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Studies on the tracheal system of the mature larva of the melon fly, *Dacus* (*Strumeta*) *cucurbitae* Coquillett

(Diptera: Trypetidae)

With 7 text figures

Introduction

No published account is hitherto available dealing with details of the respiratory system in a trypetid larva. Snodgrass (1924) has dealt with the anatomy of the mature larva of *Rhagoletis pomonella* Walsh without, however, throwing much light on the details of tracheal system. In his account of the tracheation of the anterior region of the larva, he has skipped over even basic anatomical features. Keilin (1944) has grossly described the tracheal system of the larva of *Acidia heraclei* Linnaeus in his general account of the respiratory system in the larvae and pupae of Diptera.

Palmén (1877), de Meijere (1917), Lehmann (1925), de Gryse (1926), Keilin (1944), and Whitten (1955) are some useful works dealing with the respiratory system of dipterous larvae in general. Keilin (1944), however, has not given specific details of tracheation in the larvae studied by him. Further, he has not traced homologies of the different tracheae in the larval series. His work, therefore, offers little help in arriving at a definite understanding of the organisation of tracheal system in dipterous larvae. Whitten (1955) is an outstanding work in this field as, besides providing a general understanding of the pattern of tracheation in dipterous larvae, it offers sufficient details of tracheation in individual cases studies by her.

In addition to above works of a general nature, individual studies of tracheal system in the larvae of various cyclorrhaphous Diptera have been made by Wahl (1899) in *Eristalis tenax* Linnaeus, by Rühle (1932), and Haskins & Enzmann (1937) in *Drosophila melanogaster* Meigen, and Ranade (1965) in *Musca nebulo* Fabricius.

Material and Methods

Mature third instar larvae of the melon fly were first anaesthetised using Chloroform, and were then dissected in Glycerine. The silvery sheen of the air-filled tracheae was found very useful in tracing their finer ramifications within the body. Due attention has been paid to the over-all pattern of tracheation in the cyclorrhaphous larvae, taking into account the homologies of the different tracheae.

Description

The tracheal system of the melon fly larva is amphineustic in type with two pairs of spiracles, viz., an anterior or 'prothoracic' pair, and a posterior or 'postabdominal' pair (Fig. 1; SP_1, SP_2).

The anterior spiracles are located on the dorso-lateral aspect of the posterior portion of prothoracic segment. Each spiracle bears about 15–20 papillae, 17–18 being the more common number.

The posterior spiracles are located dorso-medially on the posterior surface of the larva and are rather well developed. Each spiracle consists of a well developed atrium which opens to the exterior through three stigmatic slits which are traversed by highly chitinized

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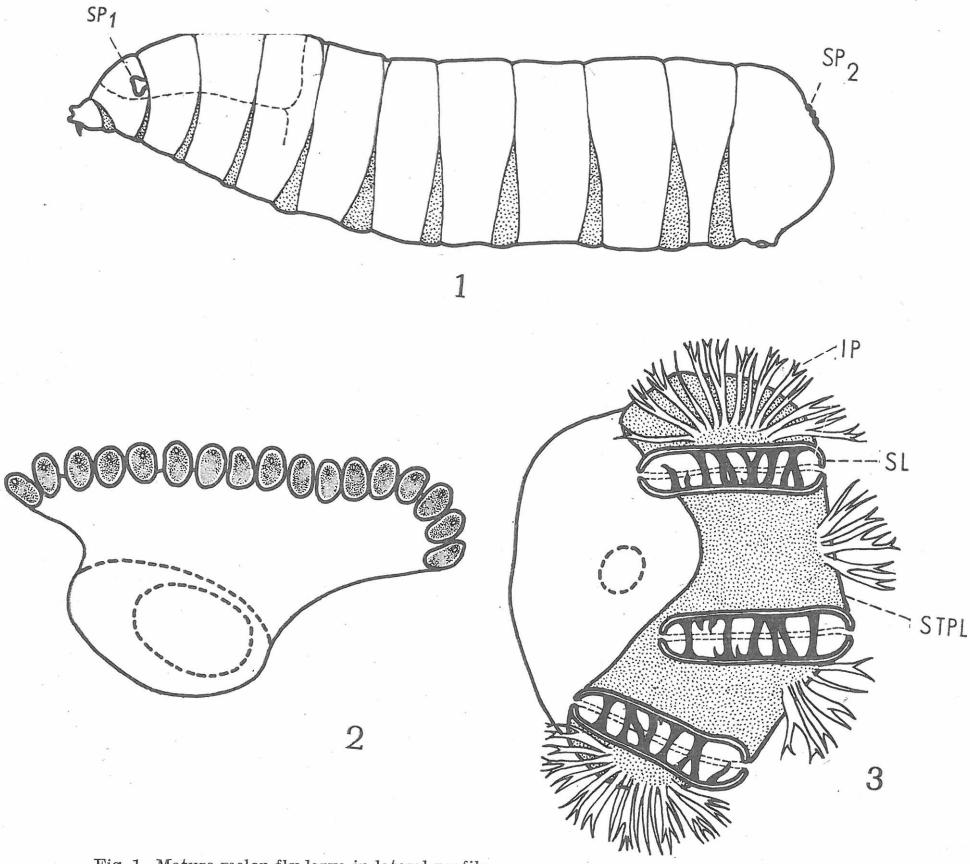

Fig. 1. Mature melon fly larva in lateral profile
Fig. 2. Prothoracic spiracle
Fig. 3. Postabdominal spiracle

cross-bars. The three stigmatic slits are borne on a stigmatic plate (Fig. 3; *STPL*). The inter-spiracular processes of the dorsal as well as the ventral groups are usually more than twelve in number and are frequently branched. RENJHEN (1949) is of the opinion that the number of these processes is 'always constant'. The observations of the present author, however, lead to the conclusion that his contention is not correct, and that the number of these processes is subject to variation even in the two spiracles of the same maggot.

The inter-spiracular processes entangle a bubble of air when the larva is feeding submerged in the medium, thereby helping in its respiration. This can easily be confirmed by dropping the larva in a little water contained in a test tube. The finer branching of these processes contributes to their efficiency in holding on to a bubble of air.

It should, however, be noted that these spiracles are purely secondary structures developed in the larva alone, and bear no relation to those of the adult.

1. Dorsal Longitudinal Trunks: (Figs. 4, 5; *DLT*)

These are two in number and form the most conspicuous feature of the tracheal system. Each trunk extends between the anterior and posterior spiracles of its side. These trunks are of great functional importance in the larva, but become greatly reduced in the adult.

2. Lateral Longitudinal Trunks: (Fig. 4; *LLT*)

These are two in number but, unlike the dorsal trunks, are much narrower in diameter and are not directly connected with the spriacles. These trunks open into the dorsal longi-

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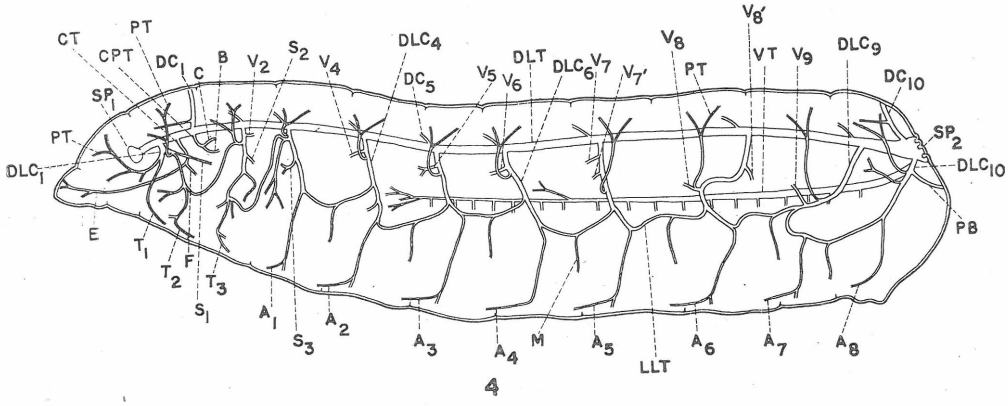

Fig. 4. Inner lateral view of larva showing tracheae

tudinal trunks through the dorso-lateral connectives. Their physical identity as definite longitudinal trunks is rather obscure so much so that they merely look like as chains of nine inter-connected tracheal loops. As a matter of fact Haskins & Enzmann (1937) erroneously called these trunks as 'intersegmental commissures'. Keilin (1944) also termed these as 'secondary latero-ventral longitudinal trunks'. However, as rightly pointed out by Snodgrass (1924) these trunks represent a part of the primitive tracheal system which is, typically, always connected with the lateral spiracles. Since the lateral spiracles have been suppressed in the cyclorrhaphous larvae, the lateral trunks have become correspondingly reduced. These spiracles, however, make their appearance in the pupal stage and become functional in the adult and the lateral trunks regain their importance and dimensions.

Each loop of the lateral trunk sends out a Pheripheral trachea (M) which tracheates the integument and the body-wall muscles in the latero-ventral region. The first two loops give out the meso-thoracic (T_2) and meta-thoracic (T_3) ventral ganglionic tracheae which tracheate the latter.

In addition to above, six ventral ganglionic tracheae (A_{1-6}) are sent forth from the lateral longitudinal trunks in the first six abdominal segments to supply to the ventral ganglionic mass. Similar tracheae from the last two abdominal segments (A_7, A_8) end short of reaching the ventral ganglionic mass. Whitten (1955) and Ranade (1965) record seven ventral ganglionic tracheae.

Another trachea (T_1) arises from the short and stumpy first dorso-lateral connective and tracheates the ventral ganglionic mass in its prothoracic portion. This lends support to the present author's contention that the first dorso-lateral connective actually represents the fused connectives belonging to the pro-, and metathoracic regions.

According to Ranade (1965) the prothoracic ventral ganglionic trachea arises from the second body segment. This observation, however, appears to be incorrect. As a matter of fact his diagrams clearly show this trachea originating in the third body segment (mesothorax). Whitten (1955) shows the first ganglionic trachea to arise from the 'ventral cervical trachea' which appears to represent the prothoracic element in the fused first dorso-lateral connective in the present case.

3. Dorsal Commissures: (Figs. 4, 5; DC_{1-10})

These are ten in number and connect the two dorsal lateral trunks with each other. The first and the last of these commissures are more stout than the rest and extend straight across between the two trunks. The remaining eight commissures are very slender, and each makes an oblong-conical loop in the preceding segment. This fact has also been noted by Snodgrass (1924) who called these as 'V-shaped dorsal tracheal commissures'.

These commissures, both anteriorly and posteriorly, give out fine branches which further ramify and supply air to the integument, muscles of the body-wall, and associated

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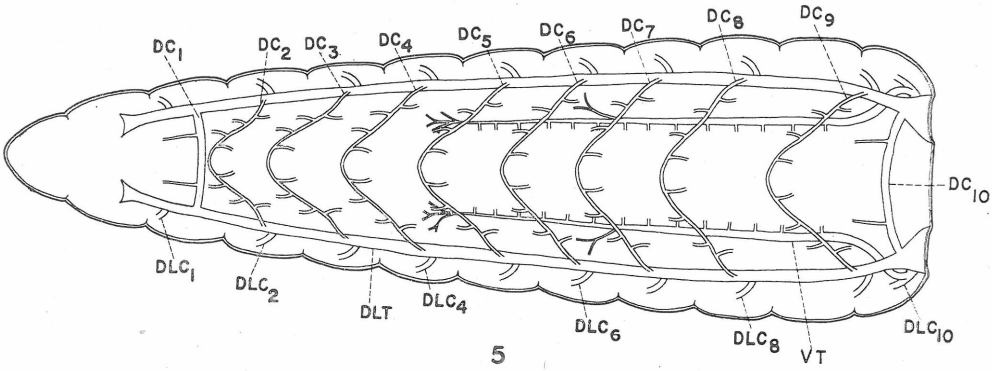

Fig. 5. Inner dorsal view of larva showing tracheae

masses of fat bodies in the dorsal region. WHITTEN (1955) terms the commissures as 'dorsal anastomoses'. RANADE (1965) terms the first dorsal commissure as 'dorsal cervical commissure' which, however, is incorrect since the said commissure clearly arises in the mesothorax.

4. Dorso-lateral Connectives: (Figs. 4, 5; DLC_{1-10})

These are ten in number and connect the dorsal trunk with the lateral trunk of its side. From the pattern of its subsequent tracheation, it appears fairly plausible that the first dorso-lateral connective which is located in the mesothorax, represents the fused pro- and meso-thoracic dorso-lateral connectives.

A regular feature of these connectives is a bifurcated peripheral trachea (*PT*) which supplies air to the integument, body-wall muscles, and the associated masses of fat bodies in the dorso-lateral region of their respective segments.

The salivary glands receive their tracheation from the second and fourth connectives. The malpighian tubules are supplied by branches from fourth to ninth connectives (V_{4-9}) and the visceral trachea given out from the tenth connective (*VT*). The cardia and its caecae receive tracheation from the branches given out from the fourth connective. The gut, in general, is tracheated by branches from fifth to eighth connectives (V_{5-8}), and the visceral branch (*VT*) of the tenth connective. The latter is a very well developed trachea which principally supplies to the gut and the malpighian tubules. The last connective posteriorly gives out a branch (*PB*) which tracheates the last abdominal segment in the posterior region bearing the spiracles.

HASKINS & ENZMANN (1937) term these connectives as 'ventral segmental branches'. SNODGRASS (1924) apparently calls similar structures as 'lateral branches of dorsal trunks' and shows eleven of them in his illustration of tracheal system. WHITTEN (1955) limits their number to eight in dipterous larvae and calls them 'transverse connectives'. RANADE (1965) makes a similar observation.

5. Ventral Commissures: (Fig. 6; VC_{1-3})

These are three in number, one in each thoracic segment. These commissures serve to inter-connect the ventral ganglionic tracheae belonging to their respective segment. These commissures are absent in the abdominal segments. WHITTEN (1955) and RANADE (1965) make similar observations.

6. Cerebro-pharyngeal Trachea: (Fig. 4; *CPT*)

Arising nearly ventrally opposite the origin of the first dorsal commissure, it soon bifurcates, one branch (*C*) proceeding in the anterior direction and tracheating the muscles of the sucking pump, whereas the other branch takes a posteriorly directed course (*B*) and supplies air to the brain. It is connected with its counter-part from the other side by a transverse commissure (*D*) which runs across the WEISMANN's ring (Fig. 7) and tracheates

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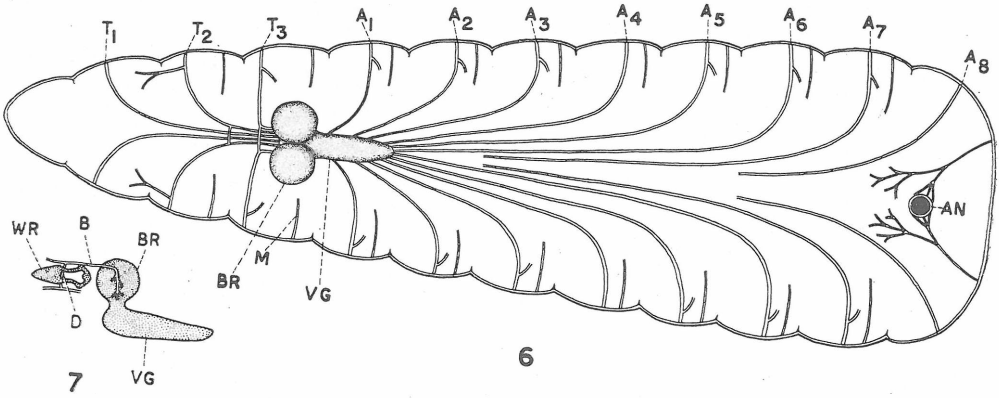

Fig. 6. Inner ventral view of larva showing tracheae
Fig. 7. Lateral view of brain with ventral ganglion showing tracheation

the latter. BODENSTEIN (1950) makes a similar observation in *Drosophila melanogaster*, whereas HASKINS and ENZMANN (1937) having worked earlier on the same insect, emphatically denied the existence of any anastomosis between the two cerebro-pharyngeal tracheae. WHITTEN (1955) and RANADE (1965) do not describe the tracheation of WEISMANN's ring, but record the presence of anastomosis before actual tracheation of the supra-oesophageal banglion. SNODGRASS (1924) makes no record of these tracheae.

7. Cephalic Trachea: (Fig. 4; *CT*)

This trachea arises in between the origin of the first dorso-lateral connective (DLC_1) and the cerebro-pharyngeal trachea (*CPT*), and soon bifurcates. The anterior branch (*E*) tracheates the oral region including the sensory papillae and the muscles of the oral hooks. The posterior branch (*F*) principally supplies to the ventral retractors of the head (commonly termed by workers as labial retractor muscles). The ventral retractor muscles also receive tracheation from branches (S_1, S_2, S_3) given out respectively from the first three dorso-lateral connectives.

The cephalic trachea is being described for the first time in a cyclorrhaphous larva. The tracheae (T_1) and (T_3) described by RANADE (1965) appear to be similar to the branches (*E*) and (*F*) respectively described in the present study. He, however, shows these tracheae to arise near the junction between the dorsal and lateral trunks in the third segment, (T_1) supplying to the ventral muscles of the body wall and oral lobes, and (T_3) tracheating the visceral organs.

Summary

A detailed study has been made of the tracheal system of the mature, third instar, larva of the melon fly, *Dacus* (*S.*) *cucurbitae* COQUILLETT. Comparison has been made with the tracheal system of other cyclorrhaphous larvae to bring out the underlying homologies and to provide an understanding of the basic pattern of organization.

Zusammenfassung

Das Trachealsystem des letzten Larvenstadiums von *Dacus* (*S.*) *cucurbitae* COQUILLETT wurde eingehend untersucht und ein Vergleich mit dem Trachealsystem anderer cyclorrhapher Larven angestellt, um die zugrunde liegenden Homologien herauszuarbeiten und das Grundmuster der Konstruktion verständlich zu machen.

Резюме

Подробно изучали трахеальную систему в последней личиночной стадии *Dacus* (*S.*) *cucurbitae* COQUILLETT и сравнивали ее с трахеальными системами других личинок Diptera cyclorrhapha с целью установления гомологий и основных признаков.

References

BODENSTEIN, D. The postembryonic development of *Drosophila*. In: DEMEREC, M. (Ed.): Biology of *Drosophila*. J. WILEY & Sons., New York, S. 275–344; 1950.
DE GRYSE, J. J. The morphology of certain types of respiratory systems in insect larvae. Trans. Roy. Soc. Canada **20**, 483–503; 1926.
HASKINS, C. P. & ENZMANN, E. V. Studies on the anatomy of the respiratory system of *Drosophila melanogaster*. Journ. Morph. **60**, 445–458; 1937.

DOI: 10.21248/contrib.entomol.28.2.257-262

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KEILIN, D. Respiratory systems and respiratory adaptations in larvae and pupae of Diptera. Parasitology **36**, 1–66; 1944.
LEHMANN, F. E. Über die Entwicklung des Tracheensystems von *Carausius morosus* BR. nebst Beiträgen zur vergleichenden Morphologie des Insekten-Tracheensystems. Hrsg. Zool. anat. Inst. Univ. Zürich, 86 S.; 1925.
DE MEIJERE, J. C. H. Beiträge zur Kenntnis der Dipterenlarven und Puppen. Zool. Jahrb. (Syst.) **40**, 177–322; 1917.
PALMÉN, J. A. Zur Morphologie des Tracheensystems. X & 149 S.; Helsingfors, 1877.
RANADE, D. R. The anatomy of the tracheal system of the larva of *Musca domestica nebulo* FABR. (Diptera: Muscidae). Indian Journ. Ent. **27**, 172–181; 1965.
RENJHEN, P. L. On the morphology of the immature stages of *Dacus* (*Strumeta*) *cucurbitae* COQ. (The melon fruitfly) with notes on its biology. Indian Journ, Ent. **11**, 83–100; 1949.
RÜHLE, H. Das larvale Tracheensystem von *Drosophila melanogaster* MEIG. und seine Variabilität. Ztschr. wiss. Zool. **141**, 159–245; 1932.
SNODGRASS, R. E. Anatomy and metamorphosis of the apple-maggot, *Rhagoletis pomonella* WALSH. Journ. Agric. Res. **28**, 1–35; 1924.
WAHL, B. Über das Tracheensystem und die Imaginalscheiben der Larven von *Eristalis tenax*. Arb. Zool. Inst. Univ. Wien **12**, 45–98; 1899.

Besprechungen

Hymenopterorum Catalogus (nova editio). UITGEVERIJ Dr. W. JUNK N.V., 's-Gravenhage. 17 × 24,6 cm.
Pars 8: VECHT, I. VAN DER & FISCHER, F. C. I. Palaearctic Eumenidae. 1972; VI & 200 S. Preis 95,00 Hfl.

Kataloge bilden die Grundlage für alle größeren taxonomischen Revisionen oder Monographien. Das trifft ganz besonders für die Ordnung Hymenoptera zu, da solche für den überwiegenden Teil der Arten fehlen. Eine kritische Wertung eines taxonomischen Status spielt dabei eine untergeordnete Rolle gegenüber der möglichst vollständigen Erfassung der Gattungen und Arten und der ihnen zuzuordnenden Literaturangaben. Im vorliegenden Werk wird daher von vornherein auf ungeklärte Klassifikationen, so zum Beispiel der Gattung *Odynerus*, hingewiesen. — Die Angaben bei den Gattungen: Typische Art, Synonymien, Literatur und allgemeine Biologie, und bei den Arten einschließlich der Synonyme: Status des Typus, Geschlecht, Aufbewahrungsort und Locus typicus sowie Literaturhinweise, entsprechen den höchsten internationalen Anforderungen. Darüber hinaus bemühten sich die Autoren, durch eigene Untersuchung von historischem Material, dem Benutzer weitere wichtige Informationen wie Fehldeterminationen, vermutliche Synonymien etc. mitzuteilen. (Es sei bemerkt, daß eine Arbeit von E. ECK aus den Ent. Abh. Staatl. Mus. f. Tierkunde Dresden **37**, Nr. 5, p. 363 bis 391; 1971 über *Odynerus melanocephalus* (GMELIN) mit der Beschreibung neuer Unterarten nachzutragen sein wird.) — Die Gattungszugehörigkeit von etwa 40 Arten konnte nicht geklärt werden. In der anschließenden Bibliographie werden noch einmal die wichtigsten Literaturangaben, gegliedert nach Biologie und Länder- respektive Gebietsfaunistik, zusammengefaßt. Literaturergänzungen, Gattungs- und Artindex beschließen das Werk.

Pars 13: SHENEFELT, R. D. & MARSH, P. M. Braconidae 9 ,Doryctinae. 1976; S. 1263–1424. Preis 76,00 Hfl.

Für diese Fortsetzung des Kataloges ist hervorzuheben, daß sich die Autoren um Typenuntersuchungen und andere nomenklatorische Klarstellungen bemüht haben. Noch bestehengebliebene Unklarheiten wurden korrekt und dem Benutzer eindeutig dargestellt. OEHLKE

Nasekomyje Mongolii. [Die Insekten der Mongolei.]. Vypusk 5. IZDATEL'STVO NAUKA, Leningrad. 1977; 14,5 × 21,3 cm; 757 S., 671 Fig.

Im fünften Band dieser Reihe werden 52 Arbeiten von 50 Autoren vorgelegt, die Material der gemeinsamen sowjetisch-mongolischen Expeditionen bearbeitet haben. Vier Gattungen, vier Untergattungen, 87 Arten und sechs Unterarten werden als neu beschrieben. Diese Bearbeitungen sind ein weiterer wertvoller Beitrag zur Vervollständigung der Kenntnisse über die Entomofauna der Mongolei. Die Fülle der Publikationen über diese Region der Paläarktis würde eine breite bibliographische Erfassung rechtfertigen, damit der gegenwärtige Kenntnisstand besser überblickt werden kann. GAEDIKE

Papavero, N. The World Oestridae (Diptera), Mammals and Continental Drift. (Series Entomologica. Vol. 14). Dr. W. JUNK BV PUBLISHERS, The Hague. 1977; 16 × 24,8 cm; vii & 240 S., 87 Fig. Preis 75,00 Hfl.

Die taxonomische Abgrenzung der Überfamilie Oestridae ist außerordentlich schwierig und bisher fehlte eine umfassende Deutung ihrer Stellung. Unter praktischem Aspekt unterscheidet der Autor nur zwei Gruppen der Oestridae: Cavicolae (Familie Oestridae), larvipare Dipteren, und Cuticulae (Familien Hypodermatidae, Ruteriidae, Cuterebridae), ovipare Fliegen. Dieser Band behandelt nur die Cavicolae. Dabei basiert die Klassifikation der Familie auf BRAUER, GRUNIN, ZUMPT und anderen Autoren, bewahrt damit etwas die konservative Ansicht der Gliederung und verzichtet auf die Einbeziehung aller sonst noch möglichen Aspekte. Die beträchtliche Zunahme von Detailwissen über die Oestridae, Mammalia, Kontinentaldrift, Palaeoklimatologie und -ökologie ermöglichte einen Analyseversuch und eine Erklärung der Evolutionsphänomene dieser Familie. Der Autor versucht, die Fragen der Klassifikation und geographischen Verbreitung der Oestridae zu beantworten, die verschiedenen Beziehungen zwischen Oestridae und ihren Wirten unter den Mammalia darzulegen sowie die Evolution der Familie zu deuten. Diese Betrachtungen werden im Werk durch eine Gliederung in folgende Kapitel vorgenommen: „Geschichte, Folklore, Biologie", „Systematik und Phylogenie der Oestridae", „Charakteristika der Wirte der Oestridae" und eine hypothetische Deutung der Evolution der Familie. — „Ein Basiswerk" im Rahmen der Dipterologie, dürfte die Bedeutung der Arbeit am besten charakterisieren. MORGE

Dmitrijenko, V. K.; Petrenko, E. S. Murav'ji taježnych biovenozov Sibiri. [Die Ameisen der Taiga-Biozönosen Sibiriens.]. IZDATEL'STVO „NAUKA" SIBIRSKOJE OTDELENIJE, Novosibirsk. 1976. 13,0 × 19,9 cm; 219 S., 52 Fig.

Auf der Grundlage vieljähriger Untersuchungen wird die Rolle der Ameisen in den Taigabiozönosen untersucht. Die biologischen und ökologischen Besonderheiten von 40 Arten Mittel- und Ostsibiriens werden charakterisiert. Neben einer zoogeographischen Einschätzung der Myrmeco-Fauna werden die Komplexe der einzelnen Arten in den verschiedenen Lebensräumen und die trophischen Bindungen analysiert. Besonders wird die Rolle der Ameisen im System der integrierten Bekämpfung von Schadinsekten diskutiert. Für die Wälder Zentral-Jakutiens wird eine Bestimmungstabelle der Ameisen nach ihren Nestbauten vorgelegt. Ein ausführliches Literaturverzeichnis beschließt diesen Band. GAEDIKE

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