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STUDIES ON THE MORPHOHISTOLOGICAL PECULIARITIES OF THE CORPUS CEREBELLI AND VALVULA CEREBELLI OF CHANNA PUNCTATUS AND HETEROPNEUSTES FOSSILIS (PISCES)

H. R. GOEL

Received February 2, 1978

Abstract: The corpus cerebelli of *Channa punctatus* (Bloch) is less developed and quadrangular in shape while that of *Heteropneustes fossilis* (Bloch) is considerably large; in the former lobus lateralis cerebelli are absent while they are present in the latter. The valvula cerebelli of *Channa punctatus* is less developed as compared to that of *Heteropneustes fossilis* but it possesses both the direct and reflex leaflets. In *Heteropneustes fossilis*, the reflex leaflet is absent. The three principal layers of corpus cerebelli and valvula cerebelli of *Channa punctatus* and *Heteropneustes fossilis* are distinct and recognizable.

INTRODUCTION

The teleost metencephalon consists of corpus cerebelli and valvula cerebelli. Both these parts vary considerably in size and shape. The notable references on the structure and function of the metencephalon are of Franz (1911), Pearson (1936), Nieuwenhuys (1967), Nieuwenhuys and Nicholson (1969), Singh (1970), Kuhlenbeck (1975) and Pearson (1976). The present paper deals with the morphohistological peculiarities of the corpus cerebelli and valvula cerebelli of *Channa punctatus* and *Heteropneustes fossilis*, the former a snake-head and the latter a cat-fish; both are fresh water air-breathing predaceous bony fishes.

MATERIAL AND METHODS

The fresh brains were taken out from the live specimens after decapitation and fixed in 4% formalin for 7 days or 90% alcohol for 5 days or aqueous Bouin's solution for 12 hours. Serial transverse paraffin sections were out at 8 μm and stained with 0.5% toluidine blue and 0.3% thionin. The brains were also fixed and stained in toto in 0.3% formol-thionin for 4 days and the paraffin sections of 5 μm were differentiated in alcohol.

OBSERVATIONS AND DISCUSSION

In *Channa punctatus* the metencephalon is less developed, quadrangular in shape and is represented by a solid lobe (Fig. 1), while in *Heteropneustes fossilis* it is very large and nearly half of the entire brain length (Fig. 2). In *Heteropneustes fossilis* it extends forward reaching over the telencephalon and behind up to the anterior margin of facial lobes. The two principal parts of the metencephalon viz.; corpus cerebelli and valvula cerebelli vary considerably in size and shape.

The corpus cerebelli of *Channa punctatus* is quadrangular in shape and lies between the optic lobes or the mesencephalon in front and myelencephalon

behind. The lobus lateralis cerebelli are absent. In *Heteropneustes fossilis*, the corpus cerebelli is dorsally flattened, thick oval plate extending infront up to the middle of telencephalon and behind hardly over the facial lobes of the myelencephalon. On the posterolateral aspect of the corpus is present a semi-circular structure known as the lobus lateralis cerebelli (Fig. 2). The lobus lateralis cerebelli of both sides are joined with each other by a central acoustic lobe which is a narrow transverse band of grey matter.

Nieuwenhuys and Nicholson (1969) reported large corpus cerebelli in Siluridae and in some other groups. Aronson (1963) also observed a strongly developed corpus cerebelli projecting rostrally not only covers the mesencephalon, but also a part of the telencephalon in *Acanthurus*. Nieuwenhuys and Nicholson (1969) described a band in the caudal region of corpus cerebelli of most teleosts but it is absent in the fishes under report.

The valvula cerebelli is a thin-walled, puch-like structure which projects forward and reaches the optic ventricle of the mesencephalon. The valvula cerebelli of *Channa punctatus* is less developed as compared to that of *Heteropneustes fossilis;* in the former it (valvula) does not fill the entire space of the optic ventricle (Fig. 4) and belongs to the salmonoid type of Banarescu (1957), while in the latter it fills most of the space of the optic ventricle (Fig. 5) and belongs to the siluroid type of Banarescu (1957). In *Channa punctatus*, the valvula cerebelli consists of thick direct leaflet which represents its ventral wall and is the anterior continuation of the body of the metencephalon. The dorsal wall formed by the inversion of the ventral wall is the reflex leaflet. The space in the centre of the valvula is called the cavum cranii. The valvula cerebelli of *Channa punctatus* has a dorsal and a ventral sac along with a dorsal and a ventral groove; the latter is more prominent than the former. In rostral sections the valvula cerebelli is oval but becomes fused with the corpus cerebelli in the caudal sections. The granular layer is thick on the lateral sides of the valvula cerebelli becoming thin on the dorsoventral sides. In *Heteropneustes fossilis*, the valvula cerebelli is large and 'V'-shaped It comprises of only a direct leaflet while the reflex leaflet has disappeared due to the absence of the lateral parts and folds. The granular layer is very thick on the ventrolateral sides of the valvula cerebelli but is absent on the dorsal side. The valvula has a dorsal and a ventral groove but the dorsal and ventral sacs are absent. The ventral groove is more deeper than the dorsal (Fig. 5). In the caudal sections the 'V'-shaped valvula cerebelli is fused with the corpus cerebelli along with the cerebellar layers..

Nieuwenhuys (1967) reported structural variations in the valvula cerebelli of mormyrid fishes. According to him in fishes like *Gobius* and *Lophius*, the valvula is merely represented by a small subtectal fold, but in most teleosts it fills up a considerable part of the optic ventricle. Franz (1911) observed that in Cyprinidae and Siluridae the valvula cerebelli is so strongly developed that it effects a lateral displacement of the caudal parts of the optic ventricle.

Ariens Kappers et al. (1936) reported highly developed lateral line system in *Mormyrus* and *Silurus* due to large valvula cerebelli. Banarescu (1957) described that specially direct leaflet of cyprinids is a gustatory centre. Singh (1970) observed that the fish having well developed gustatory and lateral line systems possesses a better formed valvula cerebelli. In *Heteropneustes fossilis* the large valvula cerebelli along with the presence of taste buds in the barbels, lips and buccopharyngeal lining indicates the well deve-

loped gustatory sense, while in *Channa punctatus* the small valvula cerebelli and the absence of taste buds show the absence of gustatory sense and supports the view of Banarescu (1957) and Singh (1970). The extent of the development of the valvula cerebelli exerts its influence on the form of some mesencephalic structures like the tori semicirculares and tori longitudinales. In *Heteropneustes fossilis,* due to large valvula, tori semicirculares heve shifted ventrally and tori longitudinales have moved upward in order to provide space, but in *Channa punctatus* the valvula being less developed, the tori semicirculares occupy a more dorsolateral position and the tori longitudinales are seen hanging towards the valvula. These findings are in conformity with those of Singh (1970).

In the corpus cerebelli of both the fishes three layers of the valvula cerebelli i. e. the molecular, Purkinje and granular can be clearly recognized, however, the arrangement of these layers is reversed to that found in the valvula cerebelli (Fig. 3 to 5).

The molecular layer of corpus cerebelli and valvula cerebelli consists mainly of fibres and a few scattered cells (Figs. 6 and 7)). The fibres are of the reticulata type and constitute the main substance of the molecular layer. The cells of this layer are much smaller than the Purkinje cells, but distinctly larger than the cells of the granular layer. Three types of cells viz., stellate, pear--shaped and oval have been found in *Channa punctatus,* while two types i. e. fusiform and oval in *Heteropneustes fossilis.*

The Purkinje zone of corpus cerebelli and valvula cerebelli consists of scattered cells arranged in a regular layer of two to three cells thick lying between the molecular and granular layers (Figs. 6 and 7). The dendrons of these cells are seen entering the molecular layer as well as the granular layer. The Purkinje cells are rounded and irregular in shape in both the fishes under report.

The granular layer comprises mainly of densely packed small and granular cells (Figs. 6 and 7). In the caudal sections of the metencephalon the differentiation between the granular zone of corpus cerebelli and valvula cerebelli disappears as the granular part of the former passes over into the latter. The dendrons of the granular cells are not clearly visible. The granular cells are small and rounded in both the fishes.

Nieuwenhuys (1967) reported similar layers in mormyrid fishes. Pearson (1936) named molecular layers of corpus cerebelli and valvula cerebelli as stratum moleculare pars principalis and staratum moleculare valvulae. Similarly the granular layers of corpus cerebelli and valvula cerebelli are named as stratum granulosum pars principalis and stratum granulosum valvulae.

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SUMMARY

The structure of corpus cerebelli and valvula cerebelli of the metencephalon in *Channa punctatus* (Bloch) and *Heteropneustes fossilis* (Bloch) has been described.

The corpus of *Channa punctatus* is less developed and quadrangular in shape while that of *Heteropneustes fossilis* is very large and nearly half of the entire brain length..

The valvula of *Channa punctatus* belongs to the salmonoid type and *Heteropneustes fossilis* to the siluroid type of Banarescu (1957).

Molecular, Purkinje and granular layers are distinct in both the fishes.

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The figures 1—7 will be found at the end of this issue.

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NOTES ON TWO SPECIES OF MORMYRIDS: GNATHONEMUS PETERSII AND MARCUSENIUS ISIDORI (PISCES, MORMYRIFORMES)

Dedicated to the Memory of Professor Carl L. Hubbs (1894—1979)

Lubomír HANEL & Jindřich NOVÁK

Received January 13, 1978

Abstract: 11 specimens of *Gnathonemus petersii* (Günther, 1862) and 3 specimens of *Marcusenius isidori* (Cuvier et Valenciennes, 1846) were examined. In *Gnathonemus petersii* 12 plastic and 8 meristic and in *Marcusenius isidori* 14 plastic and 8 meristic characters were studied. In *Gnathonemus petersii* plastic characters show some differences in comparison to data cited by Boulenger (1909). Meristic characters agree with Boulenger (1909), except the number of teeth and the number of scales in transverse series of body. In *Marcusenius isidori* meristic characters agree with Boulenger (1909) except the number of teeth, but plastic characters show differences caused probably by the small number of specimens examined.

MATERIAL AND METHOD

All measurements were made with the accuracy ± 0.5 mm. only, eye diameter, length of snout, width of mouth and depth of caudal peduncle were measured with the accuracy ± 0.1 mm by means of dividers. The rows of scales and the number of teeth were counted using the binocular microscope. All specimens were fixed in formalin. All specimens of *Gnathonemus petersii* were kept earlier in tanks of several Czech aquarium hobbyists and after death donated to the Department of Systematic Zoology. Specimens of *Marcusenius isidori* were caught by Dr. V. Skořepa in the river Nile near Cairo and kindly offered for this work. Thanks are due to Asst. Prof. Dr. O. Oliva for his help. Dr. V. Skořepa has given to us his material of *Marcusenius isidori* for disposal.

RESULTS

Our results compared with Boulenger (1909) are summarised in Table 1 and 2 *(Gnathonemus petersii)* and in Table 3 and 4 *(Marcusenius isidori)*. Coloration of examined specimens of *Gnathonemus petersii* was dark greyish or blackish with two light stripes on the back part of body. One fish was brownish-yellow. Colour of examined specimens of *Marcusenius isidori* was greyish, a little darker on the back.

DISCUSSION

Gnathonemus petersii: Table 1 and 2 show considerable differences between Boulenger's data (1909) and values found by us. But averages from our data agree with Boulenger's ones (1909) except the values of body depth in % of total length; head length in % of total length; snout length in % of head length; and length of caudal peduncle in % of depth of caudal peduncle.

Table 1. — Plastic characters of *Gnathonemus petersii*

	Our data	Average	Boulenger (1909)
Body depth in % of total length	18 – 22	20	24 – 27
Head length in % of total length	19 – 21	20	21 – 24
Snout length in % of head length	35 – 41	38	40
Length of appendage on the lower jaw in % of snout length	100 – 125	115	100 and more
Eye diameter in % of snout length	36 – 50	41	40 – 50
Length of pectoral fin in % of head length	57 – 90	79	75 – 80
Length of pectoral fin in % of length of ventral fin	154 – 243	198	200
Length of caudal peduncle in % of depth of caudal peduncle	243 – 400	333	300
Length of caudal peduncle in % of head length	68 – 84	73	67 – 75

The fish kept in aquaria had body depth, head and snout smaller than the fish living in natural condition. Boulenger (1909) had 10 specimens alltogether from Old Calabar, Lower Niger, Upper Congo, Stanley Falls and Ubanghi. Different values in proportion between caudal peduncle length and its depth (243.0 – 400.0) may be caused by deforming after death and bad fixation but in most specimens this proportion was nevertheless lower than value cited by Boulenger (1909). The other differences in plastic characters, e. g body depth in % of total length; head length in % of total length and snout length in % of head length may be caused by conditions during aquarium life. Concerning meristic characters, large differences are found only in the number of teeth. very large difference is there in the number of scales in transversal series. Unfortunately Boulenger (1901) does not explain how he has counted scales in transversal series of body. His picture is not clear. There is a sketch showing the representative of the genus *Tilapia* with uncomplete notes concerning his method. Boulenger (1909) does not mention any methodology of measurements. We have counted scales following Holšík, Hensel (1972) and Hrabě, Oliva, Opatrný (1973). In Gunther (1866) there are the same values as in Boulenger (1909). Gunther

Table 2. — Meristic characters of *Gnathonemus petersii*

	Our data	Average	Boulenger (1909)
Number of teeth in the upper jaw	1 – 5	3	3 – 5
Number of teeth in the lower jaw	2 – 5	3	5 – 6
Rays in dorsal fin	2/24 – 26	2/25	27 – 29
Rays in anal fin	2/31 – 33	2/31	34 – 36
Scales in lateral line	61 – 70	65	63 – 70
Scales in transverse series of body	12 – 13	12	12 – 13
	12 – 13	13	15 – 18
Scales between D and A	9 – 12	10	10 – 11
	10 – 12	11	10 – 11
Scales around the caudal peduncle	8	8	8

Table 3. Plastic characters of *Marcusenius isidori*

	Our data	Average	Boulenger (1909)
Body depth in % of body length	28 – 32	30	30 – 36
Head length in % of head depth	86 – 94	91	100
Head length in % of total length	19 – 20	20	22 – 25
Snout length in % of head length	20 – 27	23	20 – 25
Mouth width in % of head length	13 – 17	15	20 – 22
Eye diameter in % of snout length	86 – 100	94	100
Eye diameter in % of interorbital width	43 – 60	52	50 – 60
Length of dorsal fin in % its distance from head	45 – 54	48	50
Length of pectoral fin in % of head length	87 – 100	93	100 and less
Length of ventral fin in % of length of pectoral fin	39 – 43	41	40 – 50
Length of caudal peduncle in % of depth of caudal peduncle	264 – 288	277	250 – 300
Length of caudal peduncle in % of head length	90 – 97	94	100 and less

(1866) had only one fish from Old Calabar at his disposal, this type being deposited in the British Museum. Günther (1862) has described the small canal on the right part of the throat. It is very interesting that in our specimens that canal was not found. Colour of our fish agree with Boulenger's description (1909). Frey (1975) described the colour as brown and grey. His figure clearly shows one light stripe behind the head. This stripe was found in two specimens out of 11 we examined. Examined specimens of *Gnathonemus petersii* do not agree well in colour comparing the photograph in Frey (1975) and in Sterba (1959). Our specimens were darker. The maximal size is given by Boulenger (1909) as 230 mm, by Sterba (1959) 230 mm, but Nichols and Grissom (1917) found the maximal size to be 323 mm. Figures in Nichols and Grissom (1917) agree, as regards colour, very well with our specimens. Sterba (1959) and Frey (1975) point out that breeding in aquarium has not been successful up to the present time.

Specimens of *Marcusenius isidori* do not fully agree in meristic characters with Boulenger's description (1909). Plastic characters do not agree with

Table 4. Meristic characters of *Marcusenius isidori*

	Our data	Average	Boulenger (1909)
Number of teeth in the upper jaw	6 – 7	6	7
Number of teeth in the lower jaw	6 – 8	7	8
Rays in dorsal fin	2/17 – 19	2/17	18 – 22
Rays in anal fin	2/22 – 24	2/23	22 – 26
Scales in lateral line	53 – 57	55	53 – 60
Scales in transverse series of body	11 – 12	12	9 – 11
	15	15	15 – 17
Scales between D and A	12 – 13	12	11 – 13
	12 – 13	12	10 – 12
Scales around the caudal peduncle	16	16	16 or 18

Boulenger's (1909). This may be due to the small number of specimens examined (three from the river Nile). Boulenger (1909) had considerably larger material, 36 specimens from the Nile. Counting scales in transverse series of body we used the same method as in *Gnathonemus petersii* and our values agree with Boulenger (1909). In Boulenger (l. c.) coloration is described as silvery white beneath, brown on the back, in Sterba (1957) the same, in Frey (1975) brown with silver mustre. The maximal size is given by Boulenger (1909) 100 mm, by Sterba (1957) and by Frey (1975) the same. Following Frey (1975) breeding in aquarium has not been observed either.

SUMMARY

In 11 specimens of *Gnathonemus petersii* the total length was found to be between 84–175 mm, scales in lateral line in average 65 (all following values in average), scales between D and A above the lateral line 10,11 below the lateral line, scales in transverse series of body 12 above lateral line, 13 below the lateral line, 8 scales round the caudal peduncle, 3 teeth in upper jaw, 3 teeth in the lower jaw, D 2/25, A 2/31. Body depth in % of total length 20, head length in % of total length 20, snout length in % of head length 38, length of appendage on the lower jaw in % of snout length 115, eye diameter in % of snouth length 41, length of pectoral fin in % of head length 79, length of pectoral fin in % of length of ventral fin 198, length of caudal peduncle in % of depth of caudal peduncle 333 length of caudal peduncle in % of head length 73. The meristic characters agree with Boulenger (1909) excepting the number of scales in transverse series of body, the numbert of teeth in lower jaw and the number of teeth in the upper jaw. Plastic characters showed differences in the body depth, head length and snout length.

In 3 specimens of *Marcusenius isidori* the total length 75–78 mm, in lateral line 55, between D and A above the lateral line 12, below the lateral line 12, in transverse series of body above the lateral line 12, below the lateral line 15, round the caudal peduncle 16 scales., 6 teeth in the upper jaw, 7 teeth in the lower jaw, D 2/17, A 2/23. Body depth 30 % of total length, head length 91 % of head depth, head length 20 % of total length, snout length in % of head length 23, mouth width in % of head length 15, eye diameter in % of snout length 94, in % of interorbital width 52, length of dorsal fin 48 % its distance from head, length of pectoral fin 93 % of head length, length of ventral fin in % of length of pectoral fin 41, length of caudal peduncle in % of its depth 277, length of caudal peduncle in % of head length 94. The meristic characters agree with Boulenger (1909) excepting the number of teeth, plastic characters showed differences. Values measured by us in head length, mouth width eye diameter and length of dorsal fin showed diminishing in comparison to Boulenger's data (1909).

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RUTILUS (PARARUTILUS) FRISII MEIDINGERI IN THE CZECHOSLOVAK STRETCH OF THE DANUBE RIVER

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Received September 16, 1977

Abstract: The first find of *Rutilus frisii meidingeri* (Heckel, 1852), from the Czechoslovak stretch of the Danube river, is described.

Rutilus frisii (Nordmann, 1840) is a pontocaspian species. Its nominate form occurs in brackish waters of the northern part of the Black and Azov Seas, from which ascend the rivers Dniester, Southern Bug, Dnieper, Mius, Don, Rioni (it lives also in the Paleostom lake) and the rivers near Batumi. There is a lack of data on its presence in the delta of the Danube river (Antipa 1909, Berg 1949, Ljaščenko 1952, Bănărescu 1960), but the species is known from the Razelm lake (Bănărescu 1960). However, single specimens apparently ascend the Danube as proved by the finding at Svištovo in Bulgaria (Michajlowa 1967).

The upper part of the Danube river is inhabited by subspecies *Rutilus frisii meidingeri* (Heckel, 1852), which lives in lakes Chiem-, Mond-, Atter-, and Traunsee and also in their tributaries and effluents (Heckel 1852, Heckel and Kner 1858, Siebold 1863, Berg 1932, Bauch 1963). According to Kähsbauer (1961) this subspecies occurs also in the proper main channel of the Danube, even in the Morava river in Lower Austria (personal discussion with dr. Kähsbauer, however, did not confirm the last indication).[1])

In Czechoslovakia (Oliva and Hrabě 1968, Holčík and Hensel 1972), Hungary (Berinkey 1966, Mihályi 1954, Tóth 1970) and Yugoslavia (Taler 1953, Vuković and Ivanović 1971) this species has been not found at all.

Fisherman J. Vörös caught one specimen of *Rutilus frisii meidingeri* (Heckel, 1852) in the Danube near the village Radvaň nad Dunajom at the river km 1749 in the summer of 1975. The fish is a male, measuring 271 mm of standard length, ageing 6+. It is the first finding of this species in the Czechoslovak stretch of the Danube river. Its measurements and counts are introduced in Table 1.

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[1]) For the sake of completeness it is necessary to add that in Southern Bulgaria, in the rivers Veleka and Rezovska another subspecies — *R. frissii velecensis* Chichkoff, 1932 — was found (Berg 1949, Michajlowa 1967). It is quite possible that populations living in Turkish lakes Terkos and Iznik (Kosswig and Battalgil 1943, Berg 1949) belong to this subspecies. Finally, in the Caspian Sea, mainly in its southern part, lives *Rutilus frisii kutum* (Kamensky, 1899). It also ascends the rivers

Table 1. Counts and measurements of *Rutilus frisii meidingeri* recorded in the Danube at the river km 1749

Standard length (mm)	271	Praeanal distance	72.1
		Body depth	23.7
Counts:		Body width	15.1
Soft branched rays in D	9	Caudal peduncle length	19.9
Soft branched rays in A	10	Caudal peduncle depth	10.9
Soft branched rays in P	17	Caudal peduncle width	7.8
Soft branched rays in V	8	Minimal body depth	8.5
Soft branched rays in C	17	Distance P-V	27.5
Scales in lateral line	64	Distance V A	23.7
Scales above/below lateral line	11/5.5	Length of D	12.5
Gil brakers	8	Length of A	11.1
Pharyngeal teeth (left – right)	6 – 5	Length of C (shortest middle ray)	6.6
		Length of C (longest lower lobe ray)	19.2
Measurements:		Length of P	15.3
(in % of standard length)		Length of V	14.2
Head length	21 9	Depth of D (longest branched ray)	14.9
Praeorbital distance	7.8	Depth of A (longest branched ray)	11.0
Eye diameter	3.9	(in % of head length)	
Postorbital distance	11.3	Praeorbital distance	35.2
Head depth	16.8	Eye diameter	17.6
Head with	12.6	Postorbital distance	51.2
Interorbital distance	9.5	Head depth	76.3
Internasal distance	5.1	Head width	57.2
Praedorsal distance	48.9	Interorbital distance	43.0
Praeventral distance	48.9	Internasal distance	23.0

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The plates (Figs. 1–3) will be found at the end of this issue.

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RATE OF THE POSTEMBRYONIC DEVELOPMENT IN SEVERAL POPULATIONS OF THE GROUP OF THE SPECIES DAPHNIA HYALINA LEYDIG AT VARIOUS CONCENTRATIONS OF FOOD

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Abstract: The clones of Cladocera from lakes poor in seston (Lago Maggiore, Lake Windermere) completed the postembryonic development in the water from Slapy Reservoir within a shorter time period than the clones from standing waters which were rich in seston (Slapy Reservoir, Loch Leven, Esthwaite Water). After the enrichment of the Slapy water with algae from laboratory cultures, the postembryonic development was shorter in the clones from the eutrophic bodies of water. For the quantification of this comparison the Monod equation was used.

INTRODUCTION

Hrbáčková and Hrbáček (1978) followed the dependence of the rate of postembryonic development on the concentration of food in the species *Daphnia pulicaria* Forbes and *D. pulex L.* They found in these two morphologically allied species, which inhabit localities of various trophic conditions, a different dependence of the development rate on various food concentrations. The authors expressed this difference quantitatively by the different constants of the Monod equation.. The maximum development rate calculated from the Lineweaver-Burk linearization of the Monod relation was, if all of the experimental points were used, evidently lower than the development rate actually measured at the highest food concentration. In the straight line parameters, which connected the points corresponding with the growth rate at the highest and the lowest concentrations of food, that marked difference did not occur. As this method is much simpler from the viewpoint of experimental work, it is used here to compare the dependence of the growth rate and the food concentration in the populations of the group of *Daphnia hyalina* Leydig in which one may expect beforehand, even though they come from localities of various trophic conditions, much smaller differences in comparison with the group of *Daphnia pulex* L.

MATERIAL AND METHODS

For experimental research Cladocera of the group of the species *Daphnia hyalina* Leydig were used, i. e. (1) *Daphnia* galeata Sars from the eutrophic Slapy Reservoir in Bohemia assigned as *D. hyalina* in the previous papers, (2) *Daphnia galeata* Sars from the eutrophic lake Loch Leven in Scotland supplied by Dr Johnsona in 1972. (3) *Daphnia galeata* Sars from the eutrophic lake Esthwaite Water in England obtained from Dr Smyly, (4) *Daphnia galeata* Sars from the oligotrophic lake Windermere and (5) *Daphnia hyalina* Leydig from the oligotrophic to mesotrophic lake Lago Maggiore in Italy supplied by Dr Blažka in 1972.

The females of all these specimens were reared for at least three weeks before the experiments were started at the laboratory under favourable feeding conditions. Half of the experimental neonata were fed with individual portions (cca 10^6 cells/ml) in 100 ml flasks in the water from Slapy Reservoir enriched with the alga *Scenedesmus* from a laboratory culture (in the results given as "enriched medium"), the other half was kept separately in the water from Slapy Reservoir (in the results given as "Slapy water"). The medium was changed every 24 hours. The young were measured every day and controlled twice a day during egg production. The experimental flasks were kept at 20 °C. When it was possible to recognize reliably the specimens from the eutrophic and oligotrophic localities morphologically from the stage of neonata to that of primipara, two specimens per flask were cultivated, one from the oligotrophic populations, the other from the eutrophic ones. The observations were terminated three weeks after the beginning of the experiments when the number of the specimens which did not complete was determined.

The water from Slapy Reservoir was obtained by pumping from a depth of 0.4 m and filtered through bolting cloth No 8. At the same time, a water sample was taken every day. From the seston obtained by the continuous centrifuge (g = 2,000), the organic N was determined by the Kjeldahl method and the values were converted to caloric ones according to Blažka (1966) as described in the previous paper (Hrbáčková and Hrbáček, 1978). The concentration of the suspension of algae was measured in terms of optical density at 660 nm in a 1 cm^3 cell according to Blažka. The data on optical density were calibrated by the oxidometric procedure (dichromate catalized by Ag^{++}) to the caloric content of algae (Hrbáčková, 1974).

In all of the experiments, the authors determined the length of postembryonic development starting from the release of the young from the female and ending by the appearance of the first eggs in the brood pouch. For each of the experiments the modus (further on given as M) was established for the characterization of the most frequently occurring values. From the data on the length of the development and the reverted values of the highest and the lowest food concentrations the straight lines were established for the single clones and from the Lineweaver-Burk relations the constants of the Monod equation were calculated for the maximum development rate D (inverted value for the length of development) and the saturation constant K_s (food concentration at which the growth rate is half the maximum value). These values were used for the evaluation of the relation between the growth rate and the concentration of food by the Monod equation. Part of the specimens were measured in the course of the postembryonic development from a neonata to a primipara according to the scheme on the paper of Hrbáčková (1963). For the mutual comparison of the length such specimens were used which possessed an equal number of the stages from neonata to primipara.

RESULTS

(I) Cultivation of the species *Daphnia galeata* Sars (Slapy Reservoir) and *Daphnia hyalina* Leydig (Lago Maggiore).

(1) Cultivation in natural Slapy water (food concentration 12 joules per liter).
Daphnia galeata Sars (Slapy Reservoir)

26 neonatae from 6 females were used in the experiment. Of these 11.5 % did not complete the postembryonic development during the three weeks of cultivation, 23 % died during the 1st week, 11.5 % completed the postembryonic development on the 10th day, 34.6 % on the 11th, and 19 % on the 12th day. M = 11.4. The mean frequency of eggs per primipara was 1.5.

Daphnia hyalina Leydig (Lago Maggiore)

Of 26 experimental specimes 11.5 % died in course of the 1st week of cultivation, 15.4 % did not complete the postembryonic development during the three weeks of cultivation, 3.8 % completed the postembryonic development on the 5th day, 7.7 % on the 6th, 11.5 % on the 8th, 15.4 % on the 9th, 26.9 % on

the 10th, and 7.7 % on the 14th day. M = 9.8. The mean frequency of eggs per primipara was 2.0.

(2) Cultivation in natural Slapy water with the addition of Scenedesmus spp. (food concentration cca 100 joules per liter).

Daphnia galeata Sars (Slapy Reservoir)

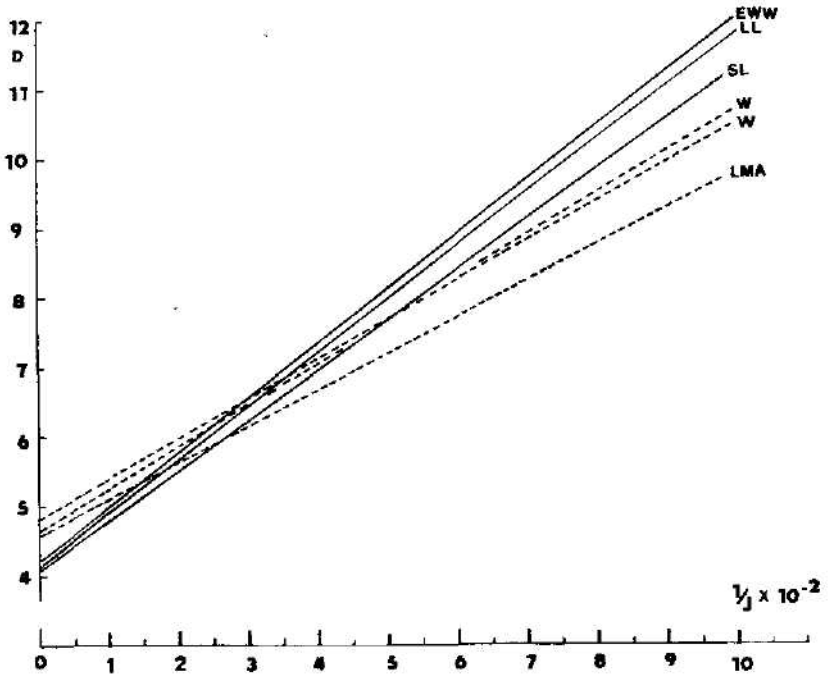

Fig. 1. Lineweaver-Burk plot of the regression of the development (D) in days on the food concentration in inverted values. Full lines are for clones from eutrophic lakes: Sl = Slapy reservoir, LL = Loch Leven, EWW = Estwaite water. Dashed lines are for clones from oligotrophic lakes: LMa = Lago Maggiore, W = Windermere. Ordinate: the length of the postembryonic development (D). Abcissa: the inversed value of the food concentration in J/1.

Of 26 neonatae 3.8 % died in course of the 1st week, 15.3 % reached maturity on the 4th day, 69 % on the 5th, and 11.6 % on the 6th day. M = 4.8. The mean frequency of eggs per primipara was 9.1.

Daphnia hyalina Leydig (Lago Maggiore)

Of 26 neonatae 7.6 % died during the 1st week of cultivation, 7.6 % completed the postembryonic development of the 4th day, 56.3 % on the 5th, 3.8 % on the 6th, and 15.3 % on the 7th day. M = 5.1 The mean frequency of eggs per primipara was 6.8.

(II) Cultivation of the species *Daphnia galeata* Sars (Loch Leven) and *Daphnia galeata* Sars (Lake Windermere).

(1) Cultivation in natural Slapy water (food concentration 10 joules per liter).

Daphnia galeata Sars (Loch Leven)

Of 24 neonatae 25 % of the specimens died during the 1st week, 8.3 % did not complete the postembryonic development during the three weeks of cultivation, 12.5 % reached maturity on the 10th day, 8.3 % on the 11th, 25 % on the 12th, 12.5 % on the 13th, and 8.3 % on the 15th day. M = 11.8. The mean frequency of eggs per primipara was 1.2.

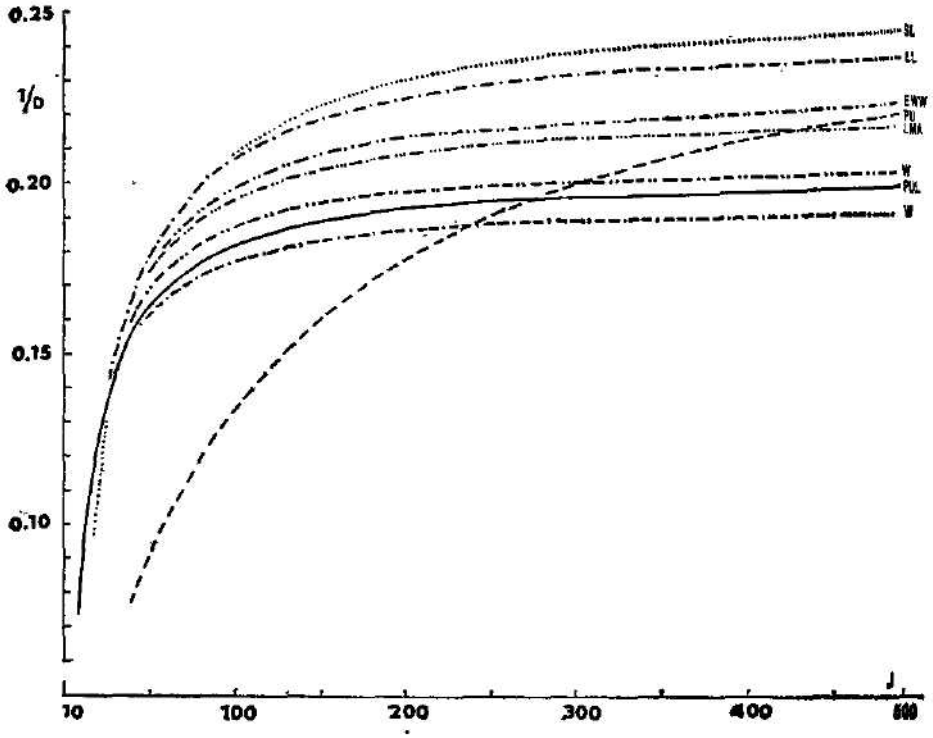

Fig. 2 Monode curves: regression of the food on the development rate (1/D inverted value of the length of the development in days) in terms of Monode equation Full lines are for clones *D. pulicaria* (Pul) and D. pulex (Pu). Dashed lines are for clones *D. galeata* L. Slapy (Sl), Lago Magglore (LMa), Loch Leven (LL), Estwaite water (EWW) Windermere (W). Ordinate: The inversed value of the length of the development (1/D). Abcissa: the value of the food concentration in J/1.

Daphnia galeata Sars (Windermere)

Of 24 neonatae 16.4 % died during the 1st week, 8.3 % did not complete the postembryonic development during the three weeks of cultivation, 25 % reached the stage of primipara on the 10th day, 25 % on the 11th, 8.3 % on the 12th, 12.5 % on the 13th, and 4.1 % on the 14th day. M = 10.5. The mean frequency of eggs per primipara was 1.8.

(2) Cultivation in natural Slapy water with the addition of *Scenedesmus* spp. (food concentration 100 joules per liter).

Daphnia galeata Sars (Loch Leven)

Of 24 neonatae 8.3 % died in course of the 1st week of cultivation, 41.6 % reached maturity on the 4th day, 12.5 % on the 5th, 25 % on the 6th, and 12.5 %

on the 7th day. M = 4.9. The mean frequency of eggs per primipara was 4.3.
Daphnia galeata Sars (Lake Windermere)

Of 24 neonatae 12.5 % died during the 1st week of cultivation, 37.4 % completed the postembryonic development on the 5th day, 33.3 % on the 6th, 8.3 % on the 7th, and 4.1 % on the 8th day. M = 5.4. The mean frequency of eggs per primipara was 4.1.

(III) Cultivation of the species *Daphnia galeata* Sars (Esthwaite Water) and *Daphnia galeata* Sars (Lake Windermere).

(1) Cultivation in natural Slapy water (food concentration 10 joules per liter).

Daphnia galeata Sars (Esthwaite Water)

Of 21 neonatae 19 % did not complete the postembryonic development during the three weeks of cultivation, 9.5 % died in the 1st week, 4.8 % completed the postembryonic development on the 8th day, 4.8 % on the 9th, 9.5 % on the 10th, 4.8 % on the 12th, 38 % on the 13th, and 9.5 % on the 14th day. M = 12.1. The mean frequency of eggs per primipara was 1.3.

Daphnia galeata Sars (Lake Windermere)

Of 21 specimens 4.8 % did not complete the postembryonic development during the three weeks of cultivation, 14.2 % died in the 1st week, 9.5 % reached the stage of primipara on the 9th day, 14.2 % on the 10th, 42.8 % on the 11th, and 14.2 % on the 12th day. M = 10.7. The mean frequency of eggs per primipara was 2.0.

(2) Cultivation in natural Slapy water with the addition of *Scenedesmus* spp. (food concentration 100 joules per liter).

Daphnia galeata Sars (Esthwaite Water)

Of 21 specimens 19 % completed the postembryonic development on the 4th day, 66.6 % on the 5th, 9.5,% on the 6th, and 4.8 % on the 7th day. M = 4.9. The mean frequency of eggs per primipara was 5.8.

Daphnia galeata Sars (Lake Windermere)

Of 21 specimens 9.5 % died during the 1st week, 4.8 % completed the postembryonic development on the 4th day, 57 % of the 5th, 14.2 on the 6th, 4.8 % on the 7th, and 4.8 % on the 8th day. M = 5.3. The mean frequency of eggs per primipara was 5.2.

The results are summarized in Table 1, Fig. 1 and 2.

DISCUSSION

Hrbáčková and Hrbáček (1978) found in *Daphnia pulex* and *D. pulicaria* a direct relationship between the values K_s and D_{max}. Thus *D. pulicaria* has lower K_s and a lower D_{max}, while *D. pulex* has a lower K_s and a higher D_{max}. This relationship in the populations of the group of *Daphnia hyalina* was not on unequivocal because the size of the primiparae greatly varied. D_{max} was high in the clones from Slapy Reservoir, Loch Leven and Esthwaite Water, whereas the size of a neonata under favourable feeding conditions was smallest in the clone from Esthwaite Water. The size of the primiparae under good feeding conditions in the clones from the studied oligotrophic lakes is evidently higher than that in the clones from the studied eutrophic localities, but even then it is substantially smaller in comparison with *D. pulicaria*. While in the last species the average size of a primipara reached 2.4 mm, the average size

of the primiparae of the clone from the oligotrophic localities studied in this paper was below 1.9 mm. Therefore, the parameters D_{max} and K_s as well as the curves established according to the Monod relation do not fully evaluate the competitive ability for food or the utilization of the given food concentration at the given time interval, respectively. So, for instance, in Fig. 2 the curves for *D. pulicaria* Forbes and *D. galelata* Sars from Lake Windermere are nearly identical. The different length of an adult female indicate that the produced biomass expressed as dry weight according to the equation

$$\ln W = \ln 1.78 + 2.72 \ln L$$

(Bottler et al., 1976) is 1.9 times greater in *D. pulicaria* than in *D. galeata*. Similar size differences were also found at low food concentrations. The fact that smaller species do not have D_{max} proportionally smaller to the lower biomass of the primiparae, shows that the efficiency of food utilization in these species is in agreement with the "Size-efficiency hypothesis" (Brooks and Dodson, 1965) and with the previously observed relatively higher metabolism of the smaller crustaceans (Winberg, 1971). On the other hand, from the fact that the clones of approximately equal size as the neonatae and primiparae have evidently different parameters of the Monod equation (*D. pulex* in contrast to *D. pulicaria* and *D. galeata* from Loch Leven and Lake Windermere), one may see that the given relationship between size and efficiency will be different in the species of equal size. The extreme r and K specialists (Hrbáček in press) are likely to provide the envelope for the distribution of these values along the regression line.

The use of the Monod equation which compares the dependence of the growth rate on the food concentration, has despite the mentioned insufficiences, an indisputable advantage in that it indicates the mechanism by which a population of *Daphnia* intensely exploited by fish cannot decrease the concentration of algee to the same level as does the population of cladocerans which is not controlled by fish. Chisholm, Stross and Nobbs (1975) summarized the data on the filtering rate of a variety of *Daphnia* species. The low incipient saturation food concentration of *D.. middendorfiana* Fisher in contrast to the other species of *Daphnia* as well as the high intensity of the filtering rate in comparison with the above mentioned K_s values show that the species *D. middendorfiana* Fisher is as concerns the relations to the food concentration nearer to the species *D. pulicaria* than to *D. pulex* with which it is commonly compared taxonomically. A thorough comparison of the filtering rate and K_s of course, cannot be performed. The filtering rate as well as the rate of ingestion evaluate the food intake, not the energy spent for filtering. It is the difference between energy input and energy output which is important for the interspecific food competition. The high filtering rate points at the capability of utilizing the low food concentration, however, regardless of the metabolic demands.

Muckle (1976) assumes from his long-term investigation of Lake Constance that the presence of a more abundant population of *D. galeata* Sars in this lake, from which *D. hyalina* (the dominant species up to the presen time) was described by Leydig, is conditioned by eutrophication, that is by the increase in the abundance of algae in this lake. The present results do not seem to confirm this interpretation, since as concerns the dependence of the length of the postembryonic development on the concentration of food, there is no

clear difference between *D. galeata* from Lake Windermere and *D. hyalina* from Lago Maggiore. Distinct differences have been found in the relation of various populations of *D. galeata* Sars to the food concentration. From the distribution of the species *D. hyalina* in lakes of various trophic levels, one may suggest that this species, too, will exhibit analogical differences among the populations living under various food conditions. Hrbáčková (1971) has found in the population of *D. hyalina* from Lago Maggiore that the first generation does not shorten the length of postembryonic development after food addition, but that this shortening occurs after several generations have developed under good feeding conditions.

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JUVENILE HORMONE ANALOGUES: EFFECTS ON THE SOLDIER CASTE DIFFERENTIATION IN TERMITES (ISOPTERA)

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Abstract: By treating orphaned grown-larvae (or pseudergate) groups of termites with juvenile hormones (JHs) or with JH analogues (JHAs) the development of presoldiers and/or soldier intercastes was induced. In screening tests with *Reticulitermes lucifugus santonensis* and *Prorhinotermes simplex* JH III and JHAs hydroprene, 11 chlorine analogue of pharnesol acid and tetrahydrophuryl analogue of methoprene were found as most active. The soldier-caste formation under JHs and JHAs influence was proved in *Kalotermes flavicollis*, *Cryptotermes brevis*, *Neotermes castaneus*, *N. jouteli*, *Zootermopsis angusticollis*, *Z. nevadensis*, *R. lucifugus santonensis*, *Prorhinotermes simplex* and *Coptotermes formosanus*. Lists of other positively responding termite species and of active compounds are attached. The formation of presoldiers was demonstrated in very early instars: for *R. lucifugus* from larva III and for *P. simplex* from larva II. Treatments of starting colonies of *Z. nevadensis* and that of colonies of *P. simplex* in natural conditions failed. The use of synthetic JHs and JHAs in caste determination and social homostasis studies and the promise of JHAs in social insects control is discussed.

The development of the soldier caste was experimentally induced in the European drywood termite, *Kalotermes flavicollis* by injecting and feeding the juvenile hormone (JH) to the pseudergates (Lüscher, 1969). This confirmed the hypothesis on the function of JH in the regulation of the development of soldiers in termite colonies, formely based mainly on implantation of corpora allata (Lüscher & Springhetti 1960; Lebrun, 1967). In 1972 reports were published showing that under adequate experimental arrangements groups of the European subterranean termite *Reticulitermes lucifugus santonensis* are producing large numbers of superfluous presoldiers or pseudergate-soldier intercastes if treated with the synthetic JH II (cecropia JH, C_{17} JH) or some JH analogues (JHAs, juvenoids) (Hrdý & Křeček, 1972; Hrdý, 1972). Assumptions have ben expressed that this principle, i. e. exerting influence on the caste ratio and the social regulation of biological functions in colonies of social insects by JHAs, could be used for the control of harmful species.

The difficulties involved in the chemical control of social insect pests are generally known. Many species are instinctively capable of response to, and avoidance of contact with toxic substances. They may also identify and isolate sections of the colony affected by a toxicant and thus enable the rest of the community to regenerate. Therefore, formulations with peculiarly protracted effect have been employed and new compounds sought, which social insects would not avoid. Juvenoids seem to fulfill this prerequisite as has been evidenced by comparative feeding tests on termites, on honeybees foraging nectar

from JHA contamined blossoms (Hrdý, 1973; Hrdý & Škrobal, 1976), and by bait tests performed on the ant *Monomorium pharaonis* (L.) (Edwards, 1975b; Hrdý, Křeček et al., 1977)..

Results reported were partially presented at the XVth International Congress of Entomology, Washington, D. C. in 1976 (published only as a summary by Hrdý, 1976). The literature on JHs and JHAs effects in termites is reviewed by Lenz (1976).

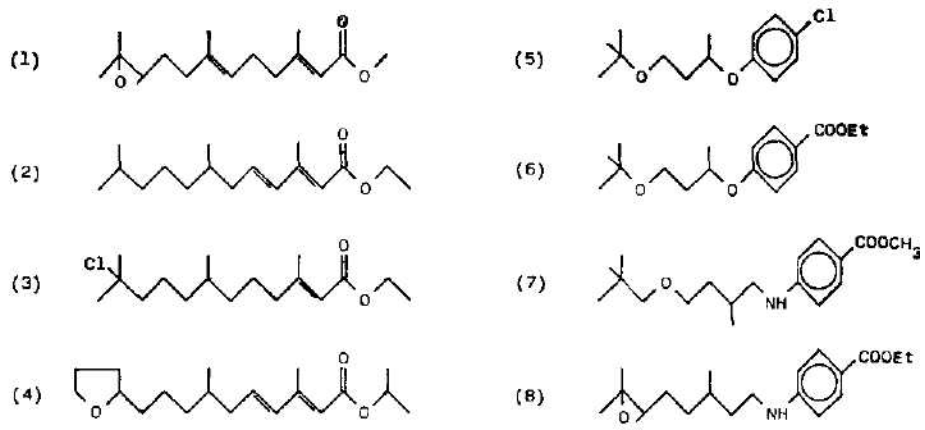

Fig. 1. Chemical structures of compounds showing JH activity in termite tests.

SCREENING OF JUVENOIDS

Unlike the tests with conventional insecticides, assessment of juvenoid effectiveness involves specific problems as it is not limited to the resulting rate of mortality only, but also includes evaluation of the morphological effect. A number of papers has been devoted to the relationship between the chemical structure and the specific biological effect of JHAs (e. g. Staal, 1972; Sláma, Romaňuk & Šorm, 1974). Due to the distinctive characters of soldiers scoring in the termite tests is very simple. On the other hand, however, a complicating factor arises in that, invariably, and similar to experiments with any other social insects, we are concerned with whole groups of interacting individuals.

Material and method: All the results reported here were obtained using the method of exposing termite groups to treated filter papers in Petri dishes. Whatman No 1 papers, 40 mm in diameter, were treated with 0.2 ml of acetone solution of the tested compounds. After evaporation of the solvent, papers were moistened with distilled water. Temperature during experiments was 27 °C ± 1 °C, e. g. the same as in the termite cultures. In the screening tests two species of the family Rhinotermitidae were used: *Reticulitermes lucifugus santonensis* and *Prorhinotermes simplex*. Colonies of these subterranean termites are continuously kept in aquaria with soil and pine wood. The test groups consisted of 20—30 grown larvae or pseudergates confined permanently during the experiments on the treated filter papers. The experiments were scored in one or two-day-intervals until day 30—40, mortality in controls (the filter-papers treated with solvent only) was usually low, not exceeding 20%. Other methodical details are evident from Tab. 1, and/or are in principle the same as in Hrdý & Křeček (1972) and Hrdý (1972).

Results: About 60 compounds were tested, mostly aliphatic analogues of the pharnesole acid, oxa analogues of 4-(geranyloxy)-benzoic acid, and 4-(geranylamino)-benzoic acid. Under the testing method used the majority of substances proved ineffective against termites. Some had a toxic effect in higher concentrations (0.5%), a few proved toxic even in concentrations of 0.1%. Table 1 shows the compounds under the effect of which presoldiers or soldier intercastes were formed. In our recent trials synthetic JH III(C_{16}JH) listed under (1 in Fig. 1) and the following three juvenoids proved most effective in termite tests: (2) hydroprene (Altozar, ZR 512, Zoecon Corp.) along with two compounds prepared in the Institute of Organic Chemistry and Biochemistry of the Czechoslovak Academy of Sciences, (3) 11 chlorine analogue of pharnesol acid, and (4) tetrahydrophuryl analogue of methoprene. The effectiveness against termites of the following four juvenoids (5–8) was less.

SPECIES AFFECTED BY JUVENOIDS

The first experiments aimed at inducing development of soldiers through the effect of JHAs included species currently encountered in laboratory cultures *Kalotermes flavicollis, Reticulitermes lucifugus santonensis, Zootermopsis angusticollis* and *Z. nevadensis* (see Hrdý & Křeček, 1972; Wanyonyi & Lüscher, 1973). Later, the same effects were proved in several other species among them some of higher economic importance e. g. *Reticulitermes flaviceps* (see Chu Hsang-hsong, Tai Tchi-dar et al., 1974), *Nasutitermes exitiosus* (see French, 1974) *Reticulitermes flavipes, Heterotermes indicola, Coptotermes amanii, C. niger* and *Nasutitermes nigriceps* (see Lenz, 1976).

Table 1. Effects of JHAs on termites in laboratory tests

Compound[1])	Concentration %	Species	Effect
(1) JH III	0.5	R. luc. sant.	(M) +++
	0.05	R. luc. sant.	+++
(2) hydroprene	0.5	R. luc. sant.	M +++
	0.05	R. luc. sant.	+++
	0.005	R. luc. sant.	0
	0.5	Prorh. simpl.	+++
	0.05	Prorh. simpl.	+++
(3)	0.5	R. luc. sant.	M ++
	0.05	R. luc. sant.	(M) +++
	0.005	R. luc. sant.	0
	0.5	Prorh. simpl.	+++
(4)	0.5	R. luc. sant.	M 0
	0.05	R. luc. sant.	+++
(5)	0.1	Prorh. simpl.	M 0
	0.01	Prorh. simpl.	+
(6)	0.1	Prorh. simpl.	+
(7)	0.1	Prorh. simpl.	+
(8)	0.5	R. luc. sant.	M +

R. luc. sant. — *Reticulitermes lucifugus santonensis*
Prorh. simpl. — *Prorhinotermes simplex*
Scale of effects: + (low) to +++ (high)
M — high mortality, (M) low mortality
[1])For chemical structures see Fig. 1

Table 2. List of species in which the development of presoldiers, soldiers and worker-soldier intercastes was induced with synthetic JHs and/or juvenoids

Fam., Genus, Species	Compound	Reference[1])
Kalotermitidae		
Postelectrotermes nayari Roonwal & Verma	farnesyl *methyl ether*	Varma, 1977
Neotermes castaneus (Burmeister)	hydroprene	
jouteli (Banks)	hydroprene	
Kalotermes flavicollis (Fabr.)	JH II	Lüscher, 1969
	methyl farnesoate	Springhetti, 1974
	hydroprene	Lenz, 1976
	methoprene	
Incisitermes schwarzi (Banks)	hydroprene	
Cryptotermes brevis (Walker)	hydroprene	
	methoprene	
Hodotermitidae		
Zootermopsis angusticollis (Hagen)	methyl farnesoate	Wanyonyi & Lüscher, 1973
nevadensis (Hagen)	hydroprene	Wanyonyi, 1974
Rhinotermitidae		
Heterotermes convexinotatus (Snyder)	hydroprene	
indicola (Wasmann)	hydroprene	Lenz, 1976
Reticulitermes flaviceps (Oshima)	hydroprene	Chu Hsang-hsoung et al., 1974
	methoprene	
	S-ethyl[2])	
flavipes (Kollar)	hydroprene	Lenz, 1976
	methoprene	
lucifugus (Rossi)	hydroprene	Lenz, 1976
	methoprene	
lucifugus	JH II, III	Hrdý, 1972
santonensis Feytaud	hydroprene[3])	Hrdý & Křeček, 1972
Coptotermes amanii (Sjöstedt)	methoprene	Lenz, 1976
formosanus Shiraki	hydroprene	
niger Snyder	methoprene	Lenz, 1976
Prorhinotermes simplex (Hagen)	JH III	
	hydroprene[3])	
Termitidae		
Nasutitermes exitiosus (Hill)	hydroprene	French, 1974
nigriceps (Haldeman)	hydroprene	Lenz, 1976
	methoprene	

Explanation: [1]) If no reference, original record
[2]) S-ethyl 11-methoxy-3,7,11-trimethyldodeca-2,4-dienethioate
[3]) see Table 1

Method: In our experiments, the method was in principle the same as when screening the compounds with the two previously mentioned species. In individual cases some modifications were necessary like adjustment of the size of termite group, or more precise regulation of the environment inside the dish (lowering or rising the humidity).

Results: By the treatment with one of the active juvenoids (most experiments were performed with hydroprene) at suitable concentrations (in the range of 0.05–0.5%) we succeeded in demonstrating the stimulating effect of JHA on the soldier caste differentiation in all the termite species tested (see Table 2).

Table 3. Effects of 0.02% hydroprene on differentiation of instar II larvae of *Prorhinotermes simplex*

Day	Larvae Instar II	Dead	Moulted into instar IV	Presoldiers[1]) Living	Dead
Start	33	—	—	—	—
5	33	—	—	—	—
10	33	—	—	—	—
15	0	8	6	14	5
20	0	8	6	0	19

Notes to Tables 3—5: The same treatment method as when screening juvenoids. Larvae of a given instar kept in a group with 10 pseudergates and one soldier. [1])Presoldiers — white soldiers and/or soldier pseudergate intercasts.

JUVENOIDS IN STUDIES OF THE SOCIAL HOMEOSTASIS

Caste development regulation

The elucidation of the chemical structure of insect juvenile hormones and synthesis of several highly active JHAs makes it possible to investigate caste differentiation and some other aspects of social regulation in termite colonies. The influence of the group composition and the nutrient factor in connection with the caste determination are discussed by Lenz (1976). It was our aim to find, whether under the impact of juvenoids morphologically and functionally perfect soldiers could be formed and what are the critical stages for induction of the soldier caste.

Methods and results: In previous experiments there was a predominance of soldier-worker (pseudergate) intercastes (not commonly occuring in nature). But especially in experiments with *Prorhinotermes simplex* some presoldiers, which developed under the impact of JHAs, are morphologically identical with those found in natural colonies. Long-run experiments with *Prorhinotermes* when experimental groups were kept in Petri dishes and fed with moistened pine wood showed that the JHA-induced presoldiers are capable to develop in perfect soldiers. Similarly with *Reticulitermes* it was possible to

Table 4. Effects of 0.02% hydroprene on differentiation of instar III larvae of *Prorhinotermes simplex*

Day	Larvae Instar III	Dead	Moulted into instar IV	Presoldiers Living	Dead
Start	35	—	—	—	—
6	33	1	1	—	—
10	32	2	1	—	—
15	15	7	5	8	—
20	8	10	6	11	—
26	5	10	7	13	—
32	4	11	7	2	11
40	0	15	7	0	13

For notes see Table 3

Table 5. Effects of 0.02% hydroprene on differentiation of instar III larvae of *Reticulitermes lucifugus santonensis*

Day	Larvae Instar III	Dead	Moulted into instar IV	Presoldiers	
				Living	Dead
Start	30	—	—	—	—
5	30	—	—	—	—
10	25	—	—	6	—
13	19	1	1	9	—
15	14	2	1	13	—
16	9	2	1	18	—
17	1	2	2	25	—
20	0	3	2	10	15
23	0	3	2	0	25

For notes see Table 3.

develop perfect soldiers out of artificially induced presoldiers, after treatment with compound (4). Thus for instance out of 28 presoldiers kept in combined group with pseudergates five moulted into perfect soldiers after 17 days. Introduction of labelled, artificially induced presoldiers into groups devoid of soldiers of their own revealed the former to continue gradually in moulting with the result of a proportionally adequate number of soldiers thus produced finally being tolerated in the colony which began to built up out of the experimental group.

JHA (hydroprene was used in these experiments) treatment also permits assessment of the developmental potential in the individual instars. Thus for instance it was easier in some species (*Cryptotermes brevis, Neotermes castaneus)* to induce development to soldiers from nymphs (with wing pads) rather than from stages lacking wing pads (larvae).

In *Prorhinotermes simplex* development to the soldier caste could be induced artifically as early as in the second larval instar (see Table 3) Under JHA presence (0.02% hydroprene) the first instar larvae continued to develop as larvae During 14 days of experimentation out of 14 instar I larvae 10 died and 4 moulted into instar II larvae. In natural starting colonies of this species small soldiers have been found which only developed as late as from instar III larvae (Miller, 1942). The differentation of presoldiers from third instar larvae was proved artificially by JHA treatment too (see Table 4).

In *Reticulitermes* also a great number of instar III larvae can be induced to develop into presoldiers (the same instar as in starting colonies in nature — see Table 5). Treatment of the younger larval instars failed to give a rise of white soldiers or soldier intercastes. Under 0.02% hydroprene treatment out of 70 instar I larvae during 14 days 5 died and the rest (65) moulted into instar II larvae. If 40 instar II larvae were treated, during 15 days, 5 of them died and 35 continued to develop as pseudergate larvae.

Tests with starting colonies

It is of our major interest whether the induction of supernumerary soldiers may possibly lead to a disbalance in the caste ratio and to disorder of the social organization not only in artificially set up termite groups, but also in complete colonies. Experiments with the mature *Kalotermes flavicollis* colonies treated with JHA were reported by Lenz (1976).

Material and method: We tested JHA on starting colonies of the American dampwood termite, *Zootermopsis nevadensis* under arrangements approximating natural conditions. At the beginning of the experiment the colony consisted of a pair of primary (or supplementary) reproductive, 2 to 24 larvae and, as a rule, one small soldier was present The colonies were moved into hollow pine stumps *(Pinus silvestris)* impregnated, beforehand, with hydroprene. Apart from the control groups the experiment included three series, each containing five colonies with graded juvenoid doses applied and comprising on average: A — 0.037 mg hydroprene/cm^3 wood (0.034—0.041); B — 0.38 (0.33—0.43) mg/cm^3; C — 3.89 (3.25—4.45) mg/cm^3.

Results: Whereas in the control blocks the development of the starting colonies was normal, variants with higher JHA doses (B and C) revealed mortality of insects (in C, except one imago, all termites were dead within 31 days). In the variant including the lowest dose the termites survived without giving rise to presoldiers or intercastes.

PRELIMINARY FIELD TRIALS

Our first field experiments in pinus forests at province Pinar del Rio of Cuba (Sierra Cajalbana) when treating the pine stumps infested with *Prorhinotermes simplex* proved unsuccessful. During August 1974 we placed cellulose cotton wool impregnated with 25 ml 1% emulsion of hydroprene, methoprene (good activity of methoprene for termites in laboratory experiments is known: Lenz, 1976) and compound (3) into stumps of *Pinus carribea* infested with termite colonies. All variants were repeated four times. Inspection conducted after 20—30 days in all cases failed to reveal any changes in the colonies and no intercastes or presoldiers were found. Similarly to most field trials with JHAs as control agents against agricultural pests our results might possibly reflect low stability and high evaporation rate of the compounds.

PERSISTANCE OF JUVENOIDS IN TERMITE LABORATORY TESTS

Rapid loss of biological activity of JHAs treated filter papers can be shown in tests with termites. Whereas immediate exposition of larvae and pseudergates of *Reticulitermes lucifugus santonensis* to moist filter papers treated with 0.5 and 0.05% hydroprene solutions (for method see "Screening") induced the development of a great number of presoldiers or intercastes, papers impregnated with 0.5% hydroprene incurred total loss of biological effectiveness after one week under artificial light (fluorescent tubes) in the laboratory and, similarly, papers kept in darkness proved almost ineffective within the same period of time. Similar results were obtained with compound (3). Its biological effectiveness to termites was maintained in 0.5% solution treated papers stored in darkness for one week, but was totally lost in papers subjected to artificial light for the same period of time.

The common formulations have proved of no substantial effect on the biological activity of juvenoids. The commercially available emulsion of hydroprene (Altozar) had a lethal effect on termites in 0.5% concentration and manifested a pronounced JH effect — the emergence of many supernumerary soldiers if the concentration was 0.05%. Technical hydroprene in emulsion with Tween 20 had a similar effect.

DISCUSSION AND SUMMARY

Juvenile hormone is the regulating factor responsible for the control of the soldier caste development probably in both, the lower as well as in the higher

termites. This kind of biological activity was proved in two out of three at present known JH structures, namely in the JH II (C_{17}) and JH III (C_{16}) and in several JHAs. In most termite experiments the two commercially available juvenoids, hydroprene (Altozar) and methoprene (Altosid) were used. The biological activity of hydroprene (2), of the 11 chlorine analogue of pharnesol acid (3) and of tetrahydrophuryl analogue of methoprene (4) seems to be approximately the same according to our findings.. The same level of activity is to be expected with methoprene and some other compounds according to the reports published previously (Lenz, 1976; Chu Hsang-hsoung, Tai Tchi-dar et al., 1974).

In this context we should like to point out the difficulties underlying the assessment of effective doses of JHAs. In termite tests, as a rule, the JHA action is very complex consisting of contact, feeding and vapour effects. The critical concentration of the effective compound may be estimated; however, further increases in concentration obviously do not necessarily entail greater numbers of larvae being transformed into presoldiers. This is largely dependent on the physiological condition of the recipient.

The relation between chemical structure and biological activity is difficult to evaluate. Fairly active substances on termites seem to resemble the natural JHAs. Much depends on how rapidly the substances degradate under the influence of environmental factors or how they are metabolized. In termites likewise in all social insects the level of final effects may be substantially influenced by the ability of the compound to be transmitted in biologically active form through the colony by trophalactic or rectal feeding.

Other critical points raised are the homeostatic relationship between the castes within the colony of social insects and the mechanisms responsible for their maintenance. Action of this factor evidently, may be discontinued in particular situations, e. g. in experiments with artificially created termite groups. We still lack sufficient experiences with complete termite colonies in the field to be able to qualify the failures so far as either methodical drawbacks, or insufficient persistance of the JHAs under investigation, or as a reflection of just a sort of "homeostatic resistance" which does not permit the balance of castes in natural termite colonies to be disturbed.

Experiments with other representatives of social insects produced some more evidence on the regulatory function of exogenous JHs (or JHAs) in insect colonies. E. g. experiments with honeybee (Wirtz & Beetsma, 1972; Hrdý, 1973; Žďárek & Haragsim, 1974; de Wilde, 1976), with the fire ant (Troisi & Riddiford, 1974) or with the pharaoh's ant. The results of experiments, when applying JHAs for pharaoh's ant control seem to be most promising (Edwards, 1975a, b; Hrdý, Křeček et al., 1977; Rupeš, Hrdý et al., 1978) among the aims for practical use of juvenoids against insect pests.

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NOTES ON GROWTH AND SYSTEMATICS OF ALBURNOIDES BIPUNCTATUS (PISCES, CYPRINIDAE)

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Abstract: The biometrical characteristics of 54 specimens of *Alburnoides bipunctatus* (Bloch, 1784) from the river Ogosta (Bulgaria) are delt in this paper. Growth was studied in specimens from Bulgaria and Czechoslovakia (sample from Moravia, river Rokytná at Vémyslice, of 33 specimens). Meristic and morphometric characters of Bulgarian specimens from the river Ogosta and those of Central Europe, both produced to be nominal sub-species *Alburnoides bipunctatus bipunctatus*. *A. b. bipunctatus* from Bulgaria shows some differences. Specimens from Bulgaria grow at higher rate than those of Czechoslovakia.

INTRODUCTION

Regarding the systematics of *Alburnoides bipunctatus* in Central Europe little is known. Only Kabisch (1974) studied taxonomically 128 specimens from river Oslava and compared his observations with that of Žukov (1965) and Skóra (1972). Berg (1949) also gave an account of this species from the territory of USSR. Banarescu (1964) studied this species from the territory of Rumania and gave same as Berg (1949), the account of different subspecies of *Alburnoides bipunctatus*. Because a sample of *Alburnoides bipunctatus* from Bulgaria was to disposal, it seemed useful to compare it with the data of Žukov (1965), Skóra (1972) and Kabisch (1974).

As far as growth studies are concerned no data are available of this species from Czechoslovak territory. Smišek (1948) gave note on three specimens from river Rimava of body lengths 109, 97, 82 mm, first two females, the third male, age 5, 4, 3 years respectively. Žukov (1965) has found low growth in this species from White Russia. Skóra (1972) also studied the growth in this species from Polish Waters.

MATERIAL AND METHODS

For the purpose of present investigations 54 specimens were collected in Bulgaria from the upper part of river Ogosta (43° 20′ north width, 23° east length) by Dr. O. Oliva and Mr. M. Živkov on August 28, 1967. The upper part of river Ogosta has got mild continental, comparatively warm climate. The spring is situated at about 2000 meters above the sea level. This area is thinly populated by human population and main vegetation consist of Beech and Oak trees. 33 speci-

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Table 1. Morphometric and meristic analysis of the data on *Alburnoides bipunctatus* from Bulgaria

Characters	Average	Ranges
Body length in mm	63.9	54–78
Dorsal fin rays. Unbranched	II	II
Dorsal fin rays. Branched	8	7– 9
Anal fin rays. Unbranched	II	II
Anal fin rays. Branched	14.8	13–18
Lateral line scales	45.8	40–48
Scales above lateral line	8.7	7– 9
Scales below lateral line	4.7	4– 5
Branchial spines	8.5	7–10
In % of body length:		
Head length	24.4	21–27
Antedorsal distance	53.3	45–57
Postdorsal distance	32.3	29–37
Min. body depth	10.1	8–13
Max. body depth	24.7	21–27
Length of caudal peduncle	20.2	16–24
Length of dorsal	12.6	10–16
Depth of dorsal	21.3	19–25
Length of anal	16.3	14–30
Depth of anal	16.9	13–20
Length of pectoral	18.7	15–22
Length of ventral	14.7	13–18
Distance P–V	21.8	18–24
Distance V–A	18.3	16–23
Length of caudal	22.7	20–27
Eye diameter	6.9	6.3–7.8
Preorbital distance	7	6.3–7.8
In % of head length:		
Preorbital distance	28.3	24–33
Eye diameter	27.8	25–31
Post-orbital distance	45.9	37–54
Head depth	68.4	60–80
Interorbital distance	31.4	25–40
In % of interorbital distance:		
Eye diameter	88.4	80–95
In % of caudal peduncle length:		
Depth of caudal peduncle	58	45–70
Min. body depth	51.5	43–66
In % of distance P–V:		
Length of pectoral	84.4	65–100
In % of distance V–A:		
Length of ventral	81.7	75–100

mens from river Rokytná at Vémyslice (49° north width, 16° 15′ east length) by Ing. M. Peňáz on 15th—16th October, 1973. The specimens were preserved in 70% alcohol and deposited in the ichthyological collections of Department of Systematic Zoology, Charles University, Prague. The material was analysed for systematic studies using the methods described by Tandon (1976).

For the studies of scales, "Meopta" microscope was used with the objectives 8×,

0.15×. The scales were removed from first, second or some times third row above the lateral line and below the dorsal fin from every specimen and were studied in dry mounts. For the construction of graph and counting of annuli diagonal radius of scale was measured. Since the specimens from Bulgaria were almost of same size ranging from 69 to 89 mm of standard length and this fact was not prosperous for constructing graph for body/scale relationship, another 33 specimens from Moravian locality (river Rokytná at Vémyslice) where the ranges greater (from 43 to 103 mm of standard length) were studied.

All the measurements are taken to the nearest millimeter, except in case of eye diameter, which was measured with the accuracy of ± 0.1 mm.

The specific rate of linear growth has been calculated by using the formula:

$$C1 = \frac{l_2 - l_1}{L_1} \cdot 100$$

Where C1 = Specific rate of linear growth.

l_1 l_2 .... mean computed standard lengths in mm at successive years of life.

RESULTS AND DISCUSSION

The results of the present investigations for systematic studies are presented in Table I and are compared mainly those of Kabisch (1974) from river Oslava (49° 10′ north width, 16° east length). The following characters show decreasing trend than the data of Kabisch (1974).

Lateral line scale in ave. 45.8 in Ogosta, 48.1 in Oslava; transverse scales above the lateral line 8.7 in Ogosta, 9.8 in Oslava; transverse scales below lateral line 4.7 in Ogosta 5 in Oslava. In the proportion of standard length the post-dorsal distance in ave. 32.3 in Ogosta, 38.2 in Oslava; maximum body depth 24.7 in Ogosta, 26.7 in Oslava; length of caudal peduncle 20.2 in Ogosta, 21.6 in Oslava; length of dorsal fin 12.6 in Ogosta, 13.8 in Oslava; depth of dorsal fin 21.3 in Ogosta, 22.5 in Oslava; length of caudal fin 22.7 in Ogosta, 24.7 in Oslava. In the proportion of head length the interorbital distance 31.4 in Ogosta, 35 in Oslava. In the proportion of pectoral-ventral distance the length of pectoral 84.4 in Ogosta, 86.6 in Oslava. In the proportion of ventral- anal distance the length of ventral fin 81.7 in Ogosta, 84.1 in Oslava..

Table 2. Growth of different age classes of *Alburnoides bipunctatus* from Bulgaria

No. of specimens	Age group	Average standard length in mm		Average back-calculated length in mm		
				l_1	l_2	l_3
1	I	60		46		
29	II	63		43	53	
	Min. range	55		32	45	
	Max. range	70		53	67	
24	III	65		36	49	60
	Min. range	57		30	42	52
	Max. range	79		45	65	74
			Average	42	51	60
			Annual increment	9	9	
			Max. body length	53	67	74
			Min. body length	30	42	52
			Absolute increment	42	9	9
			Specific rate of linear growth	21	17	

Other characters given below show greater ranges between the lower and upper limits and mean values than the data of Kabisch (1974) e. g., in the proportion of standard length the head length 21–27 (24.4) in Ogosta, 21–24 (22.5) in Oslava, minimum body depth 8–13 (10) in Ogosta, 7–11 (9.5) in Oslava; eye diameter 6.3–7.8 (6.9) in Ogosta, 5–7 (6.3) in Oslava; preorbital distance 6.3–7.8 (7) in Ogosta, 5–7 (6.6) in Oslava. In the proportion of interorbital distance the eye diameter 80–95 (88.4) in Ogosta, 70–92 (81.5) in Oslava. In the proportion of caudal peduncle length the depth of caudal peduncle 45–70 (58) in Ogosta, 48–67 (57.1) in Oslava; minimum body depth 43–66 (51.5) in Ogosta, 37–53 (44.1) in Oslava.

The comparison of Žukov's data (1965) and the author's data reveal the following similar characters e. g..; lateral line scales; in the proportion of standard length, the head length, length of the caudal peduncle distance between pectorals and ventrals and length of caudal.

Skóra's (1972) data also show similar characters when compared with the author's data, e. g.; anal branched rays, in the proportion of head length, post- and interorbital distances. In the proportion of standard length, the length of the caudal peduncle.

Skóra (1972) has observed the diminution and equalization of the relative variability of the morphological features in his sample. The author's investigations has also revealed the similar trend in certain characters, however few characters show higher or equal ranges, when compared with the data of earlier workers. The present sample is from the upper part of valley of river Ogosta, where the climate is comparatively warm. similar to mild continental climate, is responsible for mixed type of morphological characters. Mixed characters are due to the mixed type of climatic conditions existing in the upper part of valley of river Ogosta.

While comparing the meristic counts. minimum unbranched dorsal and anal rays, lateral line scales has been observed in the present sample, whereas the branched dorsal fin rays are similar to that of Kabisch (1974). Again there is a variability in the number of branched anal fin rays. This fact can be justified due the fact that the upper part of river Ogosta is situated at the height of 2000 meters above the sea level and is located at comparatively at higher altitude..

The present collection from river Ogosta is designated as nominal subspecies *Alburnoides bipunctatus bipunctatus* and its meristic counts are as follows:

$$\text{D II. 7–9. A II. 13–18, lateral line scales 40–48, transversal scales } \frac{9}{5}.$$

Banarescu (1964) has given the meristic counts of this subspecies as follows:

$$\text{D (II) III (7) 8 (9), A (II) III (11–12) 13–15 (16), L. l. } \frac{9}{4} \text{ 50 (55).}$$

Drenski (1951) studied the specimens of *Alburnoides bipunctatus* from Danubian drainage in Bulgaria and keeps as subspecies *A. b. bipunctatus* and gave the meristic counts as follows:

$$\text{D III. 8, A III. 12—15, lateral line scales 45 } \frac{9\text{—}10}{3\text{—}5} \text{ 51.}$$

Table 3. Growth of different age classes of *Alburnoides bipunctatus* from river Rokytná at Vémyslice, Czechoslovakia

No. of specimens	Age group		Standard lengths in mm	Average back-calculated lengths in mm						
				l_1	l_2	l_3	l_4	l_5	l_6	l_7
15	I	Mean	46	36						
		Min. range	39	27						
		Max. range	54	42						
2	II	Mean	56	28	43					
		Min. range	48	27	42					
		Max. range	65	30	53					
5	III	Mean	68	33	50	62				
		Min. range	64	27	48	59				
		Max. range	71	38	52	64				
7	IV	Mean	80	33	46	58	70			
		Min. range	71	26	38	51	61			
		Max. range	87	41	53	67	82			
1	V		78	37	51	58	67	74		
1	VI		99	31	44	55	61	75	88	
2	VII	Mean	101	32	43	59	71	78	88	97
		Min. range	100	27	36	55	70	74	83	95
		Max. range	103	37	50	63	72	82	93	99
		Average		33	46	58	67	76	88	97
		Annual increment		13	12	9	9	12	9	
		Min. body length		26	36	51	61	74	83	95
		Max. body length		42	53	67	82	82	93	99
		Absolute increment		33	13	12	9	9	12	9
		Specific rate of linear growth		39	26	15	13	15	10	

It appears from the above discussion that there are differences within the nominal subspecies *A. b. bipunctatus*.

For growth analyses scales from specimens ranging from 69 to 89 mm from Bulgaria and 43 to 103 mm from Moravia were studied. The results are presented in Tables 2 and 3. Age groups I to III in Bulgarian specimens and I to VII in Moravian specimens are recorded.. The body length/scale diagonal radius

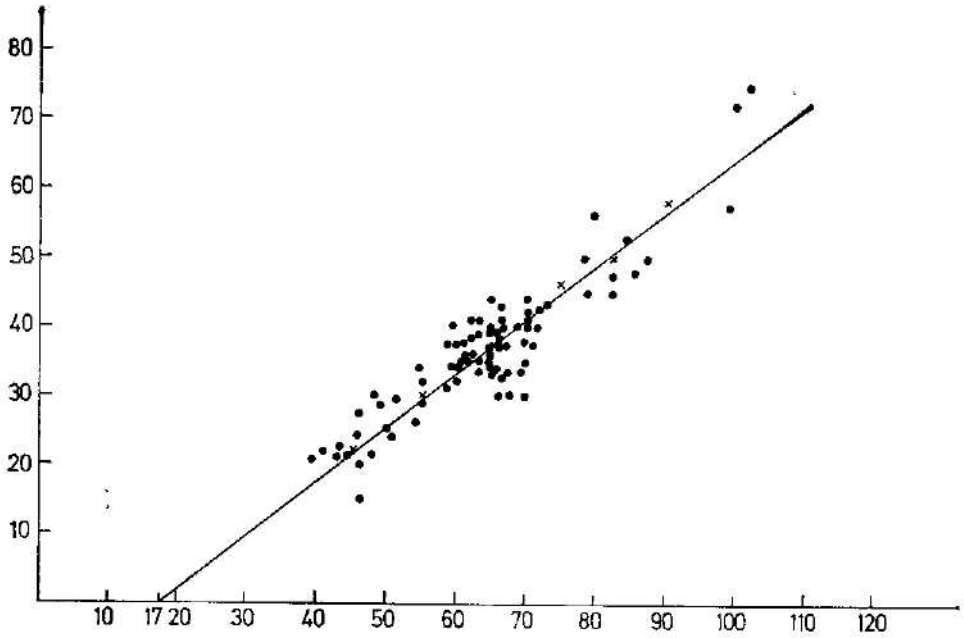

Fig 1. Relationship between body length and scale radius in *A. bipunctatus* of the mixed material from rivers Rokytná (Czechoslovakia) and Ogosta (Bulgaria). Body length (mm.) is along abscissa and scale radius (in mm.) is along ordinate. Dots = original counts, crosses = average readings at 10 mm interval.

relationship (Fig. 1) shows that the scale formation appeared at 17 mm of standard length. The back-calculated lengths, using 17 mm as a correction factor, indicate that the first annulus was formed when the fish has attained an average size of 42 mm in Bulgarian population and 32 mm in Moravian population. The maximum specific rate of linear growth in Bulgarian population has been recorded between 1_2 and 1_1 (21 mm) and minimum between 1_3 and 1_2 (17 mm) and in Moravian population maximum between 1_2 and 1_1 (39 mm) and minimum between 1_7 and 1_6 (10 mm).

Žukov (1965) has found low growth in this species from river Western Dvina (55°–56° north with, 27°–31° 20′ east length). When the present investigations are compared with the other localities, it has been observed that the population from river Ogosta has maximum rate of growth (Table 4). The populations from the rivers Rokytná at Vémyslice and Western Dvina have practically the same rate of growth in the first year. In the second year population from Western Dvina showed maximum rate of growth (59 mm) and minimum from river Rokytná at Vémyslice (46 mm).

Table 4. Tabulation of data employed in comparing the average growths and growths ranges in *Alburnoides bipunctatus from different localities*

Locality	No. of specimens	l_1	l_2	l_3	l_4	l_5	l_6	l_7
River Ogosta,	54	42	51	60	—	—	—	—
Bulgaria (Author)	Min. range	30	42	52	—	—	—	—
	Max. range	53	67	74	—	—	—	—
River Rokytná,	33	33	46	58	67	76	88	97
at Vémyslice, Moravia	Min. range	26	36	51	61	74	83	95
(Author)	Max. range	42	53	67	82	82	93	99
Western Dvina	53	34	59	—	—	—	—	—
(Žukov, 1965)	Min. range	22	43	—	—	—	—	—
	Max. range	56	75	—	—	—	—	—

Skóra (1972) has ascertained the growth from upper part of rivers San and Dunajec (between 49° 50′–50° 20′ north width, 20°–20° 40′ east length). Skóra (1972) determined the age of the fish without using back-calculation method along with standard lengths. While comparing the present data using the same method with Skóra (1972) and Žukov (1965), it has been observed (Table 5.) that in the first year Bulgarian specimens grow at higher rate and in the subsequent years the populations from Polish waters are recorded to grow at higher rate..

Skóra (1972) observed that no growth difference could be observed between V and VI age groups. In the present investigations the similar rate of linear growth has been observed in IV, V and VII (9 mm.) and II and VI (12 mm.) year age groups.

It is evident from Table 5 that the rate of growth decreases in *Alburnoides bipunctatus* from southern to northern localities. The higher rate of growth in Bulgarian population is mainly due to total large size of specimens as compared to the populations from Rokytná at Vémyslice, Czechoslovakia, rivers San and Dunajec from Poland, and river Western Dvina from White Russia.

Table 5. Tabulation of data employed in comparison of growth in *Alburnoides bipunctatus* using standard lengths from different localities and their distribution within single age groups

Locality	No. of specimens	Standard lengths (mm) of different age groups								
		I	II	III	IV	V	VI	VII	VIII	IX
River San 424	Mean	48	64	79	87	96	104	110	112	129
and Dunajec,	Min. range	43	53	66	77	85	93	103	119	124
Skóra (1972	Max. range	54	79	93	98	105	114	118	123	133
River Rokytná 33	Mean	46	56	69	81	78	99	101	—	—
at Vémyslice	Min. range	39	48	64	71	78	99	100	—	—
Czechoslovakia	Max. range	54	65	73	87	78	99	103	—	—
Author										
River Ogosta, 54	Mean	60	63	65	—	—	—	—	—	—
Bulgaria	Min. range	60	55	57	—	—	—	—	—	—
Author	Max. range	60	70	79	—	—	—	—	—	—
West. Dvina, 53	Mean	34	59	—	—	—	—	—	—	—
White Russia	Min. range	22	43	—	—	—	—	—	—	—
Žukov (1965)	Max. range	51	75	—	—	—	—	—	—	—

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SUMMARY

Fifty four specimens of *Alburnoides bipunctatus* from river Ogosta (Bulgaria) were analysed for the systematics and growth studies. Growth studies are compared with 33 specimens from river Rokytná at Vémyslice (Czechoslovakia).

Morphometric and meristic characters of Bulgarian specimens are compared with the populations from rivers Oslava, Western Dvina and upper parts of rivers San and Dunajec. Some of the characters show decreasing trend due southward location of the upper part of the river Ogosta.

Eye diameter and postorbital distance when expressed in percentage of standard length are on the higher side.

Length of caudal fin, minimum body depth in the proportion of standard length and post and interorbital distances in the proportion of head length are similar to the populations from the rivers Western Dvina and the upper part of San and Dunajec.

The total length standard length conversion factor has been found out to be: total length = 1.239 standard length.

Basing on the scale studies three age groups from Bulgarian and seven age groups from Moravian population have been recorded.

The body length/scale length relationship indicates that the scale start appears at 19 mm standard length.

The maximum rate of growth has been observed in Bulgarian population.

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NOTE ON GROWTH OF SOME FISHES FROM THE RIVER DUNAJEC

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To the Memory of Professor Carl L. Hubbs (1894—1979)

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Abstract: Growth from the scale structure was studied in grayling *(Thymallus thymallus)*, pike *(Esox lucius)* and dace *(Leuciscus leuciscus)* captured in fishladder of Rožnów valley water reservoir on the river Dunajec.

INTRODUCTION

Juszczyk (1949 was the first who seriously studied the fish migration through the Rožnów dam fishladder situated on the river Dunajec in southern Poland. He continued his work in 1946—1949 and, finally, published the paper about passingg of fish through turbines of this dam (1951). During his operations he collected also numerous scale material, mostly from migratory sea-trout *(Salmo trutta trutta)*, which he kindly placed at our disposal. Observations on growth of the sea-trout were published later by Frank (1966, 1967).

In general, the fish fauna of the Dunajec were studied chiefly by ichthyologists of the Institute of Water Biology, Polish Academy of Sciences, Cracow (e. g. Skóra-Wlodek, 1969; Skóra, 1972). In the present communication we deal with the growth of three fish species which very rarely occur in the fishladder in single specimens (Juszczyk, 1951); barbel *(Barbus barbus)* was included in another observation (Oliva — Tandon — Naiksatam, 1979).

MATERIAL AND METHODS

The scales from grayling (11 sp.), pike (24 sp.), dace (8 sp.) were used for study and analysed in the usual way (see e. g. Oliva, 1955, 1956; Holčík — Hensel, 1972).

For back calculation of fork lengths of the grayling (tab. 1) diagonal scale radius was used, body/scale relationship found to be linear (compiled from scale measurements of graylings from the upper Vltava — Naiksatam, 1974 — and scale material of Prof. Juszczyk from the Dunajec), intercept (scale start) 35 mm, Lee's method used. For back calculations of standards lengths of the pike (tab. 2) ventrolateral radius of the scale was used, body/scale relationship assumed as linear, intercept (scale start) found to be 50 mm, Lee's method used. For back calculations diagonal scale radius of the dace (tab. 3) was used, scale measurements fullfilled by addition of material of small speciments of the dace from Bohemia (brook Hejlovka, 20. 9 1955 — back-water Řehákova bouda, 26. 9. 1953, brook Výmola, 23. 7. 1953 — brook Bojovský potok, Aug. 1948, riverine lake Slapy at Živhošť, 17.—24 7 1958). Assumed scale start 12 mm, Lee's method used.

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Table 1. Growth of different age classes of *Thymallus thymallus*

Age class	n	Fork length at the time of capture ranges	Ave.	Back calculated fork lengths l_1	l_2	l_3	l_4
I	2	213	213	129	—	—	—
II	6	219—272	256	103	211	—	—
III	2	280—322	301	111	232	274	—
IV	1	329	329	121	228	267	310
Total	11	average		116	224	271	310
		annual increment		108	47	39	
		max. calcul. fork lengths		129	232	274	
		min. calcul. fork lengths		103	211	267	

RESULTS AND DISCUSSION

1. *Thymallus thymallus* (Linnaeus, 1785). The grayling..

The scale samples were collected during 1946--1956. 11 specimens ranged in total length between 228 and 356 mm (ave. 288) and 199--306 mm (ave. 276) of standard length (= fork length, Smitt's length— from the tip of snout to the centre of fork of the caudal fin, see Chitravadivelu, 1971; Naiksatam, 1973; Oliva & Naiksatam, 1974). Fork length was obtained from the total length, which was only at disposal from Juszczyk's data, by using conversion factor (see Naiksatam, 1974). For body/scale relationship (using ventral diagonal radius) the data from graylings from the upper part of the river Vltava were used to have more numerous material (altogether 35 sp.). All scales were examined in dry mounting using a microprojector (Lesegerät Carl Zeiss, Jena) with 17.5 magnification. The growth of different age classes of the grayling is the following:
Having for comparison the table of Naiksatam (1974 : 108—110), the growth of grayling in the river Dunajec is close to values of the river Nitra basin (Danube drainage, Sedlár, 1970) and the upper Vltava (Labe drainage, Naiksatam, 1974). The average annual increments resemble those found by Balon (1961), showing, in general, good growth. .

2. *Esox lucius* Linnaeus, 1758. The pike.

The growth of the pike in central Europe was studied by numerous authors, the last revision being by Poupě (1974) and Tandon — Oliva (1976). Here are also described methods used for growth studies which were followed in the present communication. The growth of different age classes of the pike is given in Table 2. Although the submontane part of the Dunajec near Rožnów below the dam cannot be designated as suitable water body for the pike and belongs rather to the "barbel zone" (Frič, 1872), the growth rate of pike, especially during the first year of life, is rather high using for comparison the table of Poupě (1974. 283), and situated near values obtained from the pike of the Slapy valley water reservoir (Čihař, 1961) or the Lipno valley water reservoir (Frank & Vostradovský, 1961). In the second and subsequent years the growth of pike in the river Dunajec became slower than in most Czechoslovak localities, but, nevertheless, the size 800 mm after finishing 7 years was not observed, this standard length being reached by pikes in the

Table 2. Growth of different age classes of pike

Age class	n	body length at the time of capture ranges	ave.	l_1	l_2	l_3	l_4	l_5	l_6	l_7
				Back calculated lengths of body in mm						
I	3	290—335	313	187	—	—	—	—	—	—
II	6	353—405	377	222	307	—	—	—	—	—
III	12	380—575	457	215	300	394	—	—	—	—
IV	2	630	630	195	273	386	536	—	—	—
VII	1	865	865	175	274	358	452	550	702	800
Total		average;		198	289	379	494	550	702	800
		annual increment		91	90	115	56	152	98	
		max. calcul. lengths		222	307	394	536	550	702	800
		min. calcul. lengths		175	273	358	452	550	702	800

Table 3. Growth of different age classes of *Leuciscus leuciscus*

Age class	n	Standard length at the time of capture ranges	Ave.	l_1	l_2	l_3	l_4	l_5
				Back calculated lengths				
II	3	110—126	118	67	98	—	—	—
III	1	146	146	62	100	124	—	—
IV	2	170—178	174	61	97	128	163	—
V	2	188—210	199	72	102	129	163	188
Total	8	ave		66	99	127	163	188
		annual increments			33	28	36	25
		max. calcul. lengths		72	102	129	163	188
		min calcul. lengths		61	97	124	163	188

Orava valley water reservoir between 7th and 8th years (Balon, 1965) or the Bohemian "trophy pikes" after finishing the age 9 (Tandon & Oliva, 1976).

3. *Leuciscus leuciscus* (Linnaeus, 1758). The dace.

Data on growth from Central Europe are very scarce (Žukov, 1965; Penczak, 1967, Klimczyk – Janikowska, 1971). Leontovyč 1975) brought a major contribution to the knowledge of its growth in Czechoslovakia. The back calculated standard lengths are, according to Leontovyč (l. c.), as follows (in mm):

$l_1 = 59$, $l_2 = 94$, $l_3 = 129$, $l_4 = 158$, $l_5 = 178$, $l_6 = 195$, $l_7 = 205$, $l_8 = 217$. These values are in good agreement with our results, the growth rate of specimens from the Dunajec is better than in dace from Lódź plateau in Poland (Penczak, 1967), the upper Vistula and the river Czarna Przemsza (Klimczyk-Janikowska, 1971), lter in the river Dnieper and Nemen (Žukov,

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SUMMARY

1. The growth of the pike (*Esox lucius*), grayling (*Thymallus thymallus*) and dace (*Leuciscus leuciscus*) from the fishladder of the Rożnów dam on the river Dunajec was analysed using the scale method.
2. The back calculated lengths (Smitt's lengths) of grayling in succesive years are as follows" $l_1 = 116$, $l_2 = 224$, $l_3 = 379$, $l_4 = 310$ mm.
3. The back calculated lengths of pike are as follows: $l_1 = 198$, $l_2 = 289$, $l_3 = 379$, $l_4 = 494$, $l_5 = 550$, $l_6 = 702$, $l_7 = 800$ mm.
4. The back calculated lengths of dace are the following: $l_1 = 63$, $l_2 = 99$, $l_3 = 127$, $l_4 = 163$, $l_5 = 188$ mm.
5. Comparing values obtained, the growth rate of all examined specied was fast, probably due to the natural conditions for fish life in the Dunajec river, almost unattached in first postwar years through pollution caused by industry or another human activity, such as angling or intensive commercial fishery.

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CONTRIBUTION TO THE BIOLOGY OF REPRODUCTION AND GROWTH OF LEUCISCUS BORYSTHENICUS (PISCES, CYPRINIDAE) FROM THE DANUBE DELTA

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Abstract: Following the quantitative and qualitative biometrical investigation of gonads and the age determination in 90 specimens of *Leuciscus borysthenicus*, the structure by size, sex and age, the main indexes of growth and breeding biology, as well as the reproductive potential of this species' population from the lake Roşuleţ Danube Delta, were established.

Leuciscus borysthenicus (Kessler, 1859) — "small roach" — is a small sized chub inhabiting the slowly running and stagnant water bodies in the basin of the Black Sea, Azov and Egean seas (Maritza river drainage in Bulgaria and western slope of Anatolia).

This fish was first recorded from Roumania by Bănărescu in 1954. It is known to occur in the ecosystems of the Danube Delta, except the Razelm littoral lake. Bănărescu believes that this fish does not live upstreams of Brăila. The biology of this small-sized cyprinid fish, which has no economical value, was not studied in Roumania; all contributions in this problem were published by Soviet authors (Berg, 1932, 1949; Troitzki, 1941, Lebedev, 1969, etc). Its morphology was studied rather recently by Marinov (1964).

The present contribution includes a lot of data about the structure of populations, length and ponderal growth and main reproductive characteristics (sexual maturity, fecundity, egg-laying) of the population of *L. borysthenicus* from lake Roşuleţ, Danube Delta. These data, the first ones dealing with the biology of the species in Roumania, complete the knowledge about this species.

MATERIAL AND METHODS

The population structure by size and sex ratio was established by a biometrical study and dissection of 90 adult specimens collected in the first decade of April 1975 in the shallow lake Roşuleţ, Danube Delta. The age of the specimens was determined from scales in the latero-dorsal and anterior part of the body. The sex and the degree of maturity (using the scale of Kulaev and Meien for Cyprinidae and Percidae) were determined by dissection and histological examination of the gonads and taking into consideration the gono-somatic relation in both sexes.

The gono-somatic ratio (or maturity coefficient) is expressed by the relation between the weight of the gonads and that of the body (without gonads) in 20 females and 13 males. The reproductive potentiality of the population was estimated from the values of absolute and relative individual fecundity of the examined mature specimens. The first index was established by the gravimetric methods, the second according to

Table 1. The structure correlated with ages, body sizes and the state of maturation of the gonads for the *Leuciscus borysthenicus* population fished in the Rosulet lake (1976, 5—6 April)

Ages years	The length (without C) mm		The body weight g		State of maturation of the gonads	n	
	average	variation	average	variation		abs.	%
			females				
2	58	49—69	3.8	2.0— 6.0	III—IV	33	36.7
3	82	71—90	10.1	6.9—13.9	IV	14	15.6
			males				
2	57	48—65	3.1	1.7— 4.6	IV	37	41.1
3	70	65—76	6.2	5.0— 8.2	IV	5	5.5
4	100	—	18.7	—	IV	1	1.1

the method of Ivlev (1953). For determining the reproductive potentiality of a certain group (shoal, local population or large population) of aquatic animals, the significant parameter in the absolute fecundity — "abstract average of the specimens belonging to this group". The notion of "average" specimen includes the average age, average fecundity, average sex and in the case of specimens which do not spawn each year, the frequence of the spawning periods. The relation between the values of these indexes is represented by the formula:

$$Fp = \frac{Fa.\ \%\ ♀♀}{Spv}$$

Fp being the fecundity of the shoal or population.
Fa the absolute individual average fecundity ..
% ♀♀ the relative average number of females.
Spv the average structure of the population by age classes.

The type of gametogenesis and that of spawning were established after the development stage of the gonads and their histological prior to the spawning season.

RESULTS AND THEIR DISCUSSION

The datta concerning the structure by sizes and sexes of the *L. borysthenicus* population from lake Roşuleţ (the 5—6th April, 1975) are represented in the graphs of Fig.. 1.

These data show that the standard length of both males and females ranged between 48—49 and 100 mm and the weight between 1.7 and 18.7 g. This rather simple pattern of structure is due to the dominance of specimens of both sexes, the length of which ranged between 50 and 60 mm (56% females, 38,3% males); this size group, together with the specimens 60—70 mm long, represented more than 88%, respectively 67% of the specimens. The males were only slightly more numerous than the females (52.2% of the population).

Analyzing the structure by age, sizes and maturity stage it resulted that the population consists in mature females (stages III to IV and IV), 2 and 3 years old and males 2—4 years old. The two years old specimens were by far more numerous among both sexes. One specimen (62 mm long and 4.3 g) was a hermaphrodite, having a pair of testes and an ovary (Fig. 2); the sexual elements were in a stage of advanced atrezy (Fig. 3).

The average values of mature specimens were 48 mm and 1.7 g in males, 49 mm and 2 g in females, at the age of two years (Tab. 1). By comparing, in

Table 2. The rate of growth both in length and in weight for *Leuciscus borysthenicus* and other little freshwater minnows (M. Papadopol 1967—1975)

The fishing place and the date	The length (without C) mm for years				The body weight g for years				
	I	II	III	IV	I	II	III	IV	n
Leuciscus borysthenicus									
l. Roşuleţ, 1976	—	57	80	100	—	3.6	8.6	18.7	90
Alburnus alburnus									
l. Somova, 1959	68	78	91	105	3.1	6.2	8.7	13,5	134
Scardinius e. racovitzai									
l. Peţea, 1963	—	63	68	—	—	4.6	5.8	—	30
Phoxinus phoxinus									
r. Bega, 1962	27	53	62	71	0.3	2.9	5.0	7.8	18

each age-class, the extreme and average lengths and weights of both sexes, one remarks that in *L. borysthenicus*, as in many other Cyprinidae, the females show constantly higher values for length and especially for weights (Tab. 1). The pattern of growth is low like in other cyprinids which usually reach sexual maturity at the age of two years and have a short life: *Alburnus alburnus, Scardinius e. racovitzai, Phoxinus phoxinus*, a. o. (Papadopol, 1970) (Tab. 2). According to Troitzki (1941), cited after Berg (1949), in the Kuban river basin dominate 2 and 3 years old specimens, having average standard length of 62 and 74 mm..

Table 3 indicates the weights of the gonads, the gono-somatic relation in males and females and the average weight of an egg.

These data show that while the average weight of the gonads and of an egg are in direct relation with the body size, the gono-somatic relation shows a less regular variation, especially in females. Its value appears to be higher in small-sized and younger specimens, the average of index being 2.7% for males and 4.3% from the body weight without gonads, for females. The reproductive potential was estimated, as already mentioned, from the value of the absolute and relative individual fecundity of the population.

The absolute number of eggs from the gonads, e. g. the individual fecundity of females between 3.0 and 13.9 g and 2—3 years old, ranges between 2376 and 11.792; M = 5890 (Table 4), the wide range depending on the size, weight and age of the specimens. The reproductive potential of this population is about twice as high as that of the same species in Kuban river (about 2500 eggs according to Troitzki, 1941). The value of the absolute individual fecundity depends on the weight of the body. Significant are, in this respect, the data about this value established with the help of the method proposed by Williams (1959); these data are mentioned in Table 5.

According to the relation of Williams, the total number of eggs is directly proportional with the weight of the body and inversely proportional with the average weight of an egg in the ovary. In this dependence, the value of the gono-somatic relation plays the role of coefficient of proportionality or constant. This can be considered a unity of measure of the physiological effort used in the elaboration of the sexual elements.

Table 6 includes data on the variation of the relative fecundity of the females of *L. borysthenicus* in relation to size and age. The number of eggs for 1 g of body ranges between 100 and 1340, with an average value of 710. The mean

Table 3. The variation of body and ovaries weights, the gono-somatic report correlated with the *Leuciscus borysthenicus* females and males sizes, collected in the Roşulet lake (1976, Avril 5–6)

The length without C mm	The testes weight of ♂♂ mg		The gono-somatic report %		n	The ovaries weight of ♀ mg		The gono-somatic report %		The egg weight mg		n
	average	variation	average	variation		average	variation	average	variation	average	variation	
55–60	57	50– 80	2.7	1.9–3.2	3	110	100–120	3.4	3.6– 3.2	0.043	0.036–0.051	2
61–70	102	55–150	2.4	1.2–4.1	6	245	165–350	4.9	3.4–10.4	0.051	0.049–0.053	4
71–80	257	195–320	3.5	3.1–4.0	1	311	220–375	4.1	3.4– 5.2	0.062	0.050–0.073	7
81–90	450	385–615	4.0	3.8–4.3	2	490	207–670	4.6	3.8– 5.8	0.062	0.052–0.076	7
55–90	170	50–615	2.7	1.2–4.3	13	340	100–670	4.3	3.4–10.4	0.058	0.036–0.076	20

Table 4. The variation of the values of the absolute fecundity of the *Leuciscus borysthenicus* females from Roşulet lake, in relation on their sizes and ages

Body length without C mm	The number of eggs in ovaries		n	Body weight g	The number of eggs in ovaries		n	Ages years	The number of eggs in ovaries		n
	average	variation			average	variation			average	variation	
55–60	2588	2376– 2800	2	3.0– 4.9	2588	2376– 2800	2	2	4070	2376– 7070	6
61–70	4809	3336– 7070	4	5.0– 6.9	4451	3020– 7070	5	3	6692	3020–11792	14
71–80	5144	3020– 6720	7	7.0– 8.9	5580	3834– 6720	5				
81–90	8241	4884–11792	7	9.0–10.9	5902	4884– 7452	4				
—	—	—		11.0–13.9	9720	7708–11792	4				
55–90	5890	2376–11792	20	3.0–13.9	5890	2376–11792	20	2–3	5890	2376–11792	20

Table 5. The average of body and ovaries weights, the gono-somatic report and the absolute fecundity of the *Leuciscus borysthenicus* females from the Roşuleţ lake in relation to their sizes

The length without C mm	Body weight without ovaries (W) g	The ovaries weight mg	The gono-somatic report (p) %	The one egg weight (w) mg	The absolute fecundity established through count	F = p.W/w.100	n
55–60	3.33	110	3.4	0.043	2.588	2.610	2
61–70	5.11	245	4.9	0.051	4.809	4.909	4
71–80	7.80	311	4.1	0.062	5.144	5.145	7
81–90	11.16	490	4.6	0.062	8.241	8.280	7
55–90	7.99	340	4.3	0.058	5.890	5.927	20

Table 6. The variation of the relative fecundity of females of *Leuciscus borysthenicus* in the Roşulet lake, in relation the their sizes and ages

The length without C mm	The number of eggs for 1 g of body average	variation		Body weight g	The number of eggs for 1 g of body average	variation	n	Age years	The number of eggs for 1 g of body average	variation	n
55–60	358	100– 616	2	3.0– 4.9	358	100– 616	2	2	742	100–1340	6
61–70	934	697–1340	4	5.0– 6.9	852	455–1340	5	3	696	455–1033	14
71–80	660	455– 794	7	7.0– 8.9	713	466– 815	5				
81–90	731	505–1033	7	9.0–10.9	591	505– 716	4				
—	—	—	—	11.0–13.9	827	682–1033	4				
55–90	710	100–1340	20	3.0–13.9	710	100–1340	20	2–3	710	100–1340	20

value of this index shows rather strong oscillations depending on the body size and age; the values are higher in younger and smaller mature specimens.

In order to give a more complete estimation of the reproductive potential and efficience of reproduction of one species, besides the individual (absolute and relative) fecundity, also the fecundity of the population must be known. This parameter, in the acception of I v l e v (1953) depends, on the one hand, on the value of the absolute fecundity and on the relative number of females, and on the other hand, on the age structure of the population and on the frequence of spawnings during the vital cycles of the species. The fecundity of the *L. borystenicus* population from lake Roşu, estimated in the above mentioned manner was 136.352 eggs.

The reproductive potential of this species is practically the same as that of the *Alburnus alburnus* population from lake Somova (135.000) and much higher than that of *Scardinius erythrophthalmus racovitzai* from the thermal lake Peţea (67.163) — both species reaching about the same size as *L. borysthenicus* and having the same type of gametogenesis and spawning. There are no data in this respect on other populations of *L. borysthenicus* and therefore no comparison is possible. The gametogenesis and the spawning are synchronous in *L. borysthenicus*. The examination of the general condition of the gonads, and especially their histological study before the spawning season, made possible following findings:

1) The growth and the maturation of oocytes are asynchronous as in many other cyprinids which spawn during the warm months (*Alburnus, Scardinius, Carassius, Phoxinus*, etc).

2) The eggs (ovules) and ovocytes in different stages of maturation are relatively uniformly distributed in the ovaries; in each small fragment of the ovaries one can distinguish, in histological slides, four categories of elements: a) maturating ovules, having a diameter of 0.55–0.62 mm; b) large ovocytes with vacuolar cytoplasm, having a diameter of 0.33–0.38 mm; c) small semitransparent ovocytes with 1–2 rows of vacuoles in the peripheral cytoplasm and a diameter of 0.19–0.26 mm; d) extremely minute (diameter under 0.1 mm), in initial phases of growth (Fig. 4). The ovaries of the specimens studied, most of them being in the III-th to IV-th stage of maturation, did not allow to establish the numerical relation between ovules (eggs) and ovocytes. The study of histological slides allowed the conclusion that to the first spawning more than 50% of the eggs and ovocytes participate. Hence, the spawning is asynchronous, occurring two or three times in the season from the beginning of May to June; the very few references in the literature (Berg. 1949, Lebedev, 1969) mention the same period. Further field observations and the study of ovaries before and during the spawning season will allow a more thorough knowledge of this matter.

CONCLUSIONS

I. From the analysis of the size and structure and of the growth pattern of the population of *Leuciscus borysthenicus* from lake Roşulet, Danube Delta, the following conclusions can be drawn:

1) The population consists above all in sexually mature specimens of both sexes, with a standard length of 50–60 mm, 56% of which were two years old.

2) Both sexes were almost equally represented, with a slight prevalence of males (52.2%).

3) A hermaphrodite specimen was found, having a pair of testes and an ovary, the eggs being degenerated.

4) As in other cyprinids with relatively short sexual cycle, the growth pattern of *L. borysthenicus* is slow, the females are slightly larger than the males of the same age.

II. The study of male and female gonads before and during the spawning season, allowed following conclusions:

1) *L. borysthenicus*, like *Alburnus, Scardinius erythrophthalmus racovitzai, Phoxinus*, etc, belongs to the category of poly-cyclical early spawning cyprinids; both sexes reach maturity when they are two years old and have 48—49 mm in length and 1.7—2.5 g.

2) The reproductive potentiality is characterized by an absolute individual fecundity ranging between 2376 and 11.792 eggs and by a relative individual fecundity between 100 and 1340 eggs/g of body; the fecundity of the spawning stock is higher than 136.000 eggs. The first value is about twice as high as that of the females of *L. borysthenicus* from Kuban river, but practically identical to that of *Alburnus* from lake Somova, Danube Delta (136.000 eggs).

3) The gametogenesis is, as in the other small sized Cyprinidae, asynchronous; the females spawn two or three times during the breeding season, in May and June.

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The figures 1—3 will be found at the end of this issue.

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THREE NEW MESAPHORURA-SPECIES (COLLEMBOLA: TULLBERGIINAE) FROM EUROPE

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Abstract: Three new species from the subfamily Tullbergiinae (Onychiuridae) are described: *Mesaphorura atlantica* sp. n. from England, *Mesaphorura betschi* sp. n. and *Mesaphorura massoudi* sp. n., both from central France.

Mesaphorura atlantica sp. n.

(Fig. 1—9)

Diagnosis: Body 510 μm long, white. Lateral sensilla s on meso- and metanotum setaceous; sensilla p_3 on abdominal tergite V slightly thickened, spindle-like. Formula of pseudocelli 11/001/00001. Antennal segment IV with sensillae a—e, sensilla e thin. Postantennal organ with 38 simple vesicles in two parallel rows. Abdominal tergite V with 2+2 microchaetae between macrochaetae a_4. Anal lobes chatae $1'_2$ and $1'_3$. Anal spines of the same length as claw. Both sexes known.

Description: Body elongated, 510 μm long and 110 μm wide (Fig. 1, 2). White. Granulation on the whole body fine, on the lateral parts and medial line of notes and tergites slightly coarser. Dorsum of the head and abdominal tergite V with very fine granulation, granules about 0.5—0.75 μm in diameter. Chaetae 11—15 μm long, not differentiated into macro- and microchaetae (Fig. 1, 2). Longest chaetae (22 μm) on last abdominal tergite (Fig. 2). Dorsal chaetotaxy as in the following formula (Fig. 1, 2):

	I	II	III	I	II	III	IV	V
a	—	10	8[1])	10	10	10	10	8[3])
m	8	8	8	2	2	2	4[2])	—
p	—	8	8	10	10	10	10	8
pl	2	3	3	2	3	3	4	1

Lateral sensilla s on meso- and metanotum not thickened, setaceous, 17 μm long (Fig. 5). Sensory rod s' on meso- and metanotum 2 μm long, in a shallow pit (Fig. 5). Chaetotaxy of anal lobes as in Fig. 7, with $1'_2$ and $1'_3$ present.

Pseudocelli circular, 8 μm in diameter, with star-like centre (Fig. 6). Number and arrangement of pseudocelli (Fig. 1, 2): 11/001/00001. Pseudocella on metanotum posterolateral, behind p_4.

1) a_2 missing, 2) m_4 and m_5 present, 3) a_1 missing.

Antennae shorter than head (73 : 100 μm) (Fig. 1). Lengths of antennal segments I : II : III : IV as 15 : 16 : 20 : 22 μm. Antennal segment IV with five thickened sensillae a–e, two small sensory rods f and g and one small globular subapical papilla (Fig. 3). Sensilla d only weakly thickened. Antennal organ III

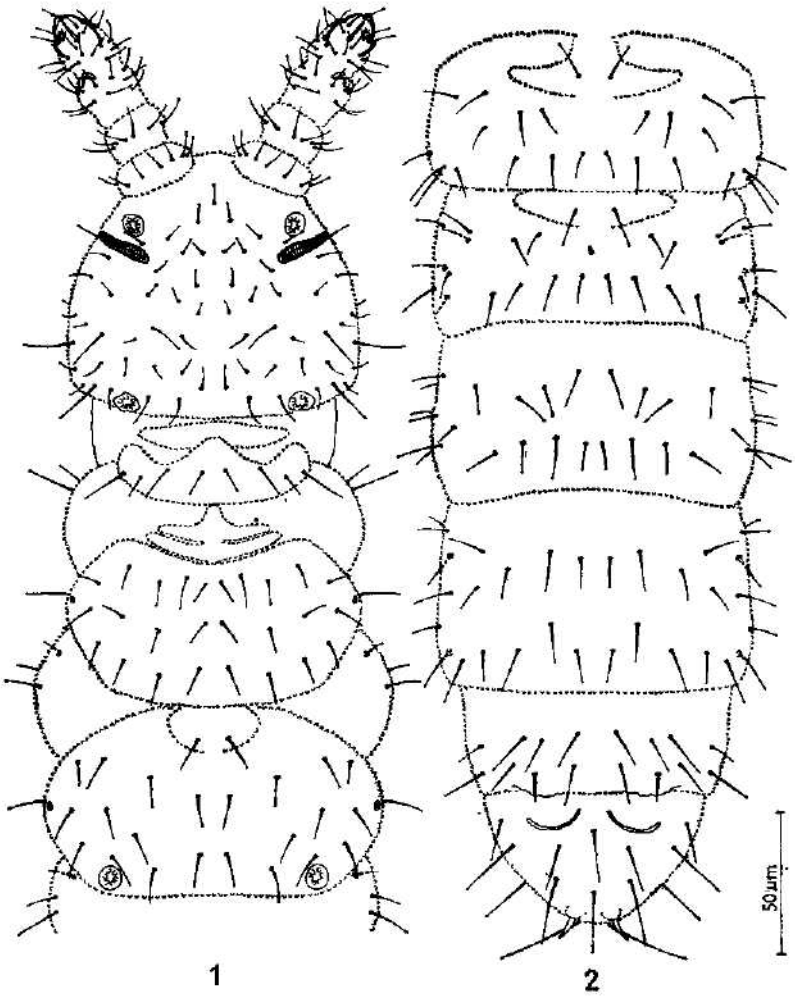


Fig. 1–2: *Mesaphorura atlantica* sp. n. 1 – dorsal chaetotaxy of head and thorax; 2 – chaetotaxy of abdominal tergites and pleurites I—VI. Scale: Fig. 1–2 50 μm.

(Fig. 3) consists of two small sensory rods concealed behing integumental fold and two thick sensory clubs bent toward each other. Thick, short sensory club present on the ventral side of antennal segment III (Fig. 3).

Postantennal organ (Fig. 6) 20 μm long and 4–5 μm wide. It consists of 38 vesicles lying in two parallel rows.

Legs short, without clavate tibiotarsal hairs. Claw without teeth, 13 μm long. Empodial appendage rudimentary, 1 μm long.

Abdominal tergite IV without transversal groove. Abdominal tergite V with slightly thickened spindle-like sensilla p_3, 10 μm long (Fig. 4). Abdominal tergite VI with two crescentic ridges anteriorly (Fig. 2) and two 13 μm long anal spines on low papillae (Fig. 2)..

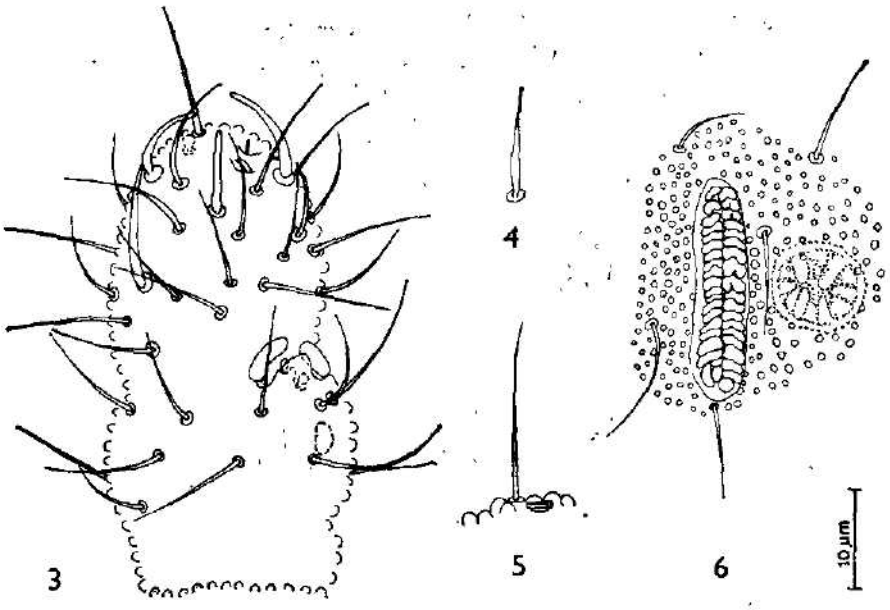


Fig. 3–6: *Mesaphorura atlantica* sp. n. 3 – dorsal side of antennal segments III and IV; 4 – sensilla p_3 from abdominal tergite V; 5 – lateral sensilla s and sensory rod s' from metanotum; 6 – postantennal organ and frontal pseudocellus. Scale: Fig. 3–6 10 μm.

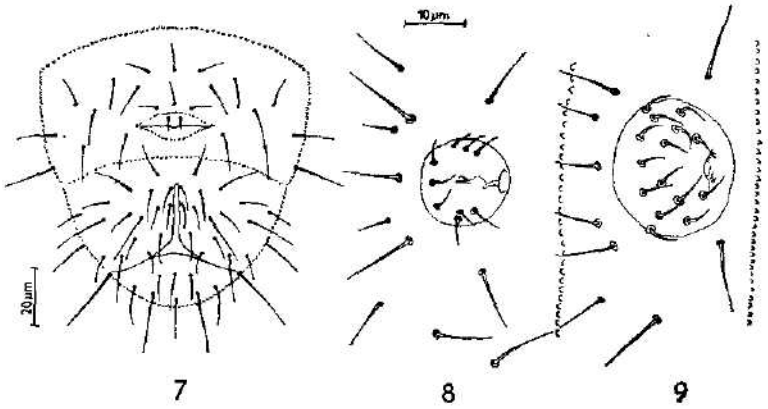
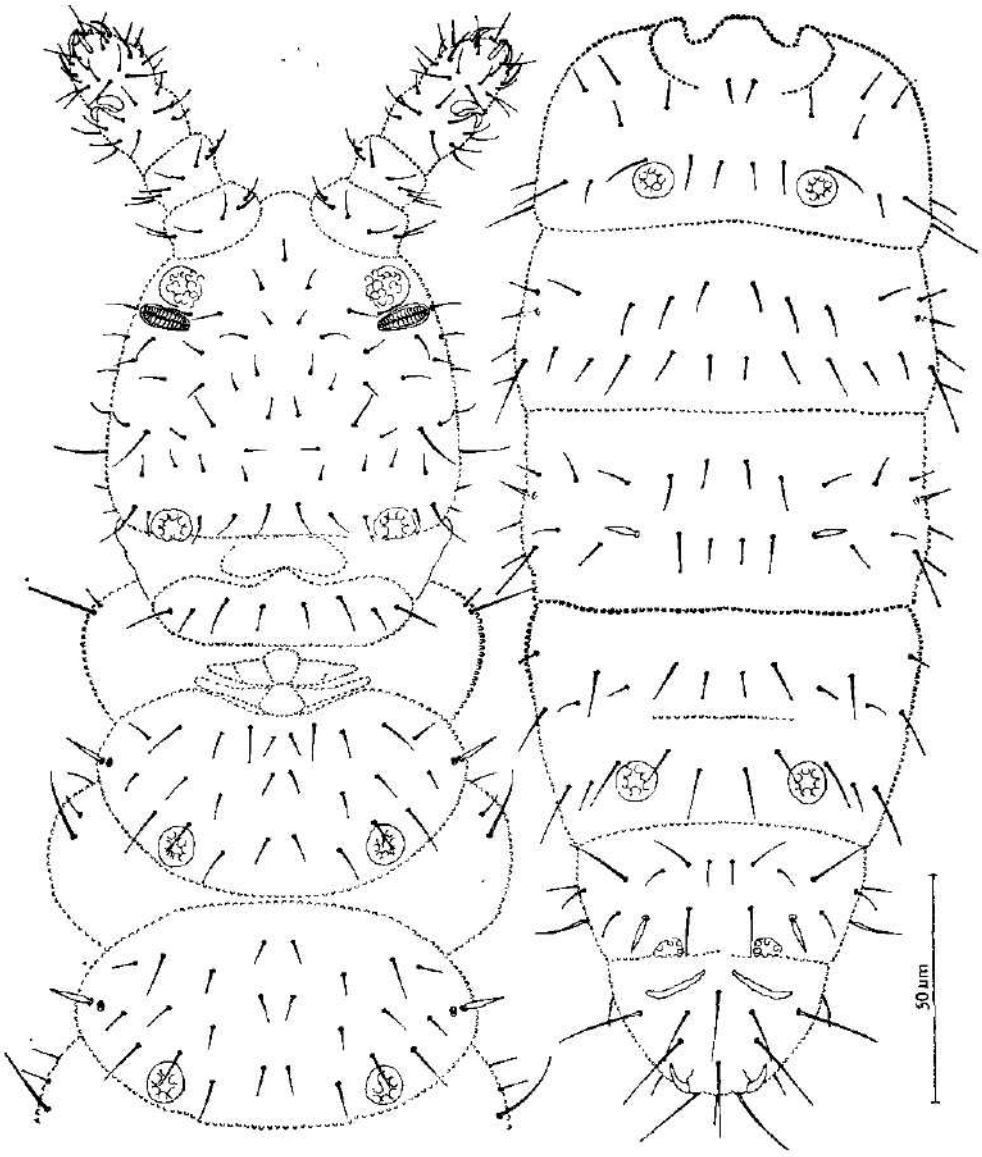


Fig. 7–9: *Mesaphorura atlantica* sp. n. 7 – chaetotaxy of abdominal sternite V and anal lobes of a female; 8 – genital plate of subadult male and chaetotaxy of surrounding area; 9 – genital plate of adult male and chaetotaxy of surrounding area. Scale: Fig. 7 20 μm, Fig. 8–9 10 μm.

Ventral tube with 6+6 chaetae. Venter without trace of furca. Genital plate of females as in Fig. 7. Male genital plate with 15 chaetae (Fig. 9), in subadult males only 9 chaetae present (Fig. 8).

Affinities: The chaetotaxy of abdominal tergite V, namely 2+2 anterior chaetae between a_4-macrochaetae, is the same as in *Mesaphorura sylvatica* (Ru-



10 11

Fig. 10—11: *Mesaphorura betschi* sp. n. 10 — dorsal chaetotaxy of head and thorax; 11 — chaetotaxy of abdominal tergites and pleurites I—VI. Scale: Fig. 10—11 50 µm.

sek, 1971), but the other characters are very different. The reduction of the pseudocellae on mesonotum and on abdominal tergite I is quite unique in the genus *Mesaphorura*. The new species differs from *M. sylvatica* also in the chaetotaxy of anal lobes (in *M. sylvatica* $1'_3$ missing), in the posterolateral position of pseudocelli on metanotum (lateral between m_5 and p_5 in *M. sylvatica*) and in some other characters..

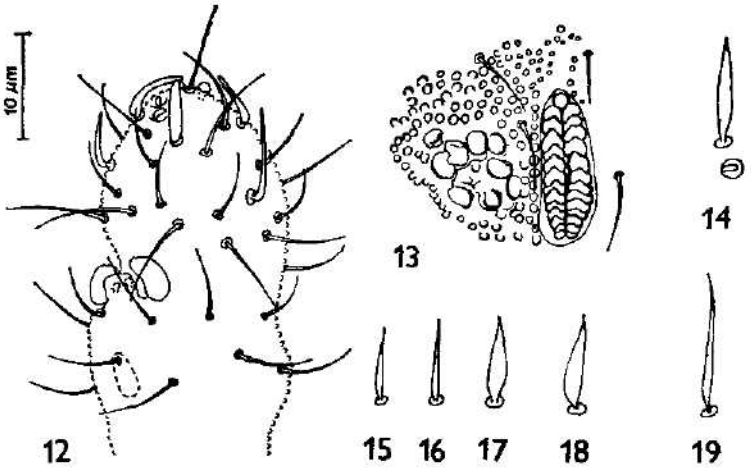


Fig. 12—19: *Mesaphorura betschi* sp. n. 12 — dorsal side of antennal segments III and IV; 13 — postantennal organ and pseudocellus; 14 — lateral sensilla s and sensory rod s' from metanotum; 15 — anterior sensilla from abdominal pleurite II; 16 — anterior sensilla p_3 from abdominal tergite II; 27 — sensilla p_3 from abdominal tergite III; 28 — — sensilla p_3 from abdominal tergite V; 19 — sensilla p_5 from abdominal tergite V. Scale. Fig. 12—19 10 µm.

Holotype ♀ No. 6. V. 1977/A-446 and some paratypes in author's collection, two paratypes in Entomological Department of the British Museum (Natural History), London.

Locus typicus: England, Welch Whittle Nr. Charnoch Richard, Lancs, 6. V. 1977 218 specimens (males : females as 3 : 5) in a soil sample from a coal shale tip, leg. Miss F. R. Moore, Liverpool.

Mesaphorura betschi sp. n.

(Fig. 10—19)

Diagnosis: Body 450 µm long, white. Lateral sensilla s on meso- and metanotum short, spindle-like, of the same shape as p_3 on abdominal tergites III and V. Formula of pseudocelli 11/011/10001. Antennal segment IV with sensillae a—e; d and e thin. Postantennal organ with 27 simple vesicles in two parallel rows. Abdominal tergite V with 3+3 anterior microchaetae between macrochaetae a_4. Anal lobes with chaetae $1'_2$ and $1'_3$. Anal spines of the same length as claw. Males and females known.

Description: Body elongated (Fig. 10, 11), 450µm long and 90 µm wide. White. Strongest granulation occurs on lateral and medial parts of nota and abdominal tergites, where the secondary granules reach 1—1.5 µm in diameter. Between these parts of stronger granulation fields of finer granulation occur.

Also whole abdominal tergite V has fine granulation. Only some macrochaetae well differentiated from the microchaetae (Fig. 10, 11). Dorsal chaetotaxy (Fig. 10, 11) as in following formula:

	I	II	III	I	II	III	IV	V
a	—	10	8[1])	8[2])	10	10	10	10
m	8	8	8	2[3])	2	2	4[4])	—
p	—	8	8	10	10	10	10	8
pl	2	3	3	2	3	3	4	1

Lateral sensilla s on meso- and metanotum spindle-like, 9 μm long (Fig. 14), of the same shape as sensilla p_3 on abdominal tergite III and p_3 on abdominal tergite V (Fig. 17, 18). Sensory rod s' on meso- and metanotum 2 μm long, in a small pit (Fig. 14). Anterior sensilla on abdominal pleurites II and III and p_5 on abdominal tergite V slightly thickened (Fig. 15, 16, 19). Chaetotaxy of anal lobes complete, chaeta $1'_2$ and $1'_3$ present. Lengths of some chaetae: metanotum — a_1 5 μm, a_3 5 μm, a_4 9 μm, m_1 5 μm, p_1 6 μm, p_3 7 μm, p_4 6 μm, p_5 10 μm; abdominal tergite IV — a_1 4 μm, a^2 10 μm, a_4 11 μm, p_1 9 μm, p_2 7 μm, p_3 11 μm, p_5 13 μm; abdominal tergite V — a_1 5 μm, a_2 7 μm, a_3 5 μm, a_4 14 μm, p_2 11 μm, p_5 13 μm.

Pseudocelli star-shaped (Fig. 13), 8 μm in diameter. Number and arrangement of pseudocelli as follows (Fig. 10, 11) : 11/011/10011. Pseudocelli on meso- and metanotum posterolateral, behind chaeta p_3 (Fig. 10).

Antennae shorter than head, as 65 : 75 μm. Lengths of antennal segments I : II : III : IV as 15 : 15 : 15 : 20 μm. Antennal segment IV (Fig. 12) with five sensillae a–e, two sensory rods f and g and small, globular apical papilla. Sensillae d and e thin. Antennal organ III (Fig. 12) consists of two small sensory rods concealed behind integumental fold and two thick sensory clubs bent toward each other. Thick, short sensory club present on the ventral side of antennal segment III (Fig. 12).

Postantennal organ (Fig. 13) 13 μm long, with 27 simple vesicles in two parallel rows.

Legs short, without knobbed tibiotarsal hairs. Claw without teeth, 8 μm long. Empodial appendage very short.

Abdominal tergite IV indistictly divided by a shallow groove into anterior and posterior parts. Abdominal tergite VI with two anterior crescentic ridges and two, 8 μm long anal spines on distinct papillae (Fig. 11). Ventral tube with 6+6 chaetae. Venter without trace of furca. Only females known.

Affinities: The new species is related to *Mesaphorura macrochaeta* Rusek, 1976. Both have the same repartition of pseudocelli and the same chaetotaxy, especially on abdominal tergites IV and V and on anal lobes. The new species differs from *M. macrochaeta* in the spindle-like shape of lateral sensilla s on meso— and metanotum and of chaeta p_3 on abdominal tergite III and in the slightly thickened anterior sensillae on abdominal pleurites II and III.

Holotype No. 11/7/77 T (0–1) and 36 paratypes in author's collection, further paratypes in J.-F. Ponge's collection (Brunoy).

Locus typicus: France centralis, Brunoy (near Paris) in the Park of the Laboratoire d'Ecologie générale, 11. VII. 1977 30 ♀♀ and 2 ♂♂ in soil samples

1) a_2 missing, 2) a_2 missing, 3) m_4 present, 4) m_4 and m_5 present.

(Moderrendzina) from a forest with *Carpinus betulus* (alliance *Fraxino-Carpinion*) with *Mercurialis perennis* and *Arum maculatum* in understory, leg. J.-F. Ponge.

Derivatio nominis: The new species is dedicated to my friend Dr. J.-M. Betsch, Laboratoire d'Ecologie générale, Brunoy (France), who has been contributing extensively to our knowledge of Collembola.

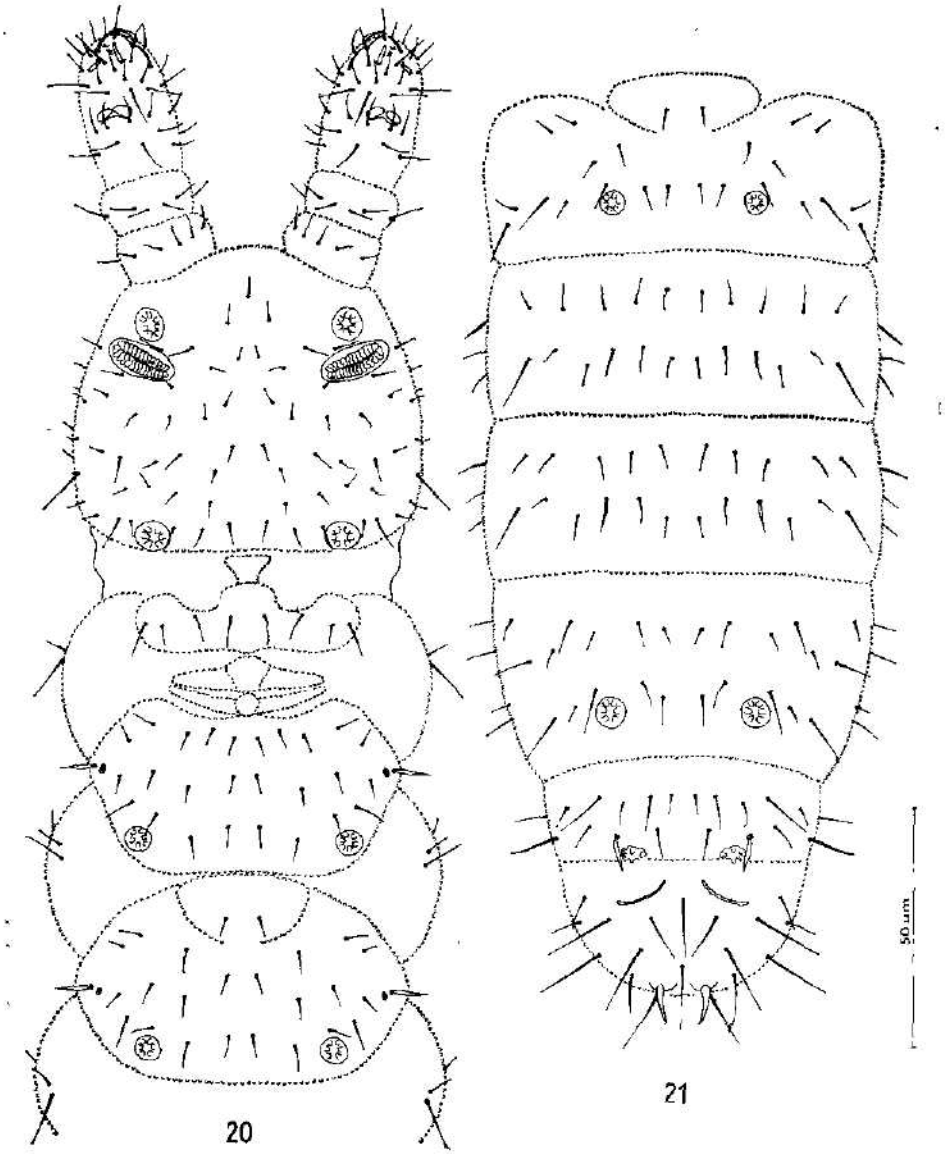


Fig. 20—21: *Mesaphorura massoudi* sp. n. 20 — dorsal chaetotaxy of head and thorax; 21 — chaetotaxy of abdominal tergites and pleurites I—VI. Scale: Fig. 20—21 50 µm

Mesaphorura massoudi sp. n.
(Fig. 20—34)

Diagnosis: Body 400 μm long, white. Lateral sensilla s on meso- and metanotum short, slightly spindle-like thickened. Chaetae p_3 on abdominal tergites II and III and anterior ones on pleurites II and III slightly thickened. Formula of pseudocelli 11/011/10011. Antennal segment IV with sensillae a–e; d short and thick. Postantennal organ with 28 simple vesicles in two parallel rows. Abdominal tergite V with 3+3 microchaetae between a_4 – macrochaetae and with spindle-like sensilla p_3. Anal lobes with chaetae $1'_2$ and $1'_3$. Anal spines of the same length as claw. Males and females known. Both sexes with slightly thickened 1+1 chaetae posterolaterally from genital plate.

Description: Body elongated, 400 μm long and 75 μm wide (Fig. 20, 21). White. Granulation on the whole body fine, on the lateral and medial parts of notes and tergites slightly coarser (diameter of granules over 1 μm). Dorsum of head and abdominal tergite V finely granulated, granules about 0.5—0.75 μm in diameter. Chaetae 4—11 μm long, weakly differentiated into macro- and microchaetae (Fig. 20, 21). Longest chaetae (15 μm) on last abdominal tergite (Fig. 21). Dorsal chaetotaxy as in following formula (Fig. 20, 21):

	I	II	III	I	II	III	IV	V
a	—	10	8[1])	8[1])	10	10	10	10
m	8	8	8	2	2	2	4[2])	—
p	—	8	8	10	10	10	10	8
pl	2	3	3	2	3	3	4	1

Lateral sensilla s on meso- and metanotum spindle-like thickened (Fig. 25), 8 μm long. Sensory rod s' on meso- and metanotum 1 μm long, in a shallow pit (Fig. 25). The following chaetae are spindle-like thickened: p_3 on abdominal tergites II (Fig. 26), III (Fig. 27) and V (Fig. 30), anterior chaeta on pleurites II and III (Fig. 23, 24) and posteromedial chaetae on abdominal sternite V (Fig. 32—34).

Chaetotaxy of anal lobes as in Fig. 32, with $1'_2$ and $1'_3$ present.

Pseudocelli circular, 8 μm in diameter, with star-like centre (Fig. 31). Number and arrangement of pseudocelli (Fig. 20, 21): 11/011/10011. Pseudocelli on meso- and metanotum posterolateral, behind p_4.

Antennae shorter than head, as 54 : 70 μm. Lengths of antennal segments I : II : III : IV as 10 : 13 : 15 : 16 μm. Antennal segment IV with five thickened a–e, two small sensory rods f and g and one small subapical papilla (Fig. 22). Sensilla d shortest. Antennal organ III (Fig. 22) consists of two small sensory rods concealed behind integumental fold and two thick sensory clubs bent toward each other. Thick, short sensory club present on the ventral side of antennal segment III (Fig. 22).

Postantennal organ (Fig. 31) 13 μm long and 4—5 μm wide. It consists of 28 vesicles lying in two parallel rows.

Legs short, without clavate tibiotarsal hairs. Claw without teeth, 9 μm long, empodial appendage rudimentary, 1 μm long.

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1) a_2 missing, 2) m_4 and m_5 present.

Abdominal tergite IV without transversal groove. Abdominal tergite V with spindle-like sensilla p_3 8 μm long (Fig. 30), p_5 slim (Fig. 29), 11 μm long. Abdominal tergite VI with two crescentic ridges anteriorly (Fig. 21) and two 9 μm long anal spines on low papillae (Fig. 21).

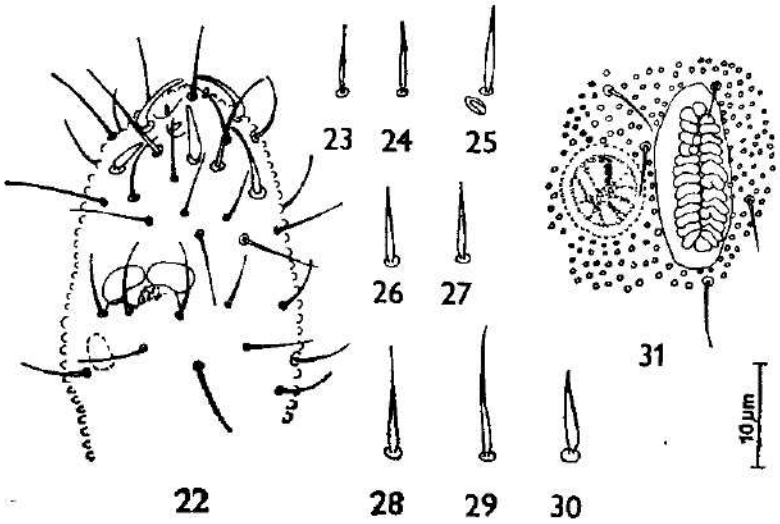

Fig. 22–31: *Mesaphorura massoudi* sp. n. 22 – dorsal side of antennal segments III–IV; 23 – anterior sensilla from abdominal pleurite II; 24 – anterior sensilla from abdominal pleurite III; 25 – lateral sensilla s and sensory rod s' from mesonotum; 26 – sensilla p_3 from abdominal tergite II; 27– sensilla p_3 from abdominal tergite III; 28 – chaeta p_3 from abdominal tergite IV; 29 – chaeta p_5 from abdominal tergite V; 30 – sensilla p_3 from abdominal tergite V; 31 – postantennal organ and pseudocellus. Scale: Fig. 22–31 10 μm.

Ventral tube with 6+6 chaetae. Venter without trace of furca. Genital plate of male with 12 chaetae (Fig. 32, 33). Females with 3+2 microchaetae on the lid of genital papilla (Fig. 34). Abdominal sternite V with 1+1 spindle-like sensilla, 4 μm long, posterolateral from the genital plate (Fig. 32–34).

Affinities: *Mesaphorura massoudi* sp. n. is related to *Mesaphorura betschi* sp., n., but the lateral sensilla s on meso- and metanotum and the spindle-like sensilla p_3 on abdominal tergite III are slimmer in *M. massoudi*, which has also the anterior sensillae on abdominal pleurites II and III and p_3 on abdominal tergite II slightly thickened. Further differences between these species are in the shape of the sensillae on antennal segment IV (d is short and thick in *M. massoudi*, thin and longer in *M. betschi*). On abdominal sternite V is 1+1 spindle-like chaeta present in *M. massoudi* whereas in *M. betschi* only slim, unthickened chaetae occur arround the genital plate.

Holotype ♂ No. 442 and 30 paratypes in author's collection, further paratypes in J.-F. Ponge's collection (Brunoy).

Locus typicus: France centralis, Forêt de Sénart. 30 km SE of Paris, 21. XII. 1976 38 specimens in soil samples (Mullrendzina) from a forest with *Carpinus betulus* (alliance *Fraxino-Carpinion*), leg. J.-F. Ponge.

D e r i v a t i o n o m i n i s : The new species is dedicated to my friend, Dr. Z. Massoud, Laboratoire d'Ecologie générale, Brunoy (France), the well-known specialist on Collembola.

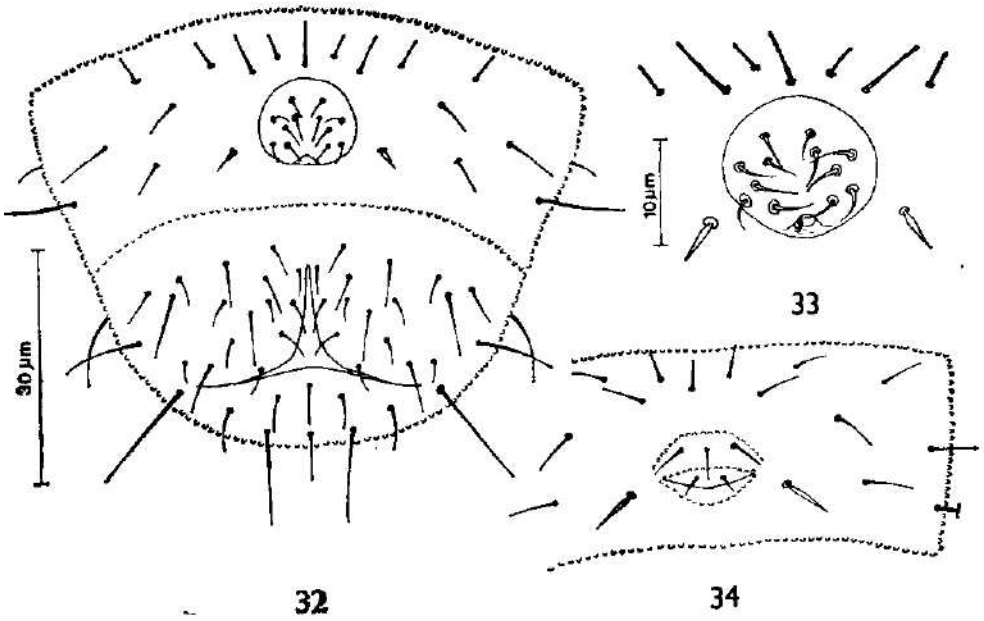

Fig. 32—34: *Mesaphorura massoudi* sp. n. 32 — chaetotaxy of abdominal sternite V and anal lobes of a male; 33 — male genital plate and chaetotaxy of surrouding area; 34 — female genital plate and chaetotaxy of abdominal sternite V. Scale: Fig. 32, 34 30 µm, Fig. 33 10 µm.

A c k n o w l e d g e m e n t s

I am very grateful to Drs. F. R. Moore (Department of Biology, Liverpool Polytechnic, England) and J.-F. Ponge (Laboratoire d'Ecologie générale, Brunoy, France) for their *Mesaphorura*-material.

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VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
Svazek XLIII — Číslo 4 — 1979 — Str. 300—302

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CASTING — A SIMPLE METHOD OF EXAMINING THE SURFACE STRUCTURE OF LEPIDOPTEROUS EGGS

Ivo NOVÁK

Abstract. A simple and rapid method of taking negative casts of lepidopterous eggs using ordinary celluloid glue is described. The negative replica precisely reflects the surface structure of an egg and can be examined on a microscopic slide under ordinary optical microscope up to about × 1000 magnification.

The eggs of Lepidoptera have rarely been a subject of interest. The reason for this is the difficulty of preserving the egg structure in fixative solutions and the laboriousness in making microscope slides. Stereoscopic microscopes do not provide the necessary magnification and are suitable only for observing coarser structures. The empty chorions left by caterpillars are partly damaged by them, if not eaten altogether, or are not sufficiently transparent and must be prepared in a special way to be investigated by optical microscopy (e.g. HARDWICK, 1958).

As to enlargement and resolving power scanning microscopes offer immense possibilities. However, the preparation of eggs for scanning is time-consuming even if not accompanied by other difficulties (DIETZ et al., 1978), and moreover few people have such expensive apparatus at their disposal. Most workers interested in Lepidoptera can easily obtain a wide range of insect eggs, but are dependent on modest technical equipment.

The following describes a simple method of taking casts, developed a long time ago by the author (NOVÁK, 1954), inspired by a method of WOLF (1954), who made similar casts of structures from larger surfaces.

MATERIALS

1. Substance for making casts. Use ordinary celluloid glue (the kind used in modelling kits, i.e. celluloid dissolved in acetone to a consistency of Canada balsam or other liquid media for microscopy). No doubt among modern glues, lacquers and liquid artificial materials are other substances suitable for this work. The glue may be colourless, but a slightly coloured glue (e.g. brownish) is better.

2. Small rectangles of cellophane with a small hole in the centre. Take a cellophane tape about 12—15 mm wide and with a red-hot needle make a row of holes spaced about 10—15 mm apart. The holes must be slightly smaller rhan the diameter of the eggs. Then cut the cellophane tape into small rectangles with one hole to each (Fig. 1). Using needles of varying thickness prepare a reserve supply of rectangles with different-size holes. The aperture must be carefully burned through or punched so as to obtain smooth margins (Fig. 2). If the holes are merely pierced they will have frayed margins and will be unsuitable (Fig. 3).

3. A strong needle fixed in a handle for applying the cast substance. A soft plate (e.g. cork) for pinning. Pins for fixing the cellophane rectangles to the plate.

4. Insect eggs: live eggs, undamaged, free of dust, moth scales and other impurities, and with a dry surface

PROCEDURE

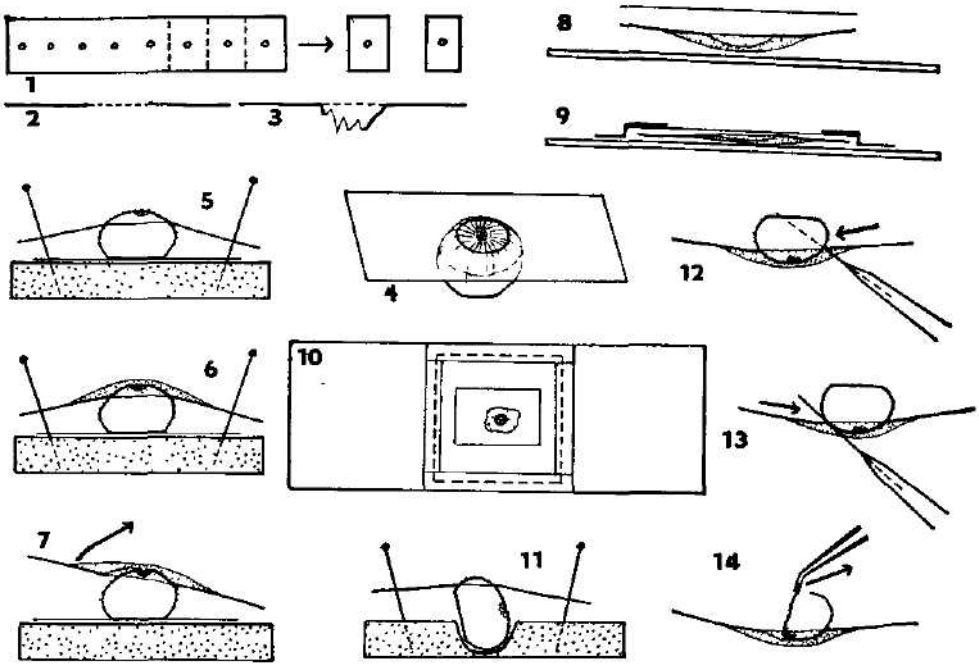
1. Place the egg on the plate and cover with a rectangle of cellophane so that only the micropylar top (or other part of the egg to be examined) can pass through the aperture. Secure the cellophane to the plate with two pins (Figs. 4 & 5).

2. With a needle put a drop of cast substance on the exposed surface of the egg and spread it evenly in a this layer over the entire surface and onto the cellophane. Let it dry (Fig. 6)

3. Remove the pins and carefully pull the cellophane and cast off the egg with forceps (Fig. 7). The preparation is ready and can be mounted (cast side up) on a slide. Secure the cover glass at the edges with adhesive tape (Figs. 8. 9 & 10).

Notes

1. Some females reared in captivity lay their eggs readily on paper (if at all). These eggs hold well on paper and can be cut out with it and used thus. Similarly eggs laid on leaves can be used with a piece of the leaf (Figs. 5, 6 & 7). Eggs laid on an unsuitable base or substrate (e.g. glass, wood, stone) must be unstuck with a small fine brush dipped in water and transferred to a more



Figs. 1—14. Procedure for taking casts of lepidopterous eggs (see text part).

suitable base, e.g. into a small pinhole in the plate. Eggs with the micropylar rosette on the side or ones in which another part of the chorion other than the top is to be cast must also be prepared in this way (Fig. 11).

2. An egg sometimes does not hold fast to paper, leaf etc., and is lifted together with the cast when the cellophane is removed. In such a case put the preparation on the plate with the egg up and try to loosen it from the cast by pressing with a needle alternately on either side (Figs. 12 & 13).

3. During this process the egg may rupture (usually at the base where it is thinnest). It is then necessary to remove the fluid content of the egg so that it does not spill out and ruin the cast. After drying out the inside grasp the edge of the chorion carefully with fine forceps and try to pull it out (Fig. 14). The content of an egg which has already begun to develop is denser and thus easier to remove.

4. Eggs which have a deeply furrowed structure also pose a problem because the substance penetrate into the folds and the hard cast can be freed only with difficulty and with risk of damaging the preparation. In such a case it has proved useful not to let the substance harden completely but to pull the cast out while it is still slightly soft. Precise estimation of the exact moment this should be done is a matter of experience.

Dry preparations can be examined under an ordinary optical microscope up to ×1000 magnification. They can be drawn and photographed by the usual methods. This technique can be applied to eggs of other insects as well as other surface structures. Examples of egg structures drawn from such preparations are figured by Krampl & Novák (1979).

The author's long experience has shown that this method of examining surface structure of lepidopterous eggs has lost neither its attractiveness nor usefulness. Clearly it cannot compare with scanning electron micrographs — nevertheless the principle can be used for this purpose, too (DIETZ et al., 1978) — but it is simple and rapid and sufficient four routine practice. The whole procedure only takes several minutes.

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Department of Systematic Zoology, Charles University, Praha

INCONSTANT NUMBER OF ABDOMINAL TRICHOBOTHRIA IN ASPIDESTROPHUS MORIO (HETEROPTERA, PENTATOMIDAE)

Pavel ŠTYS and Jitka DAVIDOVÁ-VILÍMOVÁ

Abstract. A first case of striking intraspecific variability in the number of adult trichobothria in pentatomomorphan Heteroptera other than Idiostolidae is described in *Aspidestrophus morio* Stål (Pentatomoidea, Pentatomidae, Podopinae) from the Oriental region. It is associated with vestigiality of the ectal trichobothrium and represents a stage preceding its complete elimination. Such adult intraspecific variation does not precede loss of trichobothrium in non-pentatomoid pentatomomorphans.

As far as known the adult number of ventral abdominal trichobothria is constant at least at species level (usually at tribal or higher levels) in all superfamilies of trichophorous Pentatomomorpha with oligomerous trichobothrial patterns (Piesmatoidea, Coreoidea s. lat., Pentatomoidea). Consequently, the number of trichobothria, the major pattern of their arrangement and recently also the tempo of their ontogenetic development (Schaefer, 1975; Davidová & Štys, 1976) are widely used characters in beta taxonomy studies. In this paper we report the first known case of intraspecific inconstancy in the number of trichobothria in these heteropterans. It was found in the Oriental genus *Aspidestrophus* Stal, 1854 (Pentatomidae, Podopinae, Podopini), and through the kind assistance of Dr. P. van Doesburg (Rijksmuseum van Natuurlijke Historie, Leiden) and Prof. J. Carayon (Muséum National d'Histoire naturelle, Paris) we were able to examine 16 specimens of the only known species *A. morio* Stal, 1854 (= *A. lineola* Vollenhoven, 1863) from Borneo, Sumatra, Java and Bhutan.

Trichobothria of *A. morio* are easily recognized from other ventro-abdominal hairs by their erectness, outstanding length, presence of sharply delimited and elevated pale basal rim, and paleness of the surrounding cuticle. The prevailing type of the arrangement of trichobothria is shown in Fig. 1; trichobothria are diagonally arranged and the anteromedial one is always longer and its basal rim more distinct, larger and more elevated. Whenever only one trichobothrium is present, it is invariably the less developed posterolateral one which is missing. None of the below-mentioned variants exhibits a sexual, geographical or taxonomical (the species is possibly polytypic or composite) linkage.

Trichobothria on ventrites III—IV—V—VI—VII exhibited a symmetrical arrangement 2—2—2—1—1 in 4 ex. (25 %), symmetrical arrangement 1—2—2—1—1 in 8 ex. (50 %) and an asymmetrical arrangement in 4 ex. (25 %), as follows:

Left		2—2—2—1—1		1—2—1—1—1		1—2—2—1—1		2—2—2—1—1
	(a)	,	(b)	,	(c)	,	(d)	.
Right		2—1—2—1—1		1—2—2—2—1		2—2—2—1—1		2—2—2- 2—1

Hence the actual number of trichobothria per individual was 14 (56 %), 15 (12.5 %), 16 (25 %) or 17 (6 %) — average per individual 14.8, and actual number per side was 6 (3 %), 7 (56 %), 8 (37.5 %) or 9 (3 %) trichobothria. The most frequent arrangement (counted per side) was 1—2—2—1—1 (53 %), followed by 2—2—2—1—1 (34 %); the other four types occurred in asymmetrical situations only (3 % each). Arrangement of trichobothria on ventrites III—V was symmetrical in 94 % individuals, on ventrite VI in 86.5 %, on ventrite VII in all individuals. The full number of trichobothria (two) occurred on the side of segment III in 41 %, IV and V in 97 %, VI in 6.5 % and VII in 0 % of cases.

The ventral abdominal trichobothria of trichophorous Pentatomomorpha exhibit in some groups (Lygaeidae — Ledvinka, 1970; Schaefer, 1975; Plataspidae — Davidová & Štys, 1976) considerable ontogenetic intraspecific variation — the individual trichobothria may first appear in different individuals in different instars so that conspecific individuals of the same instar need not have always the same number and arrangement of trichobothria. On the other

hand, the number of adult trichobothria is stable and the intraspecific variation concerns only their topographic arrangement within their segmental clusters (SCHAEFER, 1975) The only exception from this rule form the Idiostolidae, the family with most abundant and most plesiomorphically arranged (ŠTYS, 1964; SCHAEFER, 1966a, b) trichobothria; here the adult number is inconstant and the position fairly variable (SCHAEFER, 1966a, 1975; SCHAEFER & WILCOX, 1969).

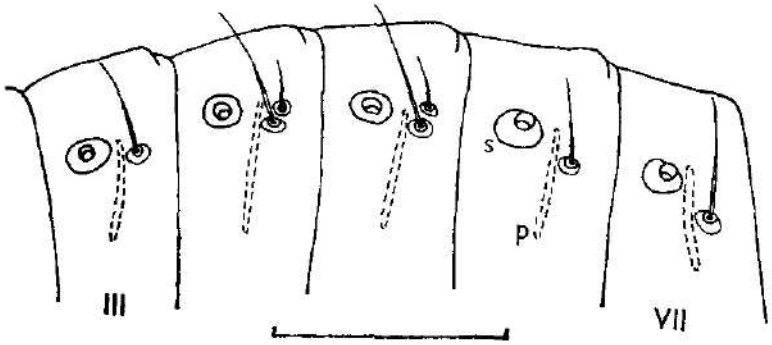

Fig. 1. *Aspidestrophus morio* — the most frequent type of arrangement of trichobothria Scale: 1 mm; s — spiracle, p — pseudosuture (cf. RUCKES, 1961).

Up to the present it has been assumed that whenever a reduction of the basic adult trichobothrial number (3 + 3 per ventrite III—VII in the lygaeoid — pyrrhocoroid — coreoid complex, 2+2 in Pentatomoidea, a lower number in Piesmatidae, higher in Idiostolidae) occurred in *phylogeny, it always resulted in a complete elimination of the respective pair of trichobothria* (the various ontogenetic mechanisms leading to loss of trichobothria were postulated by SCHAEFER, 1975, and discussed by DAVIDOVÁ & ŠTYS, 1976). In non-pentatomoid families other than Idiostolidae no cases of regularly occurring adult variation in presence — absence of individual adult trichobothria have been reported and none has been seen in thousands of specimens of species from almost all established suprageneric taxa examined for this character by the senior author. The same seemed true for the Pentatomoidea, where the basic number 2+2 per segment is occasionally reduced to 1+1 or 0 on individual segments or 1+1 throughout (RUCKES, 1961; SCHAEFER, 1975).

RUCKES (1961) noticed that in the Podopinae (Pentatomidae) a complete anagenetic series (interspecific) of the diminution and final loss of the ectal pair of the 2+2 segmental trichobothria can be traced. The described intraspecific variation in presence or absence of the anterolateral trichobothria in *Aspidestrophus morio* is undoubtedly associated with vestigiality of function of this structure which leads eventually to its irregular loss. It is a theoretically a priori expectable stage which obviously anagenetically precedes a complete elimination of this trichobothrium; it is recorded here for the first time in any adult pentatomomorphan, but in all probability such a situation is not unique The trend to weaken, shorten and finally lose one pair of trichobothria per segment occurred independently in several parallel evolutionary lines of Pentatomoidea (cf SCHAEFER, 1975) It always involved only the ectal trichobothrium (or the anterior one in longitudinally arranged clusters) as can be seen from observations by RUCKES (1961), SCHAEFER (1975), the presently described case and our developmental analysis of *Coptosoma* species (DAVIDOVÁ & ŠTYS, 1976)

The situation in adult *Aspidestrophus morio* completes the basic anagenetic series of trichobothria in modern trichophorous pentatomomorphan adults, which can be briefly characterized as follows:

a) high number and great intraspecific variation in number (Idiostolidae),
b_1) moderately lower and constant number (3+3 per segment) with occurrence of trends toward reduction to loss of individual pairs of trichobothria realized by their complete elimination without preceding phase of vestigiality associated with intraspecific variation in number (lygaeoid — pyrrhocoroid — coreoid complex and Piesmatidae),

b_2) significantly lower and constant (2 + 2 per segment) number with occurrence of trends towards reduction and loss of ectal (posterior) trichobothria (more rarely also of some of the mesal = anterior trichobothria) realized by preceding phase of their vestigiality and intraspecific variation in number (Pentatomoidea).

Intraspecific variation in number of trichobothria is thus associated with both initial and terminal stages of their anagenesis.

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IN MEMORIAM Doz. RNDr. JOSEF MAŘAN

11. 11. 1905—11. 11. 1978

Dr. Mařan wurde in der südböhmischen Stadt Písek geboren. Die Naturschönheit der Umgebung dieser Stadt wirkte schon in seiner Kindheit stark auf ihn ein und entfachte in ihm die Begeisterung zur Entomologie. Seine Kindheit verbrachte er mit seiner jüngeren Schwester Věra in einem harmonischen und ausgeglichenem Milieu einer Beamtenfamilie.

In den Jahren 1917—1925 studierte er auf dem Gymnasium in Písek. Gute Erfolge hatte er nicht nur in den Naturwissenschaften, sondern auch in den klassischen Sprachen. In der lateinischen Sprache beschrieb er eine Reihe neuer Insektenarten und er konnte sogar nach Jahren beim Besuch in Griechenland Homers Illias griechisch auswendig deklamieren.

Schon zur Zeit seines Studiums auf dem Gymnasium machte er sich mit dem bedeutenden Entomologen MUDr. J. Tyl, der damals in Písek lebte, bekannt, sowie mit einer Reihe jüngerer begeisterter Entomologen, zu denen Jindřich Madar, Egon Lekeš, Karel Táborský und Josef Dragoun gehörten.

In den Jahren 1925–1929 studierte er an der Naturwissenschaftlichen Fakultät der Karls-Universität in Prag. Auf seine wissenschaftliche Entfaltung hatten damals seine Professoren grossen Einfluss, insbesondere Prof. Dr. A. Mrázek, Prof. Dr. J. Wenig, Prof. Dr. J. Komárek, Doz. Dr. J. Storkán und Doz. Dr. J. Hahn. Mit Prof. Wenig stand er auch später bei Exkursionen auf der Hydrobiologischen Station in Lnáře in Verbindung, mit Prof Komárek und Doz. Storkán im Ausschuss der Tschechoslowakischen entomologischen Gesellschaft, deren Mitglied er bereits im J. 1923 wurde. Schon im Laufe seines Universitätsstudiums besuchte er regelmässig die entomologischen Sammlungen des Nationalmuseums in Prag, wo er mit seinem Freund K. Táborský als Hilfsassistent unter der Leitung des bekannten und erfahrenen Entomologen Dr. J. Obenberger arbeitete. Sein Hochschulstudium beendete er im J. 1930, wann er den Grad RNDr. erwarb.

In den Jahren 1929–1971 arbeitete er in der zoologischen Abteilung des Nationalmuseums in Prag, wo er eine Reihe dienstlicher Funktionen absolvierte. Nach 1950 war er tätig an dem Umbau des Objektes in Kunratice bei Prag, wohin im J. 1956 die entomologischen Sammlungen übersiedelt wurden. Im J. 1952 wurde die bisherige zoologische Abteilung des Museums geteilt und nach dem Übertritt des Prof. Dr. J. Obenberger auf die Universität wurde Doz. Mařan zum Leiter der entomologischen Abteilung. Diese Funktion hatte er bis zu seiner Pensionierung im J. 1971 inne.

Im J. 1946 habilitierte sich Dr. Mařan an der Naturwissenschaftlichen Fakultät der Karls-Universität in Prag und hielt hier bis 1965 Vorlesungen über Zoogeographie und Fauna der Tschechoslowakei. Zu dieser Zeit wirkte er an der Erziehung junger Spezialisten mit, und zwar nicht nur an der Universität, sondern auch im neuerrichteten Entomologischen Institut der Akademie der Wissenschaften.

Während seiner Tätigkeit in der entomologischen Abteilung des Nationalmuseums entwickelte sich Dr. Mařan zu einem erfahrenen Wissenschaftler. Er widmete seine Aufmerksamkeit insbesondere den Vertreten der Familie Carabidae, Meloidae, Anobiidae, Alleculidae der Ordnung Coleoptera und auch den Vertretern der verschiedenen Familien der Ordnungen Orthoptera und Dermaptera. Dr. Mařan vergass jedoch nicht auf die Problematik der Zoogeographie sowie des Naturschutzes. Im Terrain war er ein unermüdlicher und ausgezeichneter Insektensammler und während seiner zahlreichen Studienreisen im Aus- und Innland sammelte er für die Museumssammlung ein umfangreiches Material, das er dann auch verarbeitete.

Bereits während seiner Studienzeit auf dem Gymnasium widmete er die Aufmerksamkeit der Natur in der Umgebung der Stadt Písek und dem nahen Böhmerwald. Im J. 1925 war er 2 Monate in Jugoslawien (Radoha in Nordslowenien) zu Besuch der Familie eines tschechischen Forstmannes J. Bláha. Zur Zeit seiner Tätigkeit im Nationalmuseum konzentrierte sich Dr. Mařan hauptsächlich auf die Fauna der Balkanhalbinsel. In den Jahren 1929, 1932, 1933, 1961 und 1962 besuchte er Bulgarien, im J. 1934, 1935, 1936, 1937 und 1938 verschiedene Gebiete Griechenlands und Kreta, im J. 1958 wieder Jugoslawien. In den Jahren 1931 und 1959 bereiste er Rumänien, im J. 1927 und 1930 Tunis und Algerien, im J. 1928 Südfrankreich und Korsika, im J. 1957 den Kaukasus und im J. 1974 Zentralasien der UdSSR.

In den J. 1971–1978, als er bereits im Ruhestand war, setzte er die wissenschaftliche Arbeit fort. Er verarbeitete auch weiterhin das in den Sammlungen des Museums aufbewahrte Material, nahm teil am wissenschaftlichen Geschehen in der Tschechoslowakischen entomologischen sowie zoologischen Gesellschaft in Prag und war Mitglied des Kollegiums für die spezielle Biologie an der Akademie der Wissenschaften. Er war Mitglied der Kommission für die Verteidigung der Dissertationen im Fache Entomologie. Im J. 1965 wurde er zum Ehrenmitglied der Tsch. entomologischen Gesellschaft und im J. 1977 der Tsch. zoologischen Gesellschaft ernannt. Mehr als 25 Jahre wirkte er aktiv im wissenschaftlichen Beirat unserer Zeitschrift Věstník čs. společnosti zoologické. Im Jahre 1970 wurde ihm die Goldmedaille Gregor Mendels vom Präsidium der Akademie der Wissenschaften verliehen.

Dr. Mařan litt seit seiner Kindheit und besonders in den letzten Jahren an Asthma. Er begrenzte daher grössere Ausflüge und widmete sich lieber dem Fischfang in der Nähe von Prag. Wegen seines optimistischen Charakters wurde er von seinen zahlreichen Freunden und Schülern geschätzt. Seinem Geburtsort, der Stadt Písek, blieb er treu und traf sich oft mit seinen in Prag lebenden Landsleuten. Unsere und ausländische Entomologen, mit welchen er zusammenarbeitete, schätzten ihn sehr viel. Hier sei wenigstens der Akademiker Ivan Bureš aus Sofia und Akademiker Bey Bienko aus Moskau erwähnt.

Im Laufe seines Lebens veröffentlichte Doz Mařan mehr als 170 wissenschaftlicher Abhandlungen. Sie sind als kritische und synthetische taxonomische Studien bekannt. Im Buche Ursprung und Zusammensetzung der Fauna in der Tschechoslowakei, das im Jahre 1953 tschechisch herausgegeben wurde, gab er einen zusammenfassenden und kritischen Überblick über eine ganze Reihe von zoogeographischen Fragen.

A. Pfeffer

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Mařan J Dva nove druhy rodu Lydus Latr (subg Alosimus Muls) ze skupiny Lydus collaris Fabr Duae novae species Lydus Latr (subg Alosimus Muls) ex affinitate speciei Lydus collaris Fabr *Sbornik entom odd Z Musea v Praze*, 19: 60—63 1941

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Mařan J Nove druhy a formy palearktickych Anobiidů De novis Anobiidarum speciebus formisque regionis palearcticae *Sbornik entom odd Z Musea v Praze*, 19 122—125, 1941

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Mařan J Čínske druhy rodu Lytta F z příbuzenstva druhu L aeneiventris Haag. De novis parumque cognitis chinensibus generis Lytta F speciebus ex affinitate L. aeneiventris Haag (Col Meloidae) *Sbornik entom odd Z Musea v Praze*, 19 180—185, 1941

Mařan J Revise rodu Stenodera Eschschz Generis Stenodera Eschschz revisio (Col Meloidae) *Sbornik entom odd Z Musea v Praze*, 20 50—58, 1942

Mařan J · Revise subgenu Taphromeloe Rttr Subgeneris Taphromeloe Rtt revisio (Col Meloidae) *Sbornik ent odd Z Musea v Praze*, 20 58—59, 1942

Mařan J Přehled druhů rodu Lydus (subg Alosimus Muls) ze skupiny Lydus syriacus L Specierum generis Lydus (subg Alosimus Muls) ex affinitate speciei Lydus syriacus L revisio (Col Meloidae) *Sbornik ent odd Z musea v Phaze*, 20 78—98, 1942

Mařan J Nove druhy a formy rodu Prothyma Hope z ostrova Madagaskaru De novis generis Prothyma Hope speciebus formisque insulae Madagasscariensis (Col Cicidelidae) *Sbornik entom odd Z Musea v Praze*, 20 63—73, 1942

Mařan J Nova rasa druhu Molops rhodopensis Apf z Bulharska (tschechisch und lateinisch) *Acta Soc entom Bohemiae*, 39 105 1942

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Photosensitivity is mostly related to eyes, eye-spots or similar structures. After two introductory chapters surveying basic concepts of photosensitivity and types of extra-ocular photosensitivity, the book concentrates on neural photosensitivity, reported from a wide range of animal groups including Hydra, crayfish, insects, amphibians, lizards and some birds. Althoug the structure of the photoreceptive areas and the mechanism of photosensitivity are examined in detail only in several sea animals, particularly in echinoderms, the book is of interest for all zoologists and physiologists. The importance and degree of sophistication of extra-ocular photosensitivity have been underestimated as yet, a detailed analysis made in one animal group may stimulate similar studies in other groups and foster the progress of the study of *diurnal rhythmicity, induction and termination of diapause, and other related fields.*

I Hodek

Tischler, W., 1979: **Einführung in die Ökologie,** 2. überarbeitete und erweiterte Auflage, p. 1—306, 100 schwarzweise Abbildungen, G. Fischer Verlag, Stuttgart/New York.

Einer der erfahrungsreichsten europäischen Ökologen, teilweise schon ein Mitglied der europäischen ökologischen Seniorengeneration, em. Professor der Universität von Kiel, presentiert uns seine in der Menge von grossen ökologischen Kompendialwerken neu überarbeitete Einführung in die Ökologie. Das Buch ist, wie bei Prof. Tischler üblich, ausserst übersichtlich und seiner Schule entsprechend gegliedert. Im ersten Teil (allgemeine Ökologie) gibt es die Einleitung, die den Definitionen und der Auffasung von Grundbegriffen gewidmet ist. Es folgen die Kapitel über das Monosystem (Organismus-Umwelt), über die Wirkung von Umweltfaktoren auf die Lebensprozesse, über die Überlebensstrategien, Bisystem, Population und schliesslich über Ökosystem. Im zweiten Teil (Landschaftsökologie) wird die spezielle Ökologie der Meere und Brackwässer, der Meeresküsten, des Arboreals, des Oreotundrals, des Eremials, der limnischen Lebensräume und endlich der sog Anthropogaea behandelt.

Tischler gehört zu denjenigen Ökologen, die ihre Aufmerksamkeit lebenslang den agrarökologischen, also den praktischen Ausmündungen dieser dynamischen Disziplin (auch z. B der ökologischen Parasitologie usw.) widmeten, der aber andererseits eine grosse Sorgfalt der Eindeutigkeit und Klärung des semantischen Vokabulars der Ökologie einzuweihen verstanden hat. Er gehört somit zu den wenigen Ökologen, die bereits in den fünfziger Jahren den dynamisierenden Beitrag der sowjetischen Ökologie begriffen hat und, statt sich auf die Dokumentation zu verlassen, aktiv „ex privata industria" russich lernte. Das widerspiegelt sich zwangslaufig in vielen seiner Auffassungen, wodurch die sonst teilweise vorkommenden Misverständnisse oder absichtliche Ignorierungen von Quellen weitgehend vermieden werden konnten. Andererseits *ist seine Ökologie ein ausgesprochenes Lehrbuch, das sich nicht zur Aufgabe setzte, etwa* neue Wege zu suchen, sondern vielmehr die Errungenschaften zu fixieren und den Interessenten oder Studierenden auf eine ausserst aufgereifte Art und Weise darzubieten. In dieser Hinsicht wird vor allem die grosse Erfahrung des Autors als eines Verfassers von zahlreichen ökologischen Lehrbüchern und Wörterbüchern deutlich. Auf diese Weise weist sein Buch eine ganz individuelle Prägung auf, die weder einer traditionellen, noch einer ausgesprochen progressiven Behandlung der Ökologie Rechnung trägt. Das Buch will vor allem durch die Eindeutigkeit der Grundbegriffe der Ökologie dienen und auf diese Weise ein möglichst vollkommenes Bild dieser so wichtigen biologischen Disziplin widerspiegeln.

In der Literaturauslese richtete sich der Autor nach dem Prinzip der Nichtwiederholung von traditionellen Literaturquellen. Auf diese Weise findet man vor allem Hinweise auf ganz moderne Literatur. Andererseits wird dadurch in manchen Fällen ohne Hinweise auf die Ursprungsquelle die weitere Forschung einem spezialisierten Forscher einigermassen erschwert. Auch verursacht die etwas traditionelle Auffassung mancher Interpretierungen eine leichte Schematisierung von Beziehungen, die inzwischen im neuen Licht erschienen oder moderner geklärt werden konnten.

Das Buch als ein Ganzes stellt aber jedenfalls ein didaktisches Meisterwerk dar und in der deutschsprachlichen Literatur hat es sicher eine leitende Stellung. Der Druck und die Abbildungen, sowie die ganze graphische Seite des Buches sind nicht überflüssig luxuriös, aber sehr zweckmässig, klassisch einfach und perfekt. So stellt dieses Lehrbuch der Ökologie ein Werk dar, dessen Studium einem jeden Zoologen viel Freude bietet und nach dem man immer mit dem seltenen Sicherheitsgefühl greifen kann, dass man das Gesuchte nicht nur findet, sondern

dass man es nachher auf eine ausserst seriose Weise dargestellt auch weiter anwenden kann. Dem Autor, der ubrigens vielen tschechischen Zoologen gut bekannt ist und stets hilfsbereit entgegenkommt, sei zu seiner Leistung herzlichst gratuliert.

D. Povolný

Cloudsley-Thompson J. L. **Why the dinosaurs became extinct.** Patterns of Progress, Zoology Series, 85 pp., 17 figs, Meadowfield Press Ltd., Shildon, England. Price $ 8.40.

Prof J. Cloudsley-Thompson's experience in study of thermoregulation of animals enables him to offer a new circumstantial evidence for solution of evolutionists' perennial riddle, the Late Cretaceous dinosaur extinction. Classification and phylogeny of dinosaurus, climatic and geographic changes which occurred during Cretaceous, and numerous hypotheses attempting to explain their extinction are briefly reviewed. This well condensed and amply referenced account is followed by a more detailed critical discussion of those hypotheses which take the putative mechanism of thermoregulation of dinosaurs in account It is supplemented by interesting new evidence derived partly from author's original research on thermal adaptation of reptiles and large mammals Cloudsley-Thompson concludes that dinosaurs were certainly homeothermic and prebably also endothermic, and that the unability of dinosaurs to cope with thermal stress caused by hot summers in zonal climate which developed during the late Mesozoic might have been the key factor in their extinction. The author is well aware that he poses as many questions as he answers; he stresses that a multidisciplinary appproach is necessary and that certainly a complicated chain of interrelated events of both biotic and abiotic nature must have been involved.

The book is very interesting to read for any evolutionarily minded zoologist, paleontologist and ecophysiologist. However, its heavy emphasis of thermoregulatory aspects seems a bit one-sided. Any synthetic explanation of the Cretaceous ecological catastrophe must also take into account why the extinction of dinosaurs (which was a protracted, at least 12 million years long affair) so neatly coinided with the onset of the explosive radiation of birds and mammals (coincidence ? same causative factors ? causal relationship ?) and with the drastic changes apparent in the fauna of insects and various marine groups. The change of an equable climate into that characterized by presence of climatic belts and the following thermoregulatory malfunctions of organisms seem hardly to be the key factors responsible for all this faunal change. Some well adaptable groups changed profoundly (insects), some died out (large marine reptiles) while the comparable ones survived (sharks) in a little affected marine biocycle, and while all the dinosaurs disappeared from the terrestrial-limnic biocycle, some other large reptiles (crocodiles, turtles) well continued their existence. Though these paradoxes remain unexplained, Cloudsley-Thompson's book provides us with a manysided analysis and well credible conclusions concerning one of the facets of this large probem

P. Stys

Bănărescu P., N. Boşcaiu, 1978. *Biogeographie*, VEB Gustav Fischer Verlag Jena, 392 pp., 48 tab., L 6, Br., 45,00 M.

Zoolog profesor Bănărescu a botanik dr. Boşcaiu předložili prostřednictvím VEB Gustav Fischer Verlag v Jeně německy čtoucí biologické veřejnosti velice potřebnou knihu, v níž shrnují výsledky vlastní několikaleté práce a své názory na geografii rostlin a živočichů.

Po vyjasnění problematiky oboru, jeho náplni, zaměření a místu, které zaujímá v rámci biologických věd, věnují se autoři specializaci ve vztahu k biogeografii, a to z historického i genetického hlediska; navazující kapitola se zabývá cytogeografií. Následuje stať o areálu, především na druhové a poddruhové úrovni, včetně jeho změn, a to i v závislosti na tazích, např. u ptáků nebo ryb Další kapitola pojednává o náplni termínů fauna a flora a o genezi a zvláštnostech těchto souborů organismů.

Tři následující kapitoly se zabývají paleogeografickými příčinami rozšíření živočichů, biogeografickým vlivem čtvrtohorních ledových dob a konečně časovou a prostorovou rekonstrukcí areálů jednotlivých živočichů i rostlinných skupin na příkladu savců, sladkovodních ryb a nahosemenných rostlin. Poslední tři kapitoly pojednávají potom o biogeografickém rozšíření organismů na zeměkouli. V rámci moří uvádějí autoři tři samostatné zóny: litorální, abyssální a pelagickou. Pevnou zemi dělí do devíti oblastí: australské, novozélandské, polynézské, neotropické, cirkumantarktické, etiopské, madagaskarské, orientální a holarktické A v rámci sladkovodní fauny charakterisují pět oblastí: holarktickou, sino-indickou, etiopskou, madagaskarskou a neotropickou.

Tak jako znamenal de Latinův Grundriss der Zoogeographie nový přístup k řešení některých zoogeografických otázek a kromě toho přinesl řadu nových faktů o rozšíření zoogeograficky neortodoxních skupin (např. Lepidoptera) je Biogeografie obou rumunských autorů sympatickým pokusem o syntézu znalostí zoo- a fytogeografických a přináší navíc, zvláště co se týče vodních živočichů, především ryb, mnoho nového dokumentačního materiálu. Nic nevadí, že se v různých kapitolách knihy opakují totožné příklady a stejná argumentace.

V knize najdou poučení jak obecně zaměření biologové, tak i biologové speciální. Navíc je ji možno doporučit jako doplňkovou literaturu i pro vysokoškolské studenty k získání integrovaných znalostí v biogeografii.

K. Hůrka

Schwenke W. et al. (1978): *Die Forstschädlinge Europas.* 3. Band *Die Schmetterlinge.* 467 str., 244 obr. Paul Parey. Hamburg a Berlin. Cena DM 335.

Třetí díl kompendia o škůdcích lesů Evropy pojednává o řádu motýlů, Lepidoptera. Je to z teoretického i praktického hlediska velmi důležitá skupina, obsahuje množství lesních škůdců. Dílo navazuje na známý třetí svazek Escherichových *„Die Forstinsekten Mitteleuropas"* (1931), který byl — i když neúplný — po řadu let základním pramenem o lesních motýlech, nyní však už značně zastaral.

Na sepsání knihy se podílí 16 popředních domácích i zahraničních specialistů pod vedením prof. Dr. Schwenkeho. Po krátkém úvodu a stručné charakteristice řádu se podle moderního systému probírá 30 lesnicky významných čeledí motýlů. Jednu z nich — píďalkovité — zpracoval i autor z ČSSR — Ing. J. Kudler CSc. V díle je zastoupena většina druhů, které se v Evropě projevily jako škůdci lesa. Po stručných charakteristikách čeledí a někdy i určovacích klíčích se o většině lesnicky méně významných druzích pojednává jen stručně (popis jednotlivých stádií, rozšíření, bionomie, lesnický význam, možnosti ochrany). Podrobně, ale též velmi výstižně a přehledně, se píše vždy jen o několika nejvýznamnějších škůdcích, u kterých se věnuje místo i otázkám ekologie, zejména abundanční dynamiky, vztahům k neživému i živému okolí (entomofágům apod.), kontrole, prognóze, prevenci i přímému boji. Takto má čtenář k dispozici ucelený a moderní souhrn poznatků o hlavních škůdcích (např. o bekyni mnišce, můře sosnokazu, obaleči dubovému). V díle se totiž respektují svědomitě i nejmodernější literární prameny. Přiměřeně jsou zastoupeny i práce československých autorů.

Na celém díle se projevuje vynikající redakční práce prof. Schwenkeho, kterému se podařilo značně jednotně, přehledně a instruktivně skloubit různorodý materiál. Většina vyobrazení — perovek — (zejména od K. Wilhelma, ale i Ing. Kudlera) má taktéž vynikající úroveň. Jako každé tak obsáhlé dílo má i toto některé nedostatky, ať už věcné (neuvedli se někteří důležitější škůdci jako obaleči z rodu Gypsonoma, nesprávný je údaj, že příslušníci čel. Gracillariidae se kuklí jen mimo požerky, že můra Nycteola revayana žije i na topolech a vrbách; zřejmě nesprávné jsou obr. 24 B a 31 apod.) nebo formální (záměna obr. 9 a 11). Jako celek je však velmi hodnotné, se stěžejním významem pro každého, kdo se zajímá o motýly na lesních dřevinách a vůbec o ochranu lesů. Přispělo k tomu i vydavatelství vzornou typografickou úpravou.

J. Patočka

POKYNY PRO AUTORY

Věstník Československé společnosti zoologické uveřejňuje původní vědecké práce členů společnosti v rozsahu nejvýše 30 stran rukopisu, napsané v některé z kongresových řečí, a dále články, hodnotící životní dílo našich zoologů, vyžádané redakcí. Práce autorů, kteří nejsou členy společnosti, budou přijímány jen výjimečně.

Formální úprava prací:

Rukopis (originál a 1 kopie) musí být psán na stroji s většími typy obřádek, na stránce 30 řádek, řádky po 60 úhozech, bez větších oprav. Rukopisy, které by neodpovídaly těmto formalním požadavkům, budou vráceny k přepsání.

Hlavička práce: 1. Název pracoviště. 2. Název práce (u prací taxonomických v závorce za názvem systematické zařazení druhu nebo skupiny — např. Ostracoda: Cypridinidae), obojí v řeči, v níž je práce psána. 3. Jméno a příjmení autora.

Vlastní práce: 1. Velmi stručný abstrakt, v rozsahu nejvýše 15 řádek, v angličtině. 2. Úvod do problematiky (stručně). 3. Materiál a metodika (u známých metod pouze odkaz). 4. Vlastní část experimentální nebo popisná. 5. Diskuse. 6. Závěr. 7. Seznam citované literatury (nikoliv bibliografie!). 8. Adresa autora. 9. Tabulky, texty k obrázkům a grafům. Celý rukopis je průběžně stránkován.

Citace prací proveďte podle jednotného vzoru: autor, rok, název, časopis (mezinárodními bibliografickými zkratkami), ročník, sešit pouze v případě, že ročník není průběžně stránkován, stránky. U knižních titulů nakladatel a místo vydání. Např.: Hrabě S., 1975: Second contribution to the knowledge of marine Tubificidae (Oligochaeta) from the Adriatic Sea. *Věst. čs. spol. zool.*, 39 : 111—119.

Přepis cyrilice proveďte podle mezinárodních pravidel vědecké transliterace (nikoliv fonetické transkripce) — viz ISO Recommendation R 9. International System for the transliteration of cyrillic characters 1. Ed. October 1955 nebo Zekalle R., 1964: *Pedobiologia*, 4 : 88—91, Jena.

Obrázky a grafy kreslete černou tuší na kladívkový nebo pausovací papír v poměru 1 : 1 až maximálně 1 : 3, u taxonomických prací musí mít obrázky měřítko. Obrázky kreslete pokud možno tak, aby mohly být všechny stejným způsobem zmenšeny. Fotografie musí být ostré, kontrastní, na lesklém papíře. Obrázky sestavte do tabulí, které by bylo možno reprodukovat na šíři strany (126 mm), nebo s textem na celé zrcadlo (126 × 188 mm). Obrázky nebo obrazové tabule průběžně očíslujte a v rukopise vyznačte místo, kam mají být zalomeny.

Tabulky jsou tištěny jako otevřené, tj. bez svislých linek. V tabulkách oddělte vodorovnými linkami jen záhlaví tabulky a dolní okraj. Tabulky protokolárního charakteru nebo opakující údaje z textu, případně tak velké, že by je nebylo možné vytisknout na dvě protilehlé strany, nebudou přijímány.

V taxonomických pracích dodržujte zásady, ustanovení a doporučení mezinárodních pravidel zoologické nomenklatury.

V rukopisu nepředpisujte zásadně žádné typy písma, označte pouze tužkou po straně části, které mají být vysazeny petitem.

Práce zasílejte na adresu: Doc. Dr. K. Hůrka, CSc., výkonný redaktor Věstníku Čs. spol. zool. Viničná 7, 128 44 Praha 2.

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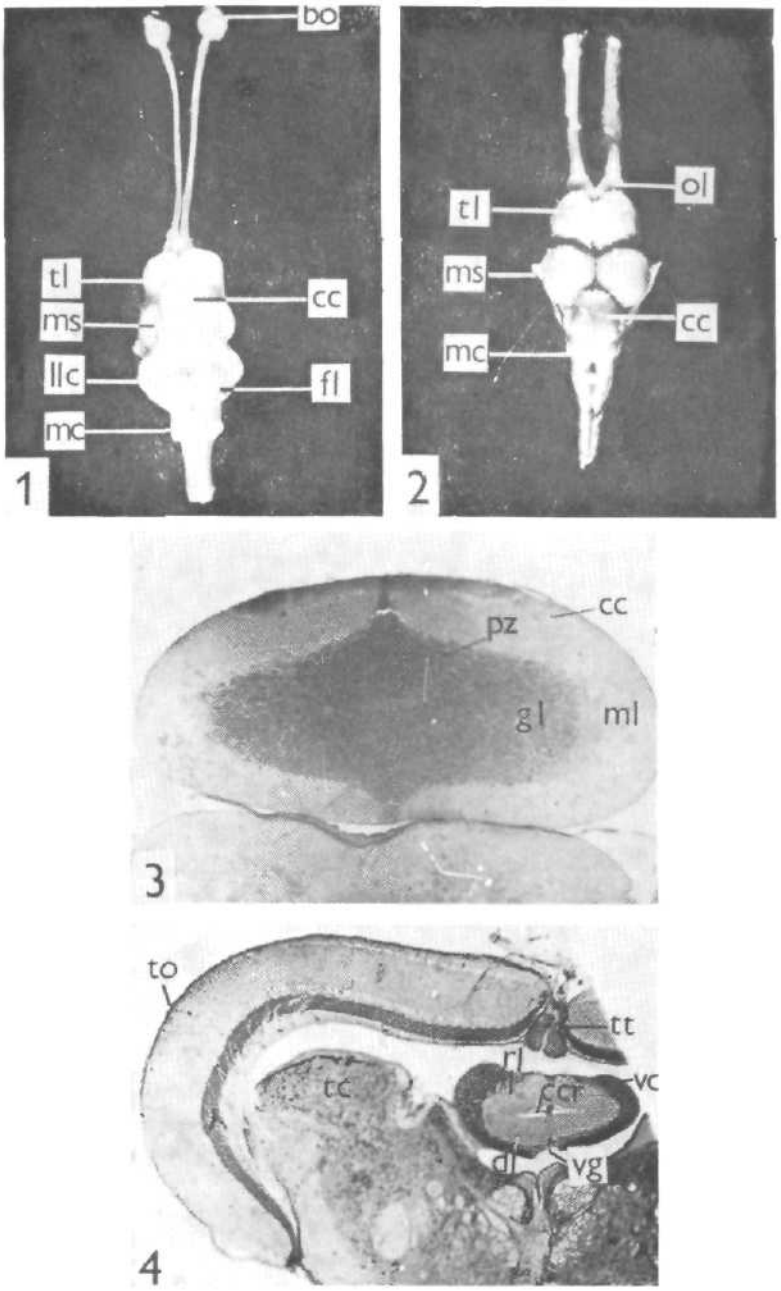
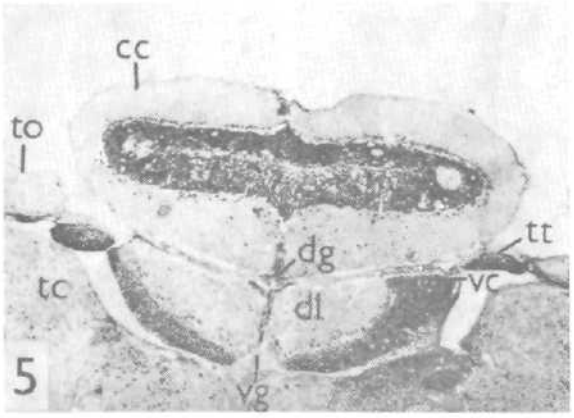
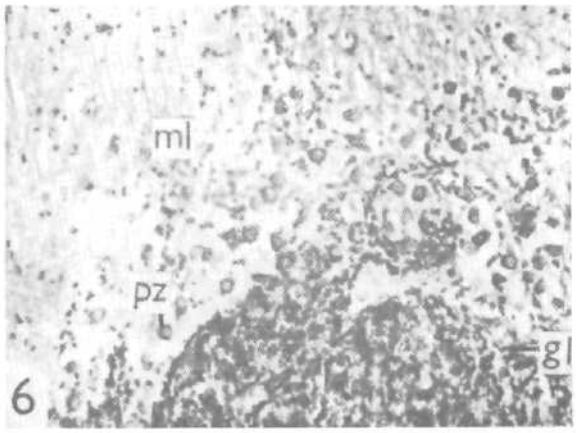


Fig. 1. Dorsal view of the brain of *Channa punctatus.*
Fig. 2. Dorsal view of the brain of *Heteropneustes fossilis.*
Fig. 3. Photomicrograph of a cross section of the corpus cerebelli of *Channa punctatus.*
Fig. 4. Photomicrograph of a gross section of the mesencephalon of *Channa punctatus,* showing valvula cerebelli.
bo — bulbi olfactorii, cc — corpus cerebelli, ccr — cavum cranii, dl — direct leaflet, fl — facial lobe, gl — granular layer, llc — lobuc lateralis cerebelli, ms — mesencephaon, m — molecular layer, mc — myelencephalon, ol — olfactory lobe, pz —





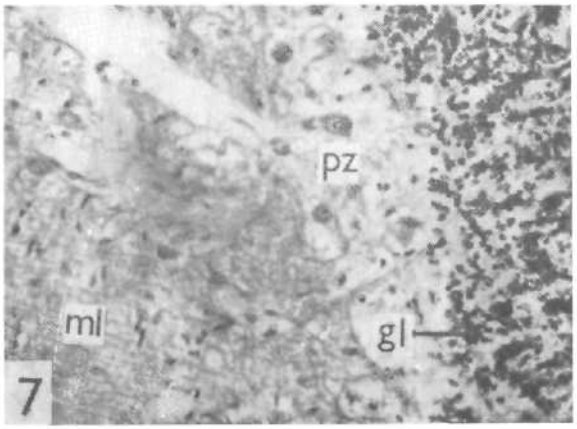
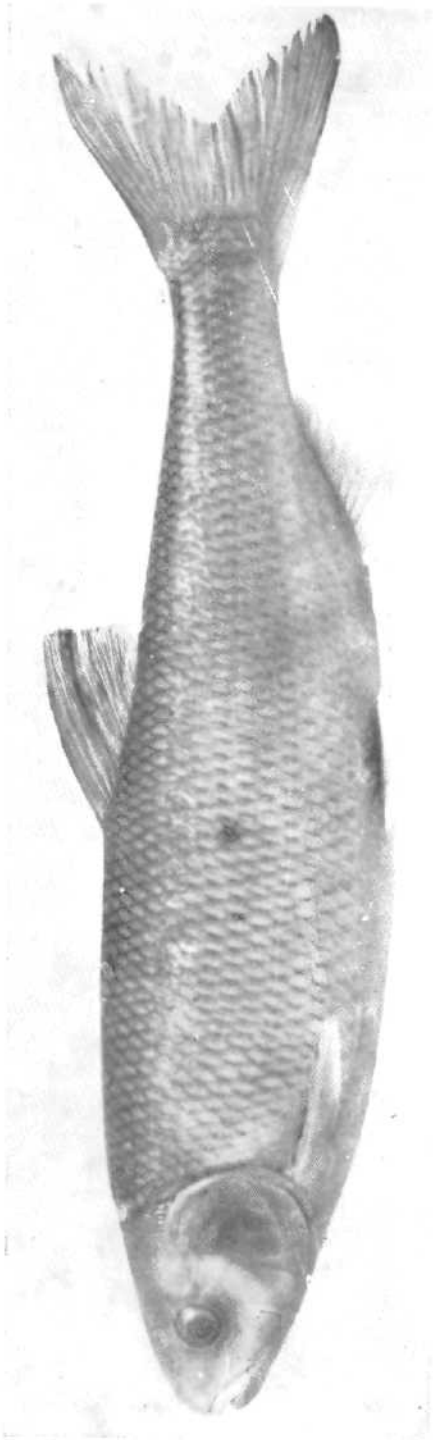
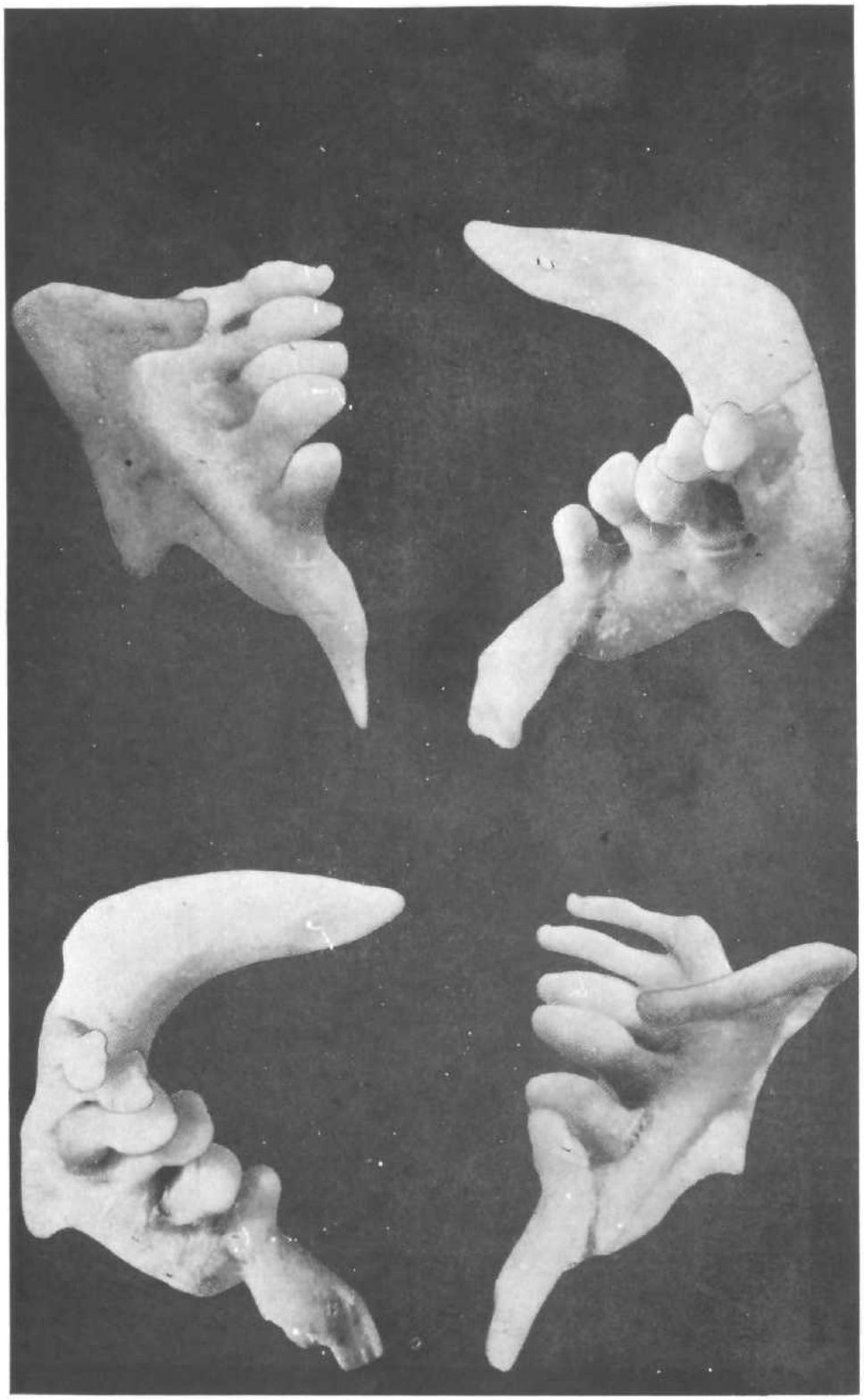


Fig. 5. Photomicrograph of a cross section of the mesencephalon of *Heteropneustes fossilis*, showing corpus and valvula cerebelli.
Fig. 6. Photomicrograph of a part of valvula cerebelli of *Channa punctatus*, showing different cells.
Fig. 7. Photomicrograph of a part of valvula cerebelli of *Heteropneustes fossilis*, showing different cells.
cc — corpus cerebelli, dg — dorsal groove, dl — direct laeflet, gl — granular layer

Hensel K.: Rutilus (Pararutilus) frisii meidingeri in the Czechoslovak stretch of the Danube river.





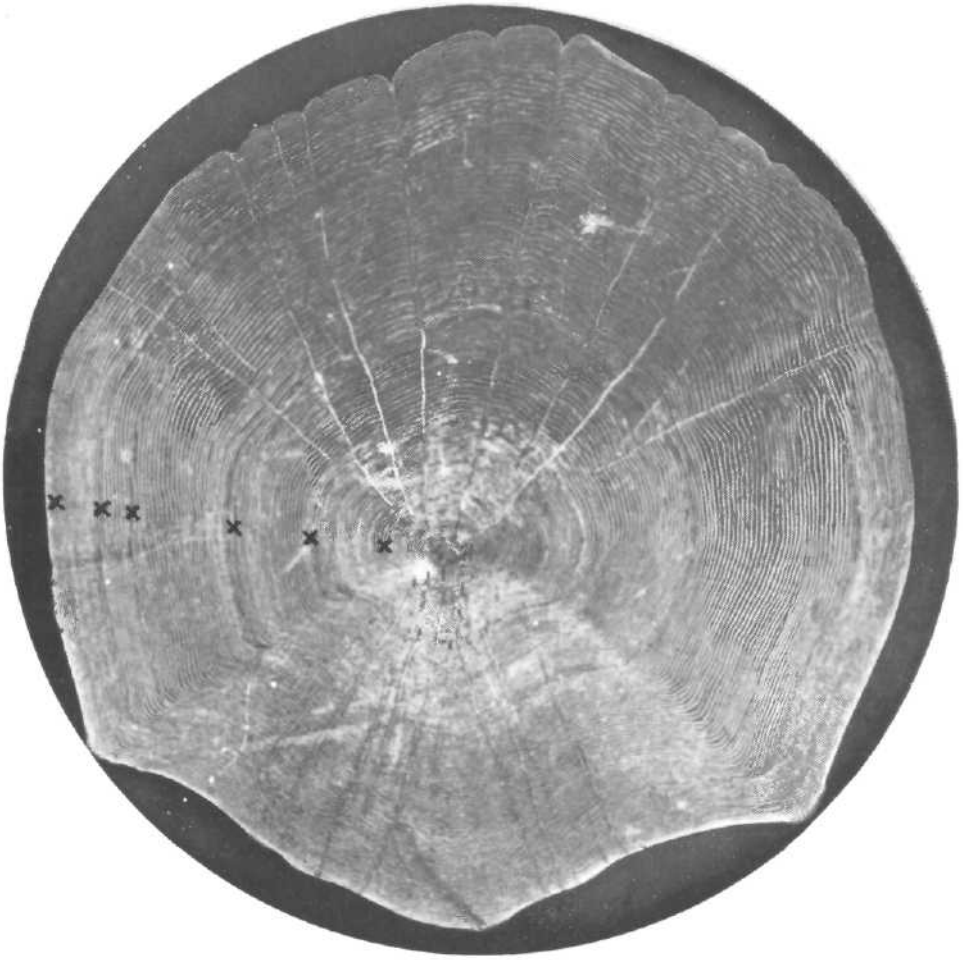
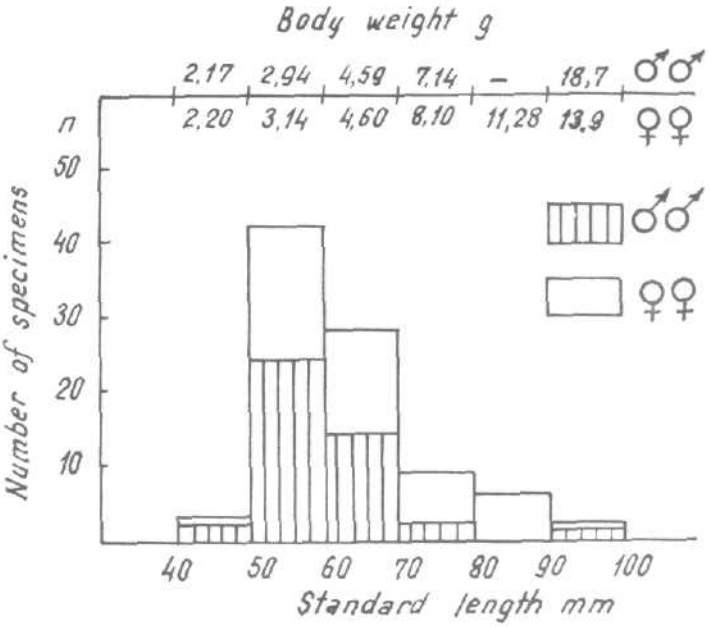
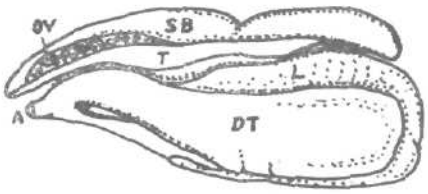


Fig. 3. Scale of *Rutilus frisii meidingeri* recorded, showing six complete annuli and new increment. Growth rate (according to the E. Lea method): 46 mm at the end of its first year, 85 mm at second, 149 mm at third, 199 at fourth, 236 mm at fifth, and 261 mm at sixth year.



1

Fig. 1 — The population structure correlated with body size and sex in *Leuciscus borysthenicus*, fished in Reşuleţ lake (1976, April 5–6).



2

Fig. 2 — The gonads' position in a hermaphrodite *Leuciscus borysthenicus*.
SB = swimming bladder; L = liver; T = testis; Ov = ovary; A = anus; DT = digestive tube.

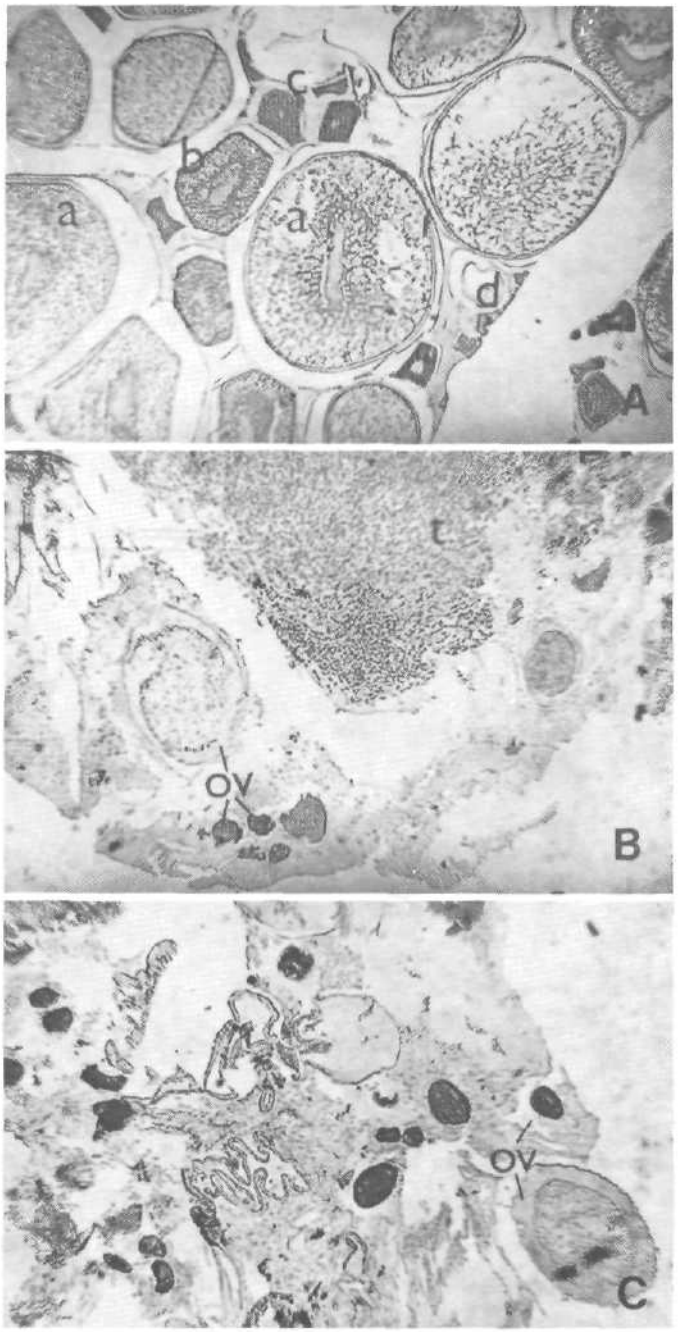


Fig. 3 — A) The histological structure of the ovary in *Leuciscus borysthenicus* ♀ (cross-section).
a = oocyte with yolk deposition; b = vacuolate oocyte; c = early oocyte; d = very small oocyte.
B) The histological structure of the gonads in *Leuciscus borysthenicus* hermaphrodite (cross-section).
t = testis; ov = athretic oocytes.
C) Athretic ovary in *Leuciscus borysthenicus* hermaphrodite.

VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
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JUVENILE HORMONE ANALOGUES: EFFECTS ON THE SOLDIER CASTE DIFFERENTIATION IN TERMITES (ISOPTERA)

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Abstract: By treating orphaned grown-larvae (or pseudergate) groups of termites with juvenile hormones (JHs) or with JH analogues (JHAs) the development of presoldiers and/or soldier intercastes was induced. In screening tests with *Reticulitermes lucifugus santonensis* and *Prorhinotermes simplex* JH III and JHAs hydroprene, 11 chlorine analogue of pharnesol acid and tetrahydrophuryl analogue of methoprene were found as most active. The soldier-caste formation under JHs and JHAs influence was proved in *Kalotermes flavicollis, Cryptotermes brevis, Neotermes castaneus, N. jouteli, Zootermopsis angusticollis, Z. nevadensis, R. lucifugus santonensis, Prorhinotermes simplex* and *Coptotermes formosanus*. Lists of other positively responding termite species and of active compounds are attached. The formation of presoldiers was demonstrated in very early instars: for *R. lucifugus* from larva III and for *P. simplex* from larva II. Treatments of starting colonies of *Z. nevadensis* and that of colonies of *P. simplex* in natural conditions failed. The use of synthetic JHs and JHAs in caste determination and social homostasis studies and the promise of JHAs in social insects control is discussed.

The development of the soldier caste was experimentally induced in the European drywood termite, *Kalotermes flavicollis* by injecting and feeding the juvenile hormone (JH) to the pseudergates (Lüscher, 1969). This confirmed the hypothesis on the function of JH in the regulation of the development of soldiers in termite colonies, formely based mainly on implantation of corpora allata (Lüscher & Springhetti 1960; Lebrun, 1967). In 1972, reports were published showing that under adequate experimental arrangements groups of the European subterranean termite *Reticulitermes lucifugus santonensis* are producing large numbers of superfluous presoldiers or pseudergate-soldier intercastes if treated with the synthetic JH II (cecropia JH, C_{17} JH) or some JH analogues (JHAs, juvenoids) (Hrdý & Křeček, 1972; Hrdý, 1972). Assumptions have ben expressed that this principle, i. e. exerting influence on the caste ratio and the social regulation of biological functions in colonies of social insects by JHAs, could be used for the control of harmful species.

The difficulties involved in the chemical control of social insect pests are generally known. Many species are instinctively capable of response to, and avoidance of contact with toxic substances. They may also identify and isolate sections of the colony affected by a toxicant and thus enable the rest of the community to regenerate. Therefore, formulations with peculiarly protracted effect have been employed and new compounds sought, which social insects would not avoid. Juvenoids seem to fulfill this prerequisite as has been evidenced by comparative feeding tests on termites, on honeybees foraging nectar

Data of offearance of the numbers 1.–26. 2. 2.–30. 4.

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