longitudinal suture.

iv. *Cryptocarenus*-type

The anterior plate is short, deeply emarginated in the anterior margin, and has several undulated transverse sutures; the apical tooth is absent, but a pair of sclerotized bands are developed in the posterior end and the closing teeth are very short and simple.

In some phloeophagous groups such as *Cryphalus*, *Ernoporus*, *Ernoporicus*, *Eocryphalus*, etc., the proventriculus is somewhat allied to that of the ambrosia beetles in the short anterior plate, but quite differs from the latter in having a very broad plate. According to Wood[235] (1954), *Cryptocarenus* has been ranked to the tribe Cryphalini from the tribe Pityophthorini;

however, it is more allied to that of the tribe Pityophthorini in the structure of the anterior plate than the tribe Cryphalini, especially in having a weakly sclerotized median area.

The relationship of these groups of the tribe Cryphalini may be illustrated as follows:

Hypothenemus-type————————*Ernoporus*-type
|
Cryptocarenus-type
|
Taenioglyptes-type

In the external characters, the tribe Xyloterini are distinguished from the other ambrosia beetles by having both the biparted eyes and solid antennal clubs. But the proventriculus is fundamentally identical with the other ambrosia beetles in the reduction of the anterior plate, and more closely allied to those of the subfamily Scolytoplatypinae and some Xyleborini in having a wider and shorter plate than those of the tribes Corthylini, Bothrosternini, Hyorrhynchini and family Platypodidae.

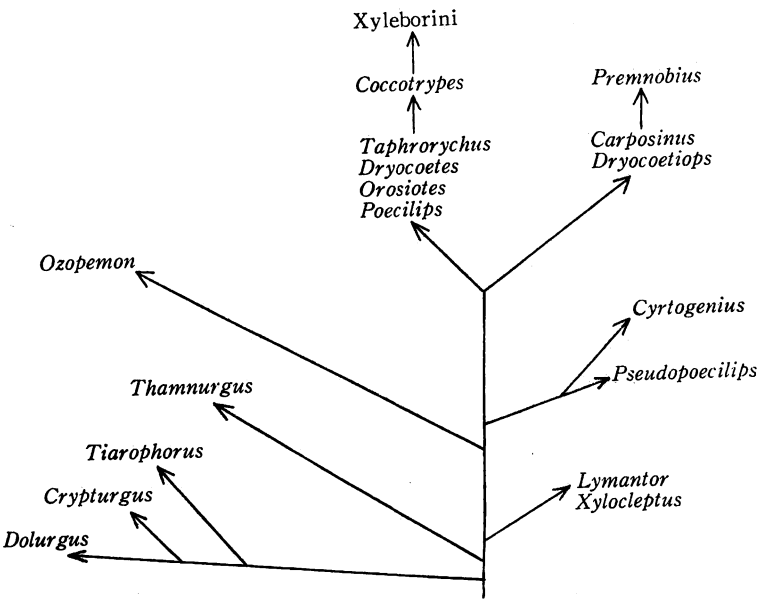
In the tribe Crypturgini, the structure of the anterior plate is very important in ascertaining the phylogenetic relationship of the groups. In the primitive genera of this tribe such as *Dolurgus*, *Crypturgus*, *Thamnurgus*, *Tiarophorus*, *Lymantor* and *Xylocleptus* the proventriculus is characteristic in the absence of both the apical and sutural teeth on the plate. *Dolurgus* and *Crypturgus* have numerous sutures armed with minute tubercles or serration, and are not divergent to the individuals in general structurs. The anterior plate of these genera is also similar to that of *Tiarophorus* which is quite different in the number of antennal funicles. This fact may be taken as indicative of a linkage among *Dolurgus*, *Crypturgus* and *Tiarophorus*. They also appear to show a relationship to *Pityophthorus* as regards the proventricular appearance, but differ somewhat in the following points: in *Pityophthorus* the median area of the anterior plate is weakly sclerotized and nearly membraneous in an inverted triangle, and the rows of tubercles are atrophied on that area. *Ozopemon* is somewhat allied to the preceding genera in the absence of the apical teeth, but differs in lacking transverse suture or rows of tubercles on the anterior plate. *Cyrtogenius* and *Pseudopoecilips* differ somewhat from the closely related genera such as *Taphrorychus*, *Dryocoetes*, *Carposinus*, *Orosiotes*, *Dryocoetiops*, *Poecilips* and *Coccotrypes* in the absence of emargination at the anterior margin of the proventricular plate. *Ozopemon*, *Poecilips* and *Coccotrypes* may each be one of the most advanced representatives within the tribe, since the sexual dimorphism is pronounced, the social organization is extreme polygamy, and the males normally never leave the host in which they have been bred as in *Xyleborus*. The proventriculus of *Coccotrypes* is closely allied to that of *Xyleborus seriatus* Blandford belonging to the tribe Xyleborini in structure, especially in having the short anterior plate and oblique arrangement of the apical teeth. Furthermore they show the similarities in the sexual dimorphism, summit of the pronotum and other external characters of the adults, with a few exceptions. On the other hand, *Xyleborus seriatus* Blandford is an only species from Japan, feeding upon the ambrosia fungi between the bark and wood, into which it does not penetrate directly as the bark beetles. It seems to suggest from the present data that the tribe Crypturgini is closely related to the tribe Xyleborini. And it may be presumed that the tribe Xyleborini is unquestionably a direct derivative from the former.

The proventriculus of *Premnobius* is as well characterized by the anterior plate as that of *Carposinus* except for the size of the apical teeth, which are very small; and it is highly

differentiated from those of the other ambrosia beetles.

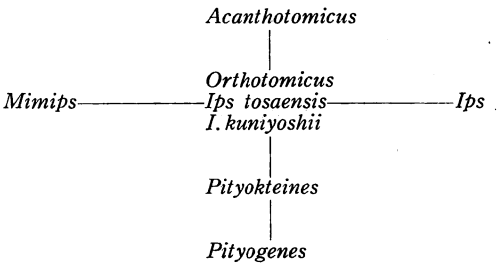
In the external feature of the adults, the tribe Xyleborini is characterized from other tribes by the following points: the maxillary lobe pilose and the middle and hind tibiae are rather broadly dilated in the middle. But the structure of the proventriculus is somewhat similar to those of the other ambrosia beetles, especially to the tribe Xyloterini and subfamily Scolytoplatypinae. *Xyleborus* is composed of a great number of the species and provided sometimes with a very short anterior plate, marginal bristles, apical and sutural teeth as in some of the tribe Crypturgini. The proventricular structure is differentiated in certain species or species-groups, as described in the diagnosis of this genus. This fact may suggest an early step in the evolutional adaptation to xylo-mycetophagous habit from the ancestral form.

It is presumable to the author that the proventricular features of the tribes Crypturgini, Premnobiini and Xyleborini are differentiated in the following way:



The tribe Ipini is best characterized by having the declivital teeth on the elytra, but the proventricular plate sometimes resembles those of *Taenioglyptes* and *Hypocryphalus* of the tribe Cryphalini and the specialized genera of the tribe Crypturgini as regards the armatures of the anterior plate. It is, however, characterized by having the simple anterior margin of the plate and the long femoral teeth as compared with the others of the Scolytidae. *Mimips* is differentiated from the other genera of the tribe Ipini in having loosely seriate apical teeth and furcate closing teeth. The proventriculus of *Pityokteines* is intermediate between *Pityogenes* and *Orthotomicus* in the phylogenetical position as well as the morphological characters. *Pityogenes* somewhat resembles *Taenioglyptes* and *Hypocryphalus* of the tribe Cryphalini in general shape of the proventricular plate and in arrangement of the apical, sutural and closing teeth, except that the closing teeth are not forked apically and the marginal bristles and femoral teeth are present in the former. This genus is also characterized from the other genera of the tribe Ipini by the longer closing teeth, which extend almost to the posterior end of the masticatory brush. Spessivtsev[221] (1926) described the *Orthotomicus longicollis* (Gyllenhal) as

having entirely large teeth in the anterior margin of the proventricular plate. This character is not found in the Japanese species examined by the author. *Ips* has two rows of marginal bristles extending from each anterior margin to the posterior end in the lateral sides, and of the sutural teeth on anterior half of the anterior plate, except in the cases of *Ips tosaensis* Murayama and *I. kuniyoshii* Nobuchi which show a somewhat *Orthotomicus*-like appearance. This tribe well shows affinity in the structure of the proventriculus among the genera. But the relationship of these genera may be illustrated as follows:



The tribe Pityophthorini is distinctive from the other tribes in the following external characters: the metepisternum is largely concealed by the elytra and partially visible in the front; the posterior oral region is not impressed. The proventricular plate is also characterized by having the weakly sclerotized area or deep cleft in the anterior margin and the transverse rows of tubercles only arranged on the lateral sides of the anterior plate. In general structure of the proventriculus this tribe bears a close resemblance to each other, except that the spermatophagous genus *Conophthorus* has a median longitudinal suture.

The tribe Corthylini resembles the preceding tribe rather than the others in the condition of metepisternum, but the proventriculus is quite different from the latter in having a narrow plate and lacking the anterior plate. *Gnathotrichus* is considerably distinctive from the other genera of this tribe in the following characters: the masticatory teeth do not begin from the anterior margin of the plate; closing teeth grow between the anterior margin of the plate and the base of the masticatory brush and are arranged in an irregular row, and posterior ones of the closing teeth are very wide and serrated on the outside. It has a considerable similarity to that of the subfamily Platypinae in possessing a row of closing teeth, though there is no such close similarity in the external structure, but in the subfamily Platypinae the closing teeth are simple and narrow. The other genera of the tribe Corthylini such as *Monarthrum*, *Pterocyclon*, *Corthylus*, *Microcorthylus* and *Tricolus*, are identical with each other and also the tribe Bothrosternini in the structure of the proventriculus, which is narrow and provided with many tubercles laterad base of the masticatory brush, lacking entirely the anterior plate.

4. Scolytidae-Scolytoplatypinae

This subfamily is comprised of *Scolytoplatypus* only and known as an ambrosia beetle. It is distinctly characterized from the other subfamilies by the following external characters: the pronotum is emarginated in the lateral sides; in the female the fore tibiae are rugged on the ventral side and the pronotum has a conspicuous pore nearby the center. The proventriculus is, however, identical with those of the tribes Xyloterini and some Xyleborini of the xylo-mycetophagous Ipinae, but differs from that of the family Platypodidae, as already mentioned. This fact agrees with the opinion of some authors that the subfamily Scolytoplatypinae

differs from the family Platypodidae in general structure of the adult.

5. Platypodidae-Platypinae

In the external morphology this family is more allied to the Scolytidae than the other Rhynchophorous families, but distinguished from the latter in having a large and broad head, and long first tarsal segments. The species are all ambrosia beetles with a monogamous social organization. According to Morimoto[84] (1962), this family is fundamentally different from the Scolytidae and more primitive in the external characters and the structure of the male genitalia.

The subfamily Platypinae is specialized in the following points: the proventriculus is cylindrical and very small; the anterior plate is nearly vestigial; the closing teeth are narrow and growing between the anterior margin of the plate and base of the masticatory brush and arranged in an irregular row. In this subfamily the proventricular feature is not so variable among the genera as those in the Scolytidae.

6. Platypodidae-Diapinae

The anterior plate is entirely wanting. Posterior plate shorter than that of the preceding subfamily. This subfamily differs slightly from the other ambrosia beetles in having the shorter posterior plate and more distinct tubercles just laterad base of the masticatory brush.

7. Ambrosia beetles

The members of the ambrosia beetle examined, a biological group possessing the xylomycetophagous habit, have a close resemblance to each other in the reduction or degeneration of the anterior plate and the contraction of the proventriculus, except *Premnobius*, but may be divided into nine types in detail as noted below.

i. *Premnobius*-type

The proventricular plate is much wider and distinctly contracted posteriorly; the anterior plate is well developed, and has distinct sutural and apical teeth, as seen in that of the tribe Crypturgini.

ii. *Xyleborus*-type

In the major species of *Xyleborus*, the proventriculus is slightly contracted posteriorly, has a short anterior plate and sometimes distinct apical or sutural teeth.

iii. *Scolytoplatypine*-type

In such groups as the tribe Xyloterini, some of the tribe Xyleborini and subfamily Scolytoplatypinae, the anterior plate is nearly vestigial; the masticatory teeth extend posteriorly from the anterior margin. The proventriculus is slightly contracted posteriorly.

iv. *Corthyline*-type

In the major genera of the tribes Corthylini and Bothrosternini, the anterior plate is quite obsolete; the masticatory teeth extend posteriorly from the anterior margin and the masticatory brush is accompanied with distinct tubercles. The proventriculus is cylindrical and not contracted posteriorly.

v. *Webbia*-type

In *Webbia* and *Xyleborus adumbratus* Blandford, the anterior plate is vestigial; the masticatory teeth are not accompanied with tubercle on the lateral sides of bases of the masticatory brush and do not reach to the anterior margin; the closing teeth are accompanied with fine tubercles beside their bases. The proventriculus is slightly contracted posteriorly.

vi. *Hyorrhynchine*-type

The anterior plate is obsolete; the masticatory teeth and closing teeth are not accompanied with the tubercle. The proventriculus is cylindrical and not contracted posteriorly.

vii. *Gnathotrichus*-type

The anterior plate is nearly vestigial; the masticatory brush is accompanied with distinct tubercles on the lateral sides and the closing teeth are arranged from the anterior margin to the base of masticatory teeth in an irregular row; the posterior ones of them are wider and serrated on the outside. The proventriculus is cylindrical and not contracted posteriorly.

viii. *Platypine*-type

This is closely allied to the preceding type, but only distinguishable in having the simple closing teeth.

ix. *Diapine*-type

This is somewhat allied to *Corthyline*-type and *Hyorrhynchine*-type, but differs from the allied types in having a wider anterior plate and abundunt tubercles on the lateral sides of base of the masticatory brush.

Key to the genera of the Scolytoidea by the proventriculus

1. Masticatory brush present 2
- Masticatory brush absent ..... *Scolytus*
2. Anterior plate usually large, with apical teeth, or transverse sutures or rows of tubercles (except *Cryphalus*) 3
- Anterior plate completely degenerate or nearly vestigial, if present, closing teeth bearing near anterior margin; apical teeth, sutural teeth, transverse suture or row of tubercles absent 51
3. Anterior plate distinctly bordered by crop in anterior margin, usually well sclerotized in middle 22
- Anterior plate contiguous to crop, usually weakly sclerotized in middle 4
4. Anterior membraneous area of plate with a tuft of long seta-like spines before emargination 5
- Anterior plate without membraneous area of emargination, never with tuft of spines on that area 6
5. Anterior plate with transverse rows of fine tubercles ..... *Pseudothysanoes*
- Anterior plate with several large spines on lateral sides ..... *Micracis*
6. Anterior plate much longer, more than one-third length of the posterior 7
- Anterior plate quite short, less than one-fourth length of the posterior 21
7. Tubercles on anterior plate arranged in transverse rows 8
- Tubercles on anterior plate arranged irregularly isolated from each other 20
8. Anterior plate with a pair of lateral teeth of serration ..... *Hylastes*, *Hylurgops*, *Pseudohylesinus*, *Tomicus*, *Hylurgus* and *Dendroctonus*
- Anterior plate without lateral teeth of serration 9
9. Closing teeth narrow and furcate apically ..... *Diamerus*
- Closing teeth wider and not or closely serrated on outside 10
10. Anterior plate nearly as long as the posterior, with transverse rows of tubercles 11
- Anterior plate usually distinctly shorter than the posterior, if not shorter than the posterior, transverse sutures present 12
11. Anterior plate with strongly curved rows of fine and dense tubercles ..... *Phloeosinus*

- Anterior plate with much larger and isolated tubercles on loose lines ……*Renocis*

12. Anterior plate with transverse sutures ……13
- Anterior plate with some rows of tubercles, never with suture……15

13. Masticatory teeth closely covered with tubercles or teeth……14
- Masticatory teeth without tubercle or tooth……17

14. Closing teeth very short, not or hardly extending to anterior third of masticatory brush …… *Hylurgonotus*
- Closing teeth much longer, extending beyond two-thirds of masticatory brush…… ……*Hylesinus, Leperisinus, Alniphagus, Scierus, Hylastinus, Phloeotribus* and *Hylesinopsis*

15. Masticatory teeth with numerous tubercles; anterior plate long, densely covered with fine tubercles ……16
- Masticatory teeth without tubercle; anterior plate short, sparsely covered with tubercles …… *Strombophorus*

16. Rows of tubercles on anterior plate somewhat irregular, not reaching to lateral margins; femoral teeth strong, wide and conical……*Pteleobius*
- Rows of tubercles somewhat arranged in rows, reaching near lateral margins; femoral teeth weak, narrow and seta-like……*Rhopalopselion*

17. Transverse sutures long, reaching to lateral margins……18
- Transverse sutures short, only situated in middle……*Phthorophloeus*

18. Posterior plate five times as long as the anterior; closing teeth not extending to middle of masticatory brush ……*Xylechinus*
- Posterior plate more than four times as long as the anterior; closing teeth extending to middle of masticatory brush……19

19. Posterior plate distinctly longer than the anterior ……*Phloeotribus puberulus* LECONTE
Posterior plate slightly longer than the anterior……*Hylesinus cingulatus* BLANDFORD

20. Anterior plate with a semicircular suture on posterior end, narrowly sclerotized, very densely tuberculate on membraneous area ……*Peronophorus*
- Anterior plate without such semicircular suture, rather widely sclerotized in lateral sides, sparsely tuberculate on membraneous area……*Sphaerotrypes*

21. Masticatory teeth or lateral sides of masticatory brush closely covered with fine tubercles …… *Ernoporus, Ernoporicus, Phellodendrophagus* and *Eocryphalus*
- Masticatory teeth and lateral sides of masticatory brush without tubercle…*Cryphalomorphus*

22. Anterior plate strongly emarginated or membraneous in middle of anterior margin……23
- Anterior plate sometimes sinuate or straight, never emarginated ……39

23. Apical teeth present ……24
- Apical teeth absent……28

24. Anterior plate very short, less than one-fourth as long as the posterior ……*Coccotrypes*
Anterior plate long, more than one-third as long as the posterior……25

25. Median margin of anterior plate strongly but narrowly marginated by sclerotized band along emargination; median corners of anterior margin usually angulate and produced …… 26
- Median margin of anterior plate not marginated by sclerotized band; median corners of anterior margin usually rounded……*Taphrorychus, Dryocoetes* and *Poecilips*

26. Anterior plate large, nearly as long as the posterior, bearing about twenty marginal

bristles ……*Dryocoetiops*

– Anterior plate shorter than the posterior, with about eight marginal bristles ……27

27. Apical teeth distinctly large and arranged obliquely; emargination of anterior margin reaching to middle of anterior plate ……*Carposinus*

– Apical teeth very small, almost transversely seriated; emargination reaching near posterior end of anterior plate ……*Premnobius*

28. Anterior plate deeply emarginated from antero-lateral corners to posterior end of the plate and strongly sclerotized along margins of cleft……*Ctonoxylon*

– Anterior plate with median concavity not reaching posterior end of anterior plate ……29

29. Lateral margins of concavity with large and sharp teeth ……*Polygraphus*

– Lateral margins of concavity with small and blunt teeth ……30

30. Anterior plate with transverse sutures or rows of tubercles……31

– Anterior plate without any transverse suture or row of tubercles……*Ozopemon*

31. Anterior plate with a pair of curved sclerotized bands at posterior end……*Cryptocarenus*

– Anterior plate without sclerotized band……32

32. Median longitudinal suture present……33

– Median longitudinal suture absent……37

33. Anterior plate with deep cleft anteriorly stretching for whole width of anterior margin or broadly membraneous in middle ……34

– Anterior plate narrowly emarginated in middle and evenly sclerotized ……35

34. Anterior plate short, about one-fourth length of the posterior; tubercles finer, in dense rows and connected with each other……*Pityoborus*

Anterior plate long, about two-thirds length of the posterior; tubercles large in sparse rows, excepting posterior two rows……*Conophthorus*

35. Tubercles on anterior plate large, not arranged in row……*Lymantor*

Tubercles on anterior plate minute, arranged in some transverse rows ……36

36. Transverse rows of tubercles on anterior plate long, almost reaching to lateral ends……
…… *Thamnurgus*

– Transverse rows of tubercles on anterior plate short, only situated in middle…*Xylocleptus*

37. Closing teeth much wider and densely serrated on outside ……38

– Closing teeth narrow and simple ……*Carphoborus*

38. Masticatory teeth tuberculate; posterior two or three transverse rows of tubercles on anterior plate, each with a pair of large conical teeth at mesal end……*Pseudopityophthorus*

– Masticatory teeth without tubercles but lateral sides of base of masticatory brush tuberculate; posterior transverse sutures only crenate ……*Pityophthorus*

39. Anterior plate with apical or sutural teeth, or both……40

– Anterior plate without both apical and sutural teeth ……44

40. Closing teeth strongly forked at apices, extending to posterior end of masticatory brush
……*Taenioglyptes* and *Hypocryphalus*

– Closing teeth usually not forked apically, if weakly forked, the teeth not extending to posterior end of masticatory brush ……41

41. Anterior plate very short, less than one-fourth length of the posterior…*Xyleborus*(in a part)

– Anterior plate long, more than one-third length of the posterior……42

42. Marginal bristles usually present, if absent, masticatory teeth with a row of femoral teeth ……43

- Marginal bristle and femoral tooth absent ……*Cyrtogenius*

43. Femoral teeth arranged in a longitudinal row; sutural teeth narrow or absent on posterior area ……Ipini
- Femoral tooth absent or irregularly arranged; sutural teeth broadened posteriorly…… …… *Pseudopoecilips*

44. Anterior plate with transverse sutures or rows of tubercles……45
- Anterior plate without both transverse suture and row of tubercles……*Cryphalus*

45. Anterior plate with median longitudinal suture, at least in some plates of *Hypothenemus* …… 46
- Anterior plate without median longitudinal suture ……47

46. Tubercles on anterior plate large, isolated in anterior and lateral sides, somewhat arranged in rows; each closing tooth with a few teeth outside……*Hypoborus*
- Tubercles on anterior plate smaller, forming some transverse sutures; closing teeth simple……*Hypothenemus* and *Stylotentus*

47. Anterior plate nearly triangular, with four angulate rows of numerous minute tubercles …… *Cryphalomimus*
- Anterior plate nearly rectangular or trapezoid, with arcuate sutures……48

48. Masticatory teeth with strong tubercles caudad from outside of closing teeth……49
- Masticatory teeth without tubercle……*Margadillius* and *Euptilius*

49. Closing teeth long, extending beyond middle of masticatory brush; masticatory teeth with irregular femoral teeth……50
- Closing teeth short, not extending to middle of masticatory brush; masticatory teeth irregular with large tubercles and with a distinct longitudinal row of seta-like femoral teeth ……*Tiarophorus*

50. Anterior plate almost as long as the posterior……*Dolurgus*
- Anterior plate distinctly shorter than the posterior……*Crypturgus*

51. Anterior plate completely degenerate; masticatory teeth bearing posteriorly from anterior margin ……52
- Anterior plate very short, nearly vestigial; masticatory teeth beginning just before anterior margin ……55

52. Masticatory teeth accompanied with abundant tubercles just laterad base of masticatory brush ……54
- Masticatory teeth not accompanied with tubercle ……53

53. Growing area of closing teeth with fine tubercles before base…… ……*Webbia* and *Xyleborus adumbratus* Blandford
- Growing area of closing teeth smooth…… …… *Hyorrhynchus*, *Pseudohyorrhynchus*, *Neohyorrhynchus* and *Sueus*

54. Posterior plate narrow, more than three times as long as wide…… ……*Bothrosterinus*, *Pterocyclon*, *Tricolus*, *Corthylus* and *Microcorthylus*
- Posterior plate wide, less than three times as long as wide……*Diapus* and *Diacavus*

55. Proventriculus cylindrical, not narrowing posteriorly; closing teeth bearing posteriorly from anterior margin in an irregular row……56
- Proventriculus more or less narrowing posteriorly; closing teeth bearing at anterior end of masticatory brush……*Trypodendron*, *Dendrotrypum*,

Xylosandrus, *Xyleborus* (in a part), *Cnestus*, *Arixyleborus*, *Eccoptopterus* and *Scolytoplatypus*

56. Posterior ones of closing teeth distinctly wider than the anterior and serrated outside ..... *Gnathotrichus*

– All closing teeth seta-like, not serrated outside .....
.....*Platypus*, *Trachyostus*, *Crossotarsus* and *Doliopygus*

5. Mutuality between the feeding habits and proventricular feature

In some cases the genera could not be distinguished by general feature of the proventriculus. Nüsslin[162] (1911～1912) commented that their mutual similarity is seen between the following two genera of the bark beetles: *Cryphalus* (=*Taenioglyptes*) and *Pityogenes*, *Taphrorychus* and *Polygraphus*, *Pityophthorus* and *Carphoborus*, and *Ernoporus* and *Phloeophthorus*. But this report presents evidence that the genera of the first three are quite different from each other in the detailed comparison.

On this point he made the following statement: "Wir werden bei unserem späteren Entwurf einer phylogenetisch-systematischen Skizze den Kaumagen als ein sehr wichtiges Kriterium heranziehen, wollten jedoch an dieser Stelle zunächst betonen, dass selbst dieses Organ wegen der Möglichkeit von Konvergenzen gelegentlich für die Beusteilung von Verwandtschaften im Stiche lassen kann".

After that, Schedl[187] (1931) mentioned the resemblance among the ambrosia beetles, such as *Gnathotrichus*, *Trypodendron* and *Xyleborus*, on the structure of the proventriculus and stressed the parallelism between the feeding habits and proventricular character. In some species of *Xyleborus*, however, the proventricular plate is differentiated from the rest in the presence of the apical teeth, and *Gnathotrichus* is also distinguished from *Trypodendron* upon careful examination, as mentioned in the preceding paragraph. From the viewpoint of the reduction of the proventriculus or degeneration of the anterior plate, it is said that the ambrosia beetles are really representative of many examples of parallel modification in widely separated tribes, subfamilies and families, as already summarized. The only exception, however, is found in *Premnobius* among many ambrosia beetles, because the anterior plate is as well-developed as those of some genera of the tribe Crypturgini. The fact that there is a quite definite relation between the form of the proventriculus and feeding habits indicates that they are specially adapted to xylo-mycetophagous habit from each ancestral form, because there is no need of the development of the anterior plate, which probably masticates food by the armature on its inner surface, for the purpose of digesting soft fungi. In the other cases, the particular correlation between the feeding habits and form of the proventriculus can not usually be found in widely separated genera in detail.

So far as the author observed, the evolutionary tendency of the proventriculus in the Scolytoidea has been shown chiefly in the direction of simplification or specialization of the armature on the anterior plate and of the reduction of the size. The advanced group, for instance, has been greatly reduced in the number of tubercles or sutures in comparison with the primitive subfamilies Scolytinae and Hylesininae. One hesitates to presume the relationship within the Scolytoidea from the structure of the proventriculus only, but this is often of decided importance in clarifying the phylogenetic relationship between the various groups of the Scolytoidea.

Bibliography

1) Arnett, R.H.: The beetles of the United States. Washington, 1112 pp., (1963)
2) Balachowsky, A.: Faune de France, 50: Coleoptera, Scolytides. Paris, 320 pp., (1949)
3) Barbey, A.: Les Scolytides de l' Europe centrale. Genève, 121 pp., (1910)
4) Beal, J.A.: The development of the proventriculus of *Pityogenes hopkinsi* Swaine. Ann. Ent. Soc. Amer., **20**, pp. 522～539, (1927)
5) Bedel, L.: Faune des Coléoptères du bassin de la Seine, VI. Paris, 444 pp., (1888)
6) Berger, B.M. (Бергеръ, Б. М.): Короеды Южно-Уссурийскаго края. Rev. Russ. d'Ent., **16**, pp. 217～248, (1916)
7) Berger, B.M. & N. A. Cholodkovsky(Бергеръ, Б. М. и Н. А. Холодковский):Къ биологии и анатомий короедовъ рода *Scolytoplatypus* Blandford(Coleoptera, Ipidae). t. c., **16**, pp. 1～7, (1916)
8) Blackman, M.W.: Mississippi bark beetles. Miss. Agr. Exp. Sta. Tech. Bull., **11**, pp. 1～130, (1922)
9) Blackman, M.W.: The Scolytid beetles of the genus *Renocis* Casey, with descriptions of nine new species. Proc. U.S. Nat. Mus., **88**, pp. 373～401, (1940)
10) Blackman, M.W.: New species of bark beetles (Pityophthorini) from Mexico and Tropical America. t. c., **92**, pp. 177～228 (1942)
11) Blackman, M.W.: Revision of the genus *Phloeosinus* Chapuis in North America. t. c., **92**, pp. 399～474, (1942)
12) Blackman, M.W.: New genera and species of bark beetles of the subfamily Micracinae. t. c., 93, pp. 341～366, (1943)
13) Blackman, M.W.: New species of American Scolytid beetles, mostly Neotropical. t. c., **93**, pp. 371～400 (1943)
14) Blandford, W.F.H.: The Scolytoplatypini, a new subfamily of Scolytidae. Trans. Ent. Soc. London, 1893, pp. 425～442, (1893)
15) Blandford, W.F.H.: The Rhynchophorous Coleoptera of Japan III. t.c., 1894, pp. 53～141, (1894)
16) Blandford, W.F.H.: Supplementary notes on the Scolytidae of Japan. t.c., 1894, pp. 575～580, (1894)
17) Browne, F.G.: The biology of Malayan Scolytidae and Platypodidae. Malayan For. Rec., **22**, pp. 1～255, (1962)
18) Browne, F.G.: Two new genera of Scolytidae. 5th Watbru Rep. pp., 75～80, (1962)
19) Browne, F.G.: Notes on the habits and distribution of some Ghanaian bark beetles and ambrosia beetles (Coleoptera: Scolytidae and Platypodidae). Bull. Ent. Res., **54**, pp. 229～266, (1963)
20) Browne. F.G.: Scolytidae and Platypodidae (Coleoptera) mainly from African and the Oriental Region. Zool. Meded., **40**, pp. 187～209, (1965)
21) Butovitsch, V.: Studien über die Morphologie und Systematik der paläarktischen Splintkäfer. Settin. ent. Ztg. **40**, pp. 1～72, (1929)
22) Chamberlein,W.J.: The bark and timber beetles of North America and North of Mexico. Proc. Oreg. Sta. Coll. Coop. Assoc., pp. 1～513, (1939)
23) Chamberlein, W.J.: The Scolytoidea of the Northwest, Oregon, Washington, Idaho and British Columbia. Oregon, 205 pp., (1958)

24) Chapuis, F.: Monographie des Platypides. Liège, 344 pp., (1865)
25) Chapuis, F.: Synopsis des Scolytides. Mém. Soc. R. Sc. Liège, **2**, pp. 213～269, (1873)
26) Chapuis, F. & W. Eichhoff: Scolytides recueillis au Japon par M. C. Lewis. Ann. Soc. Ent. Belg., **18**, pp. 195～203, (1875)
27) Chararas, C.: Anatomie et biologie des Coléoptères Curculionides xylophages comparees a celles des Coléoptères Scolytides. Rev. Path. Veg. d'Ent. Agr. Fr., **35**, pp. 1～187, (1956)
28) Chararas, C.: Etude biologique des Scolytides des conifères. Encyclopédie Entomologique **38**, Paris, 556 pp., (1962)
29) Craighead, F. E.: Insect enemies of eastern forests. U. S. Dep. Agr., Misc. Publ., **657**, pp. 1～679, (1949)
30) Doane, R. W., R. C. Vandyke, W. J. Chamberlein & H. E. Burke: Forest insects. New York, 463 pp., (1936)
31) Dodge, H. R.: The bark beetles of Minnesota (Coleoptera: Scolytidae). Univ. Minnesota Agr. Exp. Sta., Tech. Bull., **132**, pp. 1～60, (1938)
32) Duffy, E. A.: Handbooks for the identification of British insects: Coleoptera, Scolytidae and Platypodidae. London, 20 pp., (1952)
33) Eggers, H.: Seltene und neue paläarktische Borkenkäfer 2. Ent. Blätt., **17**, pp. 39～43, (1921)
34) Eggers, H.: Seltene und neue paläarktische Borkenkäfer 3. t. c., **18**, pp. 12～18, (1922)
35) Eggers, H.: Seltene und neue paläarktische Borkenkäfer 4. t. c., **18**, pp. 116～121, (1922)
36) Eggers, H.: Japanische Borkenkäfer 1. t. c., **22**, pp. 133～138, 145～148, (1926)
37) Eggers, H.: Zwei neue *Blastophagus*-Arten (Ipidae, Col.). t. c., 25, pp. 103～104, (1929)
38) Eggers, H.: Zur paläarktischen Borkenkäferfauna. t. c., **29**, pp. 1～9, (1933)
39) Eggers, H.: Zur paläarktischen Borkenkäferfauna. t. c., **29**, pp. 49～56, (1933)
40) Eggers, H.: Japanische Borkenkäfer 2 (Coleoptera, Scolytidae). Arb. morph. tax. Ent., **2**, pp. 114～123, (1939)
41) Eggers, H.: Zur Synonymie der Borkenkäfer (Ipidae, Col.). Ent. Blätt., **36**, pp. 61～62, (1940)
42) Eggers, H.: Zur paläarktischen Borkenkäferfauna 4. Stettin. ent. Ztg., **102**, pp. 119～124, (1941)
43) Eggers, H.: Ein neuer *Blastophagus* aus Ostasien (Col. Scolytidae). Ent. Blätt., **39**, pp. 50～51, (1943)
44) Eichhoff, W.: Ueber die Mundtheile und die Fühlerbildung der europäischen Xylophagi sens. strict. Berl. ent. Z., **8**, pp. 17～46, (1864)
45) Eichhoff, W.: Beiträge zur Käferfauna von Japan meist auf R. Hiller's Sammlungen besirt. Japanische Scolytiden. Dtsch. ent. Z., **21**, pp. 117～128, (1877)
46) Eichhoff, W.: Ratio, descriptio, emendatio eorum Tomicinorum. Brussells, 531 pp., (1879)
47) Eichhoff, W.: Die europäischen Borkenkäfer. Berlin, 315 pp., (1881)
48) Erichson, W. F.: Systematische Auseinandersetzung der Familie der Borkenkäfer. Arch. f. Naturg., **1**, pp. 45～65, (1836)
49) Escherich, K.: Die Forstinsekten Mitteleuropas II. Berlin, 662 pp., (1923)
50) Fuchs, G.: Morphologische Studien über Borkenkäfer, I Die Gattung *Ips* Degeer und *Pityogenes* Bedel. München, 45 pp., (1911)
51) Fuchs, G.: Morphologische Studien über Borkenkäfer, II Die europäischen Hylesiniden.

München, 53 pp., (1911)

52) Hagedorn, M.: Coleopterorum Catalogus 4: Ipidae. Berlin, 128 pp., (1910)

53) Hagedorn, M.: Genera Insectorum: Ipidae. Berlin, 178 pp., (1911)

54) Hansen, V.: Danmarks fauna: Barkbiller. Københaven, 190 pp., (1956)

55) Hopkins, A.D.: Notes on Scolytid larvae and their mouth parts. Proc. Ent. Soc. Washington, **7**, pp. 143～149, (1905)

56) Hopkins, A.D.: Contribution toward a monograph of Scolytid-beetles, I Genus *Dendroctonus*. U.S. Dep. Agr. Bur. Ent., Tech. Ser., **17**, pp. 1～164, (1909)

57) Hopkins, A.D.: Parallelism in morphological characters and physiological characters in Scolytid-beetles. Proc. Biol. Soc. Washington, **26**, pp. 209～211, (1913)

58) Hopkins, A.D.: List of generic names and their type species in the Coleopterous superfamily Scolytoidea. Proc. U.S. Nat. Mus., **48**, pp. 115～136, (1914)

59) Hopkins, A.D.: Contribution toward a monograph of Scolytid beetles, II Preliminary classification of the superfamily Scolytoidea. U.S. Dep. Agr. Bur. Ent., Tech. Ser., **17**, pp. 165～232, (1915)

60) Hopkins, A.D.: Classification of the Cryphalinae with descriptions of new genera and species. U.S. Dep. Agr., Off. Secr., **99**, pp. 1～75, (1915)

61) Hubbard, H.: Ambrosia beetles of the United States. U.S. Dep. Agr., Div. Ent. Bull., **7**, pp. 9～30, (1897)

62) Inouye, M.: A detailed book of the forest insect control (Coleoptera) II (in Japanese). Tokyo, 293 pp., (1953)

63) Inouye, M. & A. Nobuchi: A revision of *Cryphalus* species injurious to coniferous trees from Hokkaido, Japan. Bull. Gov. For. Exp. Sta., **103**, pp. 45～56, (1957)

64) Inouye, M. & A. Nobuchi: A new species of *Dryocoetes* from Hokkaido. Ins. Mats., **22**, pp. 122～123, (1959)

65) Kabe, M.: Illustrations of the galleries of bark-beetles I (in Japanese). Maebashi Regional Forest Office, 30 pp. (1954)

66) Kabe, M.: Illustrations of the galleries of bark-beetles II (in Japanese). Maebashi Regional Forest Office, 30 pp., (1954)

67) Kabe, M.: Illustrations of the galleries of bark-beetles III (in Japanese). Maebashi Reginal Forest Office, 30 pp., (1955)

68) Kabe, M.: Studies on the galleries of bark-beetles and ambrosia-beetles in Japan (in Japanese). Maebashi Regional Forest Office, 134 pp., (1955)

69) Kabe, M.: Icones of the galleries of bark-beetles and ambrosia-beetles in Japan (in Japanese). Tokyo, 290 pp., (1956)

70) Kabe, M.: An illustrated book of the bark and ambrosia beetles from Japan (in Japanese). Maebashi Regional Forest Office, 246 pp., (1957)

71) Kabe, M.: On the hosts and habits of the Scolytid and Platypodid beetles in Japan (in Japanese). Maebashi Regional Forest Office, 176 pp., (1960)

72) Kalshoven, L.G.E.: Studies on the biology of Indonesian Scolytoidea 4, Data on the habits of Scolytidae second part. Tijd. v. Ent., **102**, pp. 135～173, (1959)

73) Kalshoven, L.G.E.: Studies on the biology of Indonesian Scolytoidea 7, Data on the habits of Platypodidae. t. c., **103**, pp. 31～50, (1960)

74) Kleine, R.: Die Gesamtliteratur der Borkenkäfer. Stettin. ent. Ztg., **100**, pp. 1～184, (1939)

75) Klimesch, J.: Beiträge zur Kenntnis der Gattung *Trypophloeus* Fairm. (*Glyptoderes* Eichh.). Ent. Blätt., **9**, pp. 105～116; **10**, pp. 213～219, 231～241; **11**, pp. 6～13, (1913～1915)

76) Keen, F. P.: Insect enemies of western forests. U. S. Dep. Agr., Misc. Publ., **273**, pp. 1～280, (1938)

77) Kôno, M.: Neue und wenig bekannte Ipiden als Schädlinge an Sachalintannen und Ezofichten in Hokkaido. Ins. Mats., **12**, pp. 64～73, (1938)

78) Kôno, M. & K. Tamanuki: Die Ipiden, schädlich an Sachalintannen und Ezofichten in Sachalin. t. c., **13**, pp. 88～96, (1939)

79) Krivolutzkaja, G. O.(Криволуцкая, Г. О.): Короеды острова Сахалина. Moscow, 195 pp., (1958)

80) Lindemann, C.: Kauapparat der Scolytiden. V. Tageblatt der 48 Versammlung deutscher Naturforscher und Aerzte in Granz. p. 102, (1875)

81) Lindemann, C.: Vergleichend-anatomische Untersuchung über das männliche Begattungsglied der Borkenkäfer. Mosc. Soc. Ent., 1875, pp. 196～252, (1875)

82) Lindemann, C.: Monographie der Borkenkäfer Russlands. Bull. Soc. Imp. Nat. Mosc., 51, pp. 148～169, 320～380; **52**, pp. 159～187; **54**, pp. 53～87, (1876～1879)

83) Lφvendal, E. R.: Tomicini Danici Havan. Ent. Medd., **2**, pp.1～84, (1889)

84) Morimoto, K.: Comparative morphology and phylogeny of the superfamily Curculionidea of Japan (Comparative morphology, phylogeny and systematics of the superfamily Curculionidea of Japan, 1). Jour. Fac. Agr. Kyushu Univ., **11**, pp. 331～373, (1962)

85) Munros, J. W.: British bark-beetles. For. Comm. Bull., **8**, pp. 1～77, (1950)

86) Murayama, J.: On the Platypodidae of Formosa. Jour. Coll. Agr. Hokkaido Univ., **15**, pp. 167～228, (1925)

87) Murayama, J.: Supplementary notes on the Platypodidae of Formosa. t. c., **15**, pp. 229～236, (1925)

88) Murayama, J.: Supplementary notes on the Platypodidae of Formosa II. t. c., **19**, pp. 283～290, (1928)

89) Murayama, J.: The mode attack and tunnelling by *Crossotarsus rengetensis* Niijima et Murayama. Ins. Mats., **3**, pp. 26～35, (1928)

90) Murayama, J.: Some Scolytid-beetles, parasites on the *Pinus densiflora* S. et Z. of Korea (in Japanese). Chôsen Sanrinkaihô, **47**, pp. 41～46, (1929)

91) Murayama, J.: Sur les Scolytes qui vivent dans les pins (in Japanese). t. c., **55**, pp. 5～10, (1929)

92) Murayama, J.: Les espèces la distribution géographique et les plantes dévorées par les Scolytides de Corée (in Japanese). Spec. Publ. Univ. Meet. Sci. Agr. Keijo, 1929, pp. 1～13, (1929)

93) Murayama, J.: Des espèses des Platypides du domaine de l'Empire du Japonainsi que la dévastation par ces insectes (in Japanese). Jour. Soc. For., **11**, pp. 669～682, (1929)

94) Murayama, J.: Revisions des familles des Ipides et des Platypides de la Corée. Jour. Chôsen Nat. Hist. Soc., **11**, pp. 6～38, (1930)

95) Murayama, J.: On some Scolytid-beetles, parasitic on *Picea jezoensis* Carr., *Abies nephroepis* Max. and other conifers in Korea (in Japanese). Chôsen Sanrinkaihô, **56**, pp. 58～64, (1930)

96) Murayama, J.: Revisions des familles des Ipides et Platypides de l'île de Quelpart (Coléoptères). Ann. Zool. Japon, **13**, pp. 39～61, (1931)

97) Murayama, J.: Notes supplémentaire à la revision des Ipides et Platypides de la Corée, 2. Jour. Chôsen Nat. Hist. Soc., **15**, pp. 102～107, (1932)

98) Murayama, J.: Etude sur les organes génitaux du mâle du genre *Xyleborus* (in Japanese). t. c., **15**, pp. 21～35, (1933)

99) Murayama, J.: On the Ipidae (Coleoptera) from Formosa with special reference to their food-plants. Jour. Soc. Trop. Agr., Taihoku Imp. Univ., **6**, pp. 505～512, (1934)

100) Murayama, J.: Notes on the Ipidae (Coleoptera) from Kiushu. Ann. Zool. Japon, **14**, pp. 287～300, (1934)

101) Murayama, J.: A new species of Cryphalinae (Coleoptera, Ipidae) from Korea. Jour. Chôsen Nat. Hist. Soc., **17**, pp. 3～4, (1934)

102) Murayama, J.: Supplementary notes on the Platypodidae of Formosa IV. Jour. Coll. Agr. Hokkaido Imp. Univ., **25**, pp. 133～149, (1934)

103) Murayama, J.: On the distribution of Scolytid beetles by human agency (in Japanese). Kontyû, **10**, pp. 113～120, (1936)

104) Murayama, J.: Notes sur les Scolytides de Honshû et Kiushû, Japon. Tenthredo, **1**, pp. 121～149, (1936)

105) Murayama, J.: Notes sur les Scolytides (Coléoptères) de la Corée. t. c., **1**, pp. 367～375, (1937)

106) Murayama, J.: Notes sur les Scolytides du Manchoukuo. Ann. Zool. Japon, **18**, pp. 143～144, (1939)

107) Murayama, J.: Nouvelle note sur les Scolytides du Manchoukuo. t. c., **19**, pp. 229～237, (1940)

108) Murayama, J.: On the Scolytide-beetles from the Summer Palace, Jehol (in Japanese). Trans. Biol. Soc. Manchoukuo, **3**, pp. 33～37, (1940)

109) Murayama, J.: On the Scolytid-beetles discovered in the Tai-lin Experiment Forest, Manchoukuo (in Japanese). t. c., **5**, pp. 74～76, (1942)

110) Murayama, J.: Nouvelles espèces des Scolytides (Coleoptera) du Manchoukuo. Ann. Zool. Japon, **22**, pp. 96～100, (1943)

111) Murayama, J.: On the so-called "pine bark-beetles" (in Japanese). Kontyû, **17**, pp. 1～6, (1949)

112) Murayama, J.: Scolytid beetles from Shikoku 1 (in Japanese). Matsumushi, **3**, pp. 99～104, (1949)

113) Murayama, J.: Nouvelles espèces de Scolytides (Coléopt.) de l'île Shikoku. Ins. Mats., **17**, pp. 61～64, (1950)

114) Murayama, J.: A new genus and some new species of Scolytidae from Japan (Coleoptera). Trans. Shikoku Ent. Soc., **1**, pp. 49～53, (1950)

115) Murayama, J.: New genus and species of Scolytidae (Coleoptera) from Ohshima and Shionomisaki, Wakayama Prefecture. Bull. Fac. Agr. Yamaguti Univ., **2**, pp. 1～7, (1951)

116) Murayama, J.: On the bark beetles of lauan timber and the control measures against it (in Japanese). Jap. Jour. Prot., **19**, pp. 22～32, (1951)

117) Murayama, J.: Notes on the Scolytid-beetles from Southern and Western Parts of Izu Peninsula, Shizuoka Pref. Bull. Fac. Agr. Yamaguti Univ., **3**, pp. 15～23, (1952)

118) Murayama, J.: Scolytid-fauna of the Chugoku and Kinki Districts. t. c., **4**, pp. 1～38, (1953)

119) Murayama, J.: Studies in the pine bark beetle control. Report of the pine bark-beetle Control Investigation Society (in Japanese). Tokyo, 112 pp., (1953)

120) Murayama, J.: The insect fauna of Mt. Ishizuchi and Omogo Valley, Iyo, Japan, the Scolytidae and Platypodidae (Coleoptera). Trans. Shikoku Ent. Soc., **3**, pp. 144～165, (1953)

121) Murayama, J.: Scolytid-fauna of the Northern Half of Honshu with a description table of all the Scolytid-species described from Japan. Bull. Fac. Agr. Yamaguti Univ., **5**, pp. 149～212, (1954)

122) Murayama, J.: Scolytid-beetles from Yamaguti Prefecture (in Japanese), Yamaguti, 24 pp., (1954)

123) Murayama, J.: Supplementary notes on the Scolytide-fauna of Japan. Bull. Fac. Agr. Yamaguti Univ., **6**, pp. 81～106,(1955)

124) Murayama, J.: Polygraphinae (Coleoptera, Ipidae) from the Northern Half of Far East. t. c., **7**, pp. 275～292, (1956)

125) Murayama, J.: Bark-beetles and pin-hole borers recently imported into Japan with timbers from the United States and other foreign countries. Pan. Pac. Ent., **33**, pp. 35～37, (1957)

126) Murayama, J.: Xyloterinae (Coleoptera, Ipidae) from the Northern Half of the Far East. Bull. Fac. Agr. Yamaguti Uuiv., **8**, pp. 569～586, (1957)

127) Murayama, J.: Studies in the Scolytid-fauna of the Northern Half of the Far East, (Dryocoetinae). t. c., **8**, pp. 587～632, (1957)

128) Murayama, J.: Studies in the Scolytid-fauna of the Northern Half of the Far Fast (Coleoptera: Ipidae and Platypodidae) IV. New genera and new species. t. c., **10**, pp. 927～936, (1958)

129) Murayama, J.: Timber importation from the South with referance to the plant quarantine work of Japan (in Japanese). Osaka, 58 pp., (1960)

130) Murayama, J.: Check list of the Ipidae and Platypodidae from Kyushu. Publ. Ent. Lab. Univ. Osaka Pref. **6**, pp. 93～109, (1961)

131) Murayama, J.: Scolytid-beetles from Niigata Prefecture, Japan. Akitu, **10**, pp. 23～32, (1961)

132) Murayama, J.:Studies in the Scolytid-fauna of the Northern Half of the Far East V, Hylesininae. Fukuoka, 72 pp., (1963)

133) Murayama, J.: Scolytid beetles injurious to fruit trees in Japan (in Japanese). Plant Prot. Japan, **17**, 9, pp. 1～5, (1963)

134) Murayama, J.: Scolytid beetles from Niigata Prefecture, Japan II, Niigata, 65 pp., (1965)

135) Murayama, J. & L. G. E. Kalshoven: *Xyleborus morstatti* Hagedorn, a synonym of *Xyleborus compactus* Eichh. (Col. Scolytidae). Ent. Ber., **22**, pp. 247～250, (1962)

136) Niijima, Y.: On some Japanese species of Scolytini. Jour. Sapporo Agr. Coll., **2**, pp. 68～74, (1905)

137) Niijima, Y.: Ueber Lebensweis einiger Japan. *Scolytoplatypus*-Arten. Z. wiss. Insekt.-Biol., **3**, pp. 313～317, (1907)

138) Niijima, Y.: Ueber die japanischen *Cryphalus*-Arten. Verh. Zool.-Bot. Ges. Wien., **58**, pp. 89～92, (1908)

139) Niijima, Y.: Die Scolytiden Hokkaidos unter Berücksichtigung ihrer Bedeutung für Forstschäden. Jour. Coll. Agr. Tohoku Imp. Univ., Sapporo, **3**, pp. 109～179, (1909)

140) Niijima, Y.: Die Brokenkäfer Nord- und Mitteljapans. Trans. Sapporo Nat. Hist. Soc., **3**,

pp. 1～18, (1910)

141) Niijima, Y.: Neue Borkenkäfer nebst Frasspflanzen. Trans. Sapporo Nat. Hist. Soc., **5**, pp. 1～6, (1913)

142) Niijima, Y.: Forest entomology (in Japanese). Tokyo, 812 pp., (1913)

143) Niijima, Y.: Eine neue Gattung der Borkenkäfer. A collection of Essays for Mr. Y. Nawa, written in commemoration of his sixtieth birthday. Gifu, pp. 1～3, (1917)

144) Niijima, Y.: *Polygraphus meakanensis* n. sp. (in Japanese). Hokkaido Ringyôkaiho, **33**, pp. 1～2, (1935)

145) Niijima, Y.: Revision und Neubeschreibung der *Polygraphus*-Arten (Coleoptera, Ipidae) in Japan. Ins. Mats., **15**, pp. 123～135, (1941)

146) Niijima, Y.: Die japanischen *Phloeosinus*-Arten (Coleoptera, Ipidae) und ihre Frasspflanzen. Trans. Sapporo Nat. Hist. Soc., **17**, pp. 69～76, (1942)

147) Niijima, Y.: Die Birkensplintkäfer von Japan. t. c., **17**, pp. 140～143, (1943)

148) Nobuchi, A.: Four new species of Scolytidae from Japan. Akitu, **8**, pp. 9～13, (1959)

149) Nobuchi, A.: On *Acanthotomicus spinosus* Blandford (in Japanese). t. c., **8**, pp. 14, (1959)

150) Nobuchi, A.: Some species of Scolytidae from Ryukyu Islands, Studies on Scolytidae II. Bull. Gov. For. Exp. Sta., **116**, pp. 21～26, (1959)

151) Nobuchi, A.: Studies on Scolytidae III. t. c., **171**, pp. 129～134, (1964)

152) Nobuchi, A.: Bark beetles injurious to pine in Japan (in Japanese), Studies on Scolytidae IV. t. c., **185**, pp. 1～49, (1966)

153) Nobuchi, A.: Studies on Scolytidae VI. t. c., **185**, pp. 51～55, (1966)

154) Nobuchi, A.: On the proventriculus of the Scolytid-beetles possessing special feeding habit (in Japanese). Trans. 77 th Ann. Meet. Jap. For. Soc., 1966, pp. 282～384, (1966)

155) Nobuchi, A.: Formosan Scolytoidea (Coleoptera), Studies on Scolytidae VII. Bull. Gov. For. Exp. Sta., **207**, pp. 11～30, (1967)

156) Nobuchi, A. & K. Takahashi: Male of *Xyleborus mutilatus* Blandford and a new species of *Cryphalus* Erichson, Studies on Scolytidae V. Akitu, **13**, pp. 1～3, (1965)

157) Nunberg, M.: Klucze do oznaczania owadów Polski, 19 (99～100); Coleoptera, Scolytidae i Platypodidae. Warszwa, 106 pp., (1954)

158) Nunberg, M.: Namensänderungen und Synonymie einiger Borkenkäfer. Ann. Zool. Polsk., **16**, pp. 207～214, (1956)

159) Nunberg, M.: Zmiany nazw i synonimika niektórych kornikόw (Coleoptera, Scolytidae) II. Polsk. Pismo Ent., **29**, pp. 167～169, (1959)

160) Nüsslin, O.: Leitfaden der Forstinsektenkunde. Berlin, 454 pp., (1905)

161) Nüsslin, O.: Zur Anatomie und Biologie der Borkenkäfergattung *Cryphalus*, 1 Die weiblichen Genitalien. Naturw. Z. Land-Forstw., **8**, pp. 289～298, (1910)

162) Nüsslin, O.: Phylogenie und System der Borkenkäfer. Z. wiss. Insekt.-Biol. 1911, pp. 1～5, 47～51, 77～82, 109～112, 145～156, 333～338, 372～378; 1912, pp. 19～26, 51～61, 81～89, 125～129, 162～167, 205～211, (1911～1912)

163) Nüsslin, O.: Zur Phylogenie und Systematik der einheimischer Hylesinen. Naturw. Z. Land-Forstw. 1912, pp. 267～290, (1912)

164) Nüsslin, O.: Studien über natürliche Systematik der Borkenkäfer, Die Gattung *Lymantor* Lφv. und ihre Beziehungen zur Gattung *Dryocoetes* Eichh. Ent. Blätt., **8**, pp. 99～108, (1912)

165) Pfeffer, A.: Notulae Ipidologicae 2. Sborník Ent. Odd. Nár. Mus. Praze, **18**, pp. 107～127,

(1940)

166) Pfeffer, A.: Notulae Ipidologicae 5. Sborík End. Odd. Nár. Mus. Praze, **10**, pp. 207～222, (1942)

167) Pfeffer, A.: Notulae Ipidologicae 6. Ent. Listy, **6**, pp. 1～16, (1943)

168) Pfeffer, A.: Příspěvek k poznání rodu *Hylastes* Erichs. a *Hylurgops* Lec. (Col. Ipidae). t. c., **7**, pp. 97～105, (1944)

169) Pfeffer, A.: Fauna ČSR, 6: Scolytoidea. Praha, 324 pp., (1955)

170) Pfeffer, A.: Genus *Taphrorychus* Eichh. (Coleoptera, Ipidae). Act. Soc. Ent. Cech., **59**, pp. 240～245, (1962)

171) Pjatnitzky, G. K.: Ein neuer paläarktischer Arvenborkenkäfer aus Ostsibirien, *Orthotomicus golovjankoi* n. sp. Ent. Blätt., **26**, pp. 179～182, (1930)

172) Reichenbach-Klinke, H.: Der Darmkanal der Coleopteren als Kriterium für stammesgeschichtliche Untersuchungen. Verh. dtsch. zool. Ges., 1952, pp. 461～467, (1952)

173) Reichenbach-Klinke, H.: Der Kaumagen holzfressender Käfer. Z. angew. Ent., **34**, pp. 335～345, (1953)

174) Reichenbach-Klinke, H.: Die Entwicklung des Proventrikels der Coleopteren mit besonderer Berücksichtigung der carnivoren Arten der Unterordnung Polyphaga (Coleoptera). Ent. Blätt., **49**, pp. 2～17, (1953)

175) Reitter, E.: Bestimmungstabelle der Borkenkäfer aus Europa und den angrenzenden Ländern. Verh. naturf. Ver. Brünn., **34**, pp. 36～97, (1895)

176) Reitter, E.: *Dryocoetes baikalicus* nov. sp. Dtsch. ent. Z., 1899, p. 286, (1899)

177) Reitter, E.: Bestimmungstabelle der Borkenkäfer aus Europa und den angrenzenden Ländern. Wien. ent. Ztg., **32**, pp. 1～116, (1913)

178) Reitter, E.: Fauna Germanica, 5. Berlin, pp. 268～306, (1916)

179) Saalas, U.: Die Fichtenkäfer Finnlands, 1. Helsinki, 547 pp., (1919)

180) Saalas, U.: Die Fichtenkäfer Finnlands, 2. Helsinki, 747 pp., (1923)

181) Sampson, F. W.: Notes on the nomenclature of the family Scolytidae. Ann. Mag. Nat. Hist., (9) **11**, pp. 269～271, (1923)

182) Sawamoto, T.: Ueber die Larchenborkenkäfer von Sachalin, Hokkaido und Honshu. Ins. Mats., **14**, pp. 95～108, (1940)

183) Sawamoto, T.: Ueber die schwarzkiefern Borkenkäfer in Hokkaido. t. c., **14**, pp. 141～148, (1940)

184) Sawamoto, T.: Eine neuer Fichtenborkenkäfer aus Hokkaido. t. c., **16**, pp. 165～169,(1924)

185) Schaufuss, C.: Beitrag zur Käferfauna von Madagaskar. Tijd. v. Ent., 34, pp. 1～35, (1891)

186) Schedl, K. E.: *Scolytoplatypus nanus* n. sp. Ent. Blätt., **27**, pp. 118～122, (1930)

187) Schedl, K. E.: Morphology of the bark beetles of the genus *Gnathotrichus* Eichh. Smith. Misc. Coll., **82**, pp. 1～88, (1931)

188) Schedl, K. E.: Scolytidae, in Catalogus Coleopterorum regionis palaearcticae. F 1632～1647, (1932)

189) Schedl, K. E.: Die Einteilung der Pityophthorinae. Arch. f. Naturg., **7**, pp. 157～188, (1938)

190) Schedl, K. E.: Zur Einteilung und Synonymie der Cryphalinae (Col. Scolyt.). Mitt. Münch. Ent. Ges. e. V. **30**, pp. 583～591, (1840)

191) Schedl, K. E.: Bestimmungstabellen der paläarktischen Borkenkäfer 1, Zbl. Gesamtgeb. Ent., **1**, pp. 1～15, (1946)

192) Schedl, K. E.: Bestimmungstabellen der paläarktischen Borkenkäfer 2. t. c., **1**, pp. 50～58,

(1946)

193) Schedl, K. E.: Nachtrag zur Gesamtliteratur der Borkenkäfer (Ipidae und Platypodidae) von R. Kleine 1939. Zbl. Gesamtgeb. Ent. **1**, pp. 32, 63～64, 123～128, 185～190; **2**, pp. 63～64; **3**, pp.63～105, (1946～1949)

194) Schedl, K.E.: Die Borkenkäfer des baltischen Bernsteins. t. c., **2**, pp. 12～45, (1947)

195) Schedl, K.E.: Bestimmungstabellen der paläarktischen Borkenkäfer 3, Die Gattung *Scolytus* Geofr. t. c., **1**, pp. 1～67, (1948)

196) Schedl, K.E.: Tropical seed beetles of the genus *Coccotrypes* Eichhoff. Tijd. v. Ent., **91**, pp. 113～120, (1949)

197) Schedl, K.E.: Bestimmungstabellen der paläarktischen Borkenkäfer 4. Mitt. forstl. Bundes-Versuchs. Mariabrunn, **46**, pp. 69～88, (1950)

198) Schedl, K.E.: Nomina consewanda of Scolytoidea 1. Ent. Ber., **13**, p. 96, (1950)

199) Schedl, K.E.: Bestimmungstabellen der paläarktischen Borkenkäfer 6. Ent. Nachr. Öst. Schweiz. Ent., **2**, pp. 35～38, 58～61, 81～84, 96～98; **3**, pp. 112～114, (1950～1951)

200) Schedl, K.E.: Bestimmungstabellen der paläarktischen Borkenkäfer 5. Mitt. forstl. Bundes-Versuchs. Mariabrunn, **47**, pp. 74～100, (1951)

201) Schedl, K.E.: Zur Synonymie der Borkenkäfer 1. Ent. Blätt., **47～48**, pp. 158～164, (1951～1952)

202) Schedl, K.E.: Formosan Scolytoidea 1. Philip. Jour. Sci., **81**, pp. 61～65, (1952)

203) Schedl, K.E.: Bestimmungstabellen der paläarktischen Borkenkäfer 7. Mitt. Münch. ent. Ges., **44～45**, pp. 3～25, (1955)

204) Schedl, K.E.: Zur Synonymie der Borkenkäfer 2. Tijd. v. Ent., **101**, pp. 141～155, (1958)

205) Schedl, K.E.: Breeding habits of arboricole insects in Central Africa. Proc. 10 th Inter. Congr. Ent., **1**, pp. 183～197, (1958)

206) Schedl, K.E.: Zur Synonymie der Borkenkäfer 3. Ent. Blätt., **55**, pp. 41～43, (1959)

207) Schedl, K.E.: A check list of the Scolytidae and Platypodidae (Coleoptera) of Ceylon, with descriptions of new species and biological notes. Trans. Roy. Ent. Soc. London, **111**, pp. 469～516, (1959)

208) Schedl, K.E.: Zur Synonymie der Borkenkäfer 5. Ent. Blätt., **56**, pp. 103～112, (1960)

209) Schedl, K.E.: Zur Synonymie der Borkenkäfer 6. t. c., **58**, pp. 201～211, (1962)

210) Schedl, K.E.: Bestimmungstabellen der paläarktischen Borkenkäfer 11. Centrbl. ges. Forstw., 79, pp. 132～159, (1962)

211) Schedl, K.E.: Zur Synonymie der Borkenkäfer 8. Beit. z. Ent., **12**, pp. 485～494. (1962)

212) Schedl, K.E.: Zur Synonymie der Borkenkäfer 9. Ent. Abh. Ber. Mus. Tierk. Dresden, **28**, pp. 257～268, (1963)

213) Schedl, K.E.: Zur Synonymie der Borkenkäfer 14. Reichenbachia, Staat. Mus. Tierk. Dresden, **2**, pp. 209～223, (1964)

214) Schedl, K.E.: Zur Synonymie der Borkenkäfer 15. t. c., **3**, pp. 303～317, (1964)

215) Schimitschek, E.: Schlüssel zur Bestimmung der wichtigsten forstlich schädlichen Käfer. Wien, 109 pp., (1955)

216) Sedlaczek, W.: Ueber den Darmkanal der Scolytiden. Centrbl. ges. Forstw., **29**, pp. 241～263, (1902)

217) Sokanovsky, B. V. (Соковновский, Б. В.): К систематике и распространению короедов СССР и сопредельных стран. Rev. d'Ent. l'URSS, 39, pp. 674～678, (1960)

218) Spessivtsev, P.: New bark-beetles from neighbourhood of Vladivostok. Ent. Month. Mag., **55**, pp. 247～250, (1919)
219) Spessivtsev, P.: Bestämningstabell över Svenska Barkborrar. Medd. Stat. Skogsfant., **19**, pp. 145～194, (1922)
220) Spessivtsev, P.: Svensk Insektfauna 28: Coleoptera 6, Scolytidae 3, pp. 145～194, (1925)
221) Spessivtsev, P.: Eine neue Borkenkäferart aus Russland (*Orthotomicus starki* n. sp.). Ent. Tidskr., **47**, pp. 217～220, (1926)
222) Stark, V.N. (Старк, В. Н.): Фауна СССР 31; Короеды. Moscow, 461 pp., (1952)
223) Stebbing, E.P.: Indian forest insects. London, 648 pp., (1914)
224) Strohmeyer, H.: H. Sauter's Formosanausbeute. Ent. Mitt., **1**, pp. 38～42, (1912)
225) Strohmeyer, H.: Coleopterorum Catalogus 44: Platypodidae. Berlin, 26 pp., (1912)
226) Strohmeyer, H.: Brokenkäfer aus Korea und Tsushima. Ent. Blätt., **10**, pp. 32, (1914)
227) Strohmeyer, H.: Genera Insectorum: Platypodidae. Berlin, 55 pp., (1914)
228) Swaine, J.M.: Canadian bark-beetles 2. Dom. Canada Dep. Agr. Ent. Branch, Bull., **14**, pp. 1～143, (1918)
229) Thomas, J.B.: The immature stage of Scolytidae, the tribe Xyloterini. Can. Ent., **90**, pp. 410～419, (1960)
230) Thomas, J.B.: The immature stage of Scolytidae, the genus *Dendroctonus* Erichson. Can. Ent., 97, pp. 374～400, (1965)
231) Trédl, R.: Nahrungspflanzen und Verbreitungsgebiete der Borkenkäfer Europas. Ent. Blätt., **3**, pp. 2～4, 18～22, 37～42, 53～56, 69～72, (1907)
232) Tsai, Pang-Hwa & Li, Chao-Lin: Research on the Chinese bark-beetles of the genus *Cryphalus* Er. with descriptions of new species (in Chinese). Act. Ent. Sinica, **12**, pp. 597～624, (1963)
233) Wichmann, H.: Zur Kenntnis der Ipiden. Ent. Blätt., **10**, pp. 136～139, (1914)
234) Wichmann, H.E.: Einschleppungsgeschichte und Verbreitung des *Xylosandrus germanus* (Blandford) in Westdeutschland (nebst einem Anhang: *Xyleborus adumbratus* Blandford) Z. angew. Ent., **40**, pp. 82～99, (1957)
235) Wood, S.L.: A revision of North America Cryphalini. Univ. Kansas Sci. Bull., **36**, pp. 959～1089, (1954)
236) Wood, S.L.: Bark beetles of the genus *Carphoborus* Eichhoff. Can. Ent., **86**, pp. 502～526, (1954)
237) Wood, S.L.: Ambrosia beetles of the tribe Xyloterini in North America. t. c., **89**, pp. 337～354, (1957)
238) Wood, S.L.: New records and species of Scolytidae from Western North America. Great Basin Nat., **20**, pp. 59～69, (1960)
239) Wood, S.L.: Insect of Micronesia: Coleoptera, Platypodidae and Scolytidae. Ins. Micronesia, **18**, pp. 1～73, (1960)
240) Wood, S.L.: A key to the North American genera of Scolytidae. Coleopt. Bull. **15**, pp. 41～48, (1961)
241) Wood, S.L.: An alternative proposal to the suggested validation of *Myelophilus* Eichhoff, 1878 (Insecta, Coleoptera). Bull. Zool. Nomencl., **18**, (5), pp. 319～321, (1961)
242) Wood, S.L.: Miscellaneous taxonomic notes on Scolytidae (Coleoptera). Great Basin Nat. **22**, pp. 76～82, (1962)
243) Wood, S.L.: A revision of the bark beetle genus *Dendroctonus* Erichson (Coleoptera, Scolytidae). t. c., **23**, pp. 1～117, (1963)

Explanation of plates

Plate 1.

Figs. 1～2. *Ips cembrae* (Heer), crop and proventriculus.

Fig. 1. Lateral aspect, Fig. 2. Frontal aspect.

Figs. 3～4. Alimentary canal.

Fig. 3. *Scolytoplatypus shogum* Blandford, Fig. 4. *Platypus modestus* Blandfold.

Ai. anterior intestine, An. anus, Cr. crop, Mal. malpighian tubules, Pr. provetriculus, Re. rectum, Vt. ventriculus.

Figs. 5～8. Diagram showing four types of proventricular plate.

Fig. 5. *Scolytine*-type, Fig 6. *Hylastine-Hylurgine*-type, Fig. 7. *Ipine*-type, Fig. 8. *Scolytoplatypine*-type.

Al. apical laminate teeth, Ap.anterior plate, At.apical teeth, Ct.closing teeth, Ft. femoral teeth, Lt.lateral teeth of serration, Mb.masticatory brush, Mbl.marginal bristles, Ms.median suture, Mt. masticatory teeth, Pp. posterior plate, St. sutural teeth.

Plates 2～17. Proventicular plates.

Fig. 9. *Paroplapoderus pardalis* Vollenhoven
Fig. 10. *Niphades variegatus* Roelofs
Fig. 11. *Pissodes nitidus* Roelofs
Fig. 12. *Sitophilus orizae* Linné
Fig. 13. *Scolytus ratzeburgi* Janson
Fig. 14. *Bothrosternus cancellatus* Schedl
Fig. 15. *Sphaerotrypes pila* Blandford
Fig. 16. *Hyorrhynchus lewisi* Blandford
Fig. 17. *Pseudohyorrhynchus wadai* Murayama
Fig. 18. *Neohyorrhynchus niijimai* (Eggers)
Fig. 19. *Strombophorus ericeus* Schaufuss
Fig. 20. *Peronophorus adhorrens* Eggers
Fig. 21. *Rhopalopselion thompsoni* Schedl
Fig. 22. *Diamerus inperfectus* Eggers
Fig. 23. *Hylastes plumbeus* Eichhoff
Fig. 24. *Hylurgops transbaicalicus* Eggers
Fig. 25. *Pseudohylesinus neburosus* (Leconte)
Fig. 26. *Hylurgonotus antipodus* Eggers
Fig. 27. *Hylurgus ligniperda* (Fabricius)
Fig. 28. *Dendroctonus pseudotsugae* Hopkins
Fig. 29. *Tomicus piniperda* (Linné)
Fig. 30. *Hylesinus tristis* Blandford
Fig. 31. *Leperisinus orni* (Fuchs)
Fig. 32. *Pteleobius scutulatus* (Blandford)
Fig. 33. *Alniphagus alni* (Niijima)
Fig. 34. *Scierus annectens* Leconte
Fig. 35. *Hylastinus frankhauseri* Reitter
Fig. 36. *Xylechinus pilosus* (Ratzeburg)

Fig. 37. *Phloeotribus puberulus* Leconte
Fig. 38. *Phthorophloeus spinulosus* Rey
Fig. 39. *Hypoborus ficus* Erichson
Fig. 40. *Renocis heterodoxus* Casey
Fig. 41. *Phloeosinus rudis* Blandford
Fig. 42. *Hylesinopsis dubius* Eggers
Fig. 43. *Polygraphus proximus* Blandford
Fig. 44. *Carphoborus minimus* (Fabricius)
Fig. 45. *Micracis hirtellus* Leconte
Fig. 46. *Pseudothysanoes rigidus* (Leconte)
Fig. 47. *Cryphalomimus ghanaensis* (Schedl)
Fig. 48. *Ctonoxylon nodosum* Eggers
Fig. 49. *Cryphalus kurenzowi* (Schedl)
Fig. 50. *Ernoporus longus* Eggers
Fig. 51. *Ernoporicus spessivtzevi* Berger
Fig. 52. *Margadillius corpulentus* (Sampson)
Fig. 53. *Euptilius thailandicus* Schedl
Fig. 54. *Phellodendrophagus elegans* Krivolutzkaja
Fig. 55. *Cryphalomorphus birosimensis* (Murayama)
Fig. 56. *Eocryphalus semenovi* Kurenzov
Fig. 57. *Cryptocarenus haveae* Hagedorn
Fig. 58. *Taenioglyptes montanus* (Nobuchi)
Fig. 59. *Hypocryphalus mangiferae* Stebbing
Fig. 60. *Hypothenemus expers* Blandford
Fig. 61. *Hypothenemus* sp
Fig. 62. *Stylotentus concolor* (Hagedorn)
Fig. 63. *Trypodendron lineatum* Olivier
Fig. 64. *Dendrotrypum pubipenne* (Blandford)
Fig. 65. *Dolurgus pumilus* (Mannerheim)
Fig. 66. *Crypturgus pusillus* (Gyllenhal)
Fig. 67. *Thamnurgus euphorbiae* (Kuster)
Fig. 68. *Tiarophorus elongatus* Schreiner
Fig. 69. *Lymantor coryli* (Perris)
Fig. 70. *Xylocleptus bispinosus* (Duftschmit)
Fig. 71. *Ozopemon obanus* Hagedorn
Fig. 72. *Taphrorychus striatus* Nobuchi
Fig. 73. *Cyrtogenius cribricollis* Schedl
Fig. 74. *Carposinus philippinensis* (Eggers)
Fig. 75. *Pseudopoecilips pilosus* (Blandford)
Fig. 76. *Dryocoetiops laevis* (Strohmeyer)
Fig. 77. *Poecilips japonicus* Eggers
Fig. 78. *Coccotrypes pygmaenus* Eichhoff
Fig. 79. *Premnobius cavipennis* Eichhoff
Fig. 80. *Xylosandrus brevis* (Eichhoff)

Fig. 81. *Xyleborus adumbratus* Blandford
Fig. 82. *Xyleborus apicalis* Blandford
Fig. 83. *Xyleborus atratus* Eichhoff
Fig. 84. *Xyleborus exesus* Blandford
Fig. 85. *Xyleborus mutilatus* Blandford
Fig. 86. *Xyleborus seriatus* Blandford
Fig. 87. *Xyleborus seiryorensis* Murayama
Fig. 88. *Xyleborus rubricollis* Eichhoff
Fig. 89. *Cnestus murayamai* Schedl
Fig. 90. *Webbia costulatus* Schedl
Fig. 91. *Arixyleborus rugosipes* Hopkins
Fig. 92. *Eccoptopterus sexspinosus* Motschulsky
Fig. 93. *Mimips pilosellus* Browne
Fig. 94. *Pityokteines spinidens* (Reitter)
Fig. 95. *Acanthotomicus spinosus* Blandford
Fig. 96. *Pityoborus comatus* Zimmerman
Fig. 97. *Conophthorus lambertiarae* Hopkins
Fig. 98. *Pityophthorus jucundus* Blandford
Fig. 99. *Pseudopityophthorus pubipennis* (Leconte)
Fig. 100. *Gnathotrichus sulcatus* (Leconte)
Fig. 101. *Monarthrum fasciatum* (Say)
Fig. 102. *Pterocyclon plaumanni* Schedl
Fig. 103. *Corthylus schaufussi* Eggers
Fig. 104. *Microcorthylus puerulus* Schedl
Fig. 105. *Tricolus senex* Schedl
Fig. 106. *Scolytoplatypus mikado* Blandford
Fig. 107. *Platypus severini* Blandford
Fig. 108. *Trachyostus schaufussi* (Strohmeyer)
Fig. 109. *Crossotarsus niponicus* Blandford
Fig. 110. *Doliopygus aduncus* Schedl
Fig. 111. *Diapus truncatus* Niijima et Murayama
Fig. 112. *Diacavus serratus* Schedl
Fig. 113. *Dryocoetes autographus* (Ratzeburg)
Fig. 114. *Dryocoetes baikalicus* Reitter
Fig. 115. *Dryocoetes cristatus* Inouye et Nobuchi
Fig. 116. *Dryocoetes hectographus* Reitter
Fig. 117. *Dryocoetes luteus* Blandford
Fig. 118. *Dryocoetes niijimai* Nobuchi
Fig. 119. *Dryocoetes pini* Niijima
Fig. 120. *Dryocoetes rugicollis* Eggers
Fig. 121. *Dryocoetes striatus* Eggers
Fig. 122. *Pseudopoecilips pilosus* (Blandford)
Fig. 123. *Pseudopoecilips mikuniyamensis* Murayama
Fig. 124. *Poecilips nubilis* (Blandford)

Fig. 125. *Poecilips fagi* (NOBUCHI)
Fig. 126. *Pityogenes chalcographus* (LINNE)
Fig. 127. *Pityogenes seirindensis* MURAYAMA
Fig. 128. *Pityogenes foveolatus* EGGERS
Fig. 129. *Orthotomicus laricis* (FABRICIUS)
Fig. 130. *Orthotomicus angulatus* (EICHHOFF)
Fig. 131. *Orthotomicus golovjankoi* PJATNITZKY
Fig. 132. *Orthotomicus proximus* (EICHHOFF)
Fig. 133. *Ips typographus japonicus* NIIJIMA
Fig. 134. *Ips sexdentatus* (BOERN)
Fig. 135. *Ips acuminatus* (GYLLENHAL)
Fig. 136. *Ips cembrae* (HEER)
Fig. 137. *Ips duplicatus* (SAHLBERG)
Fig. 138. *Ips tosaensis* MURAYAMA

Index

キクイムシ上科成虫の前胃の比較形態学的研究

野淵輝(1)

キクイムシ上科既知属の約1/3について，前胃の比較形態学的検討をおこない，これの系統分類学的標徴としての価値，キクイムシの類縁関係の吟味ならびに前胃の構造と食性との関係について論じた。その結果を要約するとつぎのとおりである。

1. 前胃の形態的特徴は属内で根本的な変異が少なく，前胃の単純化した養菌穿孔虫を除き，属の識別，類縁関係の検討に好適な標徴である。

2. 同一族内に所属する種類において，かなり密接な類似性が認められるものがあるが，共通した特徴を備えない族も認められる。

3. 樹皮下穿孔虫の Hylastini 族と Hylurgini 族，Hylesinini 族と Phloeotribini 族，Cryphalini 族の属の中には全く同一の形態を備えるものがあるが，外部形態，生態からも近縁的にまとまった群であることを示している。

4. 樹木の組織を食うキクイムシでは歯状，針状突起を備えた前板が発達し，菌糸を食うキクイムシではこれが縮小あるいは退化し，単に毛状突起を備えた後板が大部分をしめる。これは前板が食物のそしゃくを，後板が濾過機能にたずさわることを証明している。

5. 養菌穿孔虫はいずれの亜科にも存在し，*Premnobius* 属を除き，すべて前胃が縮小し，前板が縮小，ないしは退化消失している。これは食性の変化による前胃の適応の結果現われた平行進化と解せられる。しかし，全く類縁関係の離れた群間において僅少の相違点が認められるが，これは前胃板の単純化の結果特徴が現われにくいと想像する。

6. 樹皮下穿孔虫，種子穿孔虫，食材穿孔虫ではこのような平行現象は認められない。

7. *Coccotrypes* 属の前胃形態，外部形態，習性から Crypturgini 族と Xyleborini 族の関連性が強く，特に前胃の形態から両族間において，樹皮下穿孔虫が養菌性を獲得するまでの過程に髄穿孔虫，種子穿孔虫が中間的に存在すると推定する。

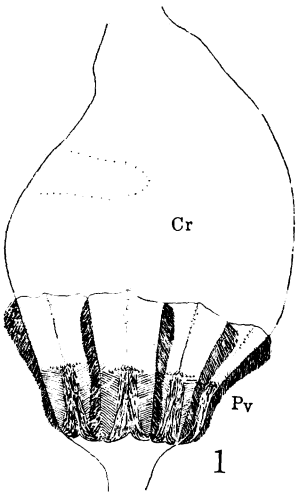
8. これに関連して，*Xyleborus* 属の前板は種間変異が著しく，祖先型とみられる Crypturgini 族に類似した型から完全に退化した型まで連続した段階のものが認められるが，これは養菌性獲得後の前胃の適応変化の初期の過程を示すと解される。

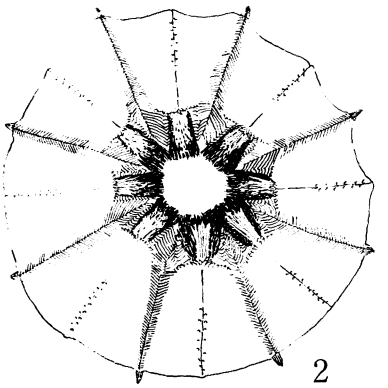
9. キクイムシ上科における前胃の進化の方向は複雑な形質から単純化，特殊化した形質へと進み，養菌性獲得によって前板の縮小，退化消失へと進んでいる。

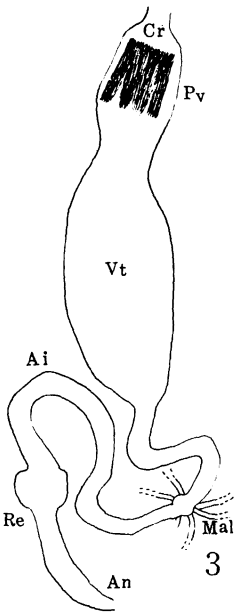
10. 以上によって，キクイムシ上科の前胃の形態は分類学上一部の属について種の識別に好適な標徴となるのみでなく，属，族の検討，類縁関係，食性の進化の検討に用いられる重要な標徴であると結論ずける。

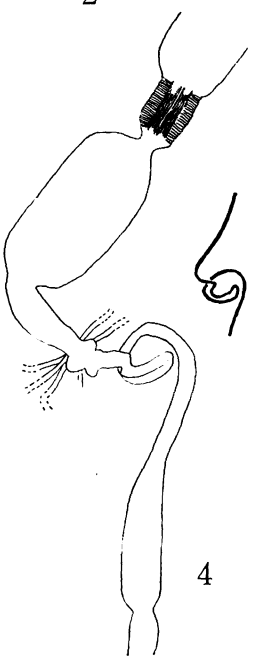
---

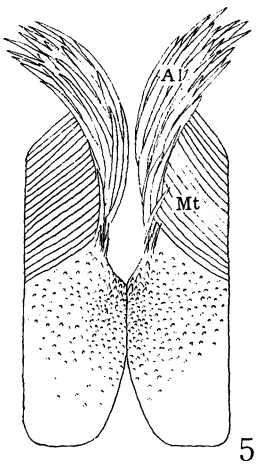
(1) 保護部昆虫科昆虫第2研究室長・農学博士

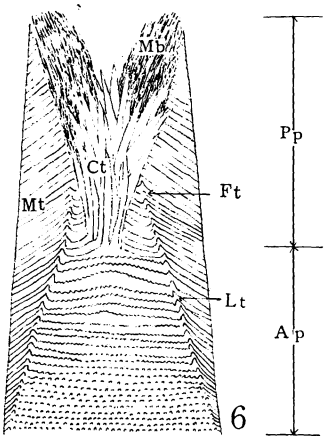

Cr
Pv
1

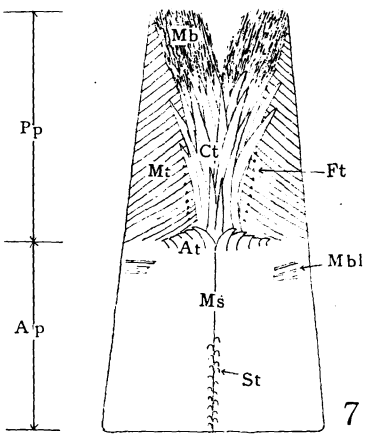

2


Cr
Pv
Vt
Ai
Re
Mal
An
3

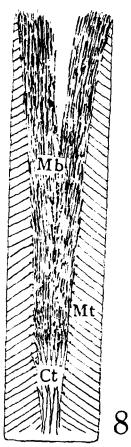

4

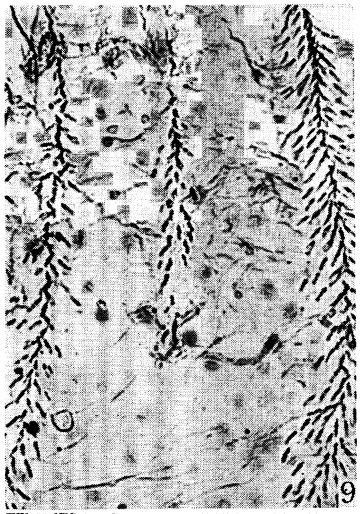

Al
Mt
5

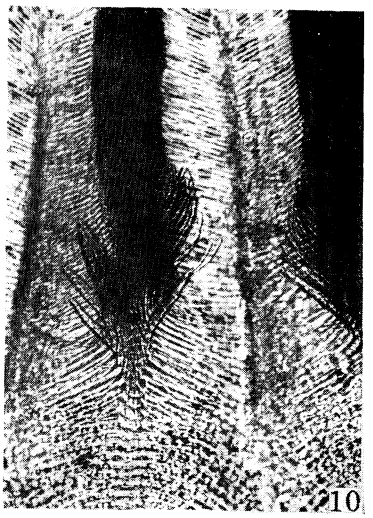

Mb
Ct
Ft
Mt
Lt
6


Pp
Ap

Mb
Ct
Mt
Ft
At
Mbl
Ms
St
7

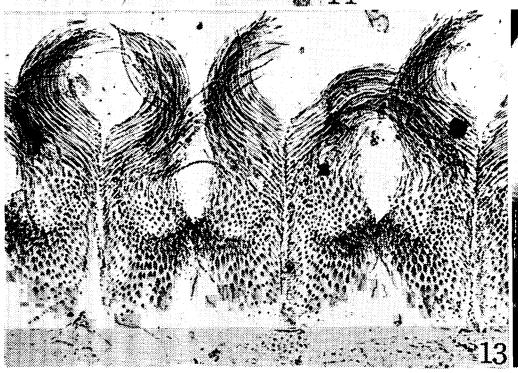

Mb
Mt
Ct
8

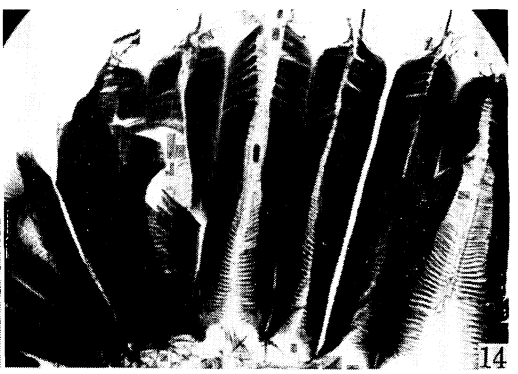

9

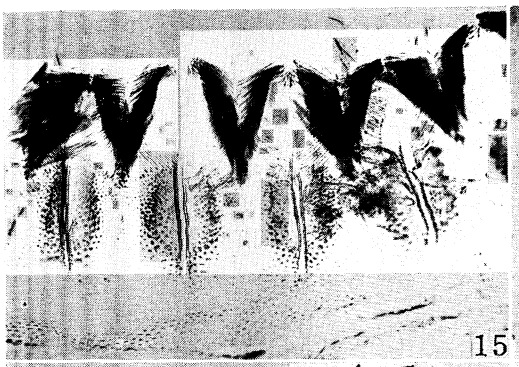

10

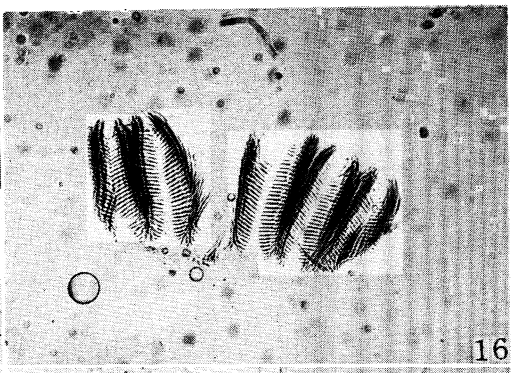

11

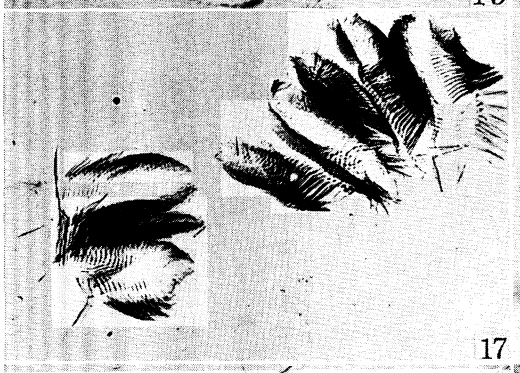

12

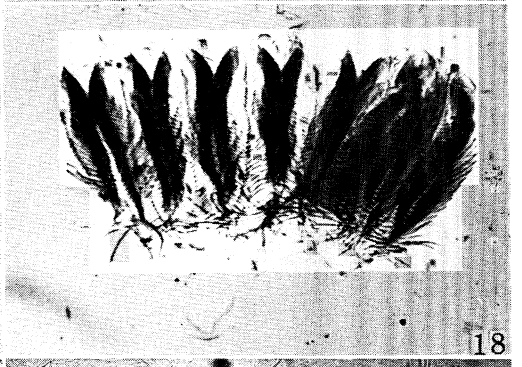

13

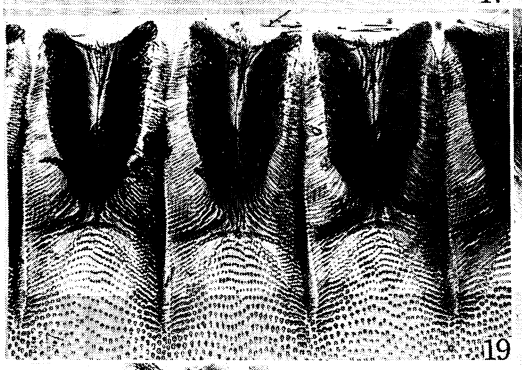

14

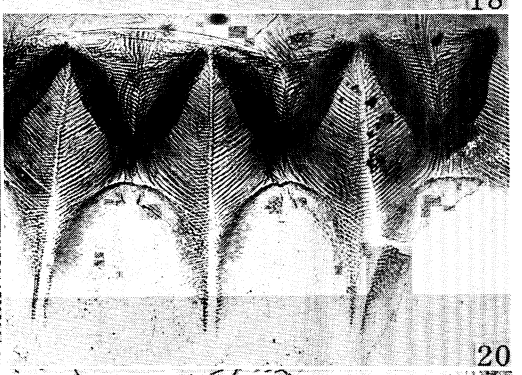

15


16

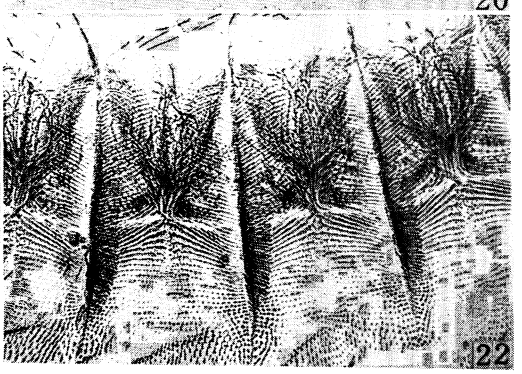

17

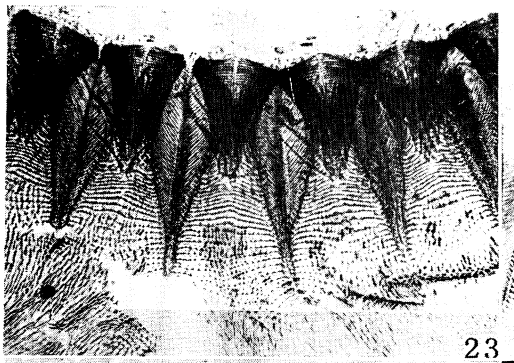

18

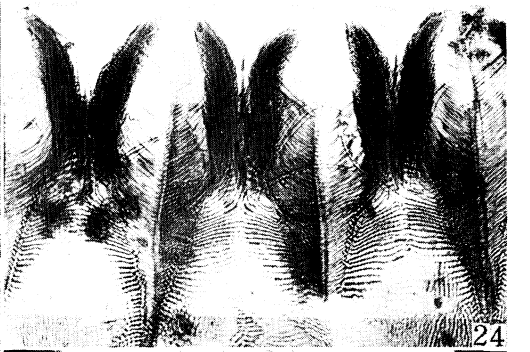

19

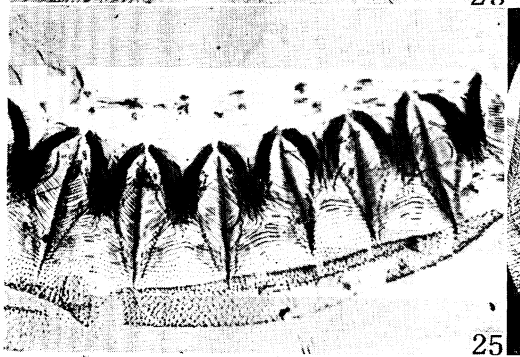

20


21

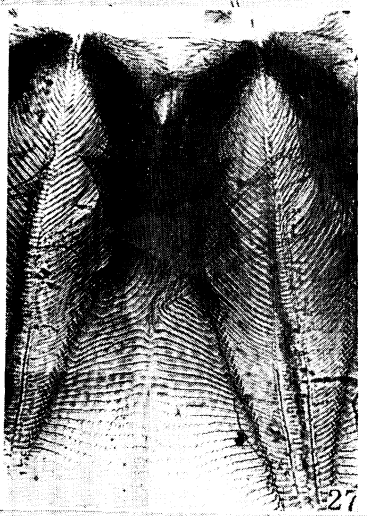

22

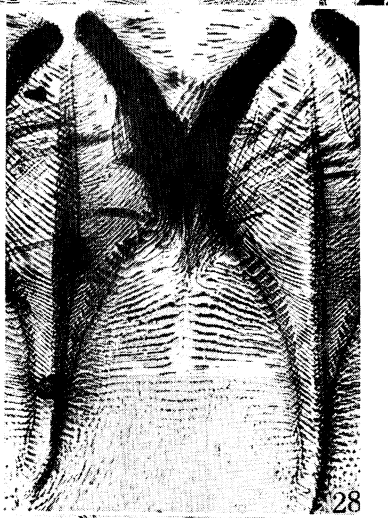

23

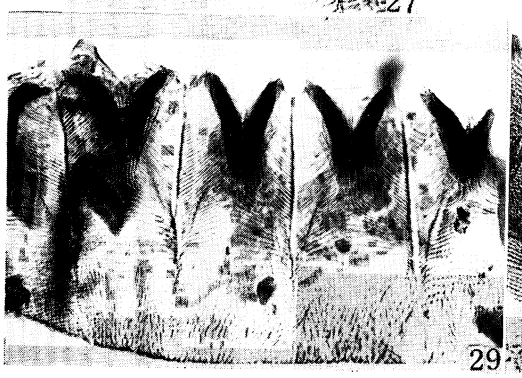

24

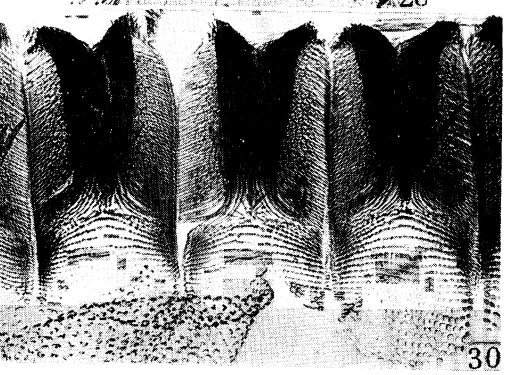

25


26

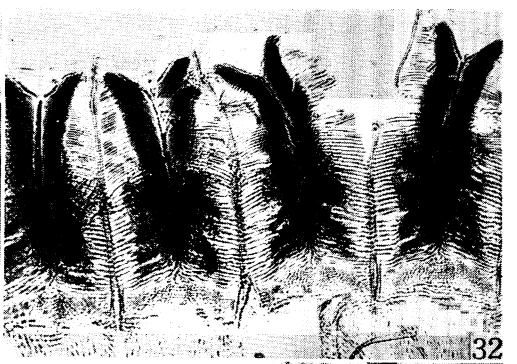

27

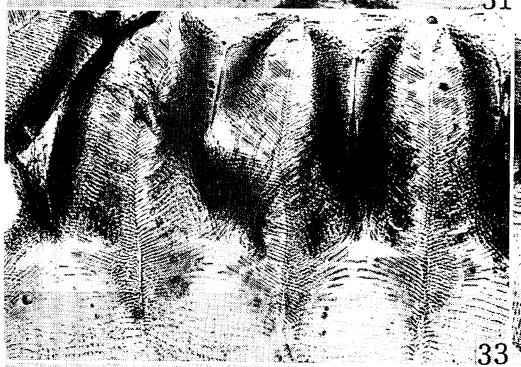

28


29


30

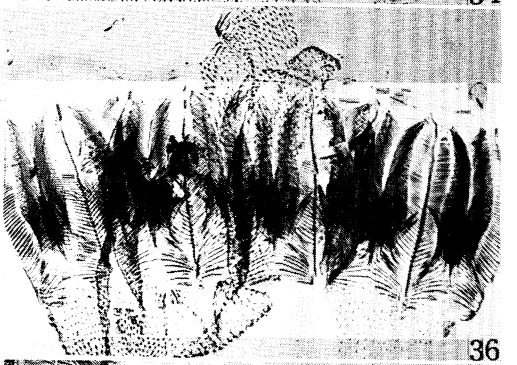

31

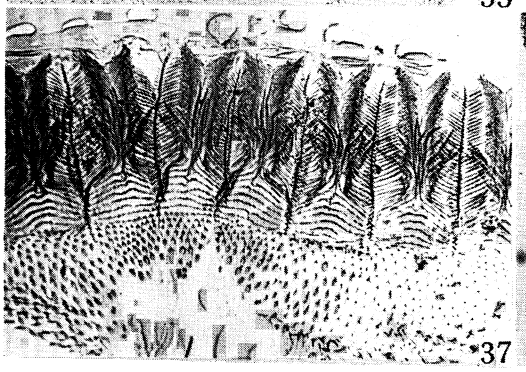

32

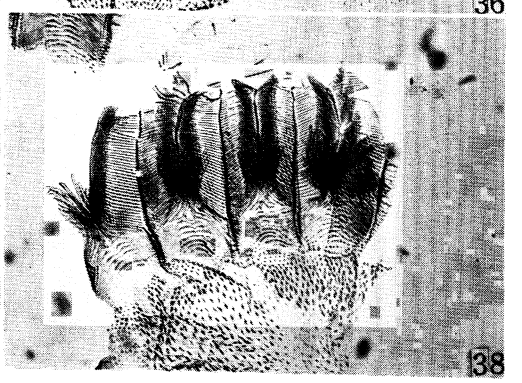

33

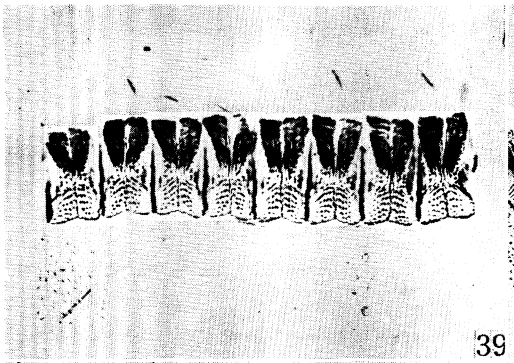

34

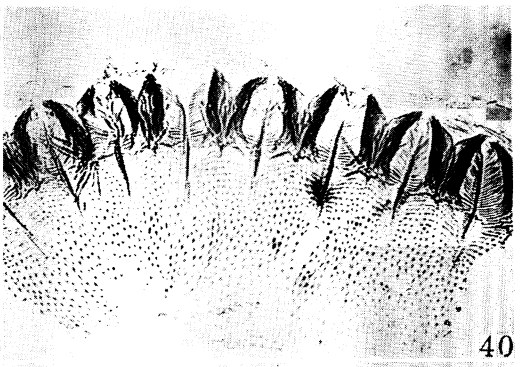

35

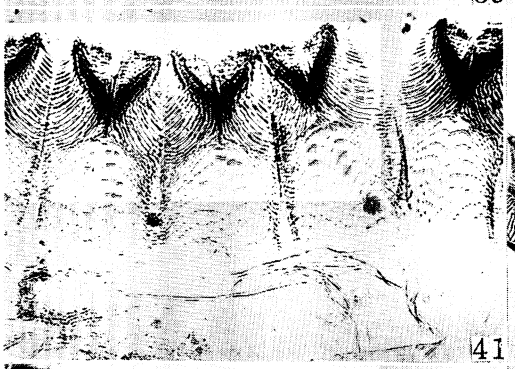

36

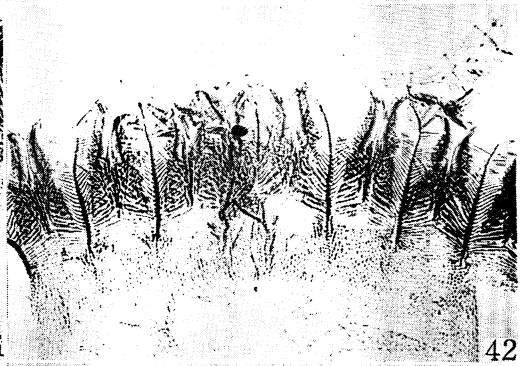

37

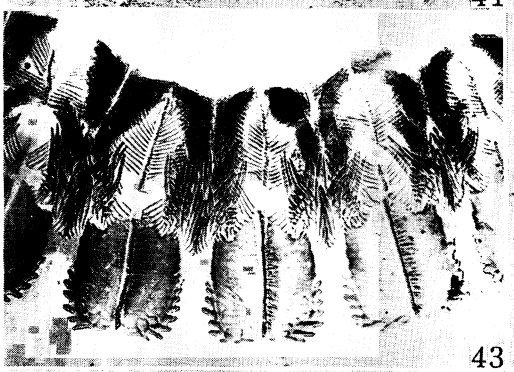

38


39

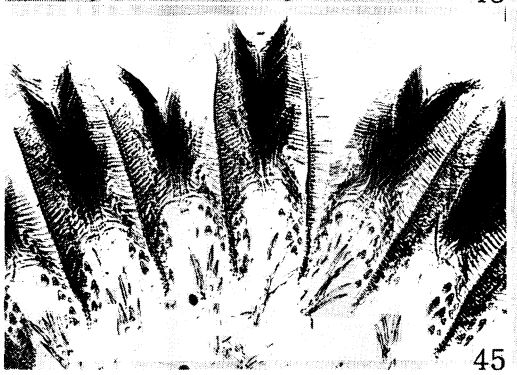

40

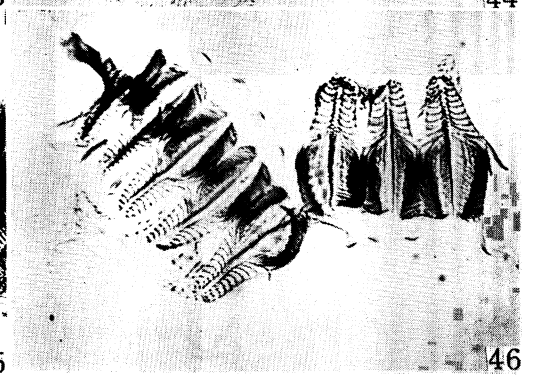

41

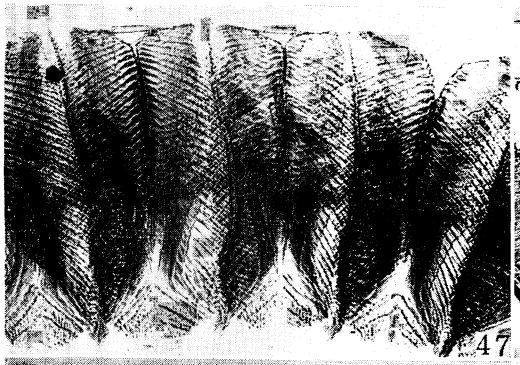

42

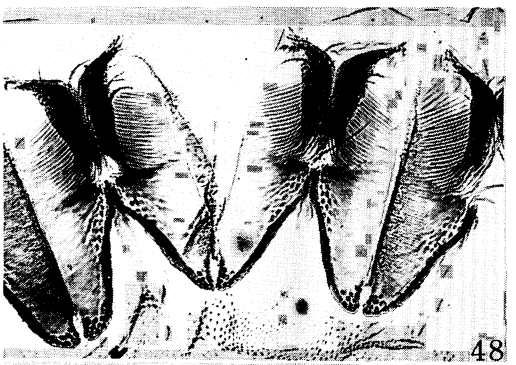

43

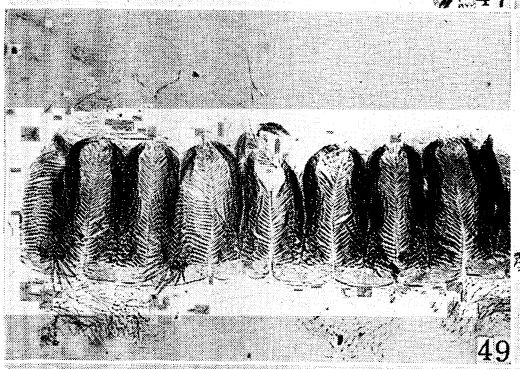

44

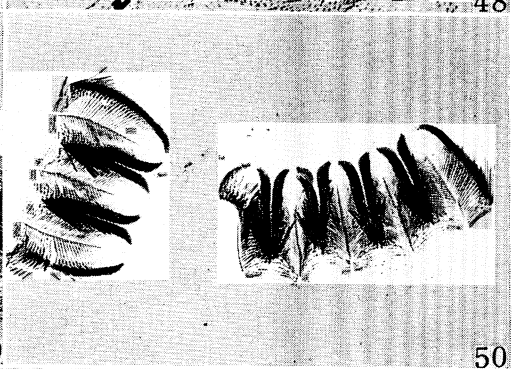

45

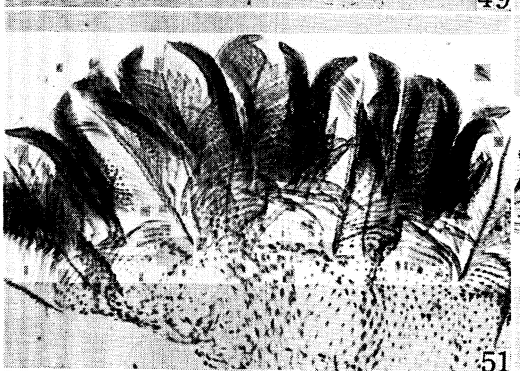

46

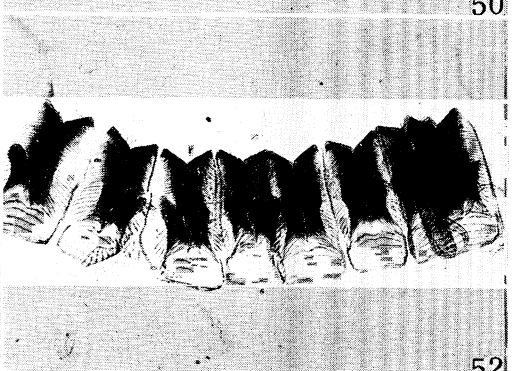

47

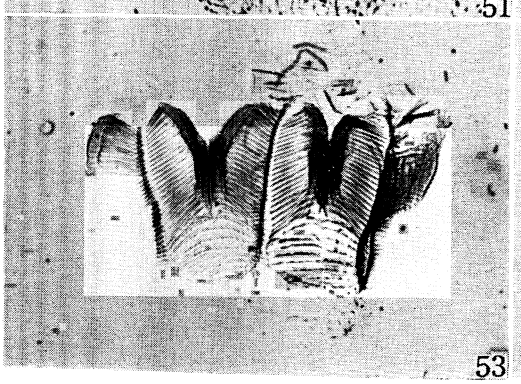

48

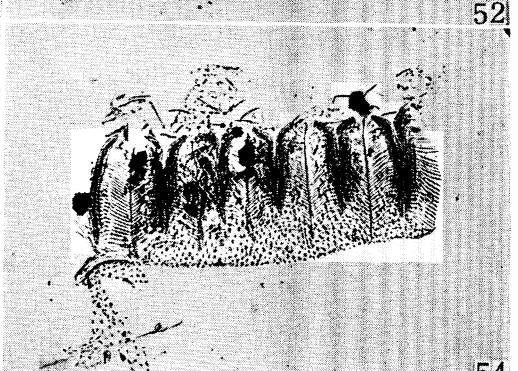

49

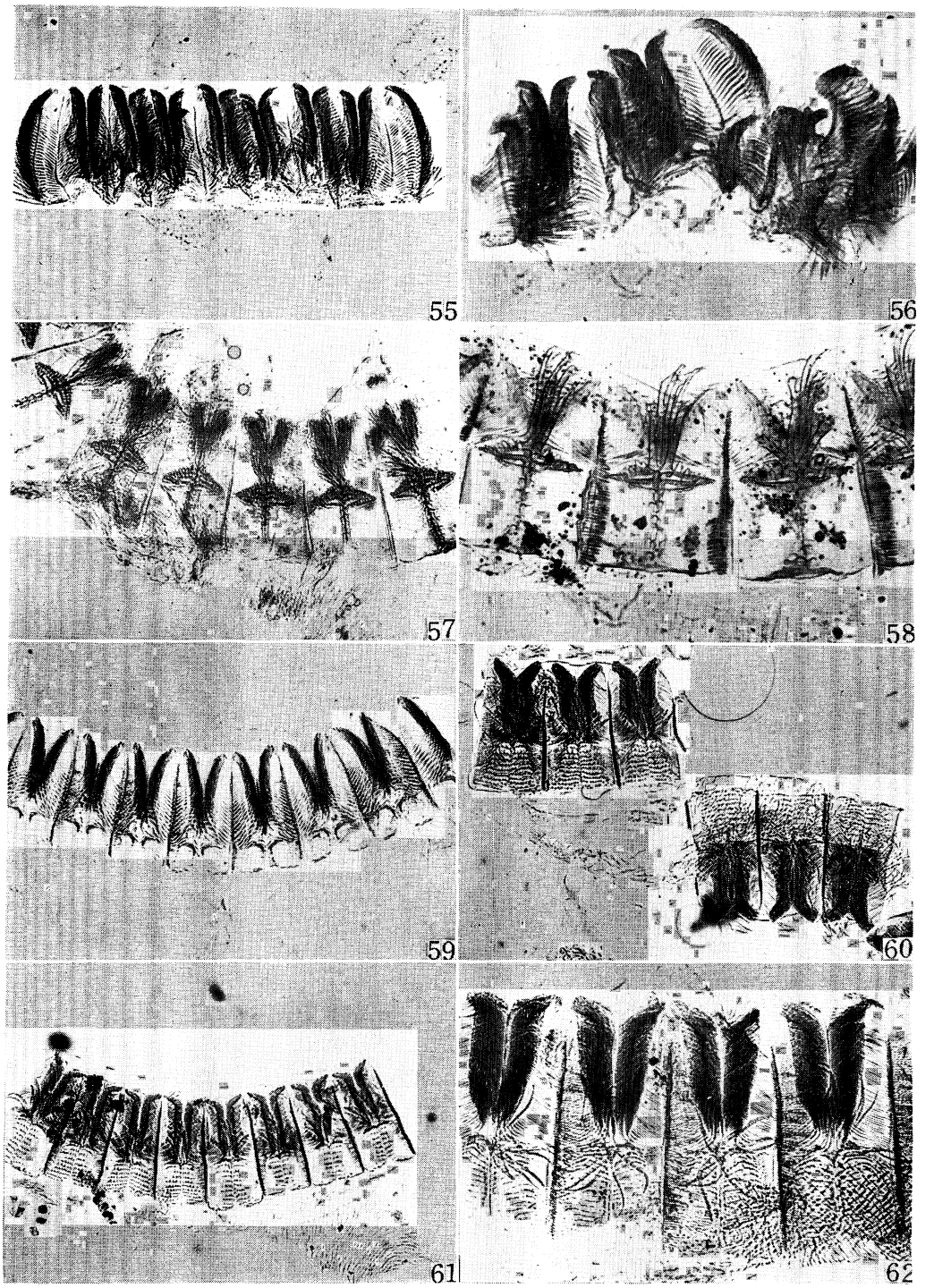

50

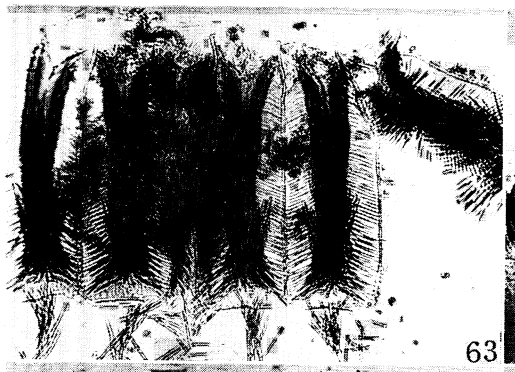

51

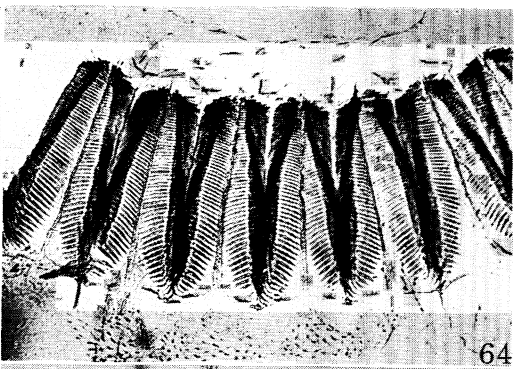

52

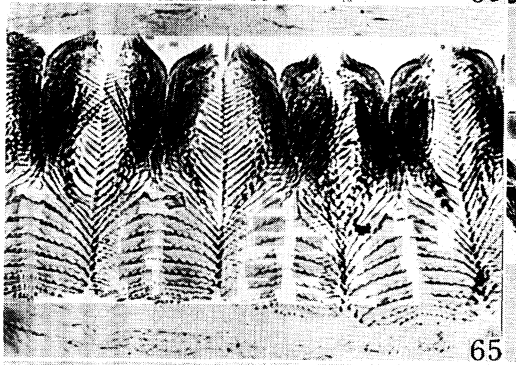

53

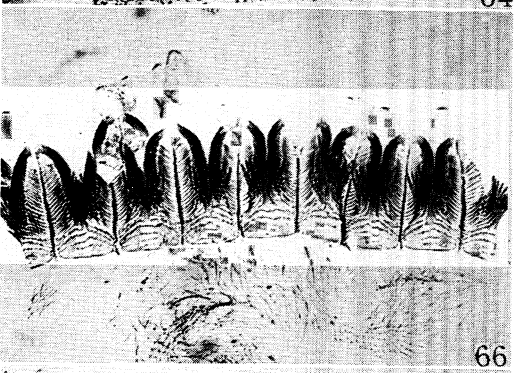

54

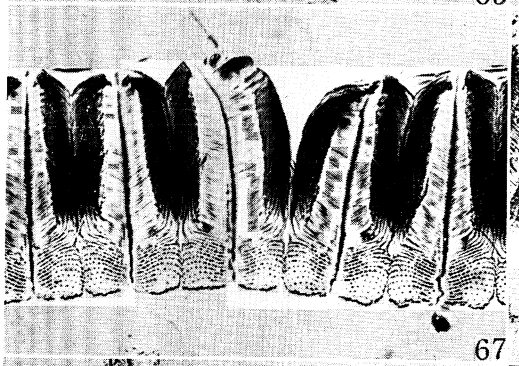

55
56
57
58
59
60
61
62

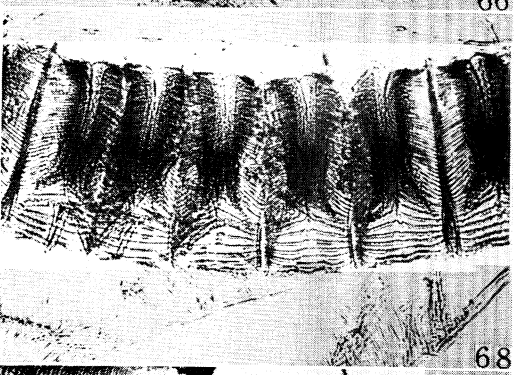

63

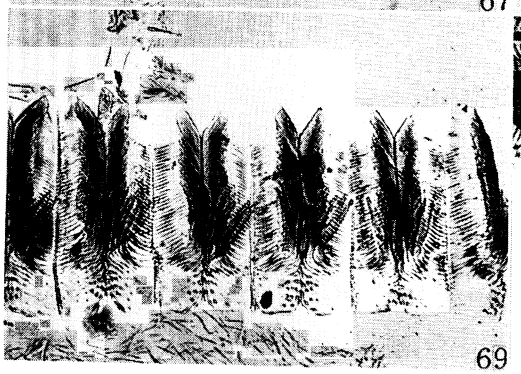

64

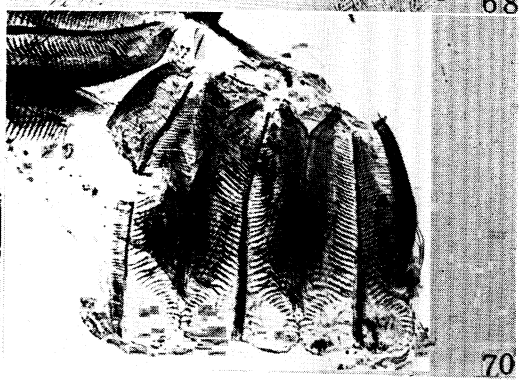

65

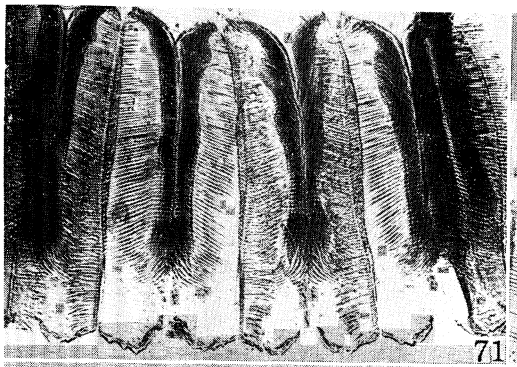

66

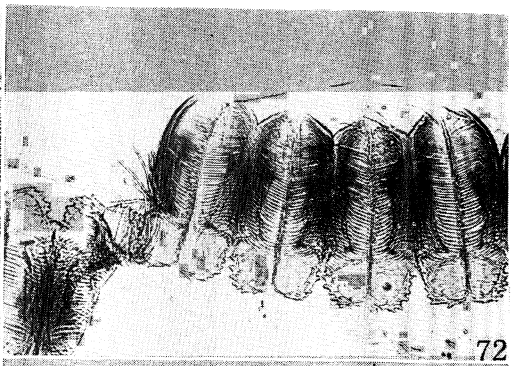

67

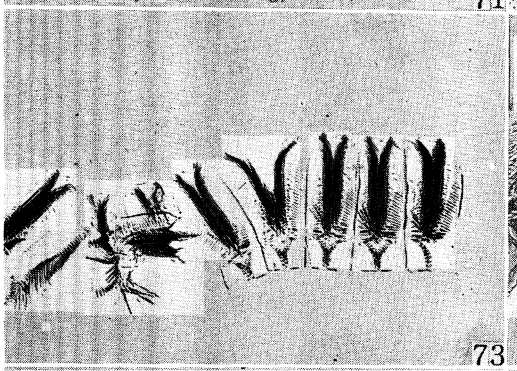

68

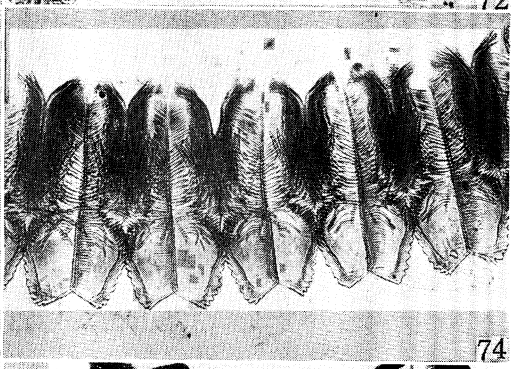

69

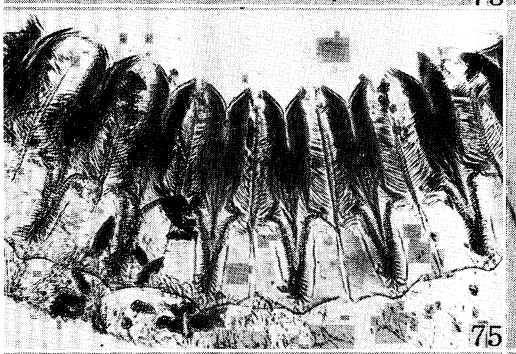

70

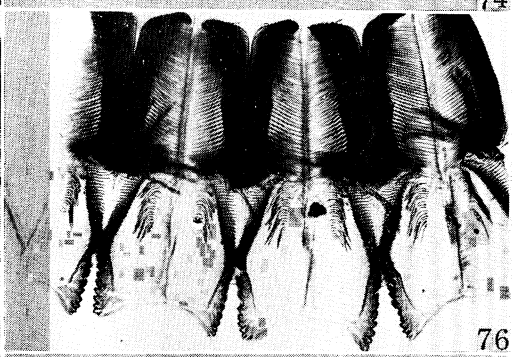

71

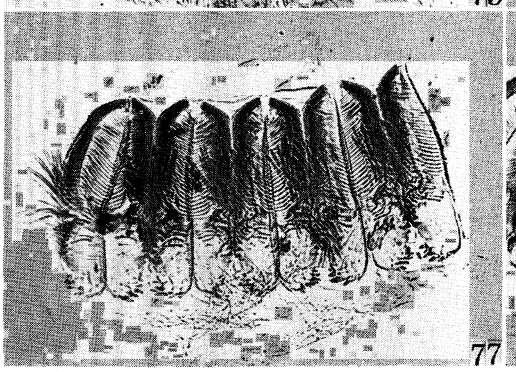

72

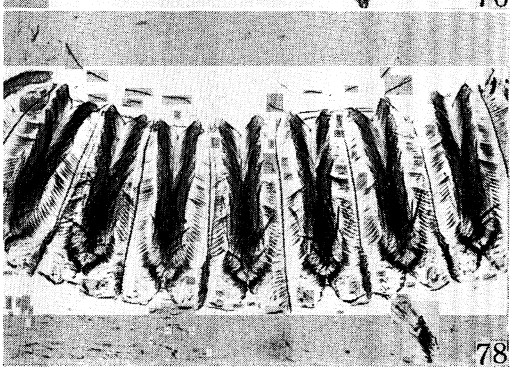

73

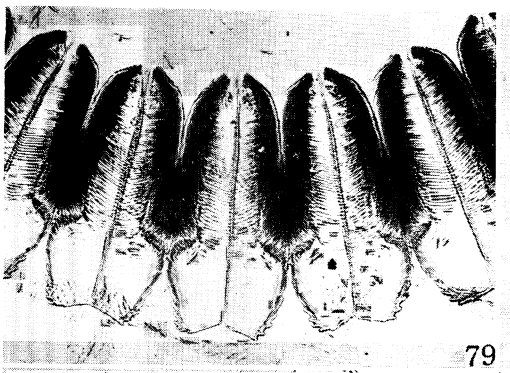

74

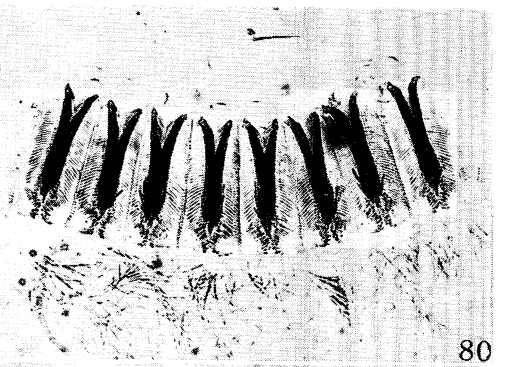

75

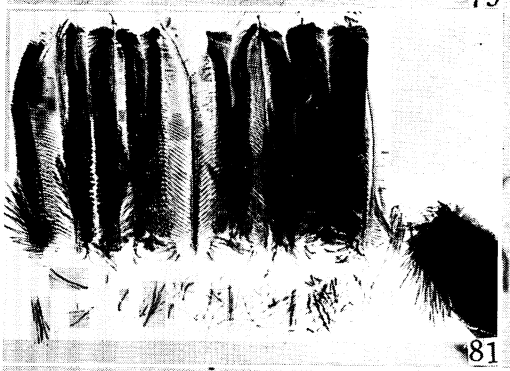

76


77

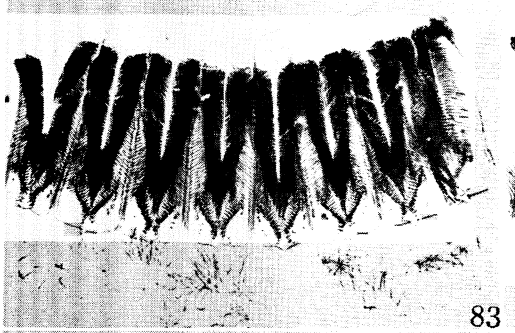

78

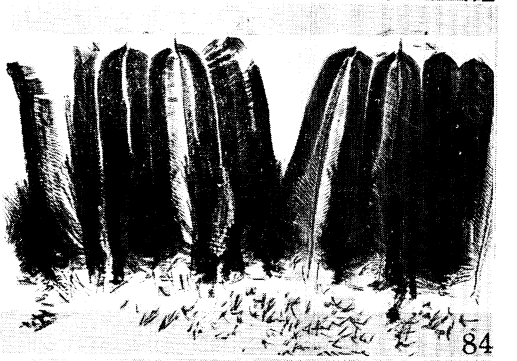

79

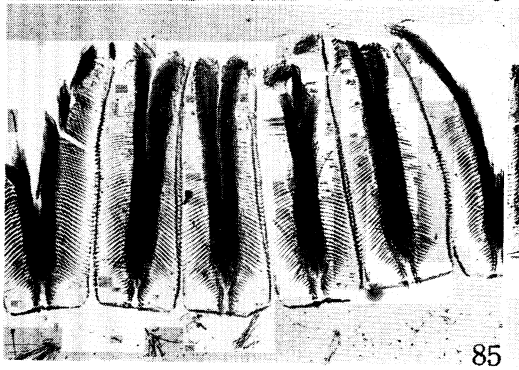

80


81

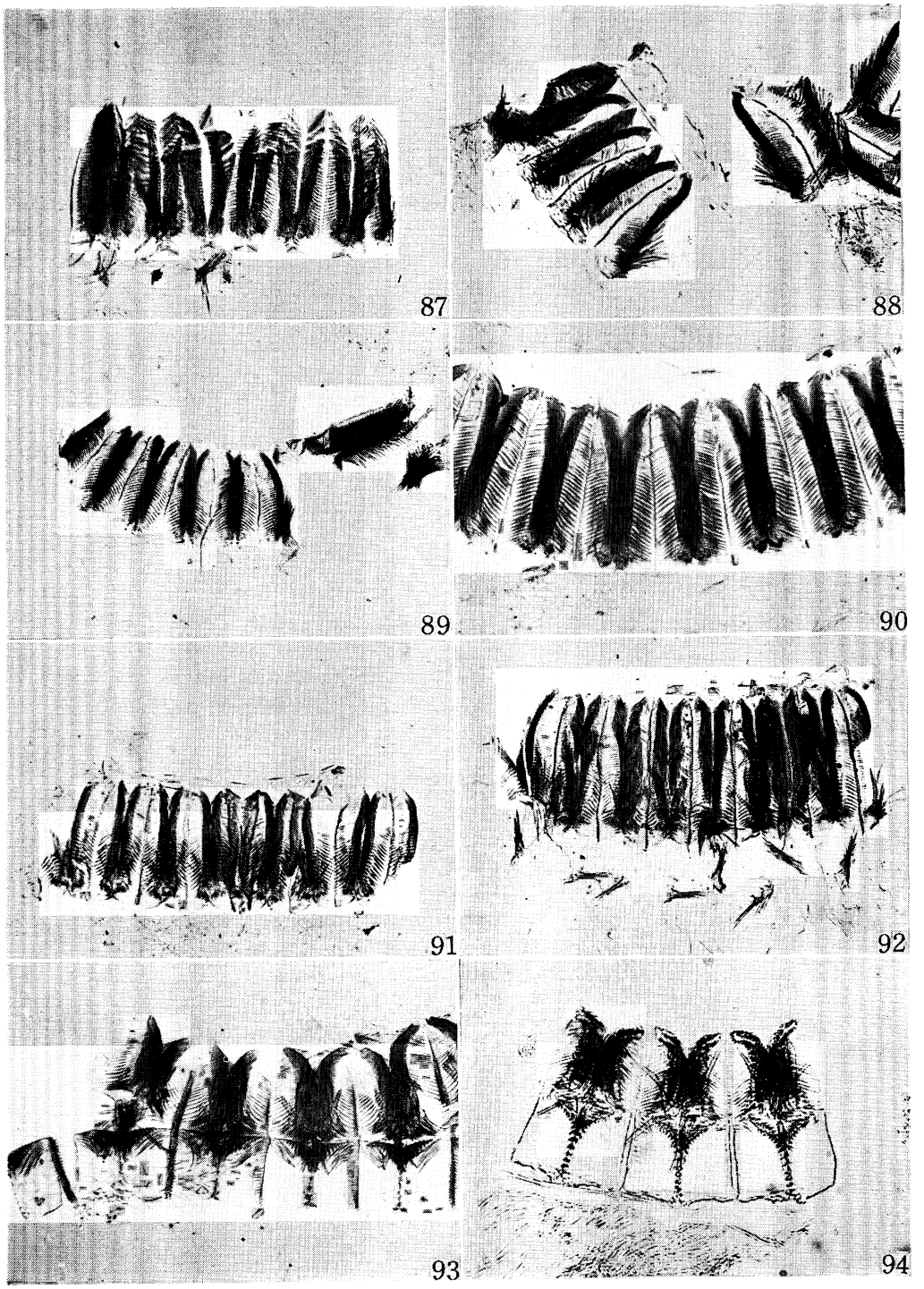

82


83


84


85


86


87
88
89
90
91
92
93
94


95


96


97

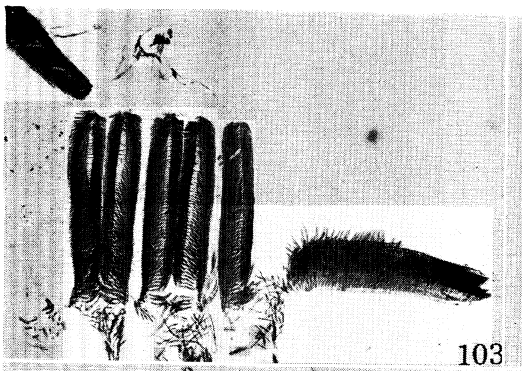

98

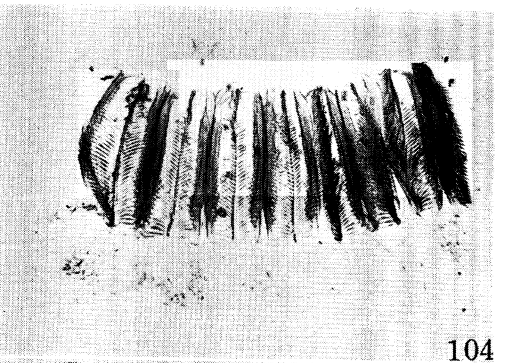

99

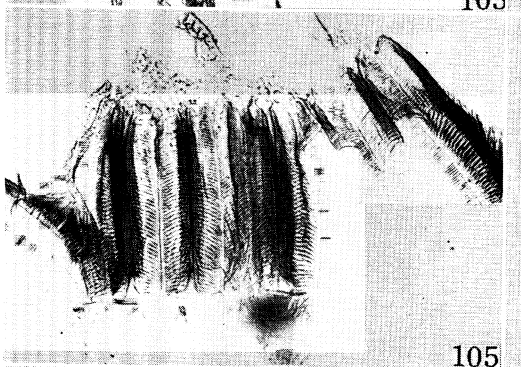

100

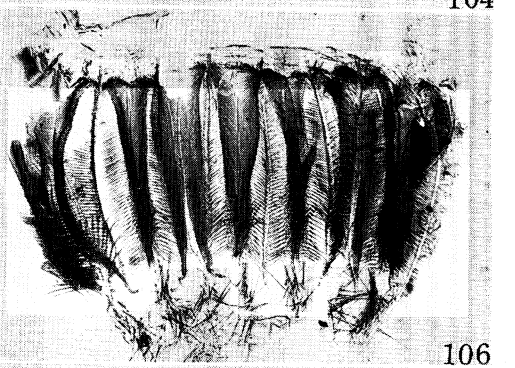

101

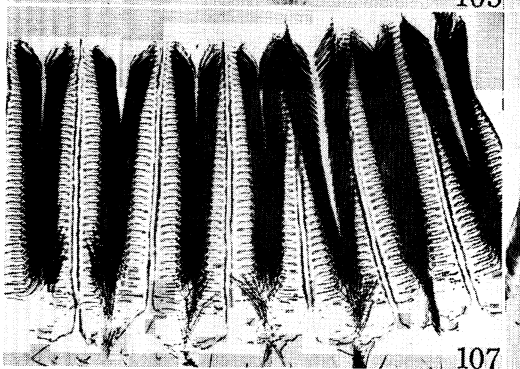

102


103

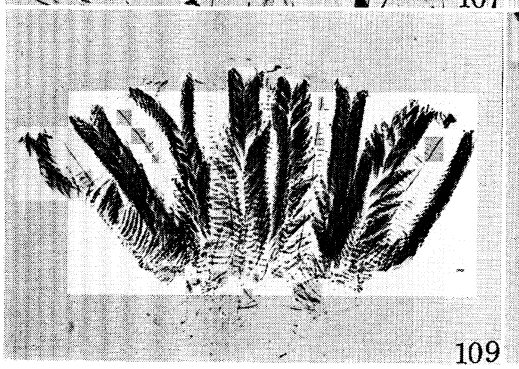

104


105

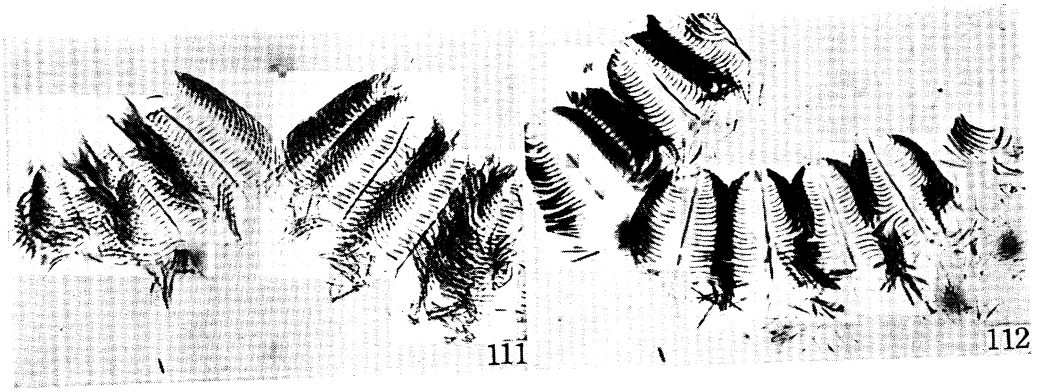

106


107

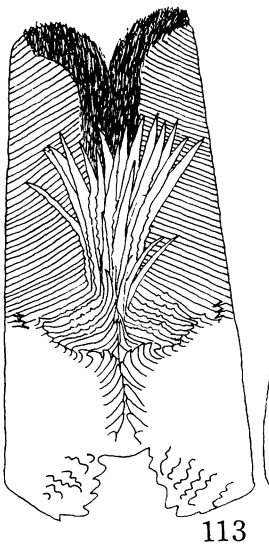

108

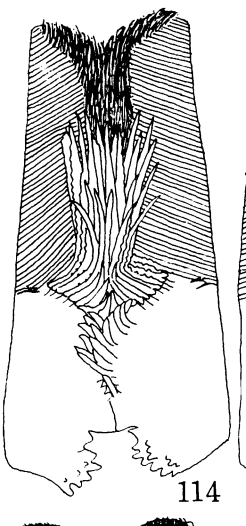

109

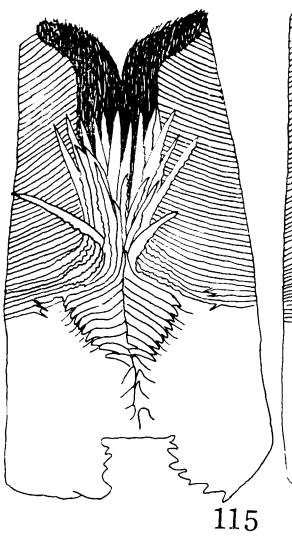

110

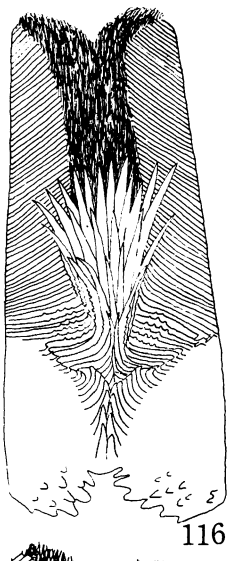

111

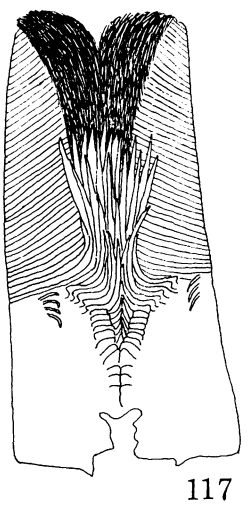
112

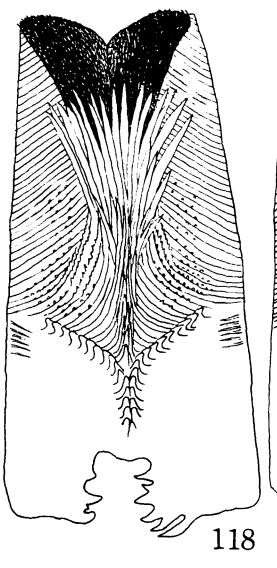

113

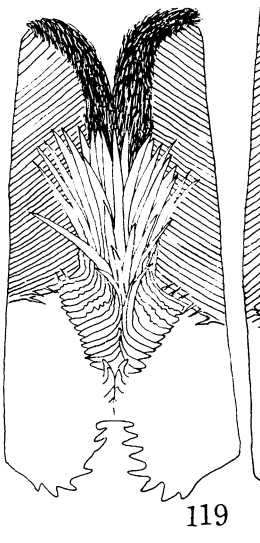

114

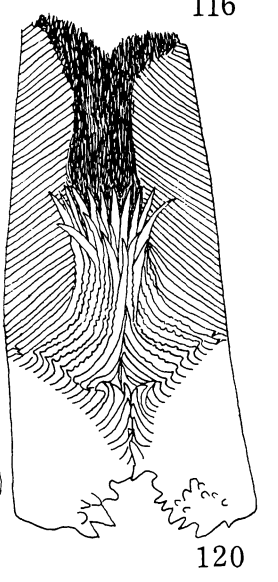

115

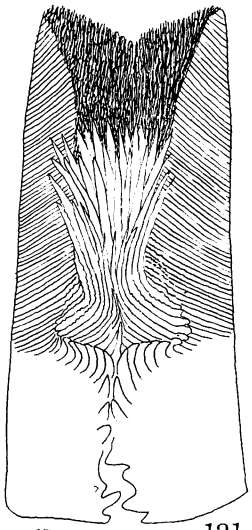

116

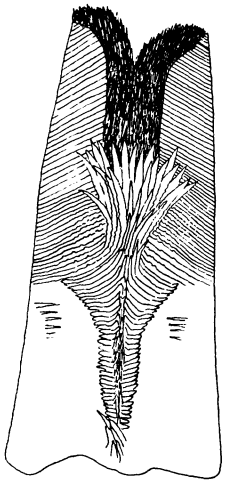

117

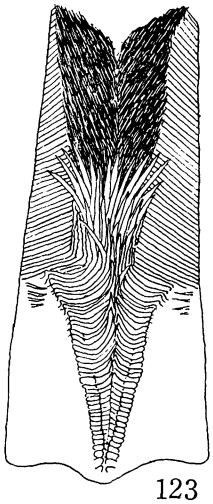

118

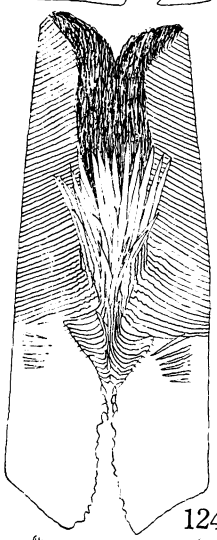

119

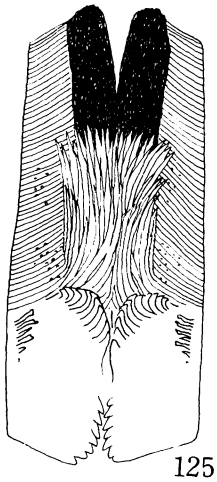

120

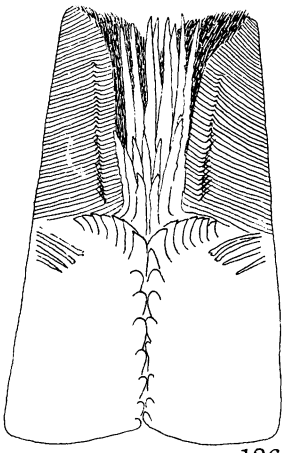

121

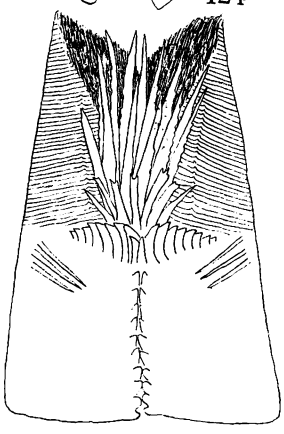

122

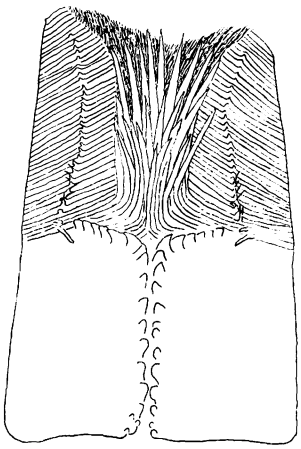

123

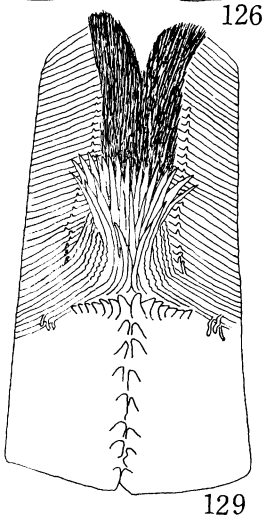

124

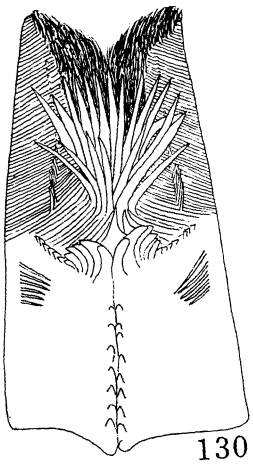

125

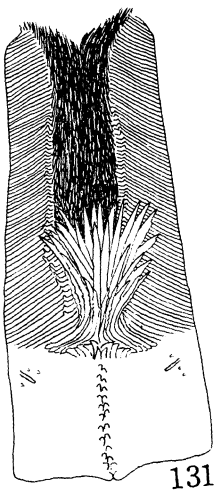

126

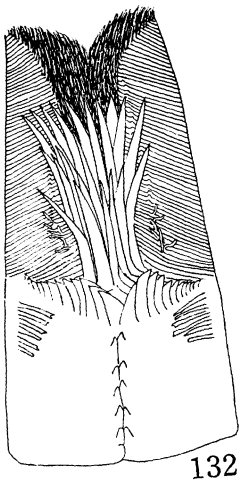

127

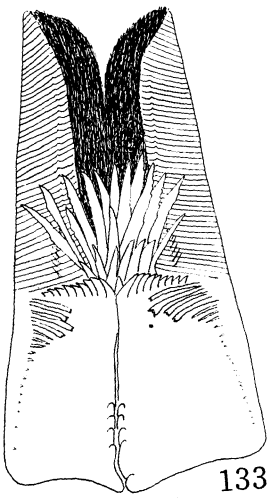

128

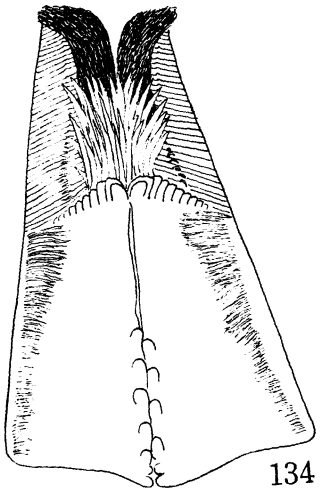

129

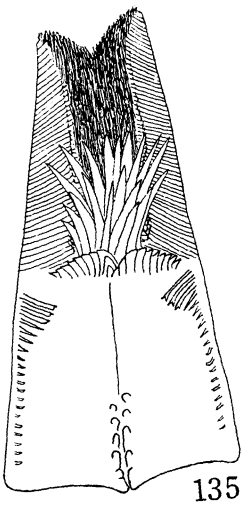

130

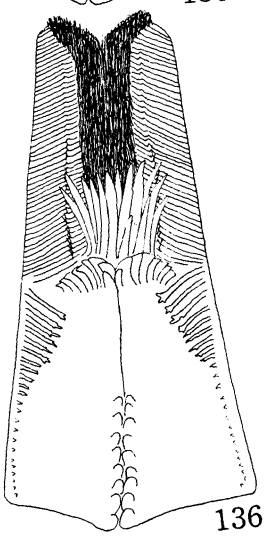

131

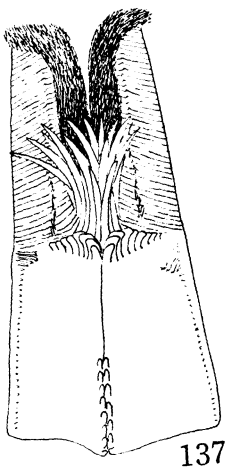

132

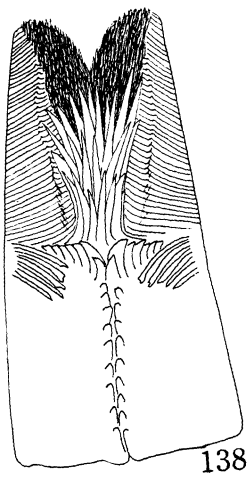

133


134


135


136


137


138