

VĚSTNÍK
ČESKOSLOVENSKÉ SPOLEČNOSTI
ZOOLOGICKÉ

XXXVI

1972

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ACADEMIA PRAHA

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Bibliografická zkratka názvu časopisu — *Věst. Čs. spol. zool.*
Abbreuatiatio huius periodici bibliografica

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NOTES ON WHITE-TOOTHED SHREWS FROM IRAQ
(MAMMALIA: INSECTIVORA, SORICIDAE)

MILOŠ ANDĚRA

Received June 29, 1971

Abstract: The presence of the subspecies *C. g. gueldenstaedti* in Iraq is demonstrated; its relationships with related taxa are discussed and some nomenclatural problems are explained.

INTRODUCTION

The occurrence of two species of white-toothed shrews in Iraq has been investigated. Harrison (1956) recorded *Crocidura suaveolens* in Kurdistan, and Hatt (1959) classed the members of a small series from Sarsank and from the vicinity of Salahuddin (northern Iraq) with the species *Crocidura leucodon*. Both data were accepted by Harrison (1964). Only Nader (1969) noticed that Hatt's material had been erroneously identified and included his white-toothed shrews, together with other specimens from Al Jadriyal (south of Baghdad), into the subspecies *Crocidura russula monacha*, Thomas, 1906. However, this name, used for East Mediterranean long-tailed forms of white-toothed shrews (Harrison, 1964), is a synonym of *Crocidura russula gueldenstaedti* Pallas, 1811 (Bobrinskij, Kuznecov, Kuziakín, 1965).

Richter (1966), having studied other East Mediterranean material, thinks that this form ought to be established as an independent species, *Crocidura gueldenstaedti* Pallas, 1811. He found that the relative length of tail, amounting to 60—80 per cent of the head and body length in *Crocidura gueldenstaedti*, is the principal character distinguishing *Crocidura gueldenstaedti* and *Crocidura russula*. The name *Crocidura russula monacha* Thomas, 1906 is then a synonym of the nominate subspecies *Crocidura gueldenstaedti gueldenstaedti* Pallas, 1811. However, some authors still use the original name *Cr. russula monacha* (Hellwing, 1970).

MATERIAL

The material for the present study (26 specimens of white-toothed shrews) was captured in snap traps in the vicinity of Mosul (Al Mawsil, altitude 330 m, northern Iraq) from 4 to 22 December 1969. The following measurements were taken: L — length of head and body; C — length of tail; P — length of hind foot; LCB — condylobasal length of skull; LCr — greatest length of skull; LaN — greatest width of braincase; LaZ — zygomatic width; LaI — interorbital constriction; LOSD — length of maxillary toothrow; LOID — length of mandibular toothrow; LMd — length of mandible; AMd — height of mandible.

Acknowledgement

My thanks are due to RNDr. V. Hanák CSc. for his valuable comments on the present study and for the loan of literature.

RESULTS

Basic characterization of the material under study

Colouring: The skins of all individuals in this series is brown-grey on the head, back and flanks, the ventral side of the body and head is grey-white. In some specimens there is a slight brownish shade on the ventral side of the body as well. There is never a sharp line of demarcation along the flanks between the colours of the dorsal and ventral surfaces. However, the back of freshly captured individuals is grey-brown, with the greyish shade more accentuated.

Size: Measurements are given in Tables 1 and 2. Owing to the number of specimens it was possible to evaluate males and females separately. Among the body measurements sexual dimorphism is pronounced in the length of the hind foot (males 13.4, females 13.1 mm), whereas the differences in the absolute and relative lengths of tail are negligible. No difference was found in the body length. The relative length of tail in both sexes ranges between 61.7 and 91.0 per cent.

Size of skull: The measurements making up the size of skull are usually larger in males than in females. Differences are found especially in the condylo-basal and total length of the skull, in the width of the braincase and in the length of the maxillary toothrow (see Tabs. 1 and 2). The mean values of the interorbital constriction and zygomatic width are similar in both sexes.

The length of the mandible and the length of the mandibular toothrow do not show any marked sexual divergence, whereas there is a conspicuous difference between males and females in the height of the mandible; the distinction appears in mean values (males 5.3 mm, females 5.1 mm) as well as in the range of variability. The AMd values range between 5.1–5.5 mm in the males, between 4.9–5.2 mm in the females.

Dentition: The antero-lateral cusp of the large upper premolar is, as a rule, slightly higher than the last small unicuspid c^1 ; in most cases i^1 has a markedly developed secondary lobe, which only rarely is smaller than i^3 .

Habitat: The white-toothed shrews were captured in two quite different habitats. One was the bank of a small stream running in a semi-desert (Fig. 1). The bank was overgrown with vegetation, whereas the adjacent landscape was without any vegetation at that time. Specimens of *Mus musculus*, a predominant species at the locality, were captured together with the white-toothed shrews in the same trap line. Thirty traps were exposed and — in daily average — the house mice were captured in 15.8% of the traps, whereas the white-toothed shrews in 4.1 % only.

The other habitat were shrubby parts of a planted eucalyptus wood on the bank of the Tigris (Fig. 2). In the thick shrubby undergrowth the white-toothed shrews were predominant; they were captured in 23.3 % of traps, whereas the house mice in 5.5 % only. One type of meat bait was used. No other species of small mammals was captured in those two habitats.

The facts given above show that *Crocidura gueldenstaedti* and *Mus musculus* are common species in this region. The occurrence of white-toothed shrews depends on the presence of herbs or shrubs; attempts at capturing them in

Table 1. Values of some external and cranial measurements of *Crocidura gueldenstaedtii* from northern Iraq — males.¹⁾

Nr.	G	L	C	P	C:L	LCB	LCr	LaN	LaZ	LaI	LOSD	LOID	LMd	AMd
I-7	10.0	55.0	50.0	13.5	91.0	18.6	19.5	8.8	6.1	4.4	8.4	7.9	10.4	5.3
I-13	7.5	69.0	44.0	12.3	63.8	18.2	19.0	8.6	5.8	4.2	8.4	7.7	10.3	—
I-30	9.0	71.0	50.5	13.0	71.2	19.2	19.7	9.0	6.2	4.3	8.8	8.0	10.7	5.5
I-36	9.0	65.0	44.0	12.0	67.7	—	—	—	6.1	—	8.2	7.7	10.3	5.1
I-45	8.5	71.0	51.0	14.7	71.9	—	—	—	6.0	4.3	8.5	7.8	10.3	5.4
I-49	9.5	67.0	48.0	14.0	71.8	19.0	19.7	8.8	6.0	4.3	8.8	7.9	10.8	5.3
I-51	8.5	65.0	43.0	13.1	66.3	18.3	19.3	8.5	6.0	4.3	8.7	8.0	10.2	5.1
I-53	8.5	66.0	46.0	13.3	69.7	18.6	19.5	8.7	5.9	4.5	8.7	8.0	—	—
I-55	9.5	71.0	48.0	14.0	67.6	19.0	19.8	8.9	6.2	4.3	8.6	7.8	10.5	5.4
I-58	9.5	70.0	50.5	13.2	72.3	19.3	19.8	8.8	6.1	4.4	8.8	8.0	10.6	5.3
I-59	11.5	71.0	50.0	14.0	70.5	—	—	—	—	—	9.0	8.1	11.1	5.4
Total		741.0	525.0	147.1	783.8	150.2	156.3	70.1	60.4	39.0	95.0	86.9	105.2	47.8
Average		67.4	47.7	13.4	71.3	18.8	19.5	8.8	6.0	4.3	8.5	7.9	10.5	5.3

¹⁾ The measurements are given in mm, only C : L in %.

Table 2. Values of some external and cranial measurements of *Crocitara gueldenstaedti* from northern Iraq - females.¹⁾

Nr.	G	L	C	P	C:L	LCB	LCr	LaN	LaZ	LaI	LOSD	LOID	LMd	AMd
I-6	7.5	67.0	44.0	12.3	65.7	18.3	19.0	8.6	5.8	4.2	8.4	8.0	10.9	5.0
I-17	6.5	67.5	44.0	12.5	65.3	18.1	18.8	8.4	5.7	4.0	8.3	7.5	10.4	5.0
I-37	7.5	68.0	44.0	12.8	64.8	18.3	19.0	8.5	6.0	4.2	8.2	7.8	10.2	5.1
I-38	8.5	70.0	48.0	13.1	69.7	18.5	19.3	8.4	6.1	4.3	8.6	7.8	—	—
I-44	9.0	70.5	50.5	13.3	71.7	18.5	19.3	8.7	5.9	4.3	8.5	8.0	10.8	5.1
I-46	8.0	54.0	42.5	12.5	78.8	18.2	18.8	8.3	5.5	4.1	8.3	7.6	—	—
I-47	9.0	68.0	48.0	13.7	70.6	18.6	19.4	8.6	5.8	4.3	8.5	7.9	10.5	5.1
I-48	7.0	59.0	49.0	13.6	83.2	—	—	—	—	—	—	—	—	—
I-50	9.5	70.0	50.0	13.0	71.5	18.6	19.4	8.9	6.1	4.3	8.8	7.9	10.4	5.2
I-52	8.0	69.0	49.0	13.2	71.0	18.0	18.9	—	6.1	4.2	8.6	7.9	10.2	5.1
I-54	8.5	69.0	51.0	13.4	74.0	18.4	19.4	—	6.0	4.3	8.4	7.6	10.5	5.2
I-57	7.0	65.0	43.0	12.4	66.2	18.1	—	8.5	5.8	4.4	—	7.6	10.3	4.9
I-60	8.0	72.0	48.0	13.5	66.7	18.4	19.2	—	5.8	4.3	8.4	7.9	10.6	4.9
I-61	9.0	73.0	45.0	13.8	74.3	18.2	19.0	8.5	6.0	4.0	8.4	7.9	10.6	5.1
I-62	8.0	66.0	49.0	12.7	61.7	18.9	19.6	8.7	6.2	4.5	8.5	7.9	10.6	5.0
Total		1008.0	705.0	195.8	1054.2	257.1	249.1	94.1	82.8	59.0	109.9	109.2	126.0	60.7
Average		67.2	47.0	13.1	70.3	18.4	19.2	8.6	5.9	4.2	8.4	7.8	10.5	5.1

¹⁾ The measurements are given in mm, only C:L in %.

semi-desert or rocky habitats were unsuccessful. Similar ecological requirements of white-toothed shrews from Israel are mentioned by Harrison (1964).

DISCUSSION

The analyses of body and skull measurements in the series of white-toothed shrews from Iraq and in other collections (Kahmann & Einlechner, 1959; von Lehmann, 1966) show that sexual dimorphism appears in many measurements, especially cranial ones. Therefore any taxonomical study must be made on sexed material, since a differing frequency of males and females might affect the total mean value. The series from Iraq and Turkey (von Lehmann, 1966) can be satisfactorily compared, as at the present time there are no other numerous collections from Middle East. The drawback of the Turkish series is that it comes from several localities. Table 3 shows that the two series are very similar; the only distinction found in the width of the braincase might be due to different manners of taking the measurements (the Turkish white-toothed shrews display higher values). With regard to von Lehman's evaluation, also the Mosul white-toothed shrews can then be

Tab. 3. The comparison of some external and cranial measurements of *Crocidura gueldenstaedti* and *Crocidura russula*

n ♂/♀		<i>Crocidura gueldenstaedti</i>				<i>Cr. russula</i>
		Iraq 11/15	Turkey 15/10	Greece 7/6	Israel 18 (♂ + ♀)	Central Europe 14/12
L	♂♂	67.4	67.7	61.8	66.8	71.7
	♀♀	67.2	64.6	63.6		70.0
C	♂♂	47.7	47.1	45.2	43.5	39.8
	♀♀	47.0	43.1	40.5		40.9
P	♂♂	13.4	—	—	12.0	12.2
	♀♀	13.1				12.4
C:L	♂♂	71.3	69.9	72.8	65.1	55.2
	♀♀	70.3	66.4	64.3		58.4
LCB	♂♂	18.8	18.8	18.9	—	19.1
	♀♀	18.4	18.5	17.8		
LaN	♂♂	8.8	9.1	9.1	8.6	9.1
	♀♀	8.6	8.9	8.8		
LaZ	♂♂	6.0	6.0	6.1	5.6	6.5
	♀♀	5.9	6.0	5.9		
LOSD	♂♂	8.6	8.6	8.4	8.0	8.4
	♀♀	8.4	8.5	7.9		
LOID	♂♂	7.9	7.9	7.7	7.2	—
	♀♀	7.8	7.7	7.4		
LMd	♂♂	10.5	10.5	10.5	—	10.4
	♀♀	10.5	10.3	9.9		

classed with the nominate subspecies *Crocidura gueldenstaedti gueldenstaedti* Pallas, 1811. It is highly probable that populations from northwestern Syria also belong to the nominate subspecies (von Lehmann, 1965).

When the Iraqi and Turkish material is compared with white-toothed shrews of the same species from the Greek islands Kapsali and Amphilyssos (Richter, 1966), differences appear in some measurements (L. C. LOŠD,

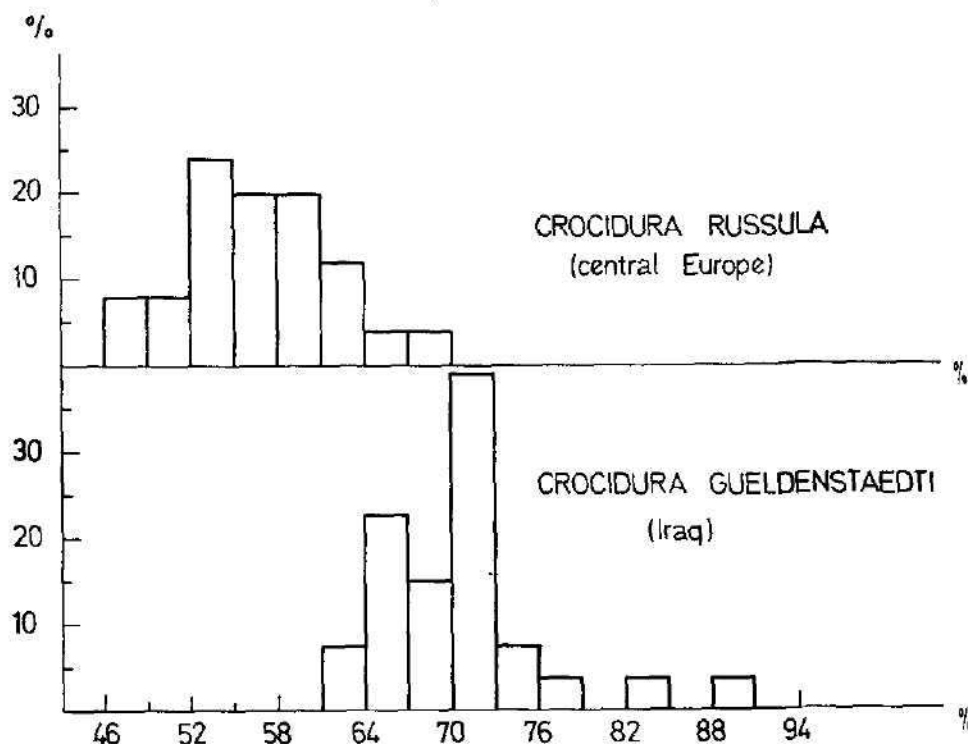


Fig. 3. Variation of the relative length of tail of *Cr. russula* (n = 25) and *Cr. gueldenstaedti* (n = 20)

LOID). Greek specimens have a characteristic colouring with a rusty shade as well. However, too great disproportions between males and females (apparently due to a small number of individuals and varied provenance of the series) do not enable us to get a correct idea of the character of these island populations. It seems that individuals from the islands are probably smaller than those from Turkey and Iraq.

The rather small Harrison's (1964) collection of long-tailed white-toothed shrews from Israel, identified as *Crocidura russula monacha*, is also available for comparison. In practically all measurements of the body and skull this series is smaller than the Iraqi or Turkish samples, but the relatively great length of tail gives evidence of a relationship with these forms. Therefore it seems correct to regard these forms as white-toothed shrews of the *gueldenstaedti*-group.

Crocidura gueldenstaedti is characterized, above all, by the relative length of tail, which according to Richter (1966) amounts to 60–80 % of the head

and body length. This is confirmed by our results obtained on the Iraqi population, where most values remain within this range. The relative length of tail is also a character distinguishing this species from *Crocidura russula*. Data on a series of *Crocidura russula* from Central Europe (Kahman & Einlechner, 1959) are given for comparison in Tab. 3 and Fig. 3. There is a substantial difference in the relative length of tail not only in the mean value, but also in the relative frequencies of rates. In the white-toothed shrews from Central Europe the hind foot is shorter, and the condylobasal length of skull and zygomatic width are greater. The relationship of European and East Mediterranean long-tailed forms of white-toothed shrews cannot be definitively established without comparative studies of numerous material, especially from southeastern Europe, because, for the time being, populations of the white-toothed shrews of the *gueldenstaedti*-group cannot be compared with the easternmost populations of *Crocidura russula*. At the present time the establishment of *Crocidura gueldenstaedti* as a separate species seems to be well-founded, as it ensues from the comparison of its East Mediterranean populations with *Crocidura russula* from Central Europe.

The Mosul population is remarkable for its dentition; in most individuals of the series the antero-external cusp of the large upper premolar is usually higher than the last small canine (c^1), i.e. of the so-called leucodon-type according to Richter (1963). In this it differs from the Central European populations of *Cr. russula* as well as from the white-toothed shrews of Israel. The dentition of the material from Turkey and Greece has not been evaluated, so that it is not possible to compare these populations in this respect.

The relationship of *Crocidura russula* and *Crocidura gueldenstaedti* can be definitively settled only when numerous material will be available and its ontogenetical variability will have been profoundly analysed; this question has not yet been examined in any of the papers published so far, including the present one.

SUMMARY

A relationship between white-toothed shrews from northern Iraq (Mosul) and long-tailed forms from Turkey identified as *Crocidura gueldenstaedti gueldenstaedti* Pallas, 1811 has been ascertained. These white-toothed shrews belong among common small mammals of that region; their occurrence depends on the presence of herbs or shrubs. The Iraqi population is compared with available material from eastern Mediterranean as well as with *Crocidura russula* from Central Europe.

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The plates will be found at the end of this issue.

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A NEW FIND OF THE GENUS FAGEPAUROPUS (PAUROPODA)

JOSEF CHALUPSKÝ

Received September 2, 1971

Abstract: Three specimens of *Fagepauropus hesperius* found in Mongolia are reported.

A larva with eight pairs of legs was found in 1951 by Remy among Pauropoda of southern Morocco ("Tiznit, dans le lit de l'oued, en amont de Bab Ait Jerrar, alt. 250 m"). It could not be placed in any of the genera of Pauropoda known so far. Double globules on its antennae would have placed it in the genus *Polypauropus*, but it differed in that that only its Ist, VIIth and VIIIth pairs of legs had 5 segmented, while the IInd to VIth pairs of legs had 6 segments each in contrast to all legs being five-segmented in this genus. Therefor Remy established for it a new genus and species *Fagepauropus hesperius*. In 1958 Remy discovered 3 other specimens of this genus in material from Gambia ("1 km à l'E. de Keneba") and completed the diagnosis of the genus with absence of a "palette médio-tergal" from head, in contrast to the genus *Polypauropus* where it is present. Again the specimens were larvae with eight pairs of legs. This form was last mentioned in a paper of 1960(b), in which Remy reviewed collections from Morocco.

Some time ago Dr Josef Rusek of the Institut of Entomology, Czechoslovak Academy of Sciences in Prague handed over to me three specimens of Pauropoda collected in Mongolia by Docent Dr. Otakar Štěrba of the Faculty of Natural History, Palacký University, in Olomouc. They were obtained from accumulated potamofreatic water of the river Tola near Ulan Bator on 25. 8. 1964 during the collecting of Harpacticidae (Štěrba, 1967). All three specimens are larvae with eight pairs of legs, belonging to the genus mentioned above owing their six-segmented legs of the IInd to VIth pairs and absence of the "palette médio-tergal" from the head. The Ist, VIIth and VIIIth pairs of legs are 5-segmented.

Comparison with the description of *Fagepauropus hesperius* does not show any marked differences; therefore I consider the specimens captured as belonging in this species, although the great distance between the places of Remy's and Štěrba's finds suggest that it might be a new, distinct species. But since comparisons drawn from literature are usually insufficient, establishment of a new taxon does not seem justified. (It would not be the first case of a world-wide distribution of Pauropoda.)

Remy's descriptions of this species are very detailed, so that in the present communication I am illustrating parts of major importance only, i.e. pygidium and trichobothria III. Both agree with the original description, only the technique employed now allowed me to see some details a little better. In

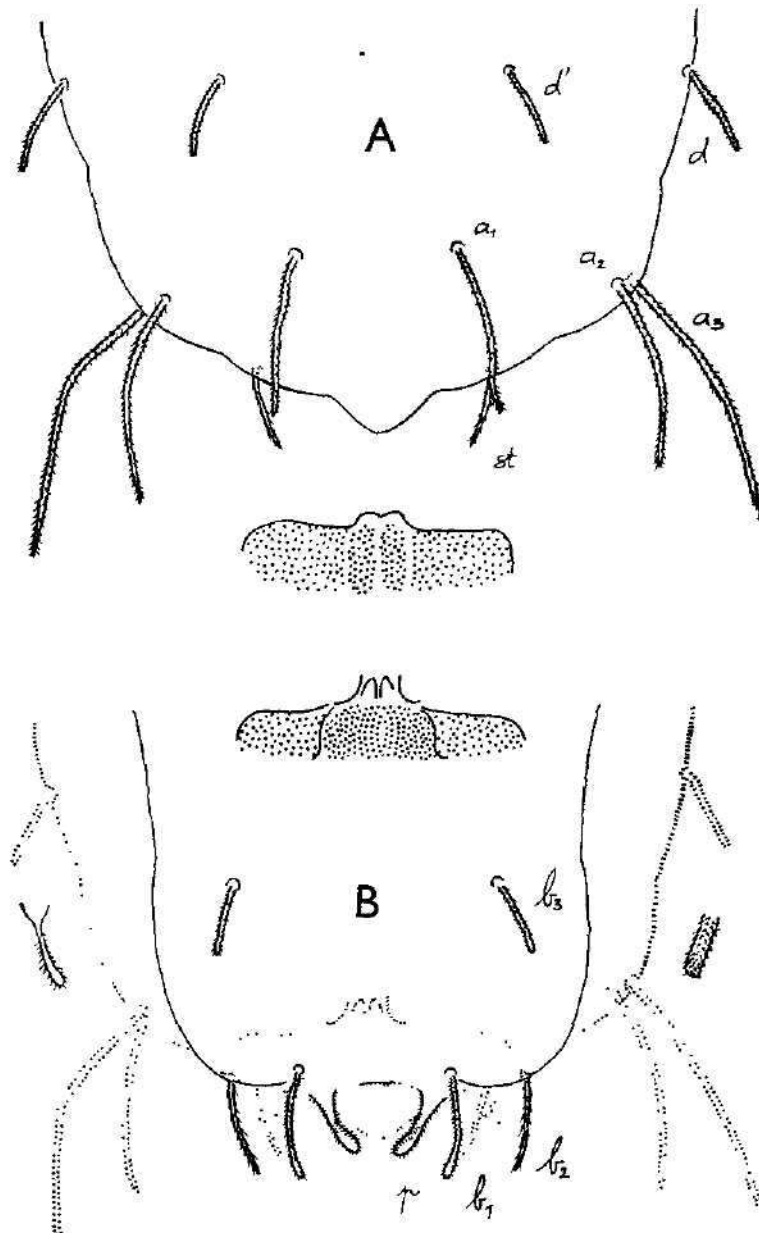


Fig. 1. Pygidium of *Fagepauropus hesperus*. A — tergal, B — sternal side of pygidium and inner pubescence of these parts, the delimitation of which is indicated in B. Laterally of the sternal side there are projections *p* as seen in diagonal view from two vertical directions.

the illustrations I am fully keeping on Remy's terminology, including styles. Remarkable are peculiar pygidial indicated here *p*. They grow out of the pygidium somewhat obliquely, so that their exact shape is better seen

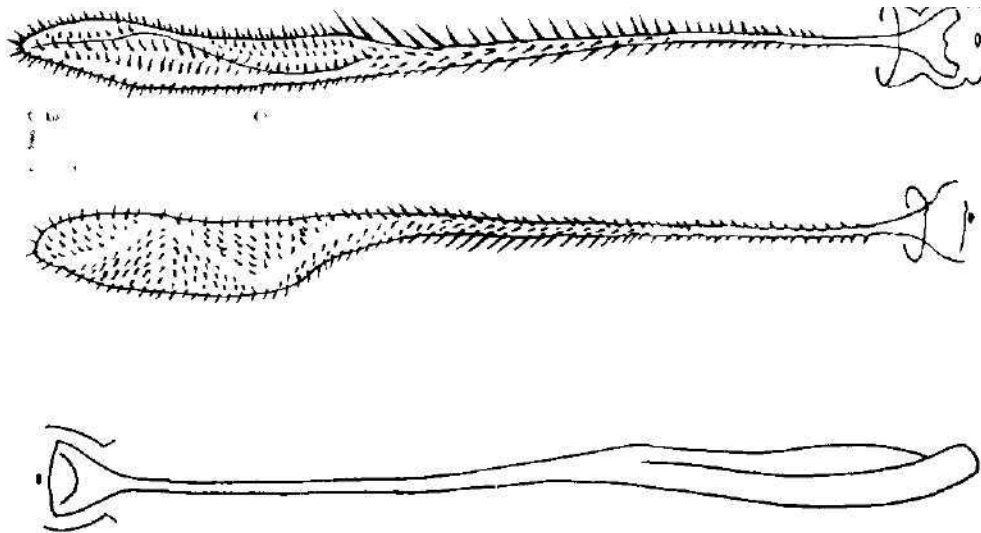


Fig. 2. Trichobothria III of *Fagepauropus hesperius*. The lower figure shows only the shape without pubescence.

in diagonal view. The habitat of this species can be conjectured from data by Remy for his first find and by Štěrba.

The conspicuous coincidence that always specimens with 8 pairs of legs were found might lead us to assume that it is the definitive stage. However, surely they are larval instars. One male specimen has developed gonopods, but there is no sperm in its body, so that it is certainly young. The other two specimens, apparently future females, possess neither receptaculum seminis nor ductus receptaculi (Chalupský, 1971), which most probably will have been developed in adult females of this species.

When describing *Polypauropus dubosqui* Remy (1932) discussed the question of primitive and advanced features in the number of leg segments from evolutionary viewpoints. The genus *Polypauropus*, found to be related to the other Pauropoda, seemed to be more derived owing to the type of pygidium, presence of the "palette" on head, and particularly owing to the double globule on antennae, but Remy was not sure about the number of leg segments. The genus *Brachypauropus*, with all legs 5-segmented but primitive in the appearance of its terga, suggested that 5-segmented legs not be an advanced character. Also the 5-segmented last pair of legs in pre-imaginal instars, latter having 6 segments in imagines, seemed contradictory to him. Remy returned to this problem in the description of the new genus *Fagepauropus* and considered tachygenesis — here reduction of leg segments — a proof of advanced evolution. This opinion of his seems to be correct, and if genera or groups of Pauropoda are compared by their leg segments and basic organization of the body (as they are taxonomically classified), there appear evolutionary lines which may terminate in representatives with all legs five-segmented. In *Eurypauropodidae* it is *Gravierypus*, here it is *Polypauropus* and elsewhere all *Brachypauropodidae* as a distinct end of a line the links of which are not obvious.

It can be concluded that one genus and apparently one species, too, *Fagepauropus hesperius*, was found at distant localities in Africa and Asia. Only 7 specimens mentioned above are known, all of them larvae with 8 pairs of legs. It is not known whether the rare finds are due to its generally rare occurrence. Data available so far suggest that with the collecting method employed by Štěrba (1967) and by Remy's co-workers (1960a) for Pauropoda more of them might be captured at the places where they occur.

Acknowledgement

I wish to express my thanks to Dr Josef Rusek of the Institute of Entomology, Czechoslovak Academy of Sciences, Prague and Docent Dr. Otakar Štěrba of the Faculty of Natural History, Palacký University, Olomouc for the material described here.

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A NOTE ON THE GROWTH
OF *BARBUS MERIDIONALIS PETENYI* HECKEL, 1847
(PISCES: CYPRINIDAE)

KARTHIGESU CHITRAVADIVELU

Received September 30, 1971

Abstract: Age and growth of *Barbus meridionalis petenyi* from the rivulet Krzyworzeka (river Vistula drainage), Poland were studied using scales. Growth histories were computed by the method of R. LEE (1920). Growth has been compared with that of *Barbus meridionalis rebeli* Koller, 1926, from lake Skadar, southern Yugoslavia and presented with the data of Starmach and Rosó1 (1961).

INTRODUCTION

The mediterranean barb, *Barbus meridionalis petenyi* Heckel, 1847 is a well known fish of some rapid Danubian tributaries in Czechoslovakia, Hungaria, Roumania and southeastern part of Balkan peninsula (for detail account on distribution, see Banarescu, 1964). There are no data available regarding the growth of *Barbus meridionalis petenyi* except for a brief reference of a sample collected in the uppermost part of the river Vistula (Wisla) in Poland by Starmach and Rosó1 (1961).

MATERIALS AND METHODS

The author had received a sample of *Barbus meridionalis petenyi*, through the courtesy of Asst. Prof. Dr. O. Oliva, collected by him in the rivulet Krzyworzeka (20°5' long. of Greenwich, 49°50' lat.), a right side tributary of the river Raba, about 35 km east of Kraków in southern Poland. The fish were collected by hand net in summer, 1969 and preserved in formalin. The biometrics of these specimens were studied by Oliva and Chitravadivelu (1971). The specimens of *Barbus meridionalis rebeli* Koller, 1926 (nomenclature used according to Banarescu, 1960) from lake Skadar, Yugoslavia were made available by Ing. T. Sekulović, Biological Institute, Titograd, Yugoslavia.

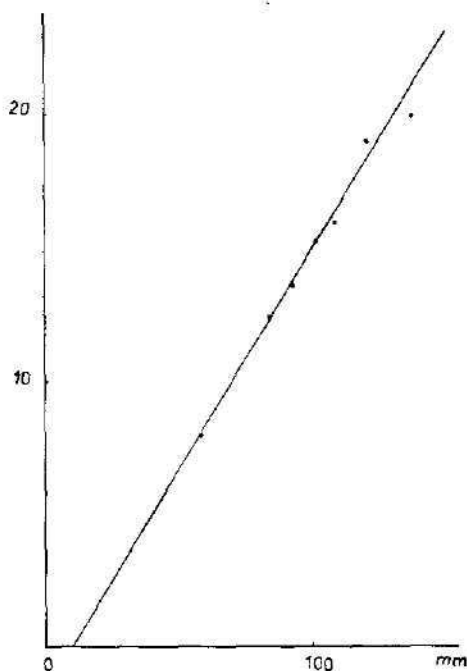
Scales were removed from the left side above the lateral line, in the region of the dorsal fin. The age was determined from the scales by counting the number of annuli, using a microprojector (Carl Zeiss Jena) with a magnification of $\times 17.5$. The distances from the centre to the different annuli were measured along the diagonal radius and used in the computation of the growth histories by the method of R. Lee (1920), using a correction of 10 mm (see graph 1).

The average body weights at the end of each growth period were computed from the logarithmic graph (Lagler, 1950) (see graph 2).

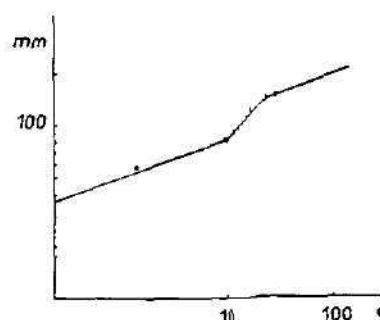
RESULTS AND DISCUSSION

The growth data are summarised in table 1. The 3 years old *Barbus meridionalis petenyi* from Krzyworzeka has a range in standard length of 121 to 143 mm (average 134.0 mm) and an average weight of 37.0 grams at the

time of capture whereas the 4 years old *Barbus meridionalis rebeli* from lake Skadar has a range in standard length of 112—122 mm (average 116.0 mm) and an average weight of 33.8 grams. It appears from these figures and the computed lengths that the growth of *Barbus meridionalis rebeli* is much slower than that of *Barbus meridionalis petenyi*, (see table)



Graph 1. Relation between standard length and diagonal radius of *Barbus meridionalis*. Abscissa, standard length in mm; ordinate, scale radius $\times 17.5$ in mm.



Graph 2. Logarithmic plot showing the relation of standard length (ordinate) to body weight (abscissa).

It is interesting to note that the annual increments in *Barbus meridionalis rebeli*, although approximately the same are nearly half those of *Barbus meridionalis petenyi*. The annual increments of *Barbus meridionalis petenyi* during the second and third years are 40 mm and 37 mm respectively.

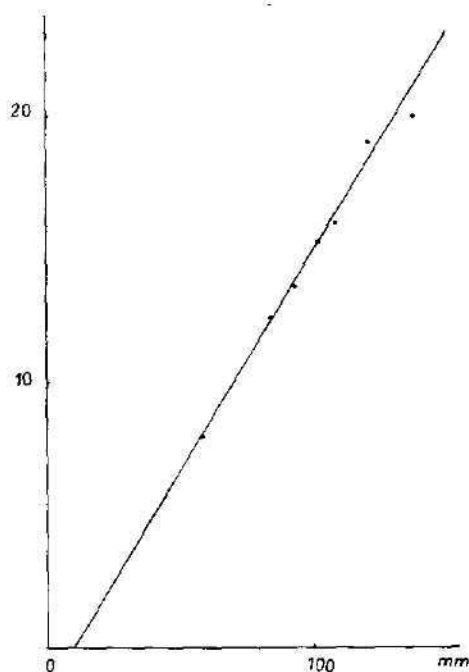
According to Starmach and Rosól (1961) the ranges in length and weight of *Barbus meridionalis* from Vistula are: 3 year old female 133—194 mm and 33.5—140.5 grams; 4 years old male 125—148 mm; 4 years old female 162 to 197 mm and 77.5—113.0 grams and 5 years old females 114—218 mm and 96.0—215.0 grams. Unfortunately Starmach and Rosól (l.c.) had not given the growth histories of their sample. Therefore only the ranges obtained in the present study are comparable with those of Starmach and Rosól (l.c.). When the growth of 3 years old *Barbus meridionalis* are considered without regard to sex, it appears that those from Krzywonia grow slower than those from the upper region of Vistula.

The Author is much obliged to Ing. T. Sekulović for providing the sample of *Barbus meridionalis rebeli*.

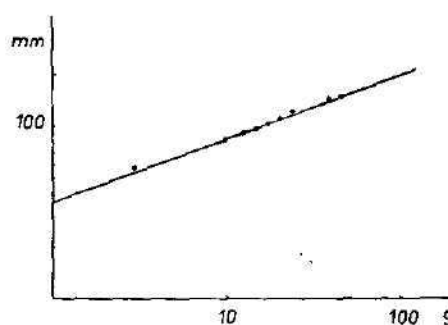
Table 1. Summary of empirical, computed standard lengths and weights of *Barbus meridionalis*

Locality	Age-class	Number	Average standard length in mm at the time of capture and ranges	Average weight in grams at the time of capture	Mean computed standard lengths in mm (above) and weights in grams (below)			
					l ₁	l ₂	l ₃	l ₄
Rivulet Krzyworzeka near Dobrzyce, Poland	I	2	58.0	3.0	58			
	II	23	98.3 (82-111)	16.0	65	98		
	III	3	134.0 (121-143)	37.0	67	108	140	
					5.5	21.0	43.0	
Total		28		Average	63	103	140	
					4.7	19.0	43.0	
				Minimum 1	38	83	136	
				Maximum 1	77	116	143	
Lake Skadar, Yugoslavia	IV	5	116.0 (112-122)	33.8	43	64	87	100

time of capture whereas the 4 years old *Barbus meridionalis rebeli* from lake Skadar has a range in standard length of 112—122 mm (average 116.0 mm) and an average weight of 33.8 grams. It appears from these figures and the computed lengths that the growth of *Barbus meridionalis rebeli* is much slower than that of *Barbus meridionalis petenyi*, (see table 1).



Graph 1. Relation between standard length and diagonal radius of *Barbus meridionalis*. Abscissa, standard length in mm; ordinate, scale radius $\times 17.5$ in mm.



Graph 2. Logarithmic graph showing the relation of standard length (ordinate) to body weight (abscissa).

It is interesting to note that the annual increments in *Barbus meridionalis rebeli*, although approximately the same are nearly half those of *Barbus meridionalis petenyi*. The annual increments of *Barbus meridionalis petenyi* during the second and third years are 40 mm and 37 mm respectively.

According to Starmach and Rosól (1961) the ranges in length and weight of *Barbus meridionalis* from Vistula are: 3 year old female 126—194 mm and 33.5—140.5 grams; 4 years old male 125—148 mm; 4 years old female 162 to 197 mm and 77.5—113.0 grams and 5 years old females 174—218 mm and 96.0—215.0 grams. Unfortunately Starmach and Rosól (l.c.) had not given the growth histories of their sample. Therefore only the ranges obtained in the present study are comparable with those of Starmach and Rosól (l.c.). When the growth of 3 years old *Barbus meridionalis* are considered without regard to sex, it appears that those from Krzyworzeka grow slower than those from the upper region of Vistula.

The Author is much obliged to Ing. T. Sekulović for providing the sample of *Barbus meridionalis rebeli*.

Table 1. Summary of empirical, computed standard lengths and weights of *Eurubus meridionalis*

Locality	Age-class	Number	Average standard length in mm at the time of capture and ranges	Average weight in grams at the time of capture	Mean computed standard lengths in mm (above) and weights in grams (below)			
					l ₁	l ₂	l ₃	l ₄
Rivulet Krzyworzeka near Dobczyce, Poland	I	2	58.0	3.0	58			
	II	23	98.3 (82-111)	16.0	65	98		
	III	8	134.0 (121-143)	37.0	67	108	140	
					5.5		21.0	43.0
	Total	28		Average	63	103	140	
				4.7		19.0	43.0	
Lake Skadar, Yugoslavia	IV	5	116.0 (112-122)	33.8	43	64	87	109
					Minimum 1	38	83	138
				Maximum 1	77	116	143	

SUMMARY

1. The age and growth of *Barbus meridionalis petenyi* from the rivulet Krzyworzeka in southern Poland have been studied, using scales and the growth compared with that of *Barbus meridionalis rebeli* from lake Skadar of Yugoslavia.
2. The growth histories have been computed by the method of R. Lee (1920) with a correction of 10 mm.
3. The growth of *Barbus meridionalis petenyi* from Krzyworzeka is faster than that of *Barbus meridionalis rebeli* from lake Skadar, Yugoslavia.
4. Results have been compared with some data of Starmach and Rosól (1961).
5. The growth in Krzyworzeka appears to be slower when compared with that in the upper region of Vistula (Wisla), but further studies with larger samples from all localities must be undertaken.

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PRODUCTION OF SPORES OF NOSEMA PLODIAE KELLEN
ET LINDEGREN IN MAMESTRA BRASSICAE L.
AFTER DIFFERENT INFECTIVE DOSAGE, I

ZDENĚK HOSTOUNSKÝ, JAROSLAV WEISER

Received July 10, 1971

Abstract: Length of infection and spore production of *Nosema plodiae* are studied in *Mamestra brassicae* after different initial doses. Final spore counts in dead caterpillars are similar in all groups and reflect the size of the host tissue. Reproduction rate changes from $713\times$ in high infectious doses of 724.000 to $131.400\times$ in low doses of 5000 spores. Most efficient modes of production of spores are to use low threshold doses of spores. Mortality occurs at time of pupation, when all tissues are filled. Infected animals live 2—2.5 times longer than the healthy larval stage.

Infections of insects caused by microsporidia are usually long lasting diseases with localization in the fat body. Mortality occurs at the time when the body of the infected larva needs the supplies of the fat body for the formation of new tissues of pupae and adults. In diseases localized in other tissues, necessary for larval life, the pathogen kills the host early. In experimental infections with different dosages of spores three specific situations are met: underdosage without development of the disease, low dosage producing a long lasting disease with great masses of spores, and overdosage resulting in a septicemia in 3 to 5 days and high mortality of the insect, without production of spores of the microsporidian.

The production of spores in normally infected insects changes according to the infected instar, the used dosage and the rearing conditions of the insect. Only a few data are given in the literature on spore production. Experimental infections of *Gnorimoschema operculella* with *Nosema infesta* (Hall, 1954) resulted in a production of 10^7 spores in one larva. Other estimates are given in a review of Ignoffo and Hink (1971): For *Thelohania hyphantriae* in *Hyphantria cunea* 10^7 spores, for *Nosema lymantriae* in *Lymantria dispar* $30-50 \cdot 10^6$ spores, *Glugea ghastli* in *Anthonomus grandis* $68-250 \cdot 10^6$. Nilova (1967) reported from one infected *Euxoa segetum* $235-1.400 \cdot 10^6$ spores of *Nosema* sp. and $177 \cdot 10^6$ spores of *Plistophora schubergi*. In all mentioned cases the degree of infection varied from host to host and the indicated productions of spores were not directly comparable.

For a calculation of an economic production of viable spores in mass reared insects it is important to produce the material with the lowest losses, in the shortest time, with the lowest possible infectious dosis, as clean and synchronously as feasible. In this study we wish to present the insect model, *Mamestra*

brassicae, on artificial media as the producing host for the microsporidian *Nosema plodiae*. Our task was to find optimum relations between spore dosage, time to death and spore output. We prepared a method of feeding where all spores were taken by the host and with use of the artificial diet and sterile conditions, the mortality due to septicaemia was postponed far behind the normal critical overdose in natural populations.

MATERIALS AND METHODS

The microsporidian, *Nosema plodiae* Kellen and Lindegren (1968) was fed to *Mamestra brassicae* L. where it produced a long lasting chronic infection of the fat body with large masses of spores and with mortality occurring before pupation. From less motile, visibly infected caterpillars, cut longitudinally in the dorsal region, lobes of the infected fat body were removed with scissors and forceps and were homogenised between two microscopical slides. The milky white suspension is washed in vials with distilled water and cleaned from debris by sieving through a fine bronze net. The suspension with addition of water, is cleaned by centrifugation from remains of tissues and the clean stock suspension is counted in a Bürker chamber to assess a standard suspension. This suspension is kept in refrigerator at 4 °C and infective doses were prepared from this stock suspension with distilled water.

Caterpillars of *Mamestra brassicae* are produced in continuous rearings on Shorey's medium (Shorey, 1965). Groups of 50 eggs deposited on paper are hatched in vials 23 by 52 mm with a layer of nutrient medium on the bottom. Surface for crawling is provided by a square sheet of perforated plastic and the vial is closed by a plastic cap with stainless grid. The food supply in the vial is calculated to feed 50 caterpillars during the first three instars. At the end of the third instar caterpillars prepared to molt are separated into individual pill vials with cotton plugs. They remain without food till next day and all molted caterpillars are used for experiments after another night without food.

Hungry caterpillars take avidly food. Fresh fourth instar caterpillars are able to drink up to 2mm³ of water after this pre-treatment. Spore suspensions are prepared with the required amount of spores in 1 mm³. Glass capillary pipets with stainless wire pistons are used with long capillary ends coated with paraffin. The 1 mm³ drops of the suspension are deposited on microscopical slides coated with paraffin, avoiding the spread of the liquid. Hungry, freshly molted caterpillars are brought in a forceps close to the drop of suspension or are brought there on a cutting of paper. The caterpillars which come close to a drop of suspension stop moving and drink the liquid. The whole drop is taken at once. After some training the procedure is performed routinely.

For further rearings of infected caterpillars the vials with a double amount (50cm) of food are used which enables to keep caterpillars without transfer till pupation. Vials are kept in constant temperature of 26 °C and 96 per cent of rel. humidity. When the caterpillar died, its surface was cleaned of remains of food and it was triturated in a homogeniser in 10 ccm distilled water. Total spore count in every caterpillar was performed on samples of this suspension in a Bürker chamber.

RESULTS

Infected caterpillars showed mortality just before the pupation, but their life was much longer than of the healthy ones: 14 to 21 days compared with 8 in healthy ones. There was wide variability in the total spore count of infected larvae when they died. The maximum counts in every group were close to a limit of 900 · 10⁶ spores pro animal. This seems to be optimal output. But in every group some caterpillars produced only one third of this amount. Long living animals produced most spores.

Calculation of the rate of multiplication of the initial dose brought a visible grouping of caterpillars according to the infective dose and the lowest increase rate in one group was higher than the highest in the next group so that there was no overlapping of the multiplication rates in different groups (Tab. 1).

When the life span of infected caterpillars was calculated and compared with the per diem increase, the groups showed a definite differentiation.

Table 1. *Mamestra brassicae* 4th larvae infected with *Nosema plodiae*

Infective dose × 1000	Days to death	Spores in mill/larva	Increase × initial dose	Increase per day of inf.
5	16	119	23.800	1.487
	18	474	94.800	5.266
	18	700	140.000	7.777
	21	716	143.000	6.819
	21	1.277	255.400	12.161
50	14	230	4.600	328
	15	397	7.940	529
	17	617	12.340	726
	20	836	16.720	836
100	15	332	3.320	221
	17	546	5.460	321
	20	476	4.740	237
	20	816	8.160	408
181	16	306	1.690	105
	17	928	5.182	304
362	20	926	2.557	127
	20	938	2.591	129
724	15	364	502	33
	17	338	453	26
	17	560	773	45
	20	814	1.124	56

Average counts in every group show relevant differences in the production of spores. In variations of infectious doses from 5000 to 724.000, the final output of spores changed from 119.10⁶ to 1277.10⁶. The produced spores were 453 to 255.400 fold the original dose. Calculated as daily increase, the production changed from 26 to 12.161 spores.

As it is shown in average numbers of Tab. 2, a dosis of 5000 spores results in a production of 130.000 folds this initial dosis whilst there is only a 713 fold increase of the high dosis of 724.000.

DISCUSSION

In this series where larvae were evaluated after their death we studied the natural filling of the fat body of the caterpillar of *Mamestra brassicae* with

Table 2. *Mamestra brassicae* 4th larvae infected with *Nosema plodiae*
Average data in infection groups

Infective dose in thousands	Days of infection	Spores in mill/larva	Increase × initial dose	Increase per day of inf.
5	18	657	131.400	6.702
50	16	520	10.400	604
100	18	585	5.848	326
181	16	617	3.436	204
362	20	932	2.574	168
724	17	519	713	40

Nosema plodiae during its development from the fourth to last prepupal instar. In caterpillars originating from the same group and under the same rearing conditions, the volume of the susceptible tissues was almost the same. The final spore count was also very close to a general standard. Therefore it seems to be clear that microsporidia grow to fill the whole susceptible tissue and than the host dies. Infected animals survive the healthy mates as larvae and this phenomenon was mentioned in early studies of infections of insects with microsporidia (Weiser, 1943).

Even when it is proven that the infectious drinks bring all presented microsporidia into the gut of caterpillars, variability occurs in the spread of the infection in tissues of different animals. There is only indirect evidence of active participation of the developing vegetative stages in this differentiation.

For a mass production of microsporidia low initial doses show to be much more efficient than massive doses. And the size of the host tissue at the end of larval life determines the the general amount of spores produced. The validity of our experience is probably limited only to cases where the microsporidian invades only the fat body, spreads in it to its extent and does not produce any metabolite which may be able to harm or kill the host before total filling of tissues. Reduced contamination of the gut with bacteria must be a factor supporting long survival.

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**BIONOMY OF THE CZECHOSLOVAK SPECIES
OF THE GENUS CALATHUS BON., WITH NOTES ON THEIR REARING
(COLEOPTERA: CARABIDAE)**

ANTONÍN KÚRKA

Received February 15, 1971

Abstract: The rearing of larvae and adults of the species *C. fuscipes*, *C. erratus*, *C. ambiguus*, *C. metallicus*, *C. mollis*, *C. micropterus* and *C. melanocephalus* is described. Data are given on the fertility of females, mortality, and duration of the development of larvae kept at various temperatures. The method and results of the hibernation of larvae of some species are described. Results of dissections of females caught in the field are compared with data given in other papers, and on the basis of a summary of these data the bionomy and type of development of each species are evaluated.

INTRODUCTION

For the study of the morphology of larvae of the genus *Calathus* Bon., which was the subject of my thesis, it was necessary for identity to establish a breeding colony; through this breeding I acquired a number of bionomical data, which are presented in this paper. Beside them there are also data on the dissections of females caught in the field, which are compared with literary data.

Many basic bionomical and ecological data are given in the studies of Dahl (1925), Burmeister (1939), Larsson (1939) and Lindroth (1945; 1949). Drift (1959) compares his own observations in Holland with the results of the latter two authors. Detailed observations in the field were made by Gilbert (1956), Skuhřavý (1959), Novák (1964) and Schjetz-Christensen (1965). Three studies from Holland give information on the bionomy and ecology of *C. melanocephalus*: Vlijm, Hartsuijker and Richter (1961) give basic ecological data, Vlijm and Dijk (1967) studied the possibility of the imaginal overwintering, Vlijm, Dijk and Wijmans (1968) discuss the question of summed reproduction after hibernation. Further bionomical and ecological data on some species of this genus are mentioned by Geiler (1956—57ab), Greenalade (1965), Renkonen (1938), West (1940) and others.

MATERIAL AND METHODS

The condition of ovaries was ascertained by dissection of females caught in the field. The beetles were captured at various places in Czechoslovakia in 1963—1970. All species of the genus *Calathus* Bon. living in our country were studied: *C. ambiguus* (Payk.), *C. erratus* Sahlb., *C. fuscipes* (Goeze), *C. melanocephalus* (L.), *C. metallicus* Dej., *C. micropterus* (Duft.) and *C. mollis* (Marsh.). There are five stages of the development of ovarioles: 1) inactive threadlike ovarioles, indistinctly separated without corpora lutea — females of a new generation that had not laid any eggs before; 2) ovarioles in the stage of maturation, distinctly separated, without corpora lutea; 3) active ovarioles, i.e. with mature or ripening eggs, without or with very small, distinct corpora lutea — ovipositing females of a new generation; 4) inactive empty ovarioles with conspicuous corpora lutea — females after oviposition (found in autumn and spring); 5) fully active ovarioles with conspicuous corpora lutea — females of the previous year, second reproduction.

The condition of the ovarioles served as one of the criteria for determination of the developmental type. (In the following text these stages are indicated 1)–5)).

All the species examined were reared partly in a laboratory, and some of the larvae were reared outside at the natural temperature. The adults were kept usually in couples in glasses (with sifted humus as substrate) in the laboratory at the average temperature of 19–22 °C. The culture was set up in 58 glasses. In the beginning eggs were isolated from the vessels, but their mortality was 100% (mechanical damage?), and that was why later only larvae of the 1st instar were isolated. Checks were made every other day or every day, so that the time of hatching was recorded accurately enough. (The fertility of the females was then determined according to the number of larvae found.) The larvae were kept in Petri dishes of the average size of 50–70 mm, the substrate was either humus or filter paper. Imagines were fed with larvae of *Tenebrio molitor* twice a week; the larvae were fed with the same (cut up) food (every day). In the course of rearing the temperature was recorded, the substrate was moistened as required, moisture in the dishes can be considered to have been 100%. The larvae and adults of some species hibernated in the following way: the larvae were placed singly into flower-pots with soil, each pot was covered with silk and immersed into a layer of peat, which was covered with a layer of Sphagnum. The hibernation took place out of doors in open boxes, temperature was recorded in the layer of peat.

BIONOMY OF THE CZECHOSLOVAK SPECIES OF THE GENUS CALATHUS BON.

According to Larsson (1939) two basic types of reproduction exist in the family Carabidae: the species belonging to the first type are spring breeders, larvae live in summer and adults of new generation emerge in late summer or in autumn; imagines overwinter ("Frühlingsfortpflanzer", "Frühlings-tiere"). The species of the second type reproduce in late summer and in autumn, larvae overwinter, new imagines emerge in early summer of the next year ("Herbstfortpflanzer", „Herbsttiere"). Lindroth (1949) uses a more accurate name "Imagüberwinterer" and "Larvenüberwinterer", Drift (1959) indicates the first type as "with summer larvae" and the second type "which winter larvae". This outline is taken over from Hürka (1971), who proposes a more accurate indication for the first type as one with regularly non-hibernating larvae ("mit regelmässig nicht überwinternden Larven"), and for the second type as with regularly hibernating larvae ("mit regelmässig überwinternden Larven"). These indications are used in this paper. Thiele and Krehan (1969) and Thiele (1969) demonstrate by examining the life histories of some species with regularly hibernating larvae that the interruption of larval development in winter and metamorphosis in spring are determined by changes in temperature, photoperiod does not influence the larval development; these authors call the interruption of larval development "thermic parapause" according to Müller's classification (1966) of the types of dormancy.

Calathus fuscipes (Goeze)

C. fuscipes is an eurytopic species occurring in areas of low and medium altitudes preferably in an open field, frequently in woods (Dahl, 1925; Larsson, 1939). According to Burmeister (1939) this species prefers calcareous and sandy soils; it avoids mere sand and peat bogs (Lindroth, 1945).

Copulation in the field was observed by Gilbert (1956) in Anglesey in mid-September, but the study of the state of spermathecae showed that copulation takes place as early as in late July.

Development of eggs and oviposition. At stage 1) there were ovaries in females caught on 11. 7.; at stage 2) from 7. 7. to 20. 7.; at stage 3) on 19. 7., with 2 mature eggs. According to Skuhřavý (1959) eggs in ovaries begin to develop more rapidly in early August in our country, in late August oviposition begins and it is most intensive in September; during October it is mostly

over. Novák 1964) states the time of oviposition as September in Moravia, Greenslade (1965) July–October in England, Gilbert (1956) August–October.

Fertility. 200, 186, 105 (+ 5 eggs) and 138 + 83 larvae (the last female had been laying eggs for two years) were obtained from the individually bred females. The number of ovarioles per ovary in 20 dissected females varied from 10–17, 14 ovarioles were most usual. Skuhřavý (l.c.) states 12, Gilbert (l.c.) 8–14, usually 9–12 ovarioles (generally for four species, studied by Gilbert).

Larvae and pupae. Gilbert (l.c.) refers to a discovery of larvae of the third instar in December; he supposes that these larvae enter the third instar at the end of autumn and overwinter as this instar; the stage of praepupa lasts from January to April, pupation occurs in April.

Immature adults. According to Skuhřavý (l.c.), in our country soft adults emerge from June to mid-July; Schjötz-Christensen (1965) refers to finds of soft adults in Denmark on 12.–25. June, as a probable time of pupation he states mid-May to early June; Lindroth (1945) found immature adults in Sweden from 10. 6. to 6. 7., the largest numbers of immature adults were found by Gilbert (l.c.) in June.

Hibernation of adults. The females with ovaries at stage 4) were found 18. 4.–20. 7. According to Lindroth (l.c.) the percentage of hibernating imagines is fairly high in Scandinavia; Skuhřavý (l.c.) refers to a very rare occurrence of old imagines in spring.

Second reproduction. The find of one female with ovaries at stage 5) on 20. 7. (with a higher number of mature eggs) in our country proves the possibility of the second reproduction. According to Schjötz-Christensen (l.c.), in Denmark a very small proportion of hibernating imagines survives until their new reproductive season. Gilbert (l.c.) found some old females with mature eggs in Anglesey.

The length of development of individual larval instars is showed in Tab. 1. Development at the constant temperature of 25° C was shorter, and no differences were found in the duration of development of larvae kept at a varying temperature with the average of 20. 5 and 14.5 (15)° C.

As results from the data mentioned above, *C. fuscipes* is a species with regularly hibernating larvae, a certain portion of adults overwinter, too, some females can lay eggs again. Copulation occurs in mid-summer, some females produce eggs as early as in July, the maximum of oviposition is in September, when the first larvae appear. Pupation takes place in late spring, immature imagines emerge in June, at some places as early as in late May.

Breeding

Larvae were easily bred, but their mortality was quite high at 20.5° C in the laboratory; larvae of the 1st instar grew best at 14.5° C, the development of larvae of the 2nd instar was similar. The constant temperature of 25° C was unsuitable for both instars (see Tab. 1). The second reproduction of one female was observed in the following year, oviposition began in mid-October in the first year, in the second year in October again. (In winter the light day was shorter and the temperature went down from 22° C to 16.5° C (\bar{x}) in the

Table 1. The development and the mortality of larvae

In- stars	Type of temperature	\bar{x} t °C	min-max t °C	\bar{x} development (days)	min-max development (days)	number of data	total number of larvae	number of dead larvae	mortality %
I.	Varying laboratory t.	20.5	(15-19)-25	13	8-21	71	93	16	17
	Varying laboratory t.	12	8-11	15	13-17	12	14	0	0
	Natural t.	14	8-19	16	14-18	9	9	0	0
	Constant laboratory t.	25	25	9	7-12	4	11	7	64
II.	Varying laboratory t.	20.5	(15-18)-25	21	17-32	24	61	37	61
	Varying laboratory t.	12.5	9-17	20	16-27	13	14	1	7
	Natural t.	9	3-(17-19)	25	24-28	8	9	1	11
	Constant laboratory t.	25	25	-	-	-	4	4	100
I.	Varying laboratory t.	20.5	16-25	14	8-22	55	112	47	42
	Varying laboratory t.	14.5	(9-12)-17	14	11-18	20	26	4	15
	Constant laboratory t.	25	25	12	10-16	6	7	6	71
II.	Varying laboratory t.	20.5	16-25	18	14-23	27	44	17	38
	Varying laboratory t.	15	12-17	18	14-26	9	12	4	33
	Constant laboratory t.	25	25	14	14	1	6	1	86
I.	Varying laboratory t.	19.5	(17-20)-(20-23)	10	7-14	34	83	24	29
	Natural t.	10.5	(4-10)-(15-24)	17	12-23	39	46	7	15
II.	Varying laboratory t.	19	(17-20)-(20-23)	12	9-15	30	30	7	18.5
	Natural t.	9.5	(0-7)-(11-19)	21	17-26	36	37	1	3
I.	Varying laboratory t.	21	(17-20)-25	14.5	8-30	49	100	25	25
	Natural t.	16.5	(6-10)-(23-27)	18	11-27	29	32	3	9.5
II.	Varying laboratory t.	20.5	(16-20)-25	20	16-29	21	40	19	48
	Natural t.	11	(0-7)-(16-22)	27	21-32	28	27	0	0

<i>C. mollis</i>	I.	Varying laboratory t.	19	17-23	12	10-16	58	98	14	14
		Natural t.	10	(0-3.5)-(15-19)	23	18-31	40	50	1	2
	II.	Varying laboratory t.	19	(15-17.5)-22	14.5	12-23	35	47	12	25.6
		Natural t.	8	(-4.5-0)-15	27.5	26-29	4	--	--	--
<i>C. micropterus</i>	I.	Varying laboratory t.	21	19-25	20	14-25	6	31	19	61
		Natural t.	21.5	(11-17)-(29-33)	--	--	--	10	10	100
		Natural t.	18	10-27	17.5	17	1	3	2	67
		Natural t. and varying laboratory t. (3 days)	5.5	-4.5-16	27	27	1	1	0	0
			14	8.5-16.5						
	II.	Varying laboratory t.	22	21-25	12	12	1	1	0	0
		Varying laboratory t.	14	8.5-16.5	about 26-30	about 26-30	1	1	0	0
		Natural t.	17	7-27	30	30	1	1	0	0
		Natural t.	11.5	3.5-22	41	41	1	1	0	0
	<i>C. metalheus</i>	I.	Varying laboratory t.	22	19-25	about 13	about 13	1	28	14
		Natural t.	7.5	3-16	about 17	about 17	1	9	2	22
II.		Varying laboratory t.	22	19-25	--	--	--	11	11	100
		Natural t. and laboratory varying t.	2	-4.5-11	about 38	about 33-34	6	7	1	14
		14	8.5-16.5							

laboratory.) Rearing up to the adult stage was unsuccessful, as all larvae died during and after the hibernation. For this hibernation 51 larvae (29 of 1st instar, 14 of 2nd instar, 8 of 3rd instar) were used; the hibernation began on 8., 12. and 23. 11.; ended (i.e. the larvae were transferred to the laboratory) 5.4. — The temperature in the layer of peat varied a little from 0° C; +3° C at the beginning of December, -6° C at the beginning of January, +4° C at the end of March. Monthly checks showed that:

- 1) during the first half of December 9 larvae of the 1st instar entered 2nd instar;
- 2) 2 larvae of the first instar entered 2nd instar in the second half of December;
- 3) in March 1 larva of the 2nd instar entered 3rd instar;
- 4) only 6 larvae survived the hibernation, 4 of them were put to hibernation as the 1st instar, and entered the 2nd instar in December, 2 remaining larvae were used as 2nd instar; all 6 larvae died in the 3rd instar during April and May. The larvae put to hibernation in the 3rd instar died during winter, in January and February.

Calathus erratus Sahlberg

An eurytopic species living in lowlands and hills; according to Dahl (1925) it occurs at 1300 meters above sea level, according to Burmeister (1939) at 1000 m. Lindroth (1945) describes it as a species living in open field mainly on sand, also on peat and clayey soils, but in woods as well, mainly on heaths in pine-woods. It is intolerant to too dense vegetation.

Copulation was observed by Gilbert (1956) in mid-September on Anglesey, but dissection of other females showed that they had already been fertilized at the end of July.

Oviposition, fertility. Dissection of the female caught on 8. 7. with ovaries at stage 3) and with 3 + 4 mature eggs (in left and right ovaries) proves the possibility of oviposition in late July in our country. At stage 4) were ovaries of the female caught on 12. 8. According to Gilbert (l.c.), Larsson (l.c.) and Greenslade (1965), oviposition takes place from July till the end of September, with the maximum in August. The fertility of two reared females was very high, 105 and 137 larvae were obtained. The number of ovarioles ranged from 10—12 in 9 females, Gilbert (l.c.) states 8—14, usually 9—12 ovarioles in each ovary (generally for four species).

Pupae and immature imagines. 4 immature females with ovaries at stage 1) were caught 21. 7. at 1050 m above sea level; this date is different from the following published data, because at this altitude the time of hatching and pupation comes certainly later. Burmeister (1939) states April and May as the time of pupation, Gilbert (l.c.) May, Schjötz-Christensen (l.c.) in Denmark late April and early May. According to Larsson (l.c.) pupation and breeding of imagines takes place in spring from late April until early June, Lindroth (1945) found in Sweden young adults from 10. 6. to 7. 7., Gilbert (l.c.) and Schjötz-Christensen (l.c.) from late May until mid June.

Hibernation of adults and a second reproduction in the following year in our country are confirmed by dissection of two females with ovaries at stage 4). The females were caught on 10. 4. and 3. 5. There were two females, collected on 21. 7. (at 1050 m above sea level) with ovaries at stage 5)

and with 5 + 4 and 2 + 2 mature eggs. Lindroth (l.c.) and Larsson (l.c.) confirm the possibility of the overwintering of adults. Gilbert (l.c.) and Greenslade (l.c.) consider the possibility of a second reproduction in England.

The duration of the larval stage is presented in Tab. 1. Small differences only were noticed at different temperatures, development at the constant temperature of 25° C was distinctly shorter. The only pupa obtained was developing at the average temperature of 21.5° C for 11 days, the eyes darkened in 9 days, the pigmentation of the adult developed in 3 days. Burmeister (l.c.) states the duration of the pupal stage to be 18—25 days. Gilbert (l.c.) lists the following data (generally for *C. erratus*, *C. mollis*, *C. melanocephalus*), obtained in the laboratory: pupal stage 3.5—4.5 weeks, eyes darkened in 2—4 days, mandibles 2—3 weeks after pupation (at 15° C), full pigmentation of adults developed in 3—5 days, full sclerotization in 3 weeks.

C. erratus is then a species with regularly overwintering larvae; some adults hibernate, too, females can lay eggs again in the following reproductive season. Copulation takes place at the beginning of summer, the females lay eggs from July to autumn. Pupae can be found from April until early June, adults emerge at the end of May and at the beginning of June; in higher altitudes even in the second half of July.

Breeding

It was easy to rear the larvae; their mortality was generally low (Tab. 1.), it was high at the constant temperature of 25° C; varying temperature with the average of 20.5° C was not suitable for the 2nd instar, on the contrary temperature with the average of 9—14° C was very suitable for both instars. The mortality of overwintering larvae was very high, nevertheless three pupae and one adult were reared. 23 larvae of the 3rd instar were used for the hibernation; the beginning and end of the hibernation and the temperature conditions are described under *C. fuscipes*. 16 larvae (i.e. 70%) survived this hibernation, 13 of them died at the end of April in praepupal torpor, the remaining ones entered the pupal stage; only one adult (male) emerged.

Calathus ambiguus (Paykull)

A steppe species of lowlands and hills, rather stenotopic, living on good, rather sandy soils with sparse vegetation; it is abundant mainly on dry sandy southern slopes, also in fields, sometimes in woods and heaths (Fowler, 1881; Dahl, 1925; Gersdorf, 1937; Larsson, 1939; Burmeister, 1939; West, 1940; Horion, 1941; Lindroth, 1945; Lohse, 1953; Geiler, 1956—57 ab). Novák (1964) mentions abundant occurrence in Moravia on loess.

Oviposition and fertility. According to Larsson (1939), the time of oviposition in Denmark is July and August. My data on the females found with emptied ovaries on 1. 10. show that oviposition is over by early October. The fertility of breeding females was moderate, 62, 40, 39 and 14 larvae were obtained from four females. Dissections of 5 females showed that 8—12, most often 10 ovarioles are present in each ovary; Skuhřavý (1959) states 12 ovarioles.

Pupation and immature adults. Larsson (l.c.) records a find of

a pupa and immature adults in June and July, Lindroth (l.c.) found immature imagines in Sweden from mid-June.

Imaginal hibernation and second reproduction. Geiler (1956—57a) and Novák (1964) mention the possibility of overwintering of adults; according to Lindroth (l.c.), only a small percentage of imagines hibernate. It is not clear if old females can lay eggs again in the following year.

Duration of development of larvae reared in the laboratory is presented in Tab. 1. The development was distinctly slower at a lower temperature.

The data mentioned above show that *C. ambiguus* is a species with regularly hibernating larvae; some imagines can hibernate.

Breeding

A sufficient number of larvae were obtained; the larvae had a generally low mortality, the natural average temperature of 9.5 and 10.5°C was more suitable than a higher one. 2 of 6 females not lay eggs, one of them died shortly after capture owing to a parasite of the class Nematoda. The second female perished without apparent cause; dissection showed fully active ovaries with a great number of mature eggs.

Calathus melanocephalus (Linnaeus)

An eurytopic species of lowlands and hills, rarely living in the mountains. Burmeister (1939) states occurrence as high as 2500 m above sea level. It lives mainly on sandbanks, avoids calcareous soils and prefers rather open, sufficiently light places; it occurs also in light woods, mainly in pine-woods in lowlands (Westhoff, 1881; Everts, 1922; Dahl, 1925; Lindroth, 1945; Schjøtz-Christensen, 1965). According to Larsson (1939), this species prefers sparse grass, on the contrary Lindroth (1945) states its occurrence mainly on sandy soils with high and dense vegetation. Vlijm, Hartsuijker and Richter (1961) explain this contradiction as a function of the influence of the degree of the humidity in the soil.

Copulation. According to Burmeister (1939) the time of copulation is in spring and autumn, the record of copulation in spring probably refers to adults that survived winter. Larsson (1939) states August as the time of copulation.

Oviposition, fertility. According to Gilbert (1956), oviposition begins in Anglesey in late July and continues till the end of the year; he found some adults with mature eggs even in March. The fertility of bred females was high, 55 (♀ died too early), 153, 169, 183, 184, 191, 197, 216 and 232 + 8 larvae (the last item refers to a female laying eggs for two years) were obtained from 9 females. The dissection of four females showed a large variability in the number of ovarioles per ovary, ranging between 8—17. Gilbert (l.c.) lists the number of larvae obtained by breeding as 14—84 larvae from remales kept at a natural temperature in October; he states 8—14, most often 9—12 ovarioles per ovary generally for four species.

Larvae found by Gilbert (l.c.) in the field were 1st and 2nd instars in November, all three instars until April, in May 3rd instar only. (He indicates these larvae as "*mollis-melanocephalus*" because they were impossible to

identify.) Larsson (l.c.) records the finding of larvae from April until late June, West (1940) on 28. 4.

Pupae and immature adults. According to Burmeister (l.c.) the season of pupation is in May and June, Gilbert (l.c.) found pupae in Anglesey between 7. 5. and 11. 6., he states late April as the time of the beginning of pupation. Immature adults were found by Gilbert (l.c.) at the end of May and in June, by Lindroth in southern Sweden from 12. 6. till 31. 7., in northern Sweden from 5. 7. till 23. 8.; by Schjötz-Christensen (l.c.) in Denmark from 29. 5. till 15. 6. The occurrence of the first immature adult (♂) on 3. 5. indicates that in our country callow adults can emerge a little earlier.

Hibernation and second reproduction. Vlijm and Dijk (1967) and Vlijm, Dijk and Wijmans (1968) confirm that a great percentage of adults hibernate in Holland and that they can breed also in the following year. The dissection of a female caught on 17. 7. with ovaries at stage 5) confirmed the possibility of the second reproduction in our country.

Duration of development. According to Burmeister (l.c.), the egg stage lasts 10—12 days, temperature is not mentioned. Gilbert (l.c.) states the duration of the egg stage as 25—30 days at the temperature of 10.5 to 15.5° C. The data on the duration of the larval stage in our culture are introduced in Tab. 1.; the development was distinctly longer at the lower average temperature. According to Burmeister (l.c.) the pupal stage lasts for about 14 days. The data by Gilbert (l.c.) are given in the chapter on *C. erratus*.

C. melanocephalus is then a species with regularly hibernating larvae, as follows from the data mentioned above. A sizable percentage of adults hibernate; they can again produce gametes in the next reproductive season. The adults of a new generation copulate in summer and in autumn, oviposition takes place from July till late autumn. Larves hibernate in all three instars, pupation begins at the end of spring, immature adults emerge in early May.

Breeding

The larvae were easily obtained in a very large number. Their mortality was quite low, but rather high in the 2nd instar kept at a varying temperature with the average of 20.5°C. The natural average temperature of 11 and 16.5°C was more suitable for the larvae of both instars than the laboratory temperature of 20.5 and 21°C (\bar{x}). A great difference is noticeable especially in the larvae of 2nd instar (see Tab. 1.). Only one of the females did not lay eggs; double reproduction was found in one female, the first one in September, the second in late July and in August of the following year. (In winter months the light day was shortened from 16 to 10 hours and the average temperature fell from 22 to 16°C.)

Calathus mollis (Marsham)

This species prefers sandy soils with xerophilous vegetation; it is a typical xerophilous species living on sandbanks in the inland, but also in coastal sand dunes (Reitter, 1908; Dahl, 1925; Fowler, 1887; Larsson, 1939; West, 1940; Horion, 1941; Lindroth, 1945).

Oviposition, fertility. According to Larsson (1939) reproduction takes place from July till September, Gilbert (1956) observed in Anglesey females with mature eggs until February, most females were not mature until

late August, but some females had active ovaries in July. The fertility of the females in our culture was fairly high, 15 (♀ died too early), 170, 180, 73 and 52 larvae were obtained from five females (the last two batches were obtained from females caught only at the beginning of October, so surely a considerable number of eggs had already been laid before the capture). 12 and 13 ovarioles were found in one dissected female, Gilbert (l.c.) states 8—14, most often 9—12 ovarioles.

Larvae, pupae and immature adults. Gilbert (l.c.) found larvae of the 1st instar in November, all three instars in winter and in late spring, pupae between 7. 5. and 11. 6., immature adults in the second half of May and in June. According to Larsson (l.c.) pupation and the emergence of new adults occurs in late June and in July in Denmark, Lindroth (1945) observed immature adults in mid-June in Sweden.

Hibernation of adults and second reproduction. Larsson (l.c.) and Lindroth (1945) mention the possibility of the hibernation of adults, Gilbert (l.c.) admits the possibility of a second reproduction in the following year.

Duration of development. Data on the development of larvae are mentioned in Tab. 1. The influence of temperature on the duration of development in both instars was obvious. Gilbert (l.c.) gives data on the pupal and adult development (see the chapter on *C. erratus*).

C. mollis is a species with regularly hibernating larvae, as follows from the data mentioned above; some adults hibernate, too. Reproduction takes place in autumn, larvae overwinter in all three instars, pupation takes place in late spring, adults of a new generation appear in early summer. It is possible that old females can lay eggs again in the following year.

Breeding

Larvae were easily obtained in large numbers in all five cultures. Their mortality (Tab. 1.) was quite low, the average natural temperature of 10°C was more suitable for larvae of the 1st instar than the average laboratory temperature of 19° C.

Owing to an extreme drop in outdoor temperature the experiment with larvae of the 2nd instar had to be interrupted and for this reason the mortality under both types of temperature was not compared.

Calathus micropterus (Duftschmid)

A species living in woods in highlands and mountains; it prefers shaded places, in higher areas less shaded localities, in lowlands it is rarely found in woods. It requires sufficiently moist soil with a layer of humus (Saalas, 1917; Dahl, 1925; Brundin, 1934; Renkonen, 1938; Burmeister, 1939; Larsson, 1939; West, 1940; Lindroth, 1945). It lives even at 1200 m above sea level (Dahl, l.c.), according to Gerhardt (1910) even at 1300 m, Burmeister (l.c.) records its occurrence even at 2000 m.

Oviposition, fertility. According to Burmeister (l.c.) eggs are laid in October, Larsson (1939) states late July — early October as the time of reproduction. The results of dissections of females caught in the mountains (850—1300 m above sea level) were, as follows: ovaries at stage 1) in 1 ♀ found on 25. 5. and in 2 ♀ on 14. 6.; at stage 2) in 1 ♀ on 14. 6. and 1 ♀ on

16. 8.; at stage 3) 2 ♀ 14. 6., a number of mature eggs 2 + 2, 2 + 2 (in left and right ovaries), 1 ♀ 18. 7., 6 + 4 eggs, 8 ♀ 22. 7., 4 + 5, 8 + 8, 8 + 6, 7 + 9, 7 + 14 (!), 5 + 4, 6 + 7, 7 + 8 eggs; 2 ♀ 24. 7., 6 and 8 eggs; 1 ♀ 16. 8. without mature eggs. These data show that females with mature eggs can be found in our country as early as in mid-June, on the other hand females with inactive ovaries without corpora lutea were found even in mid-June; in July most females had fully active ovaries. It seems that the time of oviposition is probably fairly long, in accordance with Larsson's data.

The number of larvae obtained in our culture was small: 18, 18, 13, 1 and 11 larvae from five females. It is interesting to compare the fertility of females in the laboratory with the results of dissections of females caught in the field; in the ovaries of one female caught in the field there were found as many as 21 mature eggs, on the other hand the number of larvae found in our culture was small. That can be caused by a low fertility, though it is possible that under breeding conditions more eggs are produced but their mortality is high. In 13 females caught in the field 6--12, most often 8--10 ovarioles per ovary were found.

Larvae, pupae, immature adults. Larsson (l.c.) states an occurrence of larvae in the field throughout the year (except August), pupae and immature adults appear from June until October. Lindroth (1945) found the first immature adults in Sweden at the end of July, last ones in September. Two immature adults were found as early as 25. 5. in Czechoslovakia (altitude 1300 m).

Hibernation and second reproduction. According to Larsson (l.c.) and Lindroth (1945) it is possible that a small number of females which have hibernated can produce eggs in two seasons. The finding of one female with ovaries at stage 5) confirms the possibility of a second reproduction in Czechoslovakia.

The duration of larval development is shown in Tab. 1. *C. micropterus* is a species with regularly hibernating larvae; a large number of adults hibernate, too. Copulation and oviposition probably takes place throughout summer and autumn; adults can be found for most of the year; a small percentage of adults can reproduce in two years.

Breeding

The breeding of this species was difficult; some of the females kept in the laboratory did not lay eggs (65%). The number of larvae obtained was small, their mortality was high. The larvae were kept at a natural temperature from 20. 9. to 30. 11. Because the outdoor temperature varied very much in this period, total mortality and total average temperature are not mentioned in Tab. 1., but these data are given separately for individual groups of larvae living together in a certain period, i.e. at a corresponding temperature. The mortality of larvae of the 1st instar kept outdoors at the average temperature of 21.5° C (the maximum temperature was 33°C) was 100%; it decreased with the decrease of the average temperature. The breeding of this mountain wood species is much more difficult than the breeding of the lowland and eurytopic ones.

Calathus metallicus Dejean

Mařan (1934) considers *C. metallicus* to be an alpine species living in the Carpathians and in the Balkans; it is distributed in mountain woods and

is found in the highest altitudes, where it also lives as nivicolous species. The lowest limit of its occurrence is 800 m, in the Balkans 1200 m. Besides the Carpathians and Balkans, Burmeister (1939) records its occurrence in the mountains of Asia Minor.

Bionomy. Burmeister (l.c.) states July as the time of the occurrence of adults; it is the only reference found.

Data obtained in 1968—1970:

Collections: ovaries at stage 1) were found in 1 ♀ caught 16. 9. (1800 m above sea level), this female had a large fat body (preparation for overwintering); ovaries at stage 5) in 4 ♀♀ caught on 5. 8. (1700—2000 m above sea level), ovaries with beginning oogenesis; on 26. 5. capture of a fertilized female (1700—1800 m), which began to lay eggs in our culture about mid-June; 5. 8. larva of 3rd instar (1900—2000 m).

Fertility. 32 (+8 eggs) and 9 larvae were obtained from two females. The number of ovarioles per ovary in 4 females varied between 9—11.

Duration of larval stage is shown in Tab. 1. The larvae were kept under complicated conditions of temperature. Moreover, the time of hatching and larval ecdysis was not accurately recorded; therefore I present only two data on the longest duration of development of the 1st instar recorded.

On the basis of these incomplete data it is not possible to draw conclusions on the type of development of this species. Some contradictory data indicate that the developmental cycle is probably more complicated (data on the larva of the 3rd instar caught on 5. 8 and the female found on 16. 9. suggest the type of development with non-hibernating larvae, but the capture of four females with corpora lutea on 5. 8. does not fit into it). It is possible that *C. metallicus* belongs among species with both types of development, but conclusions can be made only after a more detailed investigation.

Breeding

The breeding of this species was the most difficult of all *Calathus* species. Most of the females did not lay eggs (8 of 10), the number of larvae obtained was small, their mortality was high. Adults and larvae were kept in the laboratory for two seasons. The results from both these seasons are very different, undoubtedly owing to varying temperature conditions (Tabl. 1.). The varying laboratory temperature ($\bar{x} = 22^{\circ}\text{C}$) was entirely unsuitable for both instars.

SUMMARY

1) In 1968—70 adults and larvae of seven species of the genus *Calathus*. Bon. were bred in the laboratory: *C. fuscipes*, *C. erratus*, *C. ambiguus*, *C. melanocephalus*, *C. mollis*, *C. micropterus* and *C. metallicus*; at the same time the state of the ovaries of females caught in the field was observed.

2) The breeding of eurytopic species (*C. fuscipes*, *C. erratus*, *C. melanocephalus*) and xerophilous species (*C. ambiguus* and *C. mollis*) was easy up to the last larval instar, the fertility of females was high, the mortality of larvae was low. On the other hand, the breeding of the mountain species *C. micropterus* and alpine *C. metallicus* was difficult, the fertility of females was low, the mortality of larvae was high. The mortality and the duration of larval stages at various average temperatures were investigated and results were compared in a table.

3) Larvae of *C. fuscipes* and *C. erratus* were put to hibernation; the rearing of larvae of *C. fuscipes* up to the adult stage was unsuccessful, all larvae died either during the hibernation or in praepupal torpor; three pupae and one adult of *C. erratus* were obtained from the laboratory culture.

4) On the basis of a summary of bionomical data in literature supplemented with original findings the developmental types of all species studied were determined. The developmental cycle of *C. metallicus* has not been discovered, the other species belong to the type with regularly hibernating larvae; a certain percentage of adults also hibernate (not clear in *C. ambiguus*), and these imagines can produce eggs again in the following year.

Acknowledgements

I wish to thank Docent Dr. K. Hürka, CSc. for his valuable advice and comments on the manuscript. I am indebted to my colleagues S. Bílý, M. Martš and P. Molík for their assistance in field collecting.

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**BEMERKUNGEN ÜBER BLUTBILDUNGSSTÄTTEN
BEIM NEUNAUGE LAMPETRA PLANERI (BLOCH, 1784)
(CYCLOSTOMATA)**

ZBYNĚK LIKOVSKÝ

Eingegangen am 4. September 1971

Abstrakt: Beim Neunauge *Lampetra planeri* (Bloch, 1784) wurde Blutbildung in Leber (kleine Larven — Lymphopoese bis zu Metamorphose), in Spiralklappe des Mitteldarmes (Larven) und in Nieren (Larven und Erwachsene) beobachtet. In Mittellinie des Rückens und im peripheren Blut konnten wir keine Hämatopoese bestätigen.

Über die Lokalisation der Blutbildung bei Petromyzonten wurde bisher nur vereinzelt berichtet. Die hämatopoetische Tätigkeit wurde in Spiralklappe (*valvula spiralis*) des Mitteldarmes, in Nieren, im Fettgewebe des Rückens und im peripheren Blut beschrieben; in Leber wurde keine nennenswerte Blutbildung festgelegt. Diese Arbeit behandelt unsere Funde (nach zytologischer Untersuchung der Abklatschpräparate) über die Hämatopoese in allen angeführten Blutbildungsstätten beim Neunauge *Lampetra planeri*.

MATERIAL UND METHODIK

Von der *Lampetra planeri* (Bloch, 1784) wurden untersucht: die Larven in Länge von 22 bis 136 mm, Tiere in der Zeit der Metamorphose, und erwachsene Tiere, grösstenteils in der Laichzeit von Zdobnice und Nebenbachen bei Slatina n. Zdobnici (N.-O. Böhmen) und von Bolečský potok bei Boleč n. Orlicí (O. Böhmen)*. Die Körperlänge der Larven ist für Kriterium des Alters gehalten — Lohnský (1965).

Die Abklatschpräparate wurden aus Spiralklappe des Darmes (mit Ausnahme der erwachsenen Tiere), aus Nieren, Leber und Gewebe der Mittellinie des Rückens (die letzte nur bei adulten Tieren) angefertigt, oftmals mit Hilfe des Präparationsmikroskopes. Die Blutentnahme aus der *arteria caudalis* erfolgte unter MS-222 (Sandoz) Anästhesie — Likovský u. Mitarb. (1972).

Angewandte Färbungen — z. B. Smetana (1967), Likovský u. Mitarb. (1972):

- 1) Panoptische Färbung nach Pappenheim
- 2) Nachweis der basophilen Strukturen nach Unna-Pappenheim (Methylgrünpyroninfärbung)
- 3) Nachweis der RNS nach Smetana (Toluidinblaufärbung bei pH 5,0)
- 4) Nachweis γ -basophiler Granulation nach Ehrlich (Dahlviolett färbung)
- 5) Nachweis δ -basophiler Granulation nach Ehrlich (Methylenblaufärbung)
- 6) Nachweis basophiler Granulation nach Fey (Toluidinblaufärbung)
- 7) Nachweis der sauren Mukopolysacchariden nach Mowry (Alzianblaufärbung bei pH 2,0).

* Ich bin Herrn Dr. K. Lohnský vom Kreismuseum in Hradec Králové für die freundliche Überlassung des Tiermaterials verpflichtet.

ERGEBNISSE

In den Abklatschpräparaten von der Leber kleinerer Larven (Länge bis 110 mm) fanden wir zahlreiche Stammzellen und weitere Entwicklungsstadien der Erythrozyten, Granulozyten, Lymphozyten und Koagulozyten** (Abb. 1). Von hier können wir grosse Anzahl der unreifen Zellen untersuchen — Likovský (1972). Bei grösseren Larven kommen keine anderen Stammzellen als Lymphoblasten vor; einzelne Lymphoblasten wurden noch bei Tieren in Metamorphose beobachtet (Abb. 2 und 3). In Leber der erwachsenen Tiere wurden keine Stammzellen gefunden. Die geringen Anhäufungen von lymphatischen Zellen im periportalen Bindegewebe fand Fey (1965); wahrscheinlich wurden von ihm ältere (grössere) *Lampetra*-Larven untersucht. Nach unseren Ergebnissen bilden die Leber in den frühen Entwicklungsstadien des Neunauges ein bedeutendes blutbildendes Organ, in welchem die Erythropoese, Granulopoese, Lymphopoese und Koagulopoese verläuft; die Lymphopoese ist bis zu Metamorphose verlängert.

In der Spiralklappe des Mitteldarmes der von uns untersuchten grösseren Larven (Länge etwa 90 mm und mehr), ähnlich wie bei Tieren in den frühen Stadien der Metamorphose waren Anhäufungen der Proerythroblasten, Myeloblasten, Lymphoblasten und Koaguloblasten, sowie ihrer weiteren Reifungsstufen vorhanden. Von den Abklatschpräparaten der kleinen Larven konnten wir nur einzelne Stammzellen finden. Es ist nicht ausgeschlossen, dass diese Unterschiede die benützte Untersuchungstechnik bedingt. In jedem Falle bestätigen unsere Funde, dass hier Bildung der Erythrozyten, der neutrophilen und eosinophilen Granulozyten, Lymphozyten und Koagulozyten verläuft. Die hämatopoetische Funktion wurde schon von Bizzozero (1892) entdeckt, und weiter von Giglio-Tos (1897), Aschheim (1902), Drzewina (1905), Jordan u. Speidel (1930), Raunich (1947), Skvorzov (1948), und Fey (1965) bewiesen. Nur die von Fey (1965) erwähnten basophilen Granulozyten und ihre jungen Formen wurden beim unseren Material nicht nur hier, sondern auch in anderen Organen und im peripheren Blut gefunden, trotzdem dass wir für ihren Nachweis verschiedene Methoden benützt haben.

In den Nieren bei Larven wie bei erwachsenen Tieren fanden wir alle Reifungsstufen der erythrozytären, granulozytären, lymphozytären und koagulozytären Reihe. Sie wurden bei kleineren Larven und bei Erwachsenen in der Laichzeit grösstenteils nur einzeln gefunden. In den Nieren hat die Erythropoese, Granulopoese, Lymphopoese, und Koagulopoese statt, wie schon von Ascoli (1898, 1899), und weiter z. B. von Aschheim (1902), Raunich (1947), Fey (1965) berichtet wurde.

In den Präparaten, die von der Mittellinie des Rückens angefertigt worden waren, konnten wir keine anderen Blutelemente finden als die, die auch im peripheren Blut vorkommen. Beim erwachsenen Neunauge unseres Materials ergaben sich für Hämatopoese in dieser Region keine Anzeichen. In dem Fettgewebe des Rückens („über dem Rückenmarke“) wurde die Blutbildung der erwachsenen Petromyzonten nur von Skvorzov (1948) beschrieben. Die Original-Arbeit ist mir unbekannt; Putschkov (1954) hat keine Erwähnung, was für eine Art von Skvorzov untersucht wurde.

** Wie Koagulozyten wurden die „Thrombozyten“ der Nichtsäuger (Spindelzellen) bezeichnet — Likovský (1970, 1972).

Möglicherweise sind Unterschiede in der Lokalisation der Blutbildung zwischen nichtparasitischen (wie z. B. *Lampetra planeri*) und parasitischen Arten.

Im peripheren Blut der *Lampetra planeri* finden sich die jungen Zellen der erythrozytären Reihe — die unreifen Zellen der koagulozytären Reihe kommen hier nur bei Larven und Tieren in der Metamorphose vor. Alle jungen Blutzellen im Blut reifen und teilen sich — ähnlich wie bei anderen niederen Wirbeltieren. Es gibt auch Möglichkeit die Zellen in Teilung im Teste in vivo unter Wirkung d. Demecolcine zu beobachten — Likovský und Pokorná (1972). Einige Autoren sind der Meinung, dass die Blutbildung im peripheren Blut verläuft — Ascoli (1898, 1899), Schneider (1902), Jordan und Speidel (1930). Namentlich Komocki (1932, 1935) fand keine anderen Blutbildungsstätte als nur Blutkreislauf. Einzelne jüngste Blutzellen gehen aus blutbildenden Organen ins Blut über; über die Hämatopoese im peripheren Blut kann nicht die Rede sein.

ZUSAMMENFASSUNG

Mit Hilfe der Abklatschpräparatentechnik wurden die Blutbildungsstätten bei *Lampetra planeri* (Bloch, 1784) untersucht. In Leber von jungen (kleinen) Larven wurde die Erythropoese, Granulopoese, Lymphopoese und Koagulopoese beobachtet, bei älteren Larven und Tieren in der Metamorphose ist die Hämatopoese nur auf Lymphopoese beschränkt, bei erwachsenen Tieren konnten wir hier keine Blutbildung feststellen. Die hämatopoetische Funktion dieses Organs wurde bisher fraglich. Die Spiralklappe des Mitteldarmes ist bei Larven und bei Tieren in den frühen Stadien der Metamorphose hämatopoetisch tätig: die Erythropoese, Granulopoese, Lymphopoese und Koagulopoese wurde von uns bestätigt. In Nieren bei Larven sowie bei erwachsenen Tieren verläuft Bildung der Erythrozyten, Granulozyten, Lymphozyten und Koagulozyten. In der Mittellinie des Rückens konnten wir beim erwachsenen Neunauge keine Blutbildung finden. Im peripheren Blut kommen einzelne junge Zellen der erythrozytären und koagulozytären Reihe vor, die hier reifen und sich teilen; das Blut aber stellt keine Blutbildungsstätte vor.

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Die Platen sind am Ende des Hefes zu finden.

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**A NEW COPEPOD PARASITE LERNAEA KASHMIRENSIS N. SP.
(LERNAEIDAE, LERNAEINAE) INFECTING STONE LOACH OF KASHMIR**

Y. R. MALHOTRA & M. K. JYOTI

Received May 10, 1971

Abstract: A new species *Lernaea kashmirensis* infecting the fish *Noemacheilus kashmirensis* has been discovered and described for the first time from the Kashmir valley.

Harding (1950) reported 28 species of *Lernaea*, but none of these species had been obtained from India. Gnana muthu (1951) recorded *Lernaea chackoensis* from *Osphronemus goramy* and *Catla catla* in south India. Gnana muthu (1959) again recorded *Lernaea bengalensis* from *Channa punctatus* in Bengal (India).

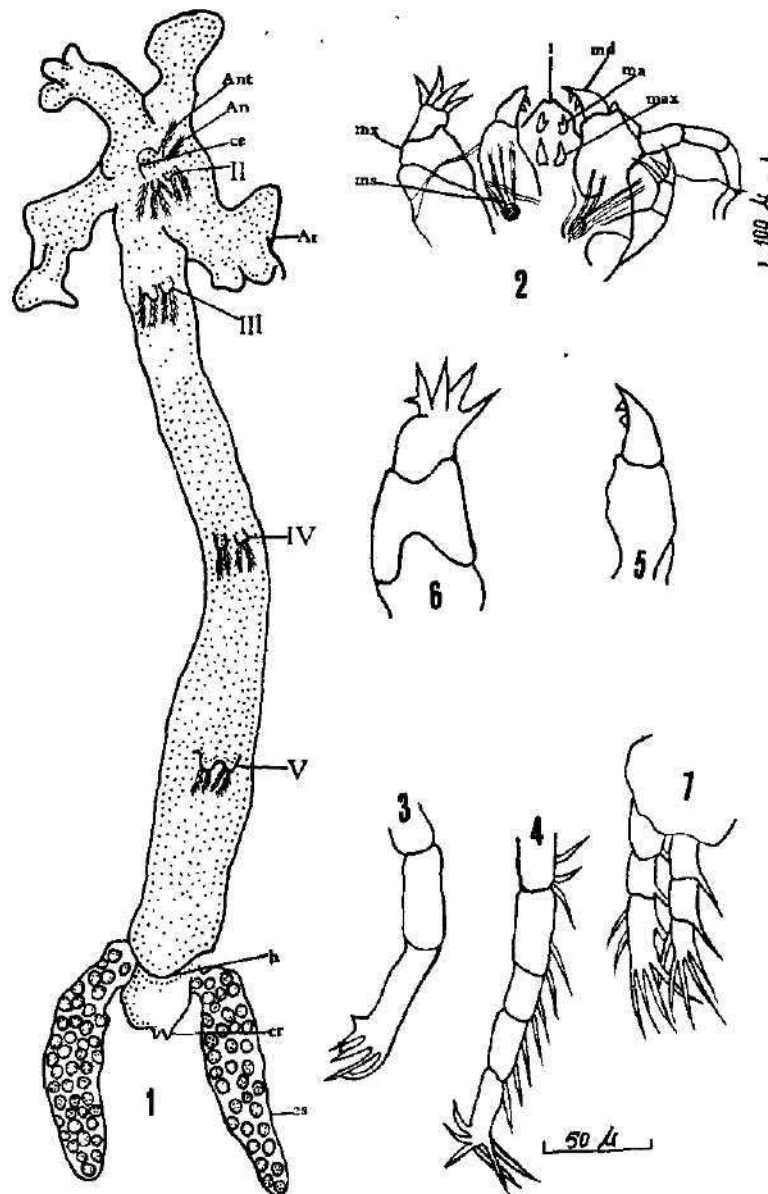
The present report of the occurrence of *Lernaea* is first from Kashmir (a north Indian valley) which is geographically isolated from south India and Bengal from where the parasites were recorded from fishes (Gnana muthu, 1951, 1959). Moreover, the host fish of *Lernaea chackoensis* and *Lernaea bengalensis* are not found in Kashmir. The present specimens of *Lernaea* have been found to parasitize the cobitid fish *Noemacheilus kashmirensis* (the stone loach of Kashmir).

Lernaea kashmirensis n. sp. (figs. 1—7)

Kashmir valley, India, parasitizing *Noemacheilus kashmirensis*, a fish of family Cobitidae. Holotype in collections of the Department of Zoology, University of Kashmir, Srinagar, India.

Description. — General. Body worm-like with anterior region of thorax sending out 4 ramifying arms, which lie embedded in host tissues and act as anchor for the parasite. Each arm tipped with knob like extremities (Fig. 1).

Head inclined at an angle to the body. Head along with its appendages is covered over by a dome like structure called cephalon. First antenna shorter than the second, being 3-segmented, its terminal segment bears a tuft of 4 setae (Fig. 3). The second antenna 5-segmented and bears setae along the anterior borders of various segments, its terminal segment bears 3 long spines towards anterior aspect of its extremity, while along the opposite border is 1 long and 2 short spines which are stout and curved (Fig. 4). Mandibles short, stout with a broad basal segment and a terminal pointed blade; on the inner edge of each blade are 2 teeth like spines and its distal end is a sharp curved tip (Fig. 5). First maxilla short hook-like while second maxilla is slightly



Figs. 1-7. *Lernaea kashmirensis* n. sp. 1 - adult female (An = first antenna, Ant = second antenna, Ar = arms, ce = cephalon, cr = caudal rami, es = egg sacs, h = heel, II-V = thoracic appendages); 2 - mouth parts (l = labium, ma = first maxilla, max = second maxilla, md = mandible, ms = muscles, mx = maxilliped); 3 - first antenna; 4 - second antenna; 5 - mandible; 6 - maxilliped; 7 - thoracic appendage. Figures 3-7 drawn to the same scale.

larger. Labrum triangular and narrow, while labium is triangular and broad (Fig. 2).

Maxillipeds made up of 3 segments, its terminal segment bears 5 spines while the basal segment bears 1 straight spine (Fig. 6).

Thorax long and tubular with only 4 pairs of distinct visible appendages (Fig. 1), the last pair situated just anterior to the pre-genital prominence. Each appendage consists of a protopodite, an exopodite and an endopodite. The exopodite has 9 spines while endopodite has 7 spines (Fig. 7).

Abdomen has a pre-genital prominence (called as heel by Gnanamuthu). Caudal rami are short without any setae (Fig. 1). Posterior to the heel is a pair of ovigerous sacs which grow outward from the abdomen on each side. An oviduct carries eggs from a beaded ovary inside the abdomen into the ovigerous sacs, the latter is full of eggs during the breeding season. Breeding season extends during May–June; shrunken empty ovisacs are observed after July.

No males have been collected. This description is based on the study of adult females only.

Table 1

	Specimens			
	I	II	III	IV
Total length	5.2 mm	5.3 mm	5.3 mm	4.5 mm
Distance of anterior origin of heel from anterior end.	4.2 mm	4.3 mm	4.3 mm	3.6 mm
Distance of anterior origin of heel from posterior end.	1.0 mm	0.9 mm	1.0 mm	0.9 mm

The position of 4 visible thoracic appendages is 8–9, 19–20, 44–45, and 73–74 percent of total length from anterior end.

DISCUSSION

Harding (1950) suggested that in degenerate parasitic forms features used to distinguish species were often ill defined and not easily seen. He regards the structure of anchor (cephalic arms), the pre-genital prominence and the shape of the body in *Lernaea* as diagnostic for various species; the structure of the appendages in different species is uniform and is thus of least diagnostic significance.

The anchor of the present form shows some resemblance to that of Japanese form of *Lernaea cyprinacea* (Harding, 1950) but the position of appendages from anterior end and the simple pre-genital prominence in contrast to the bifid prominence of *L. cyprinacea* separates the present form from Harding's species.

The other species to which the present form shows some similarity are *Lernaea chackoensis* (Gnanamuthu, 1951) and *Lernaea bengalensis* (Gnanamuthu, 1959) both of which have been obtained from India. The present form resembles both *L. chackoensis* and *L. bengalensis* in having 5 terminal teeth on maxillipeds, and that endopodite of thoracic appendages carry 7 spines. In the variable form of arms, and absence of 3 clear abdominal segments it resembles only *L. chackoensis*. It resembles *L. bengalensis* in having: i. a pre-genital prominence or heel; ii. a cephalon fused all round at its base; and iii. a tuft of 4 setae on terminal segment of first antenna.

In spite of the resemblances which it shows to both *L. chackoensis* and *L. bengalensis* or to either of the two, the present form has some features of

its own, which are: i. a 3 segmented first antenna, its segments (except the terminal) are without setae; ii. terminal segment of second antenna bears 6 spines of which 4 are long and 2 are short; iii. terminal blade of mandible has 2 teeth on its inner edge; iv. exopodite of thoracic appendages bear 9 spines; caudal rami short and devoid of setae; vi. distance between anterior end of parasite and anterior origin of heel is 80—81 percent in total length, while the anterior origin of heel from posterior end of parasite is 18—19 percent in total length (Table I). These features along with the presence of knob-like extremities of cephalic arms, a simple pre-genital prominence, and the position of visible thoracic appendages (8—9, 19—20, 44—45, and 73—74 percent of total length of parasite from anterior end, and also the discovery of the present form for the first time from *Noemacheilus kashmirensis* (a fish of family Cobitidae) justify the establishment of a new species for which the name *Lernaea kashmirensis* is proposed.

This is also the first record of genus *Lernaea* from Kashmir, and according to the list of species belonging to genus *Lernaea* given by Yamaguti (1963) this is also the first record of this parasite infecting the fish of family Cobitidae.

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**STUDIES ON THE LIFE HISTORY OF SOME CESTODES
OF WATER BIRDS
(HYMENOLEPIDIDAE: GENUS *MICROSOMACANTHUS* LOPEZ-NEYRA, 1942)**

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Received June 30, 1971

Abstract: The life history of cestodes of the genus *Microsomacanthus* (*M. compressa*, *M. paracompressa*, *M. paramicrosoma*) was studied under field and laboratory conditions. Larval development was divided into seven stages characterized by a complex of certain changes. The cyst wall of a morphologically fully differentiated cysticercoid consists of 6 layers. Larval development of the individual cestodes was studied in these intermediate hosts: 1) *M. compressa* — *Cyclops strenuus* and *Mesocyclops crassus* (natural and experimental infection); 2) *M. paracompressa* — *Acanthocyclops viridis*, *Macrocylops albidus*, *Mesocyclops crassus* (natural and experimental infection), *Eucyclops serrulatus* (natural infection); 3) *M. paramicrosoma* — *Acanthocyclops viridis*, *Mesocyclops crassus* (field conditions). All cestode species were found to utilize the new intermediate host *Mesocyclops crassus*. Of the reservoir hosts cysticercoids were found in *Lymnaea auricularia*, *L. peregra ovata* and *L. peregra peregra*. All life cycles were concluded with feeding experiments.

INTRODUCTION

The life history of cestodes of the genus *Microsomacanthus* was studied during 1963—1970 in fishponds of southern Bohemia (in the vicinity of Lomnice n. Lužnicí, Třeboň, Písek and Vodňany). In these localities wild and domestic ducks carried infection with *M. compressa*, *M. paracompressa* and *M. paramicrosoma*.

The larval development of these cestode species was studied by Jarecka (1958, 1960, 1961) and Ryšavý (1961, 1962). These authors paid attention mainly to the crustacean species, utilized by the cestode as its intermediate host in both the field and the laboratory. Petročenko and Kotelnikov (1959) described findings of the cestode *M. paramicrosoma* in the field. Kotecki (1970) first described the finding of cysticercoids of *M. paracompressa* in ostracodes *Heterocypris incongruens*.

The findings of cysticercoids in water snails were described by Petročenko and Kotelnikov (1959), Supperer (1959), Zajíček (1961), Ryšavý (1962) and Pike (1968). Supperer indicated that snails may serve as intermediate hosts, while Petročenko and Kotelnikov, Ryšavý, Zajíček were inclined to believe that the snails ingest the infected crustaceans and that the cysticercoids survive in the snails (Ryšavý called this phenomenon reservoir habitationism). Both possibilities were discussed by Pike. Our experiments confirmed very clearly the correctness of Ryšavý's concept and we shall deal with this problem in one of our later studies.

MATERIAL AND METHODS

The description of the materials used and the techniques employed has been given in an earlier paper (Neradová-Valkounová, 1971). We are adding two details only: 1) Experimental infection with cestode eggs was performed at 18–20 °C, pH of the water 6.8–7; 2) All developmental cycles were terminated by feeding experiments. We employed 4-week-old ducklings

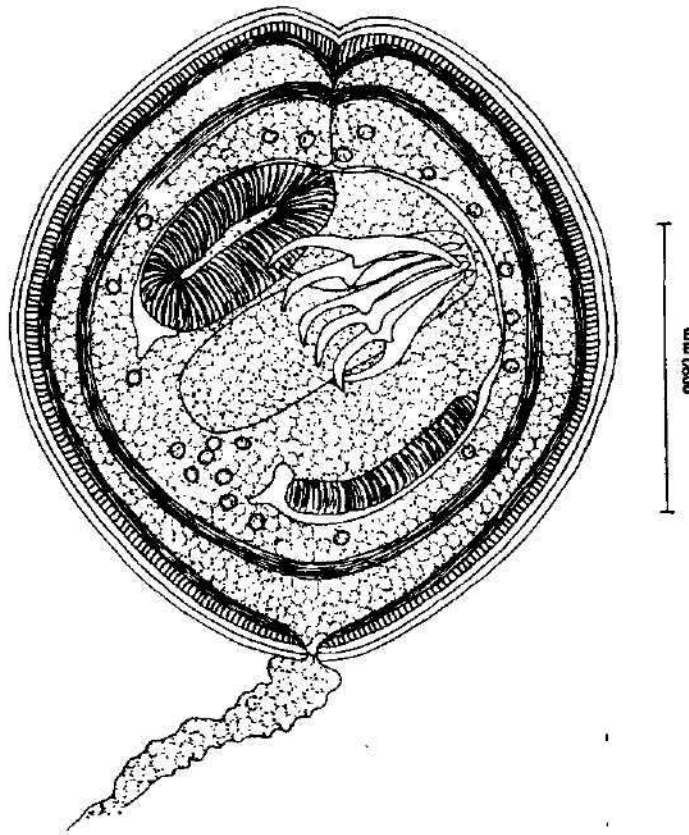


Fig. 1. Cysticercoid of *M. compressa* from the body cavity of *Cyclops strenuus*

(*Anas platyrhynchos dom.* L.) which were fed with a maximum number of cysticercoids available from intermediate or reservoir hosts. The ducklings were killed 4 weeks p.i.; adult cestodes were recovered from almost every duckling.

RESULTS

We divided the larval development of cestodes of the genus *Microsomacanthus* into seven stages: the mobile oncosphere, the growing oncosphere, the elongated larva, the differentiating larva, the differentiated larva before invagination, the invaginating larva and the cysticercoid. We distinguished 6 layers in the cyst of a morphologically fully differentiated cysticercoid: the hyaline, the homogeneous, the basal, the outer fibrous, the intermediate parenchymatous and the inner fibrous layer. The larval stages and the layers of the cyst wall were described in detail in an earlier paper (Neradová-Valkounová, 1971).

1) *M. compressa* (Linton, 1892)

Figs. 1-3; Plate I

Cysticeroids from naturally infected intermediate hosts: Cysticeroids were found twice. 1) On June 9, 1968 in the fishpond Klec (of the 700 crustaceans of *Cyclops strenuus* examined, 23 were positive — inten-

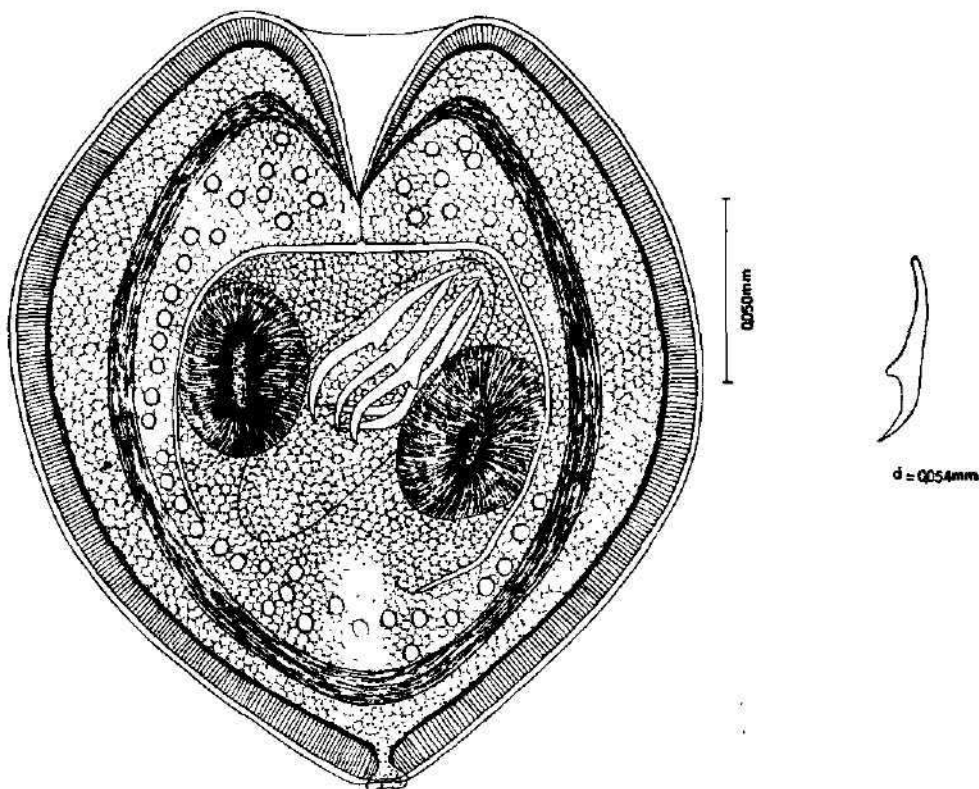


Fig. 2. A — Cysticeroid of *M. compressa* from the snail *Lymnaea peregra ovata*; B — rostellar hook

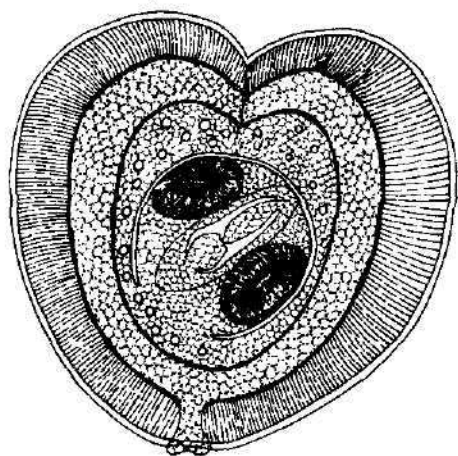
sity of infection 1-3 cysticeroids; of the 1,200 specimens of *Mesocyclops crassus* examined 5 were positive — intensity of infection one cysticeroid). 2) On May 26, 1970 in the fishpond Rod (of the 610 specimens of *Cyclops strenuus* examined 3 were positive — intensity of infection 1-3 cysticeroid).

Experimental infection of the intermediate hosts: In our experiments we used mature cestode eggs obtained from *Anas platyrhynchos* dom. L. (Vodňany). Eggs oval till spherical, $41-53 \times 35-39 \mu\text{m}$. The outer cover of the eggs swells in water and thus the eggs attain a size of up to $100 \mu\text{m}$. Oncosphere $29-34 \times 20-26 \mu\text{m}$, embryonic hooks $8-11 \mu\text{m}$. The eggs were placed in vessels occupied by crustaceans of *Acanthocyclops viridis* (Jurine), *Cyclops strenuus* (Fischer), *C. vicinus* Uljanin, *Eucyclops serrulatus* Fischer, *Macrocyclus albidus* (Jurine), *Mesocyclops crassus* (Fischer), *M. leuckarti* Claus, *Eudiaptomus vulgaris* (Schmeil), *Dolerocypris*

Table 1. Survey of the finding of cysticercoids of *M. compressa* in water snails

Locality (fishponds)	Date of collection	Reservoir hosts	No. of snails examined	Positive findings	% of positive findings	Intensity of infection
Lenešický near Louny	September 20, 1963	<i>Lymnaea peregra ovata</i>	83	1	1.2	2
Skutek near Lomnice n. Lužnice	October 10, 1963	<i>L. peregra ovata</i>	30	2	6.6	1-4
Černohol n. Vodňany	August 18, 1965	<i>L. auricularia</i>	118	20	16.9	1-10
		<i>L. peregra ovata</i>	132	32	24.2	1-12
Selibov near Písek	September 2, 1965	<i>L. auricularia</i>	160	18	11.2	1-12
		<i>L. peregra ovata</i>	146	30	20.5	1-20
Baštýř Fischraister Pěšák near Lomnice n. Lužnice	September 16, 1965	<i>L. auricularia</i>	60	12	20	1-15
		<i>L. peregra ovata</i>	140	60	42.8	1-8
Bošilecký near Písek	November 15, 1965	<i>L. peregra ovata</i>	60	19	31.6	1-10
Pančál near Písek	November 26, 1965	<i>L. peregra ovata</i>	72	12	16.6	1-5
Klec near Lomnice n. Lužnice	July 16, 1966	<i>L. peregra ovata</i>	10	10	100	11-32

fasciata (O. F. Müller), *Heterocypris incongruens* (Ramdohr), *Notodromas monacha* (O. F. Müller) and *Daphnia pulex* Leydig. Mobile oncospheres were observed in the body cavity of *A. viridis*, *C. strenuus* and *M. crassus* as early as 3 hrs p.i. The oncospheres in the body cavity of *A. viridis* died within two days, but continued to develop in the species *C. strenuus* and *M. crassus*: mobile oncosphere — day 1 and 2; growing oncosphere — from day 3



0.100mm

onwards, size 60-90 μ m; elongated larva — from day 5 onwards, length 135 to 145 μ m; differentiating larva — from day 8 onwards, length 320-360 μ m; differentiated larva before invagination — from day 14 onwards. The development of the cysticercoids was completed on day 18-20 p.i. Of the 100 specimens of *C. strenuus* in our experiment 40 were positive (intensity 1-2 cysticercoids). Of the 100 specimens of *M. crassus* 27 were positive (intensity one cysticercoid). Similar experiments were repeated three times. In

Fig. 3. Cysticercoid of *M. compressa* from *Lymnaea peregra ovata*

Table 2. Measurements of cysticeroids of *M. compressa* from intermediate and reservoir hosts

Measurements (in μm)		<i>Cyclops strenuus</i> <i>Mesocyclops crassus</i>	<i>Lymnaea peregra ovata</i> <i>L. auricularia</i>
Cysticeroid	l	180-242	154-294
	w	156-216	135-306
Hyaline layer	w	2-4	2-4*)
Homogeneous layer	w	1-4	1-4
Basal layer	w ₁	3-6	4-20
	2	3-6	6-35
	3	3-6	6-20
Outer fibrous layer	w	1-4	1-4
Intermediate layer	w ₁	10-20	14-20
	2	6-20	14-28
	3	8-20	7-18
Inner fibrous layer	w	2-5	2-10
Neck	w ₁	3-22	18-34
	2	3-16	7-15
	3	3-16	10-30
Scotex	l	110-150	84-130
	w	110-150	66-120
Suckers	l	75-79	39-90
	w	36-39	27-63
Rostellum	l	90-112	60-125
	w	21-36	21-36
Hooks	l	60	53-63
Calcareous corpuscles	Ø	4-6	4-6
Tail	l	600-700	missed

*) only minute remnants of this layer were present on the surface of the cyst

l = length; w = width

w₁ = width of the layer at the site of invagination

w₂ = width of the layer in the lateral portion

w₃ = width of the layer at the distal pole

Table 3. Survey of crustaceans infected with cysticeroids of *M. paracompressa*

Lokality (fishponds near Lomnice n. Lužnice)	Date of collection	Intermediate host	No. of crusta- ceans examined	Positive findings	% of positive findings	Intensity of infection
Víra	July 26, 1965	<i>Mesocyclops</i> <i>leuckarti</i>	3,200	180	5.6	1-3
Klec	May 26, 1966	<i>Eucyclops</i> <i>serrulatus</i>	1,900	60	3.2	1-2
Klec	October 18, 1967	<i>Mesocyclops</i> <i>crassus</i>	800	12	1.5	1
Blauík	May 1, 1968	<i>Acanthocyclops</i> <i>viridis</i>	340	1	0.3	1
Dobrá vůle	May 1, 1968	<i>A. viridis</i>	60	5	8.3	2-3
Dobrá vůle	June 5, 1968	<i>E. serrulatus</i>	110	1	0.9	2
Dobrá vůle	June 19, 1968	<i>Macrocylops</i> <i>albidus</i>	230	2	0.8	1

Table 4. Course of experimental infection with eggs of *M. paracompressa* in the crustaceans

Commencement of the experiment	Intermediate host	No. of crustaceans employed in the experiment	Positive findings	% of positive findings	Intensity of infection	Duration of cysticercoid development (in days)
November 11, 1965	<i>Acanthocyclops viridis</i>	100	18	18	1	20
	<i>Macrocyclops albidus</i>	100	15	15	1	20
	<i>Mesocyclops crassus</i>	100	20	20	1	18

the first of these experiments, cysticercoids developed again in *C. strenuus* (infection 30%, intensity 1–3) and in *M. crassus* (infection 29%, intensity one). In the remaining two experiments infection occurred only in *C. strenuus* (experiment no. 1: infection 49%, intensity 1–3; experiment no. 2: infection 17%, intensity 1–2).

Description of the cysticercoids: Cysticercoids are widely oval till spherical (measurements in Table 2).

Feeding experiments: Infection of the five definitive hosts was pro-

Table 5. Survey of the finding of cysticercoids of *M. paracompressa* in water snails

Locality (fishponds)	Date of collection	Reservoir hosts	No. of snails examined	Positive findings	% of positive findings	Intensity of infection
Černoňol near Vodňany	August 18, 1965	<i>Lymnaea auricularia</i>	118	40	33.9	1–15
		<i>L. peregra ovata</i>	132	20	15.1	1–8
Selibov near Písek	September 2, 1965	<i>L. auricularia</i>	160	40	25	1–13
		<i>L. peregra ovata</i>	146	60	41	4–20
Baštýř Fischmeister Pěšák near Lomnice n. Lužnice	September 16, 1965	<i>L. auricularia</i>	60	20	33.3	1–8
		<i>L. peregra ovata</i>	140	54	38.6	4–6
		<i>L. peregra peregra</i>	20	10	50	1–5
Pančál near Písek	October 26, 1965	<i>L. peregra ovata</i>	72	28	38.9	7–11
Hejný near Písek	October 26, 1965	<i>L. peregra ovata</i>	164	20	12.2	4–10
Pančál near Písek	October 26, 1965	<i>L. auricularia</i>	4	1	25	5
Bošilecký near Písek	November 15, 1965	<i>L. peregra ovata</i>	60	18	30	3–9
Klec near Lomnice n. Lužnice	July 6, 1966	<i>L. peregra ovata</i>	10	10	100	10–40

duced with cysticercoids from both experimental and natural infection. In post-mortem we recovered sexually mature cestodes of the species *M. compressa*.

Findings of cysticercoids in the reservoir hosts: Cysticercoids were found repeatedly in the water snails *Lymnaea auricularia* (Linné) and *L. peregra ovata* (Draparnaud) (Table 1). Cysticercoids widely oval till widely ovoid (measurements in Table 2). The colour of the cysts is yellowish brown,

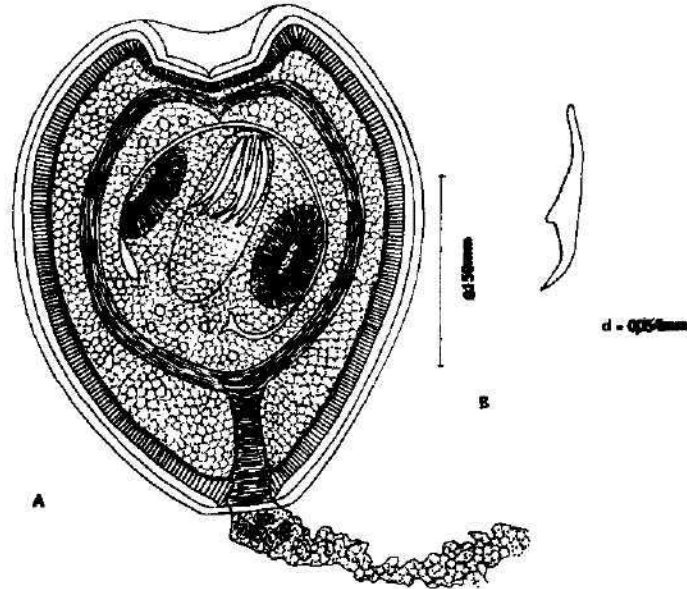


Fig. 4. A — Cysticercoid of *M. paracompressa* from the body cavity of *Macrocyclus albidus*; B — restellar hook

brown till brownish violet and, therefore, they are frequently little translucent (this applies also to *M. paracompressa* and *M. paramicrosoma*). The hyaline layer and the tail are damaged to such a degree during their passage through the digestive tube that they are either missing or present only in minute remnants. The same applies to *M. paracompressa* and *M. paramicrosoma*. Sometimes, the basal and possibly also the intermediate layer of the cyst wall of cysticercoids from snails are thicker in the lateral portions than at both poles. We do not know whether these cysticercoids did develop in crustaceans from which they had not been recovered by us as yet, or whether these layers thicken while the cysticercoids are in the snails. Feeding experiments with 8 ducklings resulted in the finding of adult *M. compressa*.

2) *M. paracompressa* (Czapliński, 1956)

Figs. 4, 5; Plate II

Cysticercoids from naturally infected intermediate hosts: Cysticercoids were recovered repeatedly from the crustacean species *Acanthocyclops viridis*, *Eucyclops serrulatus*, *Macrocyclus albidus*, *Mesocyclops*

Table 6. Measurements of the cysticercoids of *M. paracompressa* from the various intermediate and reservoir hosts

Measurements (in μm)		Intermediate hosts						<i>Lymnaea peregra</i> <i>ovata</i> <i>L. auricularia</i>
		<i>Macrocyclus</i> <i>albidus</i>	<i>Acanthocyclops</i> <i>viridis</i>	<i>Eucyclops</i> <i>serrulatus</i>	<i>Mesocyclops</i> <i>leuckarti</i>	<i>Mesocyclops</i> <i>crassus</i>		
Cysticercoid	l	240-385	214-373	203-280	182-282	184-256	160-330	
Hyaline layer	w	238-276	176-282	194-237	135-225	143-196	135-280	
Homogeneous layer	w	4-9	3-7	3-5	3-7	3-5	3-8	
Basal layer	w	4-5	2-4	3-5	3-4	3-4	2-4	
Outer fibrous layer	w	6-11	6-21	6-9	6-9	6-9	3-21	
Intermediate layer	w ₁	1-2	1-2	1-2	1-2	1-2	1-2	
	w ₁	20-45	15-45	30-35	10-15	12-21	7-30	
	s	10-13	7-12	18-21	5-14	6-9	3-17	
	s	16-90	21-33	26-30	7-15	15-30	4-30	
Inner fibrous layer	w	2-14	12-16	4-6	6-8	4-8	3-10	
Neck	w ₁	13-30	3-21	18-20	10-20	9-12	6-36	
	s	6-20	3-9	12-15	5-14	6-9	3-14	
	s	8-16	3-21	12-15	7-20	9-12	3-24	
Scolex	l	120-140	126-165	120-150	126-178	115-151	94-155	
	w	120-135	110-140	110-135	105-135	95-130	99-150	
Suckers	l	50-81	39-90	75-90	35-42	60-95	30-91	
	w	35-54	39-56	51-60	35-42	49-59	30-49	
Rostellum	l	75-128	75-119	98-111	105-140	101-110	60-105	
	w	24-50	25-42	30-36	35-42	30-36	25-58	
Hooks	l	54-63	57-63	57	56-59	57	54-63	
Calcereous corpuscles	∅	4-8	4-8	4-8	4-8	4-8	4-8	
Tail	l	560-620	400-600	400-600	280-420	400-560	missed	

l = length, w = width

w₁ = width of the layer at the site of invaginationw₂ = width of the layer in the lateral portionw₃ = width of the layer at the distal pole

crassus and *M. leuckarti* collected in fishponds near Lomnice nad Lužnicí (Table 3)

Experimental infection of the intermediate hosts In these experiments we used mature eggs of the cestode obtained from *Anas platyrhynchos* dom. (Lomnice n Lužnicí) Eggs oval, $46-76 \times 35-65 \mu\text{m}$, onco-

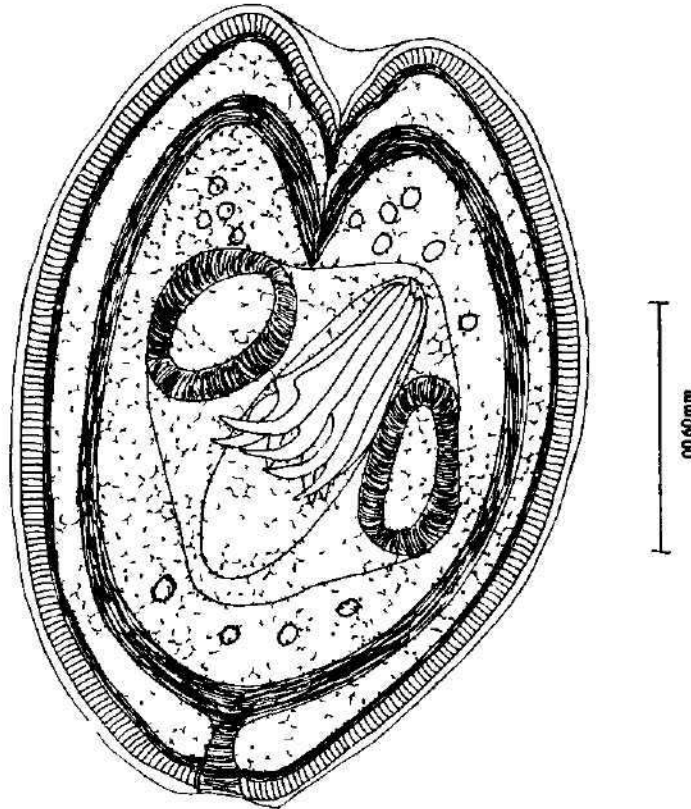


Fig. 5. Cysticercoid of *M. paracompressa* from *Lymnaea peregra ovata*

spheres $20-24 \times 26-28 \mu\text{m}$, embryonic hooks $11 \mu\text{m}$ long In these experiments we used the same crustacean species as those used for infection with *M. compressa* The first oncospheres were found after 4 hrs in the body cavity of *Acanthocyclops viridis*, *Macrocyclops albidus* and *Mesocyclops crassus* We are adding a brief description of their development mobile oncosphere — on day 1 and 2 p 1.; growing oncosphere — from day 3 onwards, size $50-67 \mu\text{m}$, elongated larva — from day 5 onwards, length $140-170 \mu\text{m}$, differentiating larva — from day 8 onwards, length $290-500 \mu\text{m}$; differentiated larva before invagination — from day 13 onwards The development of the cysticercoids was completed from day 18 till day 20 p 1. (Table 4)

Description of the cysticercoids Shape of body oval till moderately ovoid (measurements in Table 6) The two fibrous layers are generally con-

nected at the distal pole of the cysticercoïd by either two thin or one wide stripe of fibrils.

Feeding experiments: Infection of the 8 definitive hosts was produced with cysticercoïds from both natural and experimental infection. In post-mortem examination we found mature cestodes (in two instances we found cestodes with female genital organs only).

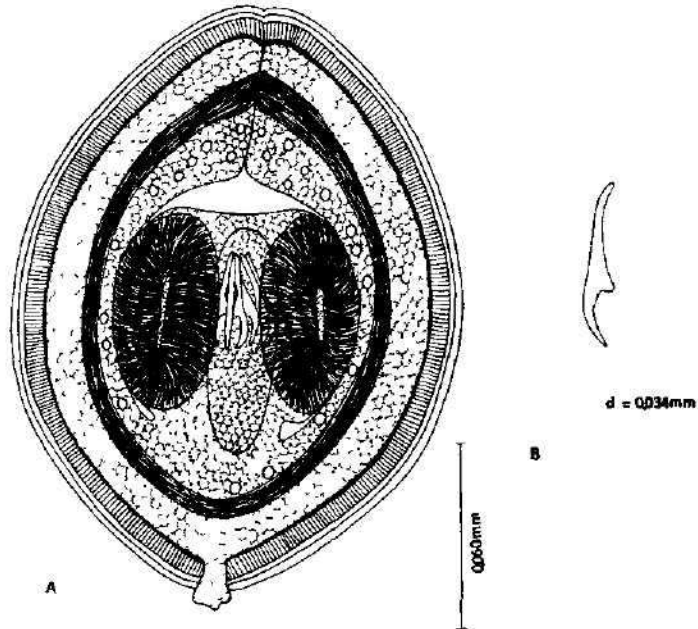


Fig. 6. A — Cysticercoïd of *M. paramicrosoma* from *Lymnaea peregra ovata*; B — rostellar hook

Findings of cysticercoïds in the reservoir hosts: These were found in water snails of the species *Lymnaea auricularia*, *L. peregra ovata* and *L. peregra peregra* (Müller) (Table 5). Measurements are given in Table 6. Adult *M. paracompressa* were obtained from feeding experiments with 10 ducklings.

3) *M. paramicrosoma* (Gasowska, 1931)

Fig. 6

Cysticercoïds from naturally infected intermediate hosts. These were found in the crustaceans *Acanthocyclops viridis* and *Mesocyclops crassus* on May 1, 1968 in the fishpond Blaník: of the 340 specimens of *Acanthocyclops viridis* examined 20 were positive, i.e. 5.9% (intensity 1-2); of the 1,040 specimens of *Mesocyclops crassus* 18 were positive, i.e. 1.7% (intensity 1).

Experimental infection: We repeated our experiments five times with the same crustaceans species as those in experiments with the two foregoing species, but did not succeed in recovering cysticercoïds.

Description of the cysticercoids: Body oval, size 167–240 × 145–168 μm, hyaline layer 3–4 μm in diameter. Thickness of homogeneous layer 2–3 μm, of basal layer 4–8 μm, of the outer fibrous layer 1–3 μm. The thickness of the intermediate parenchymatous layer is 8–13 μm at the site of invagination, 10–16 μm at both sides and on the distal pole. The thickness of the inner fibrous layer is 6–16 μm at the site of invagination, 4–8 μm at both sides and on the distal pole. The neck forms a layer which is 20–24 μm thick at the site of invagination, 3–6 μm at both sides and on the distal pole. This layer contains numerous calcareous corpuscles measuring 3 to 6 μm in diameter. Scolex spherical, 87–102 μm, suckers 36–60 × 30–45 μm, rostellum 60–80 × 21–24 μm; it is armed with 10 hooks 30–34 and 40–44 μm in length. The tail attains a length of up to 350 μm.

Feeding experiment: In this experiment we used cysticercoid obtained from the crustacean *Mesocyclops crassus*. In post-mortem we found two adult cestodes.

Findings of cysticercoids in the reservoir hosts: Cysticercoids were recovered twice from water snails:

1) On August 18, 1965 from the fishpond Černohol near Vodňany — in one of the 118 *Lymnaea auricularia* examined (intensity 3) and in one of the 132 *L. peregra ovata* examined (intensity 3);

2) On October 20, 1965 from the fishpond Hejný near Písek — in 4 of the 120 *L. auricularia* examined (intensity 2–7) and in one of the 164 *L. peregra ovata* examined (intensity 5). The shape and measurements of cysticercoids were similar to those found in the intermediate hosts. The cysticercoids from the second finding were used in feeding experiment.

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The plates will be found at the end of this issue.

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**ZUM GRITWECHSEL BEI UNSEREN WALDHÜHNERN
(TETRAONIDAE)**

JAN PORKERT

Eingegangen am 5. Oktober 1971

Abstrakt: Es wurde der Gritwechsel bei Tetraoniden mit Hilfe der Analysen von in freier Natur gesammelter Losung untersucht. Das Material ist in Tab. 1, die Ergebnisse in Tab. 2 angegeben. Der Einfluss der Schneeverhältnisse und der Nahrungszusammensetzung auf den Gritwechsel wird diskutiert. Das Erreichen und Regulieren des optimalen Gritgehaltes im Magen zur jeweiligen Nahrung ist dem Vogel nur in beschränkter Masse möglich.

EINFÜHRUNG

Es ist bekannt, dass sich im Muskelmagen der Hühnervögel Magensteine befinden, die den Vögeln zur Zerkleinerung der oft harten Nahrung dienen. Bereits mehrere Forscher befassten sich mit der Bedeutung der Gastrolithen für die Haus-, sowie Jagdhühner der Fam. Phasianidae und Tetraonidae. Bei den Haushühnern wurde die optimale Grösse, sowie die günstigste Gesteinsart für die beste Ausnutzung von verschiedenem Futter, ebensowie der Umstand, dass die Hühner überhaupt ohne Grit leben können, festgestellt. Dagegen ist bisher m. W. nur eine experimentelle Arbeit über die Wahl der Magensteingrösse bei den Tetraoniden erschienen (Rajala, 1958), obwohl die Wichtigkeit der Gastrolithen für die Zerkleinerung der im allgemeinen relativ härteren Nahrung der Waldhühner im Vergleich zu den anderen jagdbaren Hühnervögeln betont wird (u. a. Wurm, 1885; Ludwig, 1894; Fuschlberger, 1942; Suminski, 1963; Boback, 1966). Die Untersuchungen über die Anzahl und Grösse der Gastrolithen bei den europäischen Arten der Fam. Tetraonidae verfügen leider meist nur über Material, das aus den Mägen der während der Jagdsaison im Frühjahr erlegten Männchen besteht (u. a. Sládek, 1959; Wagner, 1961; Almășan, 1970), oder welches zwar mehrere Monate des Jahres, jedoch nicht alle, umfasst (Kirikov, 1952; Eygenraam, 1965). Saisonmassig am vollständigsten sind die Untersuchungen von Kolderup (1923) und Semenov-Tjan-Šanskij (1960). Es ist deshalb nicht verwunderlich, dass die Vorstellungen der genannten Autoren über die Faktoren, welche die Grösse, Menge und Art des Grits im Magen beeinflussen, sowie über dessen Unentbehrlichkeit für die Vögel, nicht übereinstimmen. Auch über den Verbleib der Steine im Muskelmagen und die Ausscheidung derselben mit der Losung widersprechen sich die Aussagen der verschiedenen Forscher. Die Ausscheidung der Magensteine mit der Losung stellten u. a. Kirikov (1952), Sládek (1959), Semenov-Tjan-Šanskij (1960), Eygenraam (1965) fest und betrachteten diesen Vorgang als eine normale Erscheinung. Dagegen haben einige Autoren das

Ausscheiden der Magensteinchen überhaupt nicht festgestellt und nahmen daher an, dass die Steinchen im Magen verbraucht werden oder nur in Form des Gruses abgehen (Schumacher, Henrich ex Fuschlberger 1942; Boback, 1966). Ihre Autorität verursacht, dass diese Feststellung im deutschsprachigen Schrifttum weiter nicht überprüft wurde und in anderen Arbeiten (z. B. Wagner, 1961) die Schlussfolgerungen beeinflusst. Im vorliegenden Beitrag bringe ich daher meine bisherigen Untersuchungen aus der freien Wildbahn, solange ich keine Möglichkeit besitze, die entsprechenden Experimente zu diesem Problem an einigen Tetraonidenarten in der Zucht durchzuführen.

MATERIAL UND METHODIK

Das Material besteht aus den Lösungsproben des Birkhuhns (*Lyrurus tetrix* (L.)), des Auerhuhns (*Tetrao urogallus* (L.)), des Rackelhahnes (*Lyrurus tetrix* ♂ × *Tetrao urogallus* ♀), des Auerrackelhahnes (vermutlich *L. tetrix* - *T. urogallus* ♂ × *Tetrao urogallus* ♀, Hoglund personal. Mitt., Foto, vergl. Meyer 1887 Taf. X, XI, S. 47-48, Rudolf, 1883) und des Haselhuhns (*Tetrao bonasia* (L.)). Die Anzahl der Tage, an welchen die Lösung gesammelt und an welchen Grit ausgeschieden wurde, sowie die Mindestzahl der sicher unterscheidbaren Lösungsproben wird nach den Jahren und Monaten verteilt in Tab. 1 angeführt.

Es wurde zwar eine wenig effektive, den Restbestand einer Wildart jedoch am wenigsten gefährdende Methode — das Sammeln und Analysieren der Lösung — angewendet. Die Lösungsproben des Birkhuhns wurden von mir vom 10. 3. 1963 bis 25. 7. 1971, die der Rackelhahne vom 3. 3. 1963 bis 24. 4. 1964 gelegentlich regelmässiger Beobachtungen (meist nur am Wochenende) eines Birkwildrestbesatzes in der zentralen Partie des Adlergebirges (Orlické hory) gesammelt (Porkert, 1967, 1969a, b, 1970, 1971a, b, 1971c, d). Die Lösungsproben der Auer- und Haselhühner stammen aus der Zeit vom 29. 5. 1965 bis 24. 5. 1971 von Exkursionen ins Glatzer Schneegebirge (Králický Sněžník) und ins Altvatergebirge (Jeseníky). Von diesen Exkursionen stammen auch einige Lösungsproben des Birkhuhns und des Auer-Rackelhahnes, was in Tab. 2 gekennzeichnet ist. Nur die sicher angesprochenen Lösungsproben des Auer-Rackelhahnes (Fahrten nach Direktbeobachtung u. a.) sind in einem selbständigen Teil in Tab. 2 angeführt. Alle, die nicht auf dem Schnee gesammelten Lösung, eventl. anhaftenden Steinchen entfernte ich sorgfältig, bevor ich die Proben in Plastikbeutel gelegt habe. Später habe ich die Lösung entweder in frischem oder getrocknetem Zustand mit der Hand vorsichtig zermalmt und in meist 400 ml Gefässen langsam ausgeschwemmt. Die sedimentierten Magensteinchen, bezw. andere Hartteile habe ich gezählt und mit einer Genauigkeit bis zu 0,5 mg gewogen. Die nicht verdaute Nahrungssubstanz wurde mit Hilfe nur eines dem Gefäss unterlegten Kuchensiebes (Maschendichte 1 mm) abgefangen und getrocknet, da die Analysen mehr der Orientierung über die Konsistenz der Nahrung dienen sollten (vergl. Methoden in Eastman & Jenkins, 1970). Allerdings geht dabei ein der Nahrungszusammensetzung entsprechend grosser Anteil der Probe durch die Maschen ab. Das in Tab. 2 angeführte Gewicht der Trockensubstanz vermittelt deshalb nur eine annähernde Vorstellung über die Lösungsmenge. Die Nahrungsreste wurden von mir, soweit erkannt, während des Zermalmens der Lösung notiert. Bei den Lösungsproben, deren Trockensubstanz aufbewahrt ist, wurden später die vegetabilischen Nahrungsreste von Dr. B. Krísa, die animalischen Reste (Arthropoda) von Dr. P. Pecina, determiniert. Die in den Jahren 1963 und 1964 gefundenen Lösungen habe ich nicht immer quantitativ gesammelt, bezw. aufbewahrt. Auch in den Jahren 1965 bis 1968 habe ich die ausgeschwemmte Trockensubstanz nicht aufbewahrt, wenn kein Gewicht derselben in Tab. 2 angegeben ist. Einzelne Lösungsproben, die an einem Tag gesammelt wurden, habe ich (mit Ausnahme einiger gritreichen) nicht immer getrennt verarbeitet, bezw. angeführt, wenn die Nahrungszusammensetzung nicht bedeutend unterschiedlich war. In Tab. 2 ist der ausgeschiedene Grit zur besseren Orientierung in Magensteinchen (> - 0,02 g) oder Grus (< 0,02 g) eingeteilt. Bei der Wahl des Grenzwertes wurde die Arbeit von Rajala (1958), sowie die in Tab. 3 ermittelten Mittelgewichte der Gastrolithen berücksichtigt. Für das Haselhuhn, sowie bei den Lösungsproben der Birkhuhnkuken vom 2. u. 10. 8. 1969 setzte ich infolge geringerer Körpergrösse als Grenzwert 0,01 g an. In den Erläuterungen zur Tab. 2 sind weitere in den Anmerkungen angeführte und mit den Lösungsfunden zusammenhängende Begleitumstände erklärt. Für die Beschreibung der Schneeverhältnisse am Platz des Lösungsfundes habe ich eine Kodenskala mit Angaben über die Schneequalität aufgestellt, da die in der Meteorologie üblichen oder von Hjorth (1966) verwendeten Kodexen den speziellen Ansprüchen nicht entsprechen. Im Gegensatz zu den Angaben über die Schneedecke in Tab. 2, welche für die nähere Umgebung des Lösungsfundes gelten, stellen die grafischen Darstellungen der

Tabelle 1. Anzahl der Tage mit Losungsfunden (T) vom Birkhuhn (B), Auerhuhn (A), Rackelhahn (R), Auer-Rackelhahn (AR), Heselhuhn (H), sowie der Tage mit Funden von mindestens 0,010 g schweren Gastrolithen (G) in der Losung und die Gesamtzahl der sicher unterscheidbaren Losungsproben (P)

	Januar		Februar		März		April		Mai		Juni		Juli		August		Sept.		Oktober		Nov.		Dez.		T	G	P
	T	G	T	G	T	G	T	G	T	G	T	G	T	G	T	G	T	G	T	G	T	G	T	G			
B Σ	16	3	9	1	18	2	40	18	31	12	13	3	10	4	13	3	7	1	20	3	25	9	24	10	234	69	381
1963	-	-	-	-	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	4	0	4
1964	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	1	0	3	1	2	1	9	2	9
1965	1	0	0	2	1	2	1	5	2	0	0	0	3	1	0	0	1	1	1	1	0	0	3	0	18	6	23
1966	2	0	2	1	2	1	7	1	3	0	1	1	4	1	0	0	1	1	4	1	4	1	3	1	32	8	45
1967	1	0	0	0	0	0	7	4	4	2	2	0	3	0	0	1	0	2	0	2	0	2	1	24	7	30	
1968	0	0	0	0	1	0	2	0	3	1	1	0	3	1	3	0	2	0	2	0	7	4	3	1	27	7	45
1969	5	2	4	0	7	1	7	4	6	1	5	2	4	0	7	3	2	0	6	0	6	2	5	3	64	18	107
1970	3	0	2	0	5	0	9	5	4	4	0	0	1	0	2	0	1	0	4	1	2	1	4	3	37	14	77
1971	4	1	1	0	0	0	4	3	5	2	4	0	1	1	-	-	-	-	-	-	-	-	-	19	7	33	
A Σ	1	1	1	0	4	3	8	6	21	19	1	1	1	1	1	0	-	-	3	1	6	2	0	0	47	34	217
1965	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	0	0	-	-	-	-	2	2	11
1966	-	-	-	-	-	-	-	-	3	3	-	-	1	1	-	-	-	-	1	0	-	-	-	-	6	4	9
1967	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	2	1	-	-	0	0	4	3	30
1968	-	-	-	-	2	2	3	1	1	1	-	-	-	-	1	0	-	-	-	-	-	-	-	-	7	4	67
1969	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	2	-	-	12	2	12
1970	-	-	1	0	-	1	0	0	8	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	8	55
1971	1	1	1	0	2	1	0	0	8	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	8	41
R Σ	1	0	1	0	6	3	5	2	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	1	16	7	18
1963	-	-	-	-	4	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	1	8	4	9
1964	1	0	1	0	2	1	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	3	9
AR Σ	2	1	-	-	0	0	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2	4
1971	2	1	-	-	0	0	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2	4
H Σ	1	1	0	0	0	0	2	0	7	4	0	0	0	0	0	0	-	-	0	0	0	0	1	0	11	5	22
1965	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	0	0	-	-	-	-	1	1	1
1967	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	0	0	-	-	-	-	1	1	4
1968	-	-	0	0	0	0	0	0	1	1	-	-	-	-	-	-	-	-	0	0	-	-	-	-	2	1	4
1970	-	-	0	0	-	-	2	0	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1	11
1971	1	1	-	-	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2

- kein Sammeln, bzw. entsprechendes Gebiet nicht besucht
0 kein Losungsfund

mittleren Höhe der Schneedecke an der Meteorologischen Station Deštné v Orli. h. (Fig. 1) die allgemeinen Schneeverhältnisse und die Veränderungstendenz der Schneedecke dar. Die Station liegt im genannten Areal in 870 m Seehöhe und ist dem Hydrometeorologischen Institut in Prag unterstellt.

Vom 8. 8. 1965 bis 11. 9. 1965 habe ich ein kleines Experiment an Haushühnern an genannter Station durchgeführt. Den etwa 3 Monate alten Hähnchen, die vorher frei herumlaufen konnten, wurden im Brot eingepackte verschieden grosse (z. T. übergrosse) Quarzsteinchen aus der Hand verabreicht. Danach wurden die Hähnchen sofort in Käfige eingesperrt, wo die Unterlage (aus hartem Papier) täglich morgens um 8 Uhr gewechselt und beschriftet wurde. Am Wochenende habe ich die Exkremente von den Unterlagen abgekratzt und ausgeschwemmt. Die Ergebnisse, sowie die Inhalte der Muskelmagen von 2 adulten Haushennen, sind in Tab. 4 zusammengestellt.

ERGEBNISSE

Wie aus Tab. 1 und 2 ersichtlich, steht mir bisher nur vom Birkwild Material von allen Monaten des Jahres zur Verfügung. Die Losungsproben der Rackelhähne, Auer- und Haselhühner sind daher, ebenso wie die wenigen in Tab. 3 angeführten Inhalte der Muskelmägen von Auer-, Rackel- und Birkhähnen, mehr wie eine Ergänzung gedacht. Die Ergebnisse der Losungsanalysen sind nebst einigen Angaben über die Begleitumstände der Funde für die untersuchten Arten in Tab. 2 angeführt. Allerdings kann in der Kolonne „Nahrung“ (Tab. 2, 3) nur ein Teil der Komponente erfasst werden, die weichen Bestandteile, die besonders während der Vegetationsperiode von Bedeutung sind, bleiben nämlich überhaupt nicht erhalten, oder können dieselben nicht determiniert werden, worauf bereits Kaasa (1959) hingewiesen hat. Die in Fig. 1 gebrachten grafischen Darstellungen der Schneedecke, wo die Tage, an welchen Magensteinchen in der Losung festgestellt wurden, gekennzeichnet sind, zeigen, dass dies meist nach der Schneeschmelze, dem Tauwetter, oder nach starkem Wind geschehen ist, was durch das Sinken der Kurve dargestellt wird. Näheres über die Erreichbarkeit der Steinchen u. ä. s. Tab. 2. Es war den Hühnern fast in allen Fällen, wo die Ausscheidung des Grits festgestellt wurde, wenn nicht zur selben Zeit, so vor Kurzem möglich, frische Steinchen irgendwo auf aperen Stellen, entwurzelten Bäumen o. ä., aufzunehmen. In einigen Fällen (Tab. 2 B 59, H 5) ist das Mitausscheiden mit den harten Ästchenbruchteilen anzunehmen. Es ist zu berücksichtigen (Tab. 2 R 1, 2), dass im Winter 1962/63 die Schneedecke mehr durch die Einwirkung der starken Winde als durch die seltenen unbedeutenden Erwärmungen formiert war.

Um eine Übersicht über die Menge und den Zustand des ausgeschiedenen Grits zu gewinnen, wird in Tab. 2 ausser der Anzahl und des Gewichtes auch die Abnutzung desselben angeführt. Obwohl ich nicht beurteilen kann, ob die frischen kantigen oder die abgeschliffenen Magensteinchen leichter mit der Losung abgehen, bedeutet eine Feststellung von frischen kantigen Steinchen in der Losung, dass die Aufnahme derselben vor Kurzem stattgefunden hat. Es gelang mir zwar, die Ausscheidung von Magensteinchen nur in einem relativ kleinen Anteil der Losungsproben festzustellen, jedoch in allen Monaten des Jahres. Die geringe Anzahl, sowie Umfang der Proben aus der Vegetationsperiode (s. Tab. 1, 2) mag der Grund sein, dass im August bei den adulten Vögeln nur Grus festgestellt wurde. Auch Semenov-Tjansanskij (1960) und Kirikov (1952) fanden beim Auerhuhn im August die kleinste Gritmenge im Magen. Die winterlichen Losungsproben sind bedeutend umfangreicher und zeigen fast immer die gleiche Nahrungszusammensetzung. Deshalb lassen sich zu dieser Jahreszeit die Verhältnisse,

Tabelle 2. Ausscheidung des Grits mit

Nr.	Datum	Grit		Gewicht in g		Ab- nut- zungs- grad	Andere Hartteile		Lösungs- proben		
		Anzahl Magen- steinchen	Grus	Total-	Maxi- mal- /1 G		Art	An- zahl	Total gewicht in g	An- zahl	Trocken- gewicht in g
1	5. 11. 1964	1	2	0,076	0,064	—			1	0,20	
2	26. 12.	1	2	0,032	0,020	—			1		
3	3. 4. 1965	2		0,046	0,032	±	Xv ₅	9			
4	(2. 5.)	1	2+	0,052	0,023	—			2		
5	(9. 5.)		5++	0,305	0,010	—			2		
6	4. 7.		15+++	0,200	0,006	—			1		
7	7. 7.		2	0,020	0,013	—			1		
8	18. 9.		4	0,033	0,013	—	Av ₄	1			
9	17. 10.	9	11	0,3535	0,052	—			1		
10	5. 12.						Mm ₂	1	0,005	1	
11	26. 12.						Mm _{1,2}	2,1	0,0325	1	
12	20. 2. 1966	8	2	0,240	0,046	—, ±	M ₁	1	0,002	2	
13	20. 3.	6		0,212	0,051	—, ±			2		
14	(16. 4.)	6	4	0,224	0,061	—, ±			2		
15	(4. 6.)	7	30+++	0,580	0,032	—			1	1,10	
16	31. 7.	4	++			—			1		
17	16. 10.	6	4+	0,246	0,043	±, —			1		
18	27. 11.	2		0,046	0,026	+			1		
19	4. 12.	3	2	0,085	0,044	+			2		
20	1. 4. 1967	1	2	0,033	0,027	+, —			2		
21	9. 4.	2	1	0,052	0,024	+, —			2		
22	16. 4.	1	1	0,032	0,030	±	Xv ₁	1	0,006	1	
23	23. 4.	1		0,025		—			3		
24	1. 5.		4	0,019	0,010	—			1		
25	8. 5.	1	5	0,030	0,021	—			1		
26	3. 12.		1+	0,035	0,016	—	S ₅ , Xv ₅	1,3		2,10	
27	3. 12.	1		0,021		—			1	0,60	
28	26. 5. 1968	1	2	0,071	0,0485	—			1	1,22	
29	28. 7.	4	6+	0,148	0,032	—			1		
30	13. 10.		9+	0,027	0,005	—	Ms ₁₂ , Mm ₂ , Rb ₅	10,1 4	0,016 0,0045	1 1	1,95
31	2. 11.		7++	0,220	0,010	—			2	2,43	
32	3. 11.		2++	0,032	0,018	—			2	1,78	
33	23. 11.	1	7++	0,360	0,022	—			2	4,42	
34	24. 11.		3	0,015	0,010	—			1	0,90	
35	14. 12.		4+	0,028	0,006	—			3	1,11	
36	24. 12.	2	6+	0,147	0,050	±, —			2	18,35	
37	4. 1. 1969	2		0,075	0,041	+			1	10,40	
38	25. 1.	2		0,072	0,048	±			1	37,30	
39	16. 3.		1	0,015		—			1	1,14	
40	22. 3.		1	0,0005		±			4	41,50	

der Lösung bei unseren Tetraoniden

Nahrung	Anmerkungen	
	Schneedecke	Direktbeobachtung, u. ä.
Vm ₁ , S ₂ , Xv ₃ S ₂ , Pa ₃ , Vm ₁	V 5 Fe II 20-25 K	
S ₂ , Pa ₃ , Vm ₁ Vm ₁ , S ₂ , Pa ₃ S ₂ , Vm ₁ , Pa ₃ Li, Xv ₃ -Cl Xv ₃₁ Vm ₅ , Xv ₃ -Cl, Av ₄ Vm ₅₁ , Vv ₅ , Xv ₃₁ Pa ₃₁ , Vm ₁ , S ₂ -Mm ₂	III 100 Fi IV - 100 Fi IV - 100 Fi I 60-80 Pa	Sg (?) Sg (?) Bl, D 1♀ 8 ²⁰ P71b, d P67, 69a (Abb.), b, Sg, 71a, c (Abb.) D 1♂ 11 ¹⁰ Sp P67, 69a, (Abb.), b Sg
Pa ₃₁ , S ₂ -Mm ₁₂	I 40-60 Ps-Fe	P67, 69a (Abb.), b Sba P69b Sg
Vm ₁ , Pa ₃ , S ₂ , Xv ₁₃ -M ₁ Vm ₁ , S ₂₁ , Pa ₃ Vm ₁ , Pa ₃ , S ₂ Er ₄₁ , Vm ₁ , Gr ₃ -Cu, Ci Vm ₅ , Xv ₃ Vm ₅ , Xv ₃₁ -Cl Vm ₁ , S ₂₁ , Pa ₃₁	II 30-100 Kw II 80-100 K, P IV - 60 Fi	P69a (Abb.), b Sba P69b Sg Sab Abb. 3
S ₂ , Pa ₃ , Vm ₁	II 30-50/1-2 P, K (R) I 30-40 /1K/ P	Sab P69b Sg, Sgo D 1♂ 8 ²⁰⁻³⁰ Vm ₁ Sba P69b
S ₂ , Vm ₁ , Pa ₃₁ S ₂₁ , Vm ₁ , Pa ₃₁ Vm ₁ , Pa ₃₁ , S ₂ , Xv ₅ Vm ₁ , S ₂₁ , Pa ₃ S ₂₁ , Vm ₁ , Pa ₃ , Xv ₃ S ₂ , Vm ₁ , Pa ₃ Vm ₁ , S ₂₁₅ , Pa ₃ , Xv ₅ Vm ₁ , Pa ₃₁ , Xv ₃	III 80-200 Fiw II 80-200 /2 Fi/ Fe III 50-130 Fi IV 30-100 Fi IV - 100 Fi IV - 120 Fi V 3-8 P-Fi V 3-8 P-Fi	P69b Sba D 1♀ 6 ¹⁵ Vm ₁ D 1♀ 7 ¹⁰ Vm ₁ Sba D 1♂ 11 ¹⁵ Vm ₁
F ₂₄ , Pa ₄ ♂ ₃ Vm ₅ , Li, Cp ₅ , Xv ₁₃ -Foi, Cui, Ci Vm ₅₃ , Li, S ₅ , Rb ₅ -Cui, Aci, Lk, Ms ₁₂₃ , Mm ₂ , M ₃₁	V - 2 Fe	♀ P69a (Abb.)
Vm ₅₁ , Li, Pa ₃ , Bm ₆ , G ₁ -Eh, Ci, I Vv ₅ , Vm ₅₁ , Li, Pa ₃ , G ₁ -Ci, Col, Hi, I, O, Av ₃ Vm ₁ , S ₂₁ , Li, Pa ₃ , Cp ₅ , Xv ₁ -Coi Vm ₁₅ , Li, Pa ₃ , S ₂ , G ₁ Vm ₁ , Pa ₃₁ , S ₂	V - 1 P-R V - 1 P-E V - 2 P-R	G, D 1♂ 9 ¹⁵ Vm ₁ P71a, c D 1♂ 9 ¹⁵ -9 ²⁰ Vm ₁ , Pa ₃ , Sp
Vm ₁₅ , S ₂₁ , Pa ₃₁ , Li	II 15-20 /12-15 K/ Ps-Fe	Sba
S ₂₁ , Vm ₁ , Pa ₃₁ S ₂₁ , Pa ₃₁ , Vm ₁ S ₂₁ , Vm ₁ , Pa ₃ S ₂₁ , Pa ₃ , Vm ₁	II 40-60 P II 40-80 K, P, E, R I 50-150 /15-40 Fi/ P-D 1♂ 10 ⁰⁵ I 50-150 /-30-100 Fi/ P-P71ac	Sg Sgo Sgo Sg (Abb.)

Fortsetzung der Tabelle 2.

Nr.	Datum	Grit		Gewicht in g		Ab- nut- zungs- grad	Andere Hartteile		Losungs- proben		
		Anzahl Magen- steinchen	Grus	Total-	Maxi- mal- /1 G		Art	An- zahl	Total gewicht in g	An- zahl	Trocken- gewicht in g
41	7. 4.		14+	0,115	0,016	-			4	28,32	
42	18. 4.	1	2	0,062	0,0305	-			2	17,10	
43	20. 4.		3+	0,025	0,016	±, -			1	8,85	
44	(27. 4.)	1	1	0,045	0,040	±, -			1	5,10	
45	9. 5.		20++	0,130	0,0155	- , ±			2	13,70	
46	1. 6.		7	0,068	0,0175	-			2	0,45	
47	14. 6.	1		0,033		-			1	0,08	
48	2. 8.	2	21++	0,123	0,011	-			1	0,25	
49	10. 8.	1	16+	0,076	0,011	- , ±			2	0,40	
50	16. 8.		6+	0,024	0,004	±	Av ₄ St	3	0,016 <0,0005	2	0,85
51	23. 8.		16+	0,042	0,008	- , ±			1	0,06	
52	31. 8.		10+	0,0545	0,015	-			1	0,39	
53	28. 10.		5+	0,012		-	Av ₁ St	> 20 1	0,087 <0,0005	1	1,82
54	3. 11.		5+	0,077	0,012	-			1	0,21	
55	17. 11.	2	3	0,0755	0,023	±			1	0,23	
56	12. 12.	1	1	0,040	0,023	±			2	10,62	
57	24. 12.	1	2	0,025	0,023	±			1	28,40	
58	27. 12.	4	2	0,1405	0,0335	±, +			7	131,10	
59	5. 4. 1970	1		0,033		+	S ₁₂	1	0,085 15 × 4,5 mm	2	3,44
60	(18. 4.)	2		0,078	0,056	+			5	118,90	
61	(25. 4.)		35+	0,307	0,018	- , ±			1	9,82	
62	(26. 4.)		18+	0,128	0,018	±			8	61,45	
63	27. 4.		25++	0,2755	0,012	- , ±			1	12,40	
64	(10. 5.)	2		0,0585	0,031	+ , ±	Pa ₁	6	0,072	10	129,63
65	23. 5.		5	0,021	0,016	-			1	2,40	
66	24. 5.	1	3	0,034	0,023	±			1	0,77	
67	31. 5.		1++	0,103	0,012	-			1	1,23	
68	31. 10.	6	25+	0,572	0,040	±, -	S ₅	18	0,043	1	3,54
69	7. 11.		10+	0,080	0,010	±, -			1	1,87	
70	13. 12.	11	6+	0,408	0,039	±, -			2	32,57	
71	19. 12.	3		0,093	0,041	±			2	23,70	
72	27. 12.	1		0,037		±			2	5,70	
73	18. 1. 1971		4+	0,042	0,014	±			2	22,00	
74	3. 4.	47	140++	2,770	0,059	- , ±			5	83,65	
75	3. 4.	5	25++	0,410	0,0485	- , ±			1	1,90	
76	4. 4.	2	45+	0,387	0,022	-	Gls	1	0,0015	2	22,70
77	(12. 4.)	1	3	0,071	0,031	-	Sk1	1	0,003	1	6,00
78	7. 5.		4+	0,021	0,014	-			1	1,40	
79	8. 5.		5	0,017	0,012	±			1	1,25	
80	27. 6.		15++	0,109	0,005	-			1	1,65	
81	25. 7.	2	3	0,085	0,0375	±	Gl	1	0,1365	1	1,18

Nahrung	Anmerkungen	
	Schneedecke	Direktbeobachtung, u. ä.
Vm ₁ , S ₂₁ , Pa ₃	III 20–130 Fi (R) P71a, c, D 2♂ 525–805 Vm ₁ , Pa ₃ , Gr ₁ , Sp (Abb.)	
Vm ₁ , S ₂₁ , Pa ₃	II 30–120 (8–12 F ₁) Pa ₃ , F ₁	Sgo, D 1♂ 1735 Vm ₁
Vm ₁ , Pa ₃ , S ₁ , Xv ₁	III 30–140 F ₁	D 1♀ 350 Sba
S ₂ , Vm ₁ , Pa ₃ , Gr ₁	IV – 100 F _{1w}	
Vm ₁ , Pa ₃ , Li, S ₂ , Xv ₃ –Foi, Coi, Ii	IV – 20 F ₁	
Vm ₁ , Li, Pa ₃ , S ₅ –Cui, Eli, Cai, Chi, Sci, Ci, Tei		Bl
Xv ₃ (F ₃ ?)–Chi, Cui, Eh, Coi, Ci, Foi		juv., Sab
Xv ₃₅ , Vm ₅ –Foi, Cui, Eli, O		juv., Sab
Xv ₃ , Vm ₅ , Li–Cui, I, O, Av ₃ –Hk		juv., Sab
Vm ₅ , Xv ₃₅ , Cp ₅ –Foi, Sci, Dp, Av ₄		
Xv ₃ , Vm ₅ , S ₅ –Cui, Coi, O		juv.,
Vm ₅₁ , Xv ₃₁ –Cui, Foi		P70 (Abb.)
Vm ₅₃₁ , Pa ₃ , Bm ₆ , Gr ₃ , Xv–O, Tei, Li, Cui, I, Av ₁₃ , M ₃		
Vm ₅₁ , Vv ₅ , S ₅ , V ₁ , Xv ₃	V 3–5 M	
Vm ₁₅ , S ₂ , V ₁₅ , Cp ₅ , Gr ₃₁ , Xv ₁		
Vm ₁ , Pa ₃ , S ₂	II 20–60 P, K	D 1♀ 1145 Vm ₁ , Pa ₃
S ₂₁ , Vm ₁	II 15–80 Ph	Sg
Vm ₁ , S ₂₁ , Pa ₃	II 20–80 Ph	6 Sg
S ₂₁ , Pa ₃	I 130–300 /10–20 Fih/ P	D 2♀ 758, 842 2 Sg
S ₂₁ , Pa ₃₁ , Vm ₁	II 20–250 F _{1w}	4 Sg (?), 1 Sba
Vm ₁ , S ₂ , Pa ₃₁	III 30–200 F _{1w}	G GS
Pa ₃ , Vm ₁ , S ₂ , Pm ₃	III 30–200 F _{1w}	5 Sg (?) GS
Pa ₃₁ –Foi	III 10–80 /2–5 Fiw/ Fe	D 1♂ 1045 Pa ₃ , G GS
S ₂₁ , Pa ₃₁ , Vm ₁	IV – 120 F _{1w}	4 Sg (?)
Er ₄ , Vm ₁ , Pa ₃ , Xv ₃ –Foi, Ci	IV – 40 F _{1w}	
Er ₄ , Pa ₃₁ , Vm ₁ , F ₂	IV – 50 F ₁	
Vm ₁ , F ₂ , Er ₄ , Gr ₃ , Xv ₃ –Cui, Foi	IV – 20 F ₁	
Vm ₅₃₁ , Vv ₅ , Vm ₅₃₁ , Gr ₃ , Xv ₃ , S ₅ , Eq–Foi	20.–29. 10. V – 15 K – Fe	
Vm ₅₁ , Gr ₁ , Pa ₃ , Bm ₇	V 4–5 P	D 1♀ 934 Vm ₅₁ – 4,0 °C
Vm ₁₃ , S ₂ , Pa ₃₁	II 12–30 /5–7 K/ Pk	2 Sgo
Vm ₁₃ , Pa ₃₁ , S ₂	II 20–40 /5–6 Pk, K/ P	1 Sgo
Vm ₁ , Pa ₃ , S ₂	II 20–80 /5–30 Ph–K/ P	D 1♀ 949 Sg, 1 Sg
Pm ₃₂₅ , Pa ₃₁ , Vm ₁ , S ₂	II 20–100 /3–10 K/ P	GS
Pm ₃₂ , Vm ₁₃ , Pa ₃₁ , Vv ₅ , Gr ₃ , S ₁	III 30–120 F _{1w}	D 1♂ 1446 Pa ₃ Sp 5,7 °C GS
Vm ₁₃ , Vv ₃ , Pm ₃ , S ₂ , Pa ₃₁	III 10–80 F _{1w}	GS
Vm ₁₃ , Vv ₃₃₁ , S ₂ , Pa ₃ , Pm ₃₂ , Bm ₆ , Xv ₁	III 30–80 F _{1w}	D 1♀ 1020 Pm ₂₃ GS
S ₂ , Vm ₁ , Pa ₃₁	IV – 60 F _{1w}	
Gr ₃ , S ₂ , Pa ₃ , Vm ₁ –Cui, Coi, Chi, Foi, Ci	IV – 20 F ₁	♀
Er ₄ , Vm ₁ , Pa ₃ –Cui, Foi, Coi		♀
F ₃ , Vm ₃ –Cui, Ci, Foi		♀ Bl
Lu ₄₅ , Gr ₃₅ –Cui, Foi, Ci		♀

A. Auerhahn *Tetrao urogallus* L.

Nr.	Datum	Grit		Gewicht in g		Ab- nut- zungs- grad	Andere Hartteile		Losungs- Proben		
		Anzahl Magen- steinchen	Grus	Total-	Maxi- mal- /1 G*		Art	An- zahl	Total- gewicht in g	An- zahl	Trocken- gewicht in g
1	(29., 30. 5. 1965)	2	5++	0,440	0,024	-, ±	Av ₄	1		11	
2	5.-7. 5. 1966	18	27+	0,789	0,043	-, ±				6	
3	10. 7.	6		0,240	0,081	-				1	
4	(29. 5. 1967)	7	13+	0,295	0,044	+, -	Pm ₅	1		10	
5	(29. 5.)		1+	0,023	0,010	-				1	
6	(4. 6.)	5	4+	0,323	0,111	±, -, +				10	
7	28. 10.		2++	0,061	0,014	-				6	
8	(30. 3. 1968)	25	200++	2,636	0,063	+, -, ±				27	408,0
9	(30. 3.)		2+	0,024	0,016	+				2	6,95
10	(31. 3.)	22	160++	2,112	0,034	+, -, ±				14	650,0
11	7. 4.	4	28	0,241	0,027	±, -				2	10,70
12	1. 5.	5	4	0,222	0,050	+, ±				2	3,88
13	(25. 4. 1970)	6	100++	1,132	0,0735	±, -				7	115,20
14	(25. 4.)	1	50++	0,538	0,028	+, ±, -				5	20,35
15	(28. 4.)	1	50++	0,394	0,029	±, -				4	21,70
16	29. 4.		1	0,016		±				1	1,025
17	(29. 4.)	19	51+	1,2185	0,054	±, +, -				20	270,50
18	30. 4.		5	0,060	0,018	±, -				3	28,26
19	1. 5.		2	0,027	0,015	+, ±				1	31,10
20	2. 5.	1	3	0,036	0,028	±				1	30,80
21	(17. 5.)	1	6	0,048	0,022	±				1	0,095
22	18. 5.	39	7	2,272	0,144	±, -, +				2	1,145
23	18. 5.	142	250++	8,894	0,102	±, +, -				7	108,90
24	18. 5.	19	16+	0,968	0,0865	±, -				1	11,10
25	(18. 5.)	1	9++	0,131	0,032	±, -				3	12,50
26	19. 5.	6	130++	1,266	0,0325	±, -, +				1	0,575
27	20. 5.	8	23+	0,4385	0,041	±, +, -				4	13,29
28	24. 1. 1971	2	50++	0,545	0,0275	+, ±, -				2	3,40
29	28. 3.		1+	0,0175	0,017	±				1	52,45
30	(1. 5.)		8+	0,070	0,0145	-				1	6,90
31	2. 5.	5	44+	0,455	0,026	±, -				1	29,88
32	2. 5.	1	6+	0,086	0,024	±	Rb ₅	12	0,017	2	7,94
33	3., 4. 5.	1		0,020		+				2	54,20
34	5. 5.	2	2	0,069	0,021	±, +				2	35,50
35	5. 5.	1	8+	0,087	0,020	±				2	23,65
36	22. 5.	32	40++	1,760	0,142	-, ±				1	6,40
37	22. 5.		1	0,015		±				1	2,05
38	22. 5.		4	0,040	0,016	±, -				3	1,55
39	(23. 5.)		5	0,034	0,017	±				2	8,00
40	23. 5.	1	6++	0,092	0,022	±, -				1	0,67

Nahrung	Anmerkungen		
	Schneedecke	Direktbeobachtung, u. a.	
Pa ₃₁ , Pm ₃ , F ₂₃ , S ₂ -Av ₄	IV - 100 Fi	6 Sg (?)	GS
Pa ₃₁ , Pm ₃ , F ₂	IV - 60 Fi		GS
Xv ₃₁		P71bd	GS
Pa ₃₁ , Pm ₃₅ , F ₂ , Vm ₁ , S ₂ , Xv ₁₃	IV - 80 Fi	3 Sg (?), 4 Sba	GS
Pa ₃₁ - Foi, Sci, Col, Cl	IV - 40 Fi	P69a 1 Sg (?)	GS
Pa ₃₁ , Pm ₃ -Cui, Cal, Chi	IV - 60 Fi	P69a 3 Sg (?) 4 Sba	GS
Vm ₅₁₃ , Pa ₃₁ , Fl ₇ , Xv ₁₃		D 1♂ 11 ¹⁵ , 1♀ 15 ³⁰ , Vm ₅₁	GS AV
Pa ₃₁ , S ₂ , Vm ₁ , Pm ₃	II 60-150 Fi	8 Sba G D 1♂, 1♀ 16 ³⁰ , Pa ₃	AV
Pa ₃₁ , F ₂ , Vm ₁ -Foi, Ar	II 60-120 Fi	♀	AV
Pa ₃₁ , F ₂ , S ₂ , Vm ₁	II 60-120 Fi	12 Sba	AV
Pa ₃₁ , F ₂ , S ₁ , Vm ₁ , Pm ₃	II 60-120 /2 Fi/ Fe		GS
F ₂ , Pa 34♂, Vm ₁ , S ₁	IV - 30 Fi	D 1♂ 8 ³⁵ Bo	GS
Pa ₃₁ , Vm ₁ , F ₂ , S ₁ , Gr ₁	III 30-200 Fiw	2 Sba	GS
Pm ₃ , Vm ₁ , Pa ₃₁ , F ₂	III 30-200 Fiw		GS
Vm ₁ , Pa ₃₁ , F ₂ , S ₂ -Ci	III 30-150 Fiw	G	AV
Gr ₂ , Vm ₁ , F ₂ , S ₁₂ , Pa ₃	III 30-150 /2 Fiw/ Fe	D 1♀ 17 ⁰⁷ Gr ₃ , Vm ₁	AV
Pa ₃₁ , Vm ₁ , F ₂ , Gr ₃₁ , S ₂ , Pm ₃ , Xv ₃ , Fl ₇ -Ci	III 30-200 /2 Fi/ Ps-Fe	D 1♂ 8 ¹⁰ Vm ₁ G,4 Sba♂	AV
Pa ₃₁ , Vm ₁ , S ₂ , Pm ₃	II 30-200 /2-3 Fi/ Ps-Fe ¹		AV
Pa ₃₁ , F ₂	I 30-150 /5-10 Fi/ Ps	Sba D 1♂ 7 ¹⁵ -8 ³⁰ Bo	AV
Pa ₃₁ , S ₂ , Vm ₁ , G ₁ , F ₂	I 30-150 /10-15/ Fi Ps	Sba, Bo	AV
Pa ₃₁ , Vm ₁ , F ₂ , Xv ₃ -Cui	IV - 60 Fiw	♀	GS
F ₂ , Lu ₄ , Gr ₃ , Vm ₁ , Pa ₃ -Cui, Foi	IV - 20 Fiw	Abb. 1, 2	AV
Er ₄ , F ₂ , Lu ₄ , Gr ₃₁ , Vm ₁ , Pa ₃ -Foi, Cui, Col, Chi, Ci	IV - 100 Fi		AV
Er ₄₁ , Gr ₁ , Vm ₁ , Bm ₆ -Foi, Cui, Col	IV - 100 Fi	♂	AV
Pa ₃ , Vm ₁ , S ₂ , F ₂	IV - 100 Fi		AV
F ₂ , Lu ₄ , Gr ₃₁ , Vm ₁ , Pa ₃ , Xv ₃ -Cui	IV - 20 Fi	D 1♀, 1♀ 16 ⁴⁶ -17 ¹⁵ Sub Gr ₃ Vm ₁ ,	AV
Er ₄₁ , Gr ₃₁ , Vm ₁₃ , F ₂ , Pa ₃ , Xv ₃ -Cui, Foi, Col, Ci	IV - 100 Fi		AV
Pa ₃₁ , Vm ₁ , Xv ₃	II 30-100 /4-6/ K Fe	♀ G	AV
Pa ₃₁	I 100-150 /15 Fi/ P	Sba, D ♂ 8 ²² Sp	AV
Pa ₃₁ , Vm ₁	III 40-80 Fi	♀	AV
Pa ₃₁₅ , Vm ₁ , Vv ₅	II 15-80 /15-20 Fi/ K-Ps	♀ Sba	AV
Pa ₃₁ , Vm ₁ , Rb ₅ , Xv ₃	II 15-100 /15-20 Fi/ K-Ps	♂ Sba	AV
Pa ₃₁ , Bm ₆	II 50-100 /20 Fi/ Kw	D 3. 8 ⁰⁰ -9 ¹⁵ , 17 ¹⁵ -18 ²⁵ 1♂ Bo Sba	AV
Pa ₃₁ -Av ₃	II 50-100 /5-10 Fi/ M, Kw	♂	AV
Pa ₃₁ , Vm ₁ , Li	II 30-120 /5-10 Fi/ Kw, M	♀ Sba D 1♀ 9 ⁰⁴ Vm ₁	AV
Er ₄ , Pa ₃ -Chi, Cui, Foi	IV - 20 Fi		AV
Pa ₃₁ , Vm ₁ -Cui	IV - 20 Fi	♂	AV
Lu ₄₃ , Pa ₃₁ , Vm ₁ , Er ₄ , Gr ₃ -Av ₃	IV - 30 Fi	♀	AV
Pa ₃₁ , Gr ₃	IV - 30 Fi		AV
Lu ₄₃ , Er ₄ , Pa ₃ , Vm ₁ , Vv ₅ -Cui, Av ₃	IV - 30 Fi	♀	AV

Nr.	Datum	Grit		Gewicht in g			Andere Hartteile			Losungsproben	
		Anzahl Magen-steinchen	Grus	Total-	Maxi-mal- /1 G	Ab-nut-zungs-grad	Art	An-zahl	Total-gewicht in g	An-zahl	Trocken-gewicht in g
R Rackelhahn <i>Lyrurus tetrix</i> ♂ × <i>Tetrao urogallus</i> ♀											
1	3. 3.										
	1963	8	9	0,284	0,0345	±, +				2	52,35
2	31. 3.	2	2	0,058	0,032	±				1	3,60
3	24. 11.	1		0,022		±				1	1,25
4	15. 12.		1	0,012		±				1	1,95
5	1. 3.										
	1964	3		0,117	0,045	+, ±				1	25,00
6	12. 4.	1	1	0,024	0,021	±				1	1,08
7	(17. 4.)	1	1		3,5 mm	+				1	1,00
8		2	15	0,134	0,025	-, ±				4	9,95
AR Auer-Rackelhahn <i>Lyrurus tetrax</i> - <i>Tetrao urogallus</i> ♂ × <i>Tetrao urogallus</i> ♀											
1	24. 1.										
	1971	2	5	0,103	0,027	+, ±				1	20,30
2	5. 5.		1+	0,023	0,0185	+				1	32,25
H Haselhuhn <i>Tetrastes bonasia</i> (L.)											
1	29. 5.										
	1965	1	3+	0,026	0,012	±, -				1	0,23
2	(29. 5.										
	1967)	1	1+	0,030	0,014	-	Av ₄	2		2	
3	1. 5.										
	1968		10++	0,132	0,009	-, ±				4	4,20
4	18. 5.										
	1970	1	9	0,046	0,010	+, -				2	4,15
5	24. 1.										
	1971	1	+	0,0495	0,047	±	Pa _I	4	∅ 1,5 bis 1,8 mm	1	1,47

* nur Lösungsfunde mit > = 0,015 g

die die Ausscheidung des Grits ausser der Nahrungsbeschaffenheit beeinflussen können — wie der Einfluss der Schneedecke auf den Entzug oder die Erreichbarkeit der Steinchen — gut verfolgen. Von diesem Gesichtspunkt aus waren die Winter, wenn die Schneedecke in ihrer Höhe und Konsistenz recht variabel war, oder die Schneeschmelze plötzlich einsetzte, günstig. Z. B. die Funde Tab. 2 B 3, 12, 13, 20, 39, 41, 42, 61, 63, 70—75, R 1, 3, A 8, 10, 11, 28 zeigen, dass nach der vermutlichen Aufnahme von frischen Steinchen, die die Schneeverhältnisse ermöglichten, ausgeschiedene Magen-steinchen in der Losung zu finden waren. Dagegen wird das Ausscheiden nicht, oder nur in geringem Masse fortgesetzt, wenn eine weitere Gritaufnahme infolge neuer Schneefälle verhindert wurde (Tab. 2 B 40). Das kann der Grund sein, warum das Ausscheiden von Magen-steinchen in den Winterperioden, wenn die Schneeverhältnisse längere Zeit die Aufnahme von neuen

Nahrung	Anmerkungen	
	Schneedecke	Direktbeobachtung, u. ä.
Pa ₃₁ , S ₂₁ , Pm ₃ Pa ₃₁ , S ₂₁ , Vm ₁ Vm ₁₅₃ , Pa ₃₁ , B ₆ , S ₂ Pa ₃₁ , Vm ₃₁ , S ₂₁	II 120-150 P II 100-135 Fe V 2-5 K, Fe II 3-5 P	P69b (Abb.) Sg P69b D 1♂ 10 ⁰⁰ -10 ²⁰ G
Pa ₃₁ , S ₂₁ Pa ₃₁ , Vm ₁ , S ₂ -Ci Pa ₃₁ , S ₂₁ Pa ₃₁ , S ₂₁ , Vm ₁	II 60-80 F ₁ III 20-50 F ₁ IV - 50 F ₁ (Grit verloren, Grösse nach Foto) vor 1. 3. 1963 gesammelt, nicht datiert	
Pa ₃₁ , Vm ₁ Pa ₃₁	II 20-80 /3-6 K/ Ps-Fe II 50-100 /5-10 F ₁ / M, Kw	D 1♂ 14 ²⁵ Pa ₃
F ₂ , Gr ₁ , Vm ₁ , Pa ₃ , Xv ₃ -Foi, Lk, Ci	IV - 30 F ₁	GS
Pa ₃ , Vm ₁ , Xv ₃ -Av ₄	IV - 80 F ₁	Sg (?) GS
F ₂ , Pa ₃ , Vm ₁ -Ci, Foi	IV - 30 F ₁	1 Sba, 2 Sab GS
F ₂ , Vm ₁ , Gr ₃ , Xv ₃ , Pa ₃ -Cui	IV - 100 F _{1w}	AV
S ₂₁ , Vm ₁ , Xv ₃ , Pa ₁	II 20-80 /3-4 K/ Ps	P72 D 1♂ 9 ¹⁵ -9 ²⁵ Sp AV

Steinchen verhinderten, so selten waren (Tab. 2 B 59, 60). In solchen Fällen handelt es sich um das von Semenov-Tjan-Sanskij (1960) erwähnte Durchgleiten der Magensteinchen durch den Pylorussphincter mit den harten Zweigresten. Allerdings ist die Wahrscheinlichkeit eines Fundes der Gastrolithen in den nicht quantitativen Lösungsproben, wie man sie in der Natur findet, ziemlich gering.

Das in Tab. 4 dargestellte Experiment an Haushühnern soll eine Vorstellung über den Einfluss der Nahrungskonsistenz auf das Ausscheiden von Magensteinchen mit der Losung vermitteln, sowie die Fähigkeit der Hühner-vögel zeigen, wie sie sich der überoptimalen Gritmenge oder übergrossen Gastrolithen* entledigen. Die gewonnenen Ergebnisse stehen mit den vergleichbaren Experimenten von Mikolášek (1966), die an einem beträchtlichen Material durchgeführt wurden, im Einklang. Es hat sich gezeigt, dass

* Den absolut grossten Gastrolithen fand ich im Magen eines Fasanhahnes im November 1965 - Gewicht 0,473 g (Anzahl 428, Totalgewicht 8,830 g, Mittelgewicht 0,0206 g). Wagner (1961) fand bei einem Auerhahn sogar einen 2,37 g schweren Magenstein.

Tabelle 3. Einige interessante Mageninhalte von Auer-, Rackel- und Birkhähnen

Art	Nr.	Datum	Lokalität	Anzahl	Totalgewicht	Magensteinchen		Abnutzung
						Mittelgewicht in g	Maximalgewicht	
A	1	(15. 4. 1965)	(Mimoň) Nordböhmen	636	19,323	0,030	0,237	±, +
	2	(20. 4. 1965)	Beskydy	783	32,969	0,043	0,308	+, ±
	3	25. 4. 1967	Domašov Altwatergebirge	465	26,718	0,057	0,250	+, ±
	4	8. 5. 1967	(Dol. Kubín) Slowakei	688	37,370	0,054	0,225	+, ±
	5	1. 5. 1970	Šumava Böhmerwald	481	24,761	0,0515	0,2535	+, ±
	6	30. 8. 1970	(Hořovice) Westböhmen	392	14,302	0,0363	0,168	±, +
R	1	18. 12. 1967	Chvalšiny Böhmerwald	528	12,962	0,0245	0,085	±, -
	2	15. 4. 1968	Blažejovice Böhmerwald	616+	20,514	0,0317	0,100	±, -
B	1	16. 4. 1966	Deštné Orl. h. Adlergebirge	119	2,380	0,020	0,095	±, -
	2	(5. 5. 1966)	Králíky Glatzer Schneegebirge	99	4,175	0,042	0,096	-, ±
	3	20. 4. 1970	Králíky Glatzer Schneegebirge	26	1,493	0,0575	0,110	±
	4	25. 4. 1970	Králíky Glatzer Schneegebirge	260+	7,632	0,029	0,072	±, -, +
	5	8. 5. 1970	Králíky Glatzer Schneegebirge	167	4,670	0,028	0,0805	±
	6	8. 5. 1970	Králíky Glatzer Schneegebirge	84	3,221	0,038	0,088	±
	7	10. 5. 1970	Králíky Glatzer Schneegebirge	71	4,673	0,066	0,1525	±, +
	8	11. 5. 1970	Králíky Glatzer Schneegebirge	83	2,938	0,035	0,0705	±
	9	(10. 5. 1970)	Šumava Böhmerwald	250+	9,923	0,0395	0,099	+, -
	10	(10. 5. 1970)	unbekannt (Westböhmen ?)	7	0,243	0,035	0,0975	-
	11	(10. 5. 1970)	unbekannt (Westböhmen ?)	11	0,326	0,030	0,053	-, ±
B♀	1	18. 7. 1971	Velká Deštná Adlergebirge	41	0,9235	0,0225	0,166	±, -

Die Birkhähne aus Deštné Orl. h. und Králky stammen nicht aus den Kammlagen.

Erläuterungen zu Tab. 2, 3

(Datum) – Fund alter Losung, (Datum – z. T. alte Losung)

Grus: + wenig, ++ sehr viel;

Abnutzungsgrad: + viel, ± wenig, - frisch (scharfkantig)

Nahrung: vegetabilische (Gruppenfolge annähernd der Häufigkeit nach)

Vaccinium – V, *V. myrtillus* – Vm, *V. vitis-idaea* – Vv, *V. uliginosum* – Vu;

Nadelhölzer: *Picea abies* – Pa, *Pinus mugo* – Pm, *Abies alba* – Ab;

Laubhölzer: *Sorbus aucuparia* – S, *Fagus sylvatica* – F, *Salix* – Sa, *Crataegus* – Cr, *Corylus* – Cl, *Rosa* – Ro; *Rubus* – Rb;

(A, R und B), sowie einer vom Habicht geschlagener Birkhenne (B♀)

Anzahl	Andere Hartteile Total- gewicht in g	Art	Nahrung	Anmerkungen Körpergewicht
			Pa ₃₅ , An ₅	
			Ab ₃ , F ₂ , Vm ₁ , Pa ₃	
19	0,310	Ro ₅	Pa ₃ Pa ₃₁	nach Židek, nicht gesehen
			Pa ₃₁ , F ₂ , Fl ₇ , Xv ₃	
100	0,243	Rb ₅	Rb ₅₁	
169; I	1,770	Ro ₅ ; Br ₅	Gr ₃₁ , B ₅₆ , Ru ₃₁	2212 g
39	0,334	Xv ₁		im Darm
1	0,002	Ro ₅	Sr ₃₁₅ , Gr ₁₃ , Bm ₆ , V ₁ , Sa ₄₁ , Xv ₁ Vm ₁ , Xv ₃	2395 g im Darm Abb. 4
146	1,632	Ro ₅	Vm ₁ , Gr ₁ , Pa ₃ , F ₂ , Xv ₁ —Chi, Foi, I	
1	0,205	Pb	Xv ₃₁ , Gr ₁₃ , V ₁ , Cp ₅ —I	
20	0,234	Ro ₅		
15	0,142	Ro ₅	Pa ₃ , Xv ₃₅ —Chi	1230 g
24	0,290	Ro ₅	Pa ₃ , Gr ₉ , Xv ₅ —Chi, Cui	1080 g
1	0,008	Ro ₅	An ₅ , Xv ₁ —Chi, Ci	1210 g
69	0,737	Ro ₅	An ₅ , T ₆ , Xv ₁ —Chi	1370 g
1	0,009	Ni	An ₅ , Xv ₃	
308	4,150	Ro ₅	Xv ₃ , Gr ₃ , An ₅ —Cui	
124	1,762	Ro ₅ , Cr ₃ , Cl ₅	Sa ₂₄ , Xv ₁₃ , V ₁ Vm ₅₃ , Gr ₃ , Pa ₃ —Foi, Cui	Rupfung, Magen z. T. geöffnet

Grasähnliche Pflanzen: Graminales — Gr (manchmal auch Beimischung folgender Pflanzen nicht auszuschliessen), *Eriophorum* — Er, *Luzula* — Lu, *Cyperales* — Cp, *Avena* — An, *Triticum* — Tt; Sporenpflanzen: Lichenes — Li, Bryophyta — B, Musci — Bm, *Sphagnum* — Bs, Filicales — Fl, *Equisetum* — Eq;

übrige Pflanzen: Brassicaceae — Br, Rubiaceae — Ru, Scrophulariaceae — Sr, undeterminierte vegetabilische Reste — Xv.

Pflanzenteile: Triebe, Stengel, Zweige, Borke — 1, Knospen — 2, Blätter, Nadeln — 3, Blüten, Blütenstaub — 4, Samen, Früchte, Zapfen — 5, Gametophyt — 6, Sporophyt — 7.

Animalische (Gruppenfolge annähernd der Häufigkeit nach) Coleoptera — C, Carabidae — Cb, Cerambycidae — Ce, Chrysomelidae — Ch, Coccinellidae — Co, Curculionidae — Cu, Elateri-

dae — El, Scarabaeidae — Sb, Scolytidae — Sc; Hymenoptera — H, Formicidae — Fo, Tenthredinidae — Te; Lepidoptera — L; Acridioidea — Ac; Diptera — D₁, Insecta — I (undeterminiert), Stadien: Imago — i, Larva — l, Puppe — p, Kokon — k; übrige Arthropoda: Opiliona — O, Arachnida — Ar, Diplopoda — Dp; Vertebrata: Aves — Av, Passeriformes — Avp; Mammalia — M, Microtinae — Mm, Soricidae — Ms; Reste: Knochen — 1, Zahn — 2, Haare, Federn, Krallen — 3, Eierschalen — 4; undeterminierte animalische Reste — Xa.

Übriges (Zivilisationsprodukte u. a.): Glas — Gl, Spiegel — Gls, Holzkohle — Hk, Nickel — Ni, Blei (Schrotkugel) — Pb, Staniol — St, Skilack — Skl.

Schnee-Verhältnisse: I — geschlossene Schneedecke, keine Grittaufnahme möglich; II — geschlossene Schneedecke, Grittaufnahme auf Wurzeln von Windwürfen oder an geringen aperen Flecken möglich; III — mehr als drei Viertel der freien Flächen schneebedeckt, meist geschlossene Schneedecke im Walde; IV — weniger als drei Viertel der freien Flächen schneebedeckt, manchmal noch geschlossene Schneedecke im Walde, manchmal nur vereinzelt Schneefelder; V — geschlossene oder nicht zusammenhängende Schneedecke ohne Schneeeunterlage, meist vor oder nach der eigentlichen Winterperiode.

Qualität der Schneedecke: P — Pulver- und feinkörniger trockener Schnee, Ph — windgeharteter, den Vogel tragender Pulverschnee, Pk — kristallisierender Pulverschnee, Ps — schwerer Pulverschnee; Fe — feuchter feinkörniger Schnee, Pappschnee; Fi — Firn- und anderer grobkörniger Schnee, Fiw — weicher Firn, der Vogel hinterlässt deutliche Spuren; K — Kruste, Kw — weiche, den Vogel nicht tragende Kruste; M — Matschschnee; E — Eisglatte, Eisbelag; R — Reif, Raufrost, (R) betrifft nur die Nahrungspflanzen, nicht die Schneeoberfläche.

Reihenfolge: Höhe der Schneedecke (von — bis) in cm /davon Neuschnee in cm Qualität der Schneeeunterlage/ des Neuschnees. Wenn mehrere Qualitätssymbole angeführt, handelt es sich um wechselnde oder sich während der Beobachtung verändernde Schneequalität.

Anmerkungen: D — Direktbeobachtung, vor anderen Angaben: Vogelzahl, Geschlecht, Zeitdauer, Aufnahme von: siehe Nahrung, Sp — Schneepicken, n°C — Lufttemperatur 5 cm oberhalb des Schnees; G — Grittaufnahme (nach Fahrten, wenn ohne D); Sg — Schneehöhle, Sgo — offene Schneegrube, Sg (?) — alte Ruhestelle im Schnee; Sba — Schlafbaum (auch Balzbaum), Bo — Bodenbalz, Sab — Staubbadstelle, Bl — „Brutlosung“ (von brutendem ♀ nach Verlassen des Nestes abgesetzt); Abb. — Abbildung des ausgeschiedenen Grits, bzw. der Losung; P mit abgekürzter Jahreszahl — Näheres in eigener Arbeit siehe Literatur, z. B. P69a (Abb.) — Porkert J., 1969a: Skelettreste ... Abb.

nach dem Verabreichen der Steinchen, wenn also im Magen der Hühner zu viele und z. T. sogar übergrosse Gastrolithen vorhanden waren, sogleich eine ausgiebige Ausscheidung des Grits erfolgte. Dabei scheint die Nahrungskonsistenz eine Rolle gespielt zu haben — verhältnismässig geringe Ausscheidung des Grits mit abnehmender Tendenz bei harter Diät im Vergleich zur starken Ausscheidung bei normaler oder besonders bei weicher Kost. Interessant war die ausgiebige Ausscheidung des Grits bei weicher Diät (eingeweichtes Weissgebäck — I 21. — 25. 8., II. 6. — 11.9. 1965), wo kein mechanisches Mitausscheiden der Gastrolithen mit den Nahrungsresten voraussetzen war. Auch die verabreichten übergrossen Steinchen gingen ab. Die in Tab. 4 angeführten Inhalte der Muskelmägen von zwei gleichalten Haushennen gleicher Rasse zeigen den Unterschied im Gritgehalt, welcher bei Nr. IV auf den Gritentzug zurückzuführen ist, sowie dass die Knochen splitter nach 24 Stunden und die Eierschalen noch nach 10 Stunden im Magen erhalten blieben.

Vergleicht man die Ergebnisse in Tab. 2 und 4, kann man annehmen, dass nicht nur die Haushühner, sondern auch die Waldhühner imstande sind, die der Nahrungskonsistenz nicht entsprechende überschüssige Menge von Gastrolithen mit der Losung auszuschleiden. Dabei kann die ausgeschiedene Gritmenge, evtl. die Grösse der einzelnen Steinchen im Vergleich zur Losungsmenge, beträchtlich sein (z. B. Tab. 2 B 1, 15, 28, 29, 48, 49, 66, 75, A 3, 12, 22, 23, 24, 26, 36, H 5). Einige Funde (Tab. 2 B 9, 15, 17, 28, 68, A 3, 12, 22, 23, 24, 26, 36, H 1) deuten darauf hin, dass auch bei den Tetraoniden die weiche Nahrung ein verstärktes Ausscheiden von Grit zur Folge hat. Aller-

dings muss man in Erwägung ziehen, ob dies durch die strukturellen Eigenschaften der einzelnen Nahrungskomponenten mechanisch bewirkt wird, oder ob es auf dem Prinzip irgendwelcher inneren¹ Steuerung einer der besten Nahrungsverwertung nicht entsprechenden Magensteinchenmenge beruhen kann. Z. B. die verschiedenen halbverdauten² Blattreste oder Beerenschalen dürfen wohl das Mitausscheiden von Magensteinchen verursachen, andererseits kann man sich diesen Vorgang bei überwiegendem Anteil des Blütenstaubes in der Losung (Tab. 2 B 28) nicht vorstellen. Auf Grund meiner bisherigen Untersuchungen können beide erwähnten Faktoren wirksam werden.

Ausser den Magensteinchen habe ich in den Losungsproben auch andere Hartteile pflanzlicher (Tab. 2 B 3, 22, 30, 59, A 4, H 5) und animalischer Reste, z. B. Skelettreste, Zähne (Tab. 2 B 10, 11, 12, 30, 53), Eierschalenreste (Tab. 2 B 8, 50, A 1, H 2), sowie verschiedene Zivilisationsprodukte (Tab. 2 B 50, 53, 76, 77, 81, vergl. Tab. 3 B 3, 9) festgestellt. Es kann die Funktion als Gritersatz bei den harten Fruchtschalen oder Samen (Tab. 3 A 4, R 1, B 3, 4, 5, 6, 8, 10, 11), sowie Kalkgritersatz im Falle der Eierschalen (Tab. 2 B 8, 50, A 1, H 2) angenommen werden.

DISKUSSION

Es wurde von mehreren Forschern nachgewiesen (u. a. Kirikov, 1952, Sládek, 1959; Semenov-Tjan-Šanskij, 1960; Eygenraam, 1965) und nun von mir für alle Monate des Jahres bestätigt, dass die Magensteinchen ausgeschieden und nicht im Magen verbraucht (u. a. Fuschlberger, 1942; Boback, 1966) werden. Diese Tatsache hat zur Folge, dass die Waldhühner bestrebt sind, die verlorengegangene Gritmenge wieder zu ersetzen, was jedoch nicht immer das ganze Jahr hindurch möglich ist. Das genannte Bestreben erreicht seinen Höhepunkt im Herbst vor der Bildung einer geschlossenen Schneedecke, zur Zeit des Überganges auf die derbere Winteräsung (Rajala, 1958). Gleichfalls im Winter oder im zeitigen Frühling, wenn die ersten für die Gritaufnahme günstigen Stellen schneefrei werden, ist das Bestreben der Vögel, ihren Gritmangel auszugleichen, bedeutend. Es wurde mehrmals über das regelmässige kollektive Aufsuchen von geeigneten Gritsammelstellen — Ufer, Strassen u. ä. — durch die Auerhühner im Herbst und Frühjahr berichtet (u. a. Semenov-Tjan-Šanskij, 1960; Belžanin, 1968; Nazarov & Šubnikova, 1968; Romanov, 1970), und durch die Fangresultate Romanov's (1968) demonstriert. Diese Erscheinung hängt nicht nur mit der Suche nach Grit, sondern auch mit dem herbstlichen Biotopwechsel zusammen (Semenov-Tjan-Šanskij, 1960; Nazarov & Šubnikova, 1968). Im Herbst unternehmen Auerhühner in den nördlichen Regionen längere Flüge, die als periodische Massenmigrationen auftreten können (Solovjev ex Romanov, 1970), um solche Stellen zu finden. Die adulten Vögel suchen offensichtlich immer dieselben Stellen auf, die sie in der „Sammelsaison“ auch bei höherer Schneedecke absuchen (Romanov, 1970). Die Funde von Steinchen in den Kröpfen von Tetraoniden zu Anfang des Winters (Kirikov, 1952; Kaasa, 1959; Semenov-Tjan-Šanskij, 1960), ebenso wie meine Beobachtungen eines Rackelhahnes, der auf einem überwiegend schneebedeckten Waldweg eifrig nach Steinchen suchte (Tabel-

Tab. 4. Experiment

Nr.	Datum	Anzahl	Total- gewicht in g	Steinchen		Grus Gewicht	Andere Hartteile		
				Mittel- gewicht	Maximal- gewicht		Art	An- zahl	Gewicht
I	8. 8. 65	35	5,5	0,157					
	9. 8.	16	0,385	0,024	0,163				
	10. 8.	6+	0,217	0,038	0,158*		+		
	11.-13. 8.	42++	1,687	0,042	0,422*		++		
	14. 8.	0							
	15. 8.	20	3,8	0,19					
	15. 8.	14	0,799	0,057	0,476*				
	16. 8.	5	0,415	0,083	0,305*		Cp ₅	2	0,006
	17. 8.	4	0,030	0,0075	0,016				
	18. 8.	1	0,032						
	19.-20. 8.	0							
	21.-22. 8.	7	0,870	0,124	0,322*		Cp ₅	1	0,004
	23. 8.	63+	2,562	0,041	0,344*	0,050			
	24.-25. 8.	20	0,670	0,033	0,218*				
	26.-28. 8.	0							
	28. 8.	350++	8,619	0,0246	0,236	1,132			
II	5. 9. 65	0							
	6. 9.	3+	0,017	0,0056			+		
	7. 9.	3	0,030	0,010	0,022				
	8. 9.	32+	0,911	0,028	0,113				
	9. 9.	25	1,122	0,045	0,100				
	10. 9.	50+	1,310	0,026	0,074	0,05			
	11. 9.	15	0,290	0,019	0,078		Cp ₅ , Xv ₅	4	0,016
	11. 9.	310++	11,510	0,037	0,130	0,592	Fe/Nagel	1	0,222
III	11. 9. 65	380++	14,770	0,039	0,163	1,071			
IV	13. 11. 65	610+	18,740	0,0305	0,184	0,287			
V	12. 12. 69	162	8,926	0,055	0,354		Av ₄ M ₁ Gr ₁	25	0,413 0,340 1,325

Erläuterungen zur Tab. 4

I, II, III junge Mischling-Hähne,

IV, V 3½ Jahre alte Italiener-Hennen

+ Grus, ++ viel Grus, * verabreichtes Steinchen

Tt5 Weizenkorn, Kf Kartoffel, Wb Weissgebäck (eingeweicht), Gr 31 Gras und anderes Grünfütter (Blätter, Stengel), Cp5 Cyperaceae (Frucht), Fe Eisen, Av4 Eierschalen, M1 Hasenschädelknochen (vgl. Erläuterungen zur Tab. 2)

le 2 R 3), zeigen, dass die letzte Gelegenheit, sich vor der schneereichen Winterperiode mit Grit zu versorgen, von den Vögeln ausgenutzt wird. In den schneereichen Regionen kommt es vor der Bildung der endgültigen Schneedecke zu einer intensiven Gritaufnahme (u. a. Rajala, 1958; Semenov-Tjan-Šanskij, 1960; Siivonen, 1962), die in den schneearmen Gebieten nicht notwendig ist (vergleiche Zwickel, 1966). Zwar sind wir durch eine

an Haushühnern

Futter	Körpergewicht in g	Anmerkungen
Tt5, Kf, Wb, Gr31		verabreicht
Tt5, Kf, Wb, Gr31		ausgeschieden
Tt5, Kf, Wb, Gr31		ausgeschieden
Tt5, Kf, Wb, Gr31		ausgeschieden
Tt5, Kf, Wb, Gr31		ausgeschieden
Tt5, Gr31		verabreicht
Tt5, Gr31		ausgeschieden
Tt5, Gr31		ausgeschieden
Tt5, Gr31		ausgeschieden
Tt5, Gr31		ausgeschieden
Tt5, Gr31		ausgeschieden
Wb, Kf		ausgeschieden
Wb, Kf		ausgeschieden
Wb, Kf		ausgeschieden
Wb, Kf		ausgeschieden
	1 920	getötet
Wb, Kf		verabreicht
Wb, Kf		ausgeschieden
Wb, Kf		ausgeschieden
Wb, Kf		ausgeschieden
Wb, Kf		ausgeschieden
Wb, Kf		ausgeschieden
	2 100	getötet
Tt5, Kf, Wb (Zufütterung)	2 250	Kontrollhahn, frei (Wiese, Wald)
Tt5, Kf, Wb (Zufütterung)	1 820	getötet, frei (Wiese, Wald)
Tt5, Kf, Kb, Wb Av4 vor 10 St.	1 760	getötet, seit 24. 11. keine Grittaufnahme
Tt5, Kf, Kb, Wb M1 vor 24 St.		möglich

experimentelle Arbeit von Rajala (1958) darüber unterrichtet, welche Grösse der Steinchen von den Auer-, Birk- und Moorschneehühnern bevorzugt und in welcher Menge dieselben vom Herbst an bis zum Frühjahr aufgenommen werden, doch hat derselbe Forscher gleichzeitig keine Lösungsanalysen durchgeführt. Dass die Magensteinchen von den Waldhühner in einem beträchtlichen Umfang ausgeschieden werden können, lassen ausser meinen obengenannten Ergebnissen (Tab. 2 B 15, 48, 68, 75, A 3, 22, 23, 24, 26, 36) auch die Untersuchungen an Haushühnern voraussetzen (u. a. Mikolášek, 1966 — der 2 mm Kieselgrit zu 50–60% bei einer Tagesaufnahme von 3–7 g / Huhn, der 4 mm Kieselgrit zu 15–20%, 2–3 g / Huhn, vergl. mein Experiment Tab. 4). Vance (1971) stellte im Experiment bei 7 juvenilen Jagdfasanhenen im Mittel 24,3% des aufgenommenen Grits in den Exkrementen fest.

Die Wahl der Grösse und Qualität der Steinchen ist bei den Waldhühnern

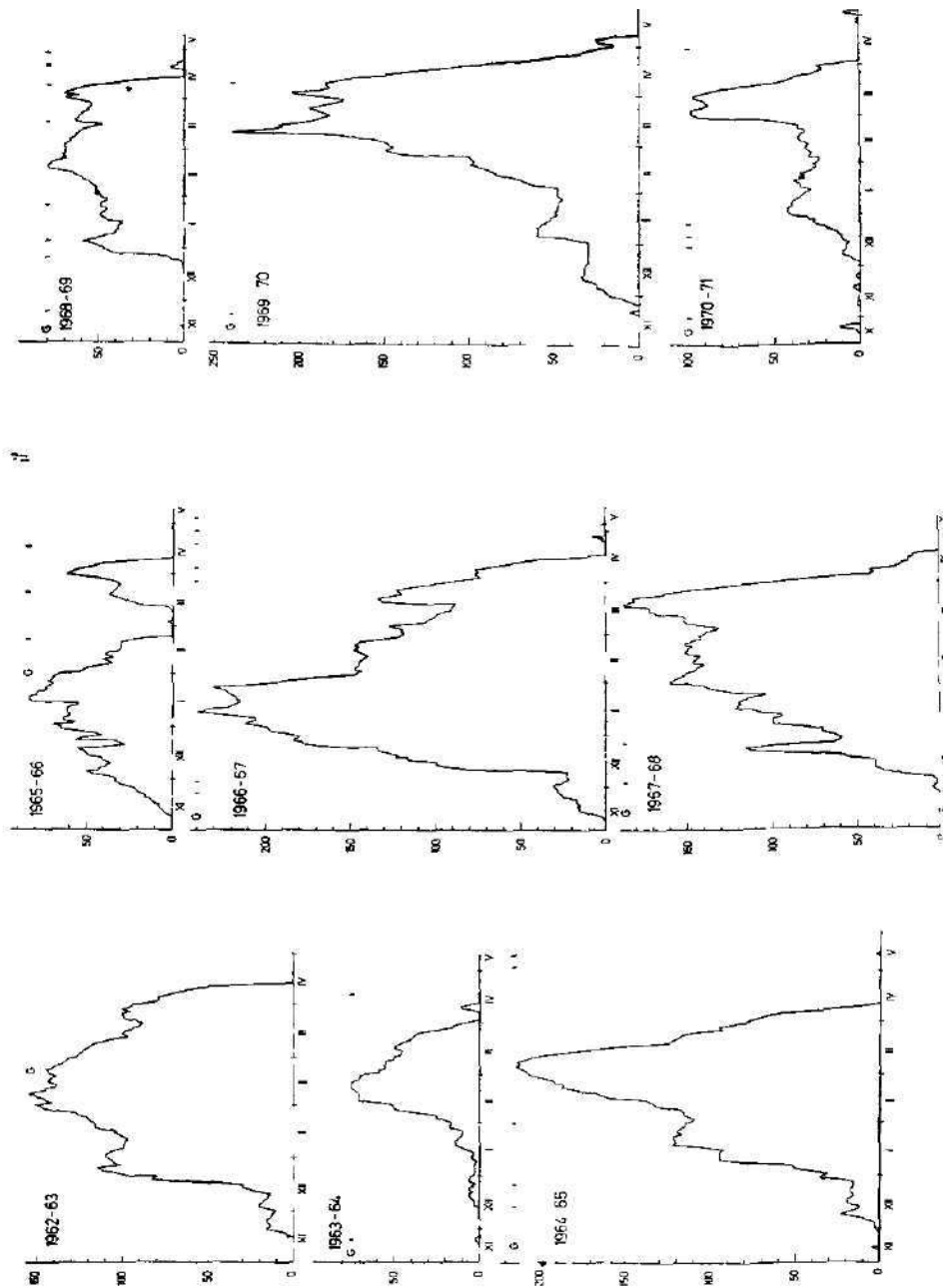


Fig. 1. Grafische Darstellungen der mittleren Höhe der Schneedecke in cm an der meteorologischen Station Deštné v Orli h., 870 m u. d. M., in den Winterperioden 1962-63 bis 1970-71. G | Grit mit der Losung ausgeschieden. Eine nicht zusammenhängende Schneedecke ist durch eine dickere Linie auf der Nullwertachse dargestellt.

vom örtlichen Angebot, sowie der Erreichbarkeit derselben, wie allgemein bekannt ist, beeinflusst. Offensichtlich hängt auch die Ausscheidung des Magensteins von den genannten Faktoren ab. Grundsätzlich kann man den Grit in zwei funktionell unterschiedliche Gruppen einteilen. Eine Gruppe bilden harte Minerale, meist Quarz, die die eigentliche Funktion der Mahlsteine bei der Zerkleinerung des Futters im Muskelmagen erfüllen. Die andere Gruppe bildet Kalkgrit, sowie Sand u. ä. Die weichen Minerale, welche zu dieser Gruppe gehören werden durch die Einwirkung der Magensäure z. T. aufgelöst und können deshalb nur während der schneefreien Jahreszeit in der Losung zu finden sein. Ihre Funktion beruht in einer direkten Teilnahme am Metabolismus — in der Versorgung des Vogelkörpers mit den wichtigen Mineralstoffen (Westerskov, 1965; Kopischke, 1966; Kopischke & Nelson, 1966, Vance, 1971). Hinkson et al. (1970) stellten experimentell die maximale Eierproduktion bei Jagdfasanhen und den minimalen Futterverbrauch bei Verfütterung von isokalorischen Futtergemischen unterschiedlichen Calcium-Gehaltes fest (2,5% Ca bzw. 1,8% Ca). Es fehlen meines Wissens bisher im Schrifttum vergleichbare Untersuchungen, die auf einen quantitativen Unterschied in der Aufnahme von Kalkgrit bei den eierlegenden Tetraoniden-Weibchen im Vergleich zu den Männchen oder derartige Gritselektion hindeuten würden, obwohl Krutovskaja & Krutovskaja (1953) berichten, dass ihre eierlegenden Auerhennen gierig Eierschalen verzehrten. Henrich (ex Fuschlberger, 1942) meint sogar, dass das Auerwild überhaupt keinen Kalk aufnimmt. Auch bei der Winterfütterung vom Birkwild in Finnland wurde grobgemahlener Futterkalk verschmäht (Raitis, 1971). Die Funde des Kalkgruses oder der Reste von Eierschalen (Tab. 2 B 8, 50, A 1, H 2) zeigen, dass diese Auffassung nicht immer zutrifft, sondern deuten auf eine Art von Calcium-Erwerb in einem kalkarmen Biotop — Schiefergestein — bei dessen grösserem Verbrauch während des Wachstums oder Eierlegens hin. Die Hühner, insbesondere Küken, picken gerne nach weissen, glänzenden oder kleinen sich bewegenden Objekten (Höglund, 1955a; Rajala, 1959; Helminen & Viramo, 1962; Krott, 1966). Weiss wurde als die zweitbevorzugte Farbe schon bei der ersten instinktiven Nahrungswahl der Auerhuhnküken festgestellt (Höglund, 1955b). Es liegt also die Erklärung der obengenannten Funde nahe, da auf den Touristenwegen Eierschalen, sowie Staniol (sh. Tab. 2 B 50, 53) reichlich zu finden sind. Übrigens werden Eierschalen und Holzkohle (Tab. 2 B 49) bei der Aufzucht von Tetraoniden verabreicht (Krutovskaja & Krutovskaja, 1953; Krott, 1966; Krinickij & Nemeev, 1968). Dagegen sind die von mir früher mitgeteilten Funde von Skelettresten der Kleinsäuger und eines Vogels (Porkert, 1967, 1969a, 1970) kaum als Folge des Bestrebens Calcium zu gewinnen, anzusehen. Zwei Funde (Tab. 2 B 30, 53) sprechen eindeutig für den Verzehr der ganzen Tiere samt Körperbedeckung, was durch den Fund eines 40 g schweren Berglemmings im Rachen eines toten adulten Auerhahnes bestätigt wurde (Borg, 1971). Im Einklang mit Kirikov (1952), Wagner (1961) u. a. kann man annehmen, dass die harten Früchte und Samen die Funktion des Grits erfüllen, da die Anzahl derselben in den Mägen mit wenig Gastrolithen ziemlich hoch sein kann (sh. Tab. 3 R 1, B 3, 10, 11). Ausserdem können verschiedene Zivilisationsprodukte die Funktion des Grits erfüllen (Westerskov, 1965: Almășan, 1970, vgl. Tab. 3 B 4).

Beim Vergleich der Ergebnisse einiger Forscher von Magenuntersuchungen an Tetraoniden, die in Bezug auf die Schneedecke unter völlig abweichenden Verhältnissen arbeiteten, kommt der Einfluss der fehlenden Erneuerung des Grits zum Vorschein (vergl. Semenov-Tjan-Šanskij, 1960 S. 54–92, 116–121, Abb. 26 S. 77, Abb. 37 S. 119 und Kolderup, 1923 mit Eygenraam, 1965 S. 12–14). Nach Kolderup (1923) entsteht den Moorschneehühnern durch Gritmangel kein Schaden. Dieser Forscher setzt voraus, dass *Lagopus lagopus* imstande ist, die Steinchen im Magen zurückzuhalten, wenn dies in Anbetracht der Nahrungskonsistenz erforderlich ist und vermutet eine instinktive Wahl der richtigen Grösse von Magensteinchen. Auch nach Bump et al. (1947) richtet sich das relative Gritvolumen im Magen von *Bonasa umbellus* nach dem Typ der Nahrung. Die vielfach wiederholte Auffassung, dass die Waldhühner nach Entziehung der Magensteinchen unbedingt eingehen (z. B. Ludwig, 1894; Fuschlberger, 1942; Waddington, 1958; Boback, 1966), trifft also, wenigstens für eine kürzere Zeitspanne, nicht zu. Nach Gerstell (1942) können Fasane und *Colinus virginianus* mehrere Wochen ohne Zugang zu den Steinchen ohne Verlust an Körpergewicht leben, indem der Grit automatisch im Magen zurückgehalten wird. Andererseits berichtet Siivonen (1962) über eine grössere Schwächung der Waldhühner, die sogar zum Hungertod führen kann, wenn sich die Vögel infolge vorzeitiger Bildung der endgültigen Schneedecke nicht rechtzeitig mit frischem Grit versorgen können, da sie mit den abgenutzten und zu kleinen Magensteinchen nicht mehr imstande sind, ihre Nahrung ordentlich zu zerkleinern. Es ist m. E. schwierig, einen eindeutigen Beweis für den Hungertod der Raufusshühner auf Grund des Gritmangels im Winter zu bringen, denn es ist zwar eine niedrigere Widerstandsfähigkeit der Vögel unter solchen Umständen anzunehmen, doch müssen vor allem auch die Fragen der Thermoennergiebilanz zum beschränkt möglichen Energiegewinn durch das Äsen (sh. Volkov, 1970, auch Gullion, 1970; Formozov, 1970 u. a.) berücksichtigt werden. Sehr wichtig ist deshalb das Erscheinen der ersten schneefreien Stellen im Frühjahr, denn es bringt nicht nur den Nahrungswechsel mit sich (Siivonen, 1957) — zu welchem es nach meinen Beobachtungen an genannten Birkwildrestbeständen auch mitten im Winter kommt — sondern ermöglicht gleichfalls die Erneuerung des Gritvorrates im Magen der Vögel (Semenov-Tjan-Šanskij, 1960). Solche Stellen befinden sich meist an sonnigen Hängen, welche in unseren Gebirgen tagsüber oft von Menschen besucht werden. Dadurch kann die Aufnahmemöglichkeit der erwähnten Äsung, sowie des frischen Grits, in den von Menschen dicht besiedelten Gegenden zeitlich sehr beschränkt werden, was zur schädlichen Wirkung des Unruhefaktors im Sinne Jurgensons (1968) einzurechnen ist. Vermutlich hängt der durch die Veränderung der Schnee- und Raufrostverhältnisse hervorgerufene Nahrungswechsel des Birkhuhns im Winter mit der Verdaulichkeit und dem Nährwert verschiedener Nahrungspflanzenteile zusammen (vergl. die stenophage Art *Canachites canadensis*, Pendergast & Boag, 1970). Denn nach Pulliainen et al. (1968) beträgt bei *Lagopus lagopus* die Verdaulichkeit der organischen Substanz von Heidelbeertrieben 31% und von Preiselbeeren 81%. Seine Analysen zeigen, (Pulliainen, 1970 u. briefl. Mitt.), dass die Triebe von *Vaccinium myrtillus* und Zweige von *Sorbus aucuparia* relativ nitrogen- und calciumreich sind (2,33 bzw. 1,26% N und 0,750 bzw. 0,82% Ca der Trockensubstanz). Vielleicht bilden gerade

deshalb diese Pflanzenteile, wenn erreichbar, die bevorzugte Winternahrung des Birkwildrestbesatzes im fraglichen artuntypischen Biotop im Adlergebirge, wo sonst im Winter als Reservennahrung nur Fichtennadeln zur Verfügung stehen (Porkert, 1969a). Es scheint folglich bei den Hühnervögeln wichtiger zu sein, dass ausreichend geeignete Nahrung vorhanden ist, da die Verwertung derselben bei Gritmangel schlechter und der Verbrauch grösser ist, wie an Haushühnern gezeigt wurde (z. B. Mikolášek, 1966). Gerstell (1942) stellte zwar praktisch keinen Unterschied im Nahrungsverbrauch fest, seine Versuchsvögel hatten jedoch infolge der bereits erwähnten Retention eine normale Gritmenge im Magen. Auch die Tetraonidenküken nehmen schon in den ersten Tagen ihres Lebens, besonders beim Sandbaden, Grit in Form kleiner Steinchen und Sandkörner zu sich (Bump et al., 1947; Kirikov, 1952; Krutovskaja & Krutovskaja, 1953; Rajala, 1959; Semenov-Tjan-Šanskij, 1960; Krott, 1966). Semenov-Tjan-Šanskij, (1960) erklärt das ausnahmsweise Fehlen der Magensteinchen bei den Küken dadurch, dass Grit bei ihnen schlecht zurückgehalten wird und ständig erneuert werden muss. Diese Vorstellung wird durch meine Funde (Tab. 2 B 48, 49, 50, 51) bestätigt. Trotz des Ausscheidens nimmt jedoch die Menge des Grits im Laufe des Sommers allmählich zu (Kirikov, 1952 S. 111 Tab. 26), was mit dem Übergang der Küken zur vegetabilischen Nahrung zusammenhängt (Kolderup, 1923). Allerdings kann man nicht darüber entscheiden, ob die schlechte Zurückhaltung des Grits bei Küken durch die Nahrungskonsistenz verursacht ist, oder ob da auch noch irgendwelche mit der Unreife des Alters zusammenhängende Faktoren mitspielen.

Vergleichen wir die Gründe, die für eine nur mechanische Regulierung der Menge und Qualität des Grits sprechen mit der Annahme von der Existenz einer inneren Regulierung. Es gibt zweierlei Weisen der mechanischen Wirkung der Nahrung auf das Ausscheiden von Magensteinchen. Die Gastrolithen werden gleichzeitig mit größeren harten Nahrungsteilen (z. B. Stückchen von Zweigen — Tab. 2B 59, 64, H 5) vom Pylorussphincter durchgelassen (Semenov-Tjan-šanskij, 1960) oder werden dieselben mit Blatt-, Beerenschalen- bzw. Rinderesten umwickelt und gleichzeitig ausgeschieden, wie man es bei den Losungsanalysen findet. Setzt man voraus, dass die Regulierung der Ausscheidung von Magensteinchen nur durch die mechanische Wirkung der Nahrungszusammensetzung stattfindet, wie es Semenov-Tjan-Šanskij (1960) annimmt, oder wenn man sogar die Voraussetzung jeglicher Beeinflussung der Durchströmung von Magensteinchen durch die Nahrungsqualität ablehnt (Kirikov, 1952; Eygenraam, 1965), stösst man bei Deutung einiger Funde in Tab. 2 auf gewisse Schwierigkeiten. Manchmal enthalten nur einige Losungswürstchen — selbst in umfangreichen Losungsproben — auffallend viel Grit (Tab. 2 B 1, 9, 12, 13, 15, 17, 48, 55, 61, 68, 70, 74, 75, 76, R 1, 5, AR 1, A 3, 8, 10, 12, 22, 23, 24, 26, 27, 28, 36). Andererseits ist oftmals in einer beträchtlichen Menge, besonders von Winterlösung, kein einziges Körnchen zu finden, obwohl die Nahrungszusammensetzung die gleiche ist. Das Vorhandensein der Gastrolithen bei den Tetraoniden und die verstärkte Aufnahme von Steinchen vor der Winterperiode wird übereinstimmend von vielen Forschern für eine Adaptation zum besseren Verwerten besonders der harten Winternahrung angesehen. Semenov-Tjan-Šanskij (1960) meint, dass das Ausscheiden von Magensteinchen mechanisch einfach zu erklären ist — bei *Lagopus* werden die Magensteinchen leichter mit der

Nahrung (Birken- und Weidenästchen) als beim Auerhuhn (Kiefernadeln) durch den „Magensphincter“ durchgelassen. Er sieht darin ein Beispiel der unvollkommenen Adaptation, denn das mangelhafte Zurückhaltungsvermögen bewirkt, dass sich wenig oder sogar keine Steinchen zum Ende des Winters im Magen befinden, gerade wenn dieselben am meisten benötigt werden (vergl. Kolderup, 1923). Andererseits zeigen die von mir durchgeführten Lösungsanalysen, dass nicht immer Magensteinchen in der Lösung zu finden sind, wenn die Knospen und Ästchen der Eberesche, oder andere die Ausscheidung begünstigende Nahrung darin überwiegt. Dagegen gibt es in Tab. 2 mehrere Beispiele, dass die Magensteinchen ausgeschieden wurden, wenn bei gleicher Nahrungszusammensetzung die Aufnahme von frischen Steinchen plötzlich möglich geworden war (Tab. 2 B 12, 13, 39, 61, 63, 74, 75, 76, R 2, A 8, 10, 13—17, 28, AR 1), oder wenn ausgesprochen weiche Nahrung, zu deren Zerkleinerung keine Magensteinchen benötigt werden, geäst wurde (Tab. 2 B 9, 17, 28, 68, A 3). Die Tatsache, dass die Ausscheidung der ganzen und oft nicht abgenutzten Magensteinchen stattfindet, widerlegt die Auffassung, dass dieselben bis zu deren vollkommenem Verbrauch im Magen verbleiben (u. a. Fuschlberger, 1942; Boback, 1966), bzw. erst abgenutzt mit der Lösung abgeführt (Ludwig, 1894; Suminski, 1963; Almäsan, 1970) und nur dann nach Bedarf ersetzt werden. Gegen die Vorstellung von einer alleingültigen inneren Steuerung des Gritgehalts im Magen und dessen Ausscheidung sprechen die Funde nahezu oder überhaupt gritfreier Mägen im Spätwinter (Semenov-Tjan-Sanskij, 1960; Kolderup, 1923). Aber auch das Ausscheiden von Magensteinchen allein nach der mechanischen Wirkung der Nahrungsbeschaffenheit ist nicht in allen oben erwähnten Fällen zu vertreten. Nach meiner Ansicht geschieht die Ausscheidung der Gastrolithen nicht gleichmässig, wie es bei praktisch gleicher Nahrung während der Winterperiode zu erwarten wäre, sondern es ist eine Beeinflussung des genannten Vorganges durch die Erreichbarkeit des Grits unter verschiedenen Schneeverhältnissen zu erkennen. Der Einfluss der Nahrungsbeschaffenheit ist das ganze Jahr hindurch anzunehmen, es ist jedoch bisher unklar, welche Rolle bei diesem Faktor nur der mechanischen Wirkung und welche den durch die Nahrungskonsistenz hervorgerufenen Reizen zuzuschreiben ist.

SCHLUSSFOLGERUNGEN

Wahrscheinlich nehmen die Waldhühner in einem betreffs Steinchenangebot zusagendem Biotop während der schneefreien Jahreszeit annähernd eine zur Zerkleinerung der jeweiligen Nahrung optimale Menge, sowie Qualität des Grits auf. Die Erneuerung des Gritvorrates im Winter ist von den jeweils herrschenden Schneeverhältnissen abhängig. Meist entsteht zu dieser Jahreszeit, trotz der geringeren Ausscheidung von Magensteinchen, in Bezug auf die Nahrungskonsistenz ein relativer Gritmangel. Wenn die Schneeverhältnisse eine Sättigung mit Grit erlauben, kommt es im Frühjahr oder manchmal im Winter wieder zu einer ausgiebigen Ausscheidung von Magensteinchen, die durch Aufnahme von weicher Äsung noch verstärkt werden kann.

Die bisherigen Untersuchungen lassen eine Hypothese, die im Experiment zu überprüfen ist, zu. Es besteht meines Erachtens ein Bestreben, für die jeweilige Nahrungskonsistenz eine optimale Menge und Qualität des Grits zu allen Jahreszeiten im Magen aufrecht zu erhalten. Die Menge der Magensteinchen kann durch deren Ausscheiden stets, dagegen durch deren Auf-

nahme nur wenn die Möglichkeit dazu gegeben ist, reguliert werden. Die Ausscheidung des Grits steht dabei unter einem ständigen Einfluss der jeweiligen Nahrungsbeschaffenheit. Durch innere Reize, welche eine über- oder unteroptimale Gritmenge im Magen hervorruft, kann das Ausscheiden nach Bedarf gesteigert oder beschränkt gebremst werden.

Zum Schluss möchte ich allen, die meine Arbeit gefordert haben, herzlichst danken. Den Herren Dr. B. Krísa CSc. und Dr. P. Pecina CSc. Naturwissenschaftliche Fakultät der Karls-Universität Prag für das Detemmerieren der Nahrungsreste. Herrn Dr. N. H. Hoglund Boda Viltforskningsstation Schweden für interessierte Diskussionen, Durchsicht des Manuskripts und grosse Bereitwilligkeit, meine Freiland-Ergebnisse an Zuchtvoögeln überprüfen zu lassen. Herrn Ing. A. Mikolášek CSc. Landwirtschaftliche Hochschule Suchdol bei Prag, für interessierte Diskussionen und bereitwillige Durchführung einiger Kontrollen an Haushühnern. Meiner Mutter Frau Eva Porkertová, Deštné v Orli. h., für grosse Hilfe beim Durchführen des Experimentes an Haushühnern und Einverständnis für die Lösungsanalysen. Den Herren A. W. Boback, Radeberg DDR, Dr. S. V. Kirikov, Moskau UdSSSR, Dr. P. Krott, Kleinsölk Österreich, Dr. E. Pulliamen und Dr. P. Rajala, Helsinki, Finnland, sowie Dr. O. I. Semenov-Tjan-Sanskij, Laplandskij zapovednik Mončegorsk UdSSR für Hinweise. Diskussionen oder/und briefl. Anskünfte. Den Herren Doz. Dr. W. Černý für Interesse an meiner Arbeit, sowie Vermittlung der leihweisen Überlassung zweier toter Rackelhühne zur Untersuchung, Dr. L. Sigmund CSc. und Dr. P. Vlasák CSc. alle Naturwissenschaftliche Fakultät der Karls-Universität Prag für Durchsicht des Manuskripts. Einigen der genannten Herren und Dr. B. Jensen, Kalø Dänemark, für Überlassen von Literatur.

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Die Platen sind am Ende des Heftes zu finden.

Anschrift des Verfassers: Jan Pokert, prom. biol., Na Slupi 12, Praha 2.

Third International Congress of Acarology

The Third International Congress of Acarology was held between August 31 and September 6, 1971 in Prague under the auspices of the Czechoslovak Academy of Sciences that had authorized the Institute of Parasitology with its organization. This third meeting of acarologists was attended by 206 scientists from 32 countries of all five continents. Czechoslovakia was represented by 42 specialists. Academician B. Rosický was elected the President and Dr. N. G. Bregetova (USSR) and Dr. G. W. Wharton (USA) the Vice-Presidents of the Congress.

The Congress was officially opened by the President of the Czechoslovak Academy of Sciences, Academician J. Kožešník. The introductory paper, read by Academician B. Rosický, dealt with the economic and medical importance of mites as pests responsible for many damages inflicted to man's economy and health. The afternoon session of the opening day was devoted to a Symposium on scanning electron microscopy in acarology, presided by Dr. D. A. Griffiths of Great Britain. Valuable results presented at the symposium showed that this method would soon be widely applied in acarology because it makes possible more exact and detailed studies of mites than those achieved by optical microscopes.

The Congress sessions were divided into 12 sections in which a total of 153 papers were presented. The Czechoslovak specialists submitted 25 papers. The section concerning the mites and ticks of medical and veterinary importance and headed by Dr. H. Hoogstraal (USA) aroused great interest. A number of papers were concerned with mites of the genus *Dermatophagoides* living in house dust and inducing aspiration allergy in man, other papers dealt with demodicosis in man and animals and with scabies which has lately shown an upward tendency in its occurrence. Quite numerous were also papers dealing with ecology, bionomy and zoogeography of ticks. The section concerned with faunistics and taxonomy of parasitic mites, headed by Dr. N. G. Bregetova (USSR) also attracted attention. Most papers were devoted to the studies of faunistic complexes and zoogeography of mites and to the nest fauna of small mammals. The papers of ecology of mites and ticks were included in a separate section headed by Dr. G. W. Wharton (USA). An extraordinary interest of participants was aroused by the section concerning taxonomy of higher categories, phylogeny and zoogeography, directed by Dr. G. O. Evans (Eire). The proceedings of this section showed, that on the whole acarologists agree with the theory of diphyletic origin of mites and consequently with the existence of two distinct orders. However, the differences in the concept of the two orders continued, resulting in some inaccuracies in nomenclature. These problems were dealt with by Dr. L. van der Hammen (Netherlands) who proposed a unification of these problems in his opening paper. There were many papers on the role of mites and ticks in the natural foci of diseases, on physiology, genetics and behaviour of mites, as well as papers concerning soil mites, plant mites and stored products pests, all presented in respective sections. On the other hand the number of papers devoted to the problems of freshwater and marine mites was surprisingly low.

During the Congress there were several informal gatherings at which topics of mutual interest were discussed (morpho-taxonomic problems and setal nomenclature, preparation of catalogue of acarological collections, problems of research of nest fauna etc.). Also sessions of the representatives of WHO Regional Tick Reference Centres and meetings of the International Acarology Congress Executive Committee were held.

On the final day of the Congress a new International Acarology Congress Executive Committee was elected, with Dr. F. J. Radovsky (USA) as the Secretary. Its President will be the President of the next, i.e. Fourth International Congress of Acarology. One of the main tasks of the new Committee will be the selection of venue of the next Congress.

An excursion to the Karlštejn and Konopiště castles and other social events organized during the Congress were welcome opportunities for informal friendly meetings of all participants.

In general, the Congress may be characterized as successful, especially due to its high professional standard and excellent level of papers presented. It provided an excellent opportunity for personal meetings of prominent world acarologists and for making new contacts with specialists from different countries.

All papers read at the Congress will appear in full in the Proceedings of the Third International Congress of Acarology, which will be published before January 1, 1973 by Academia, the Publishing House of the Czechoslovak Academy of Sciences in Prague and Dr. W. Junk N. V., Publishers, 13 van Stolkweg, The Hague, Netherlands, who will secure the distribution abroad.

F. Dusbábek

Anděva M.: Notes on white-toothed shrews from Iraq.



Fig. 2. View of the second type of habitat of *Crocidura gueldenstaedti* with dense thickets of vegetation.

Likovsky Z.: Bemerkungen über Blutbildungsstätten beim Neunauge Lampetra planeri
(Bloch, 1784).

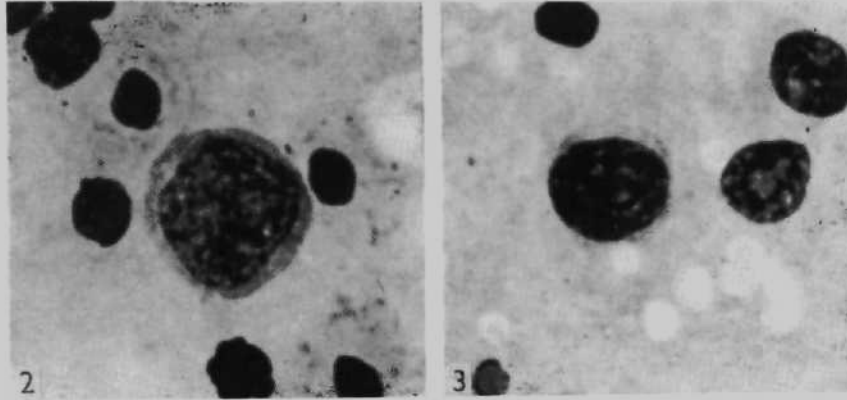


Abb. 2–3. Zellen der lymphozytären Reihe (2. Lymphoblast, 3. Prolymphozyt). *Lampetra planeri*
in Metamorphose — Leberabklatschpräparat. Panoptische Färbung nach Pappenheim. Vergr.
2000fach. (Foto Dr. J. Mészéek.)

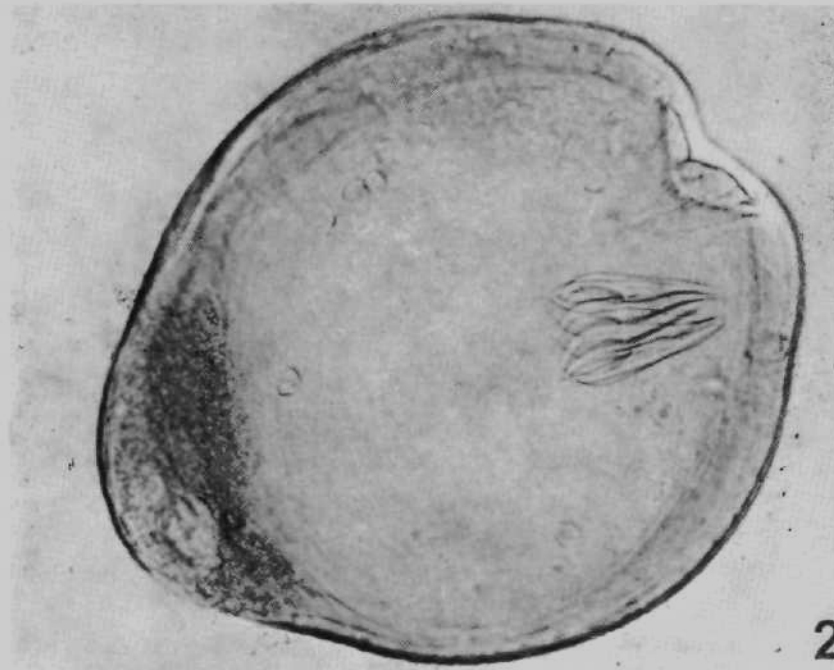
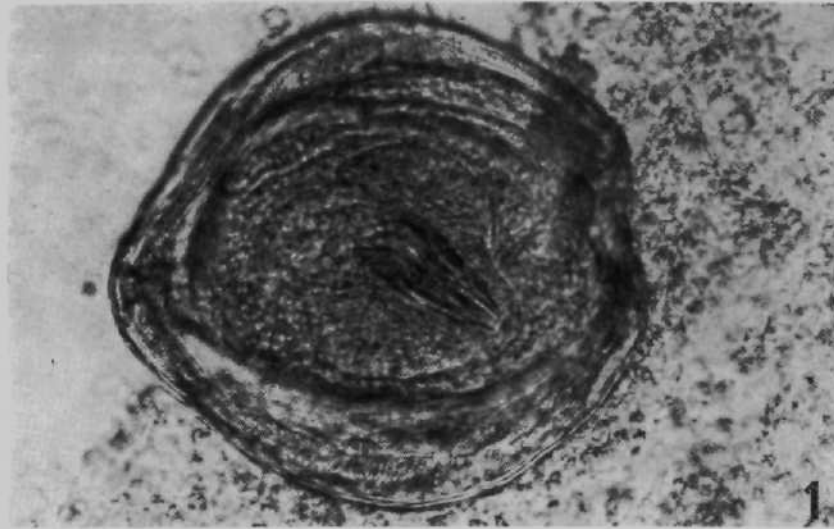


Plate I

Fig. 1. Cysticercoid of *M. compressa* from *Lymnaea peregra ovata*, fixed with 10% formalin ($\times 350$)

Fig. 2. Cysticercoid of *M. compressa* from *L. peregra ovata*, fixed with ammonium glycerine picrate ($\times 450$)



Plate II

Cysticercoid of *M. parucompressa* from the body cavity of *Macrocylops albidus*, fresh preparation
($\times 400$)



Abb. 1. Ein Teil der Auerhuhnlosung vom 18. 5. 1970, Tab. 2 A Nr. 22, Altvatergebirge (Jeseníky) 1096 m ü. d. M.

Abb. 2. Grit aus der Auerhuhnlosung vom 18. 5. 1970, Tab. 2 A Nr. 22, Altvatergebirge (Jeseníky)

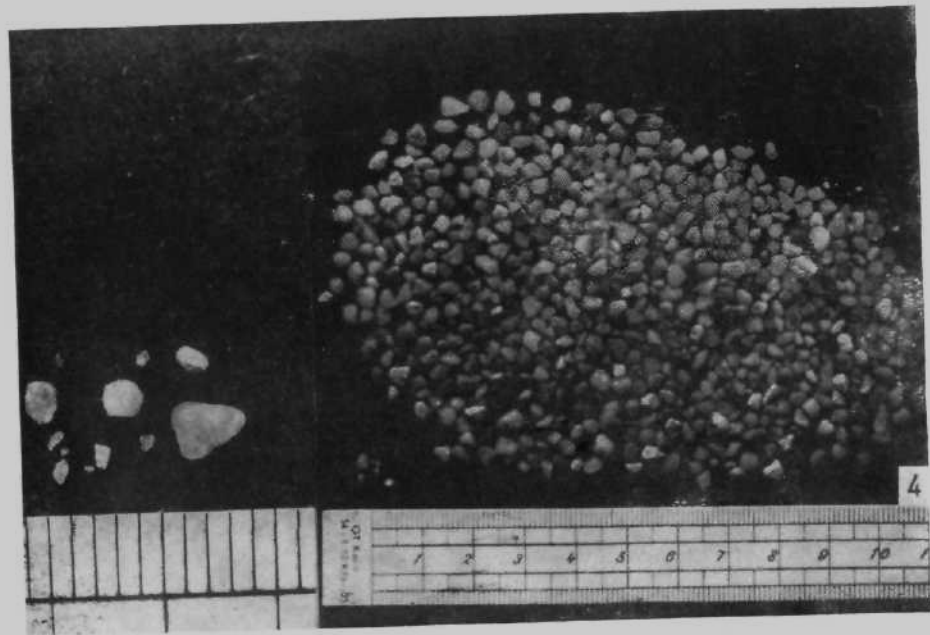


Abb. 3. Grit aus der Birkhahnlosung vom 4. 6. 1966, Tab. 2 B Nr. 15. Adlergebirge (Orlické hory) 1070 m ü. d. M.
Abb. 4. Grit aus dem Darminhalt und aus dem Magen eines Rackelhahnes, Tab. 3 R Nr. 2. Alle Aufnahmen J. Porkert.

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Notes on white-toothed shrews from Iraq (Mammalia: Insectivora, Soricidae).
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Toto číslo vyšlo v květnu 1972