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STUDIES ON THE STOMACH FLUKES OF BUFFALO IN EGYPT (TREMATODA: PARAMPHISTOMATA)

O. SEY

Department of Zoology, College of Education of Pécs

Abstract. Three amphistomous species, *Paramphistomum gotoi* Fukui, 1922; *Paramphistomum microbothrium* Fischoeder, 1901 and *Carmyerius gregarius* (Looss, 1896) have been found as a result of the investigation of stomach flukes of buffalo in Egypt. Specific status of *Paramphistomum gotoi*, variability of *Paramphistomum microbothrium* collected in different Egyptian domestic ruminants and histological structure of the muscular organs of *Carmyerius gregarius* have been examined.

In the literature there are only a few papers dealing with stomach flukes of buffalo in Egypt. Looss (1896, 1912) found *Carmyerius gregarius* and *Paramphistomum microbothrium* and the latter species has been repeatedly found there by Näsmark (1937) and Dinnik (1961). Recently Tadros (1958) has pointed out eggs of "Paramphistomes" in the faeces of buffalo slaughtered in Shebin El Kanatir abattoir.

The purpose of this paper is not only to give further details to the histology of the species in question but to draw the attention to the potencial harm caused by conical flukes among grazing stocks in Egypt.

MATERIAL AND METHODS

The test material was collected in slaughter houses in Cairo and Alexandria, 1973/1974. Altogether 142 rumina were examined, 103 in Alexandria and the rest in Cairo. Flukes after removing from the rumen were fixed in AFA and stored in 70 per cent alcohol with 3 per cent of glycerine. Median sagittal sections 8—10 μm in width were prepared, stained in haematoxylin and eosin and mounted in balsam. Specimens in toto were stained in carmine. Convolutions of the pars musculosa were elucidated by dissection.

RESULTS AND DISCUSSION

After histological and organological examinations of the present collection three trematode species have been identified.

1. *Paramphistomum gotoi* Fukui, 1922 (Plate 1, Figs. 1-5)

This species was described by Fukui as a rare fluke from cattle in Japan. Later it was found by Dawes (1936) in Malaya, then Yamaguti (1939) has repeatedly found it in cattle in Japan as a common parasite. Tandon (1955) recorded this species in India, Stepanov (1969) in the Soviet Union (Mordvin ASSR) in buffalo and cattle, respectively. Recently Lee et al. (1971) have recovered this species from buffalo in Malaysia.

Description: Body length 6.8—8.0 mm width 1.9—2.0 mm. The pharynx is of the *Liorchis* type its structure is the same as it was described by Näsmark (1937). It is 900 to 1100 μm in length and

640—660 μm in width. On the inner surface of the anterior part of the pharynx there are a great number of long papillae, 50—60 μm in length (Plate I, Fig. 1). Circular muscle elements of the oesophagus increase gradually along its way and there is a muscular swelling at its end which can be considered a poorly developed oesophageal bulb (Plate I, Fig. 2). The caeca form some undulations and their blind ends turn inwards and overlap each other in the dorsal surface of the body end. The genital atrium is of the *Gracile* type with several weakly developed radial muscle elements in its genital atrium (Plate I, Fig. 3). The pars musculosa is a small tube, 450- 470 μm in length, with a poorly developed circular musculature and with some convolutions. The pars prostatica is short, 100 to 125 μm in length. The acetabulum is of the *Paramphistomum* type (Plate I, Figs. 4, 5), its diameter is 1350 to 1650 μm. The number of the muscular units in the muscle series is as follows: d.e. 1: 14—22; d.e. 2: 17—27; d.i.: 33- 37; v.e.: 12- 24 and v.i.: 43—51. The excretory duct and Laurer's canal cross each other, the former opens 3250 to 3500 μm and the latter 2100 -2250 μm from the posterior end of the body.

According to the above presented data our material fully agrees with both gross morphology and histology of Fukui's (1922) and Näsmark's (1937) descriptions.

On the basis of the material collected in buffalo and goat in North Borneo, Schad et al. (1964) have described a new species, *Ceylonocotyle gigantopharynx* and *P. gotoi* of Dawes (1936) and Tandon (1955) was considered as belonging to the former species. At the same time, Lee et al. (1971) have expressed their opinion that *C. gigantopharynx* is very probably a synonym of *P. gotoi* found in Malaysia by themselves. In comparison with the description of the two mentioned species it can be stated that their *P. gotoi* exhibits more similarities (e. g., pharynx, acetabulum, position of the excretory duct and Laurer's canal) to *C. gigantopharynx* than the specimens described by Fukui (1922) and Näsmark (1937) or our findings.

On the basis of these similarities I believe that *P. gotoi* of Lee et al. (1971) is identical with *C. gigantopharynx* of Schad et al. (1964). With this, I should like to dispel the appearance that the histological features display such a wide variability which comes from the discussion of the erroneously identified species of *P. gotoi* of Lee et al. (1971).

Recovery of *P. gotoi* in Egypt represents not only a new species for its fauna but this is the first record of its occurrence in Africa. According to the personal communication of the head of the Veterinary Laboratory in the slaughter house, buffaloes slaughtered there were of Egyptian origin; therefore *P. gotoi* should be considered a permanent member of the Egyptian fauna.

2. *Paramphistomum microbothrium* Fischoeder, 1901 (Plate I, Figs. 6-7)

Although the material used for the description was collected from a wild ruminant, *Gazella dorcas* (L.), subsequent investigations revealed that *P. microbothrium* is a common parasite of domestic ruminants as well. Moreover this species is mainly incriminated as an aethiological agent of the disease, paramphistomosis, therefore it is one of the best studied species of amphistomes from morphological (Fischoeder 1903, Stunkard 1929 under the name *P. cervi*), histological (Näsmark 1973, Swart 1954, Prudhoe 1957, Lengy 1960, Reingardt 1969) and biological (Lengy 1960, Dinnik 1961, 1962 a, b, 1964, Horak 1967) views.

In Egypt, this fluke could be collected beside the buffalo also from cattle and sheep. We had thus an opportunity to carry out a comparison of the specimens collected from different final hosts. These results are summarized in Table 1. There seems to be a direct correlation between the lenght of fluke and the size of their final hosts. In the literature the smallest (3.7 mm) mature specimens of *P. microbothrium* were mentioned from sheep (Lengy 1960) and the biggest ones (13.5 mm) from cattle (Dinnik 1962 a). Body dimensions of this species may depend on different effects (e.g., prefixation, fixation etc.) and the age of the flukes, because Dinnik's observations (1962 a) show that they reach their full length in 5—9 months after maturation.

Table 1. Characteristics of specimens of *Paramphistomum microbothrium* from different hosts

Hosts	Body dimension in mm	Pharynx in mm	Genital atrium in µm			Diameter of acetabulum in mm
			G.O.*)	G.F.	G.Ch.	
buffalo	7.0—13.2×2.8—3.0	1.00—1.10×0.70—0.75	550—1000	275—325	100—150	1.5—2.3
cattle	6.0—11.0×2.5—2.9	0.85—1.00×0.60—0.70	400—700	160—350	150—190	1.6—2.0
sheep	4.7—8.5×2.0—3.0	0.65—1.00×0.45—0.60	425—600	75—150	50—125	1.4—1.6

*) G.O. = Genital opening, G.F. = Genital fold, G.Ch. = Genital chamber

The pharynx is of the *Paramphistomum* type (Näsmark 1937). Subsequent examinations have confirmed Näsmark's designation. Dinnik (1964), compared seven species of *Paramphistomum* with a pharynx of *Paramphistomum* type and three species of *Calicophoron* having *Calicophoron* and *Ijimai* types of pharynx and proposed to unite these types into one, the *Calicophoron* type. Such a reduction seems to be correct in connection with certain organs showing similarities in their structure and, in the light of the results obtained since the publication of Näsmark's monograph, a general survey of his organ types would be desirable.

The ends of caeca turn dorsally and point inwards which can be considered as a normal position. To clarify the variability and systematic value of this feature, 150 specimens of *P. microbothrium* have been examined. Out of them 120 showed this normal position of the caeca, in 29 specimens they were not observable precisely due to overlapping by the vitelline follicles and only one specimen was found to have caeca with lateral tending. This feature therefore seems to be valuable in identification owing to its constancy.

The structure of the genital atrium has already been used by Fischoeder (1903) in the description of certain species. It was found by Näsmark (1937) that the genital atrium was an important specific feature for different amphistomous species. Reinhardt (1960) and Dinnik (1961) have described newer parts of the genital atrium and the latter author has introduced the numerical characterization for the genital fold and the genital chamber. The genital atrium as a muscular organ may appear in variable forms depending on the temporary position of its functional circumstances. Classification of genital atrium types has been mainly based rightly by Näsmark (1937) on the presence or absence of their circular and radial muscle elements. The genital fold, introduced by Dinnik (1961), does not seem to be a reliable feature because establishment of its measurement is sometimes difficult (Plate I, Fig. 6). We have found at the same time that the measurement of the genital opening itself is a more utilizable feature in the identification of certain species.

Table 2. Muscular units of *Paramphistomum microbothrium* from different hosts

Hosts	d.e. 1	d.e. 2	d.i.	v.e.	v.i.
buffalo	20—22	26—29	47—50	15—17	56—59
cattle	13—20	16—37	38—42	16—19	44—56
sheep	13—28	21—32	20—47	15—22	43—62

The number of convolutions of the pars musculosa of the specimens collected in the three final hosts agreed well with each other, having six or eight convolutions. The acetabulum is of the *Paramphistomum* type, muscular units in certain muscular series are as follows (see Table 2).

Measurements of the eggs in specimens from different final hosts are: buffalo 150—158 × 95—100 μm, cattle 149—160 × 95—100 μm and sheep 140—150 × 98—100 μm.

3. *Carmyerius gregarius* (Looss, 1896) (Plate I, Fig. 8, Plate II, Figs. 1-8)

This species was described by Looss in Egypt, outside this country it was also found in Sudan (Myers et al. 1960). Dollfus (1963) described a subspecies, *C. gregarius congolensis*, which was considered by Round (1968) a synonym of *C. gregarius*.

The gross morphology of *C. gregarius* can be found in Looss's (1896) and Otto's (1896) papers. In Näsmark's (1937) monograph there are "Preliminary notes" for the whole subfamily Gastrothylacinae without any data referring to this species. Introduction of Näsmark's (1937) conceptions to the identification of the species of *Carmyerius* seems to be correct as it was pointed out by Gretillat (1964 a, b). Especially the structure of the genital atrium may have specific characters.

A detailed description of muscular organs (pharynx, genital atrium and acetabulum) of this species is given which can serve as a basis for comparison with the same organs of the other species of *Carmyerius*.

The pharynx is of the *Paramphistomum* type (Plate I, Fig. 8, Plate II, Fig. 1). It is characterized by a strongly developed outer and inner circular and an outer and a weakly developed inner longitudinal muscle layers. The middle circular muscle layer is poorly developed and is seen only in cross section. The caeca are sometimes almost straight, in other specimens, however, they form a great number of undulations. End points of them have not gone beyond the middle part of the body. The genital atrium is similar in its structure to that of Näsmark's (1937) *Bothriophoron* type (Plate II, Figs. 3, 4). It is situated at the bottom of a chap-shape depression in the ventral pouch. The wall of this depression is covered by papillae. The radial musculature of the genital atrium is strongly developed. There are genital sphincter, poorly developed sphincter papillae and a ventral sphincter with less packed muscle elements. The pars musculosa is a short tube with 4—7 convolutions, the pars prostatica is two or three times longer and forms some twists along its longitudinal axis. Clusters of the vitelline glands extend from the bifurcation of the oesophagus to the level of the middle of the testes. The cover the ventral, lateral and dorsal sides alike. There were specimens, however, with poorly developed vitellaria on their ventral sides. The arrangement of the vitelline glands observed by us shows a considerable deviation as described by Looss (1896). The excretory duct and Laurer's canal do not cross each other, the former opens 1000—1100 μm and the latter 1800—1900 μm from the posterior end of the body. In cross section, the ventral pouch is triangular (Plate II, Fig. 6) at first, then the dorsal angle ramifies and at about the middle and lower parts of the body it is quadrangular (Plate II, Figs. 7, 8). The acetabulum is of the *Gastrothylax* type (Näsmark 1937) which is considered to be a fundamental type for the subfamily Gastrothylacinae. It has four muscle series, in case of *C. gregarius* the number of muscle units in the muscle series is as follows d.e.: 43—45, d.i.: 51—55, v.e.: 40—42, v.i.: 43—45.

Stomach flukes were found in different frequency in buffalo in Egypt. Seventy eight per cent of the examined rumina were infected by *P. microbothrium* both in Cairo and Alexandria. *P. gotoi* and *C. gregarius* occurred rarely, their infestations were 7 and 25 per cent, respectively and they were found only in Alexandria. During the collection of our material we have very often found seriously infected rumina and in such cases the whole surface of the rumina was covered with a great number of worms, sitting close together and distruction of the ruminal papillae was observable.

An acute disease, paramphistomosis caused by immature stomach flukes in the small intestine has been reported from various parts of the world (Horak 1971) including the Middle-East area as well. In countries with an advanced animal husbandry paramphisto-

mosis is regarded as being of economic importance. In consideration of the high percentage and serious infestation of buffalo by amphistomes in Egypt more attention should be given to the economic losses caused by these helminths.

ИЗУЧЕНИЕ ТРЕМАТОД ИЗ ЖЕЛУДКА БУЙВОЛА В ЕГИПЕТЕ (TREMATODA: PARAMPHISTOMATA)

О. Сей

Резюме. Три вида трематод, *Paramphistomum gotoi* Fukui, 1922; *Paramphistomum microbothrium* Fischoeder, 1901 и *Carmyerius gregarius* (Looss, 1896), были обнаружены при изучении трематод из желудка буйвола в Египете. Обсуждается видовое положение *Paramphistomum gotoi*, вариабельность *Paramphistomum microbothrium*, собранных от разных домашних жвачных Египета и гистологическая структура мышечных органов *Carmyerius gregarius*.

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O. S., College of Education of Pécs, Department of Zoology, Ifjuság u. 6, H-7644 Pécs, Hungary

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K. Odening (Ed.): Perspektiven der Cercarienforschung. Perspectives of research on Cercariae.

Parasitologische Schriftenreihe Bd. 21. VEB G. Fischer Verlag, Jena 1971. 205 pp., 68 Figs. Price 44.30 M.

K. Odening edited an outstanding comprehensive volume dealing with larval stages of trematodes. It consists of 26 reports on cercariae. Some of them were read or discussed at the symposium on cercariae in Berlin in 1968, the remaining ones were prepared later. The reports are divided into four groups according to the subject:
1. Theoretical problems of life cycle, phyletic relations and phylogeny of trematodes;
2. General problems of determination, classification and nomenclature, characters of some systematic groups and species, importance of certain morphological features;
3. Ecology, life cycles, faunistics;
4. Recommendations made by participants in the symposium of cercariae.

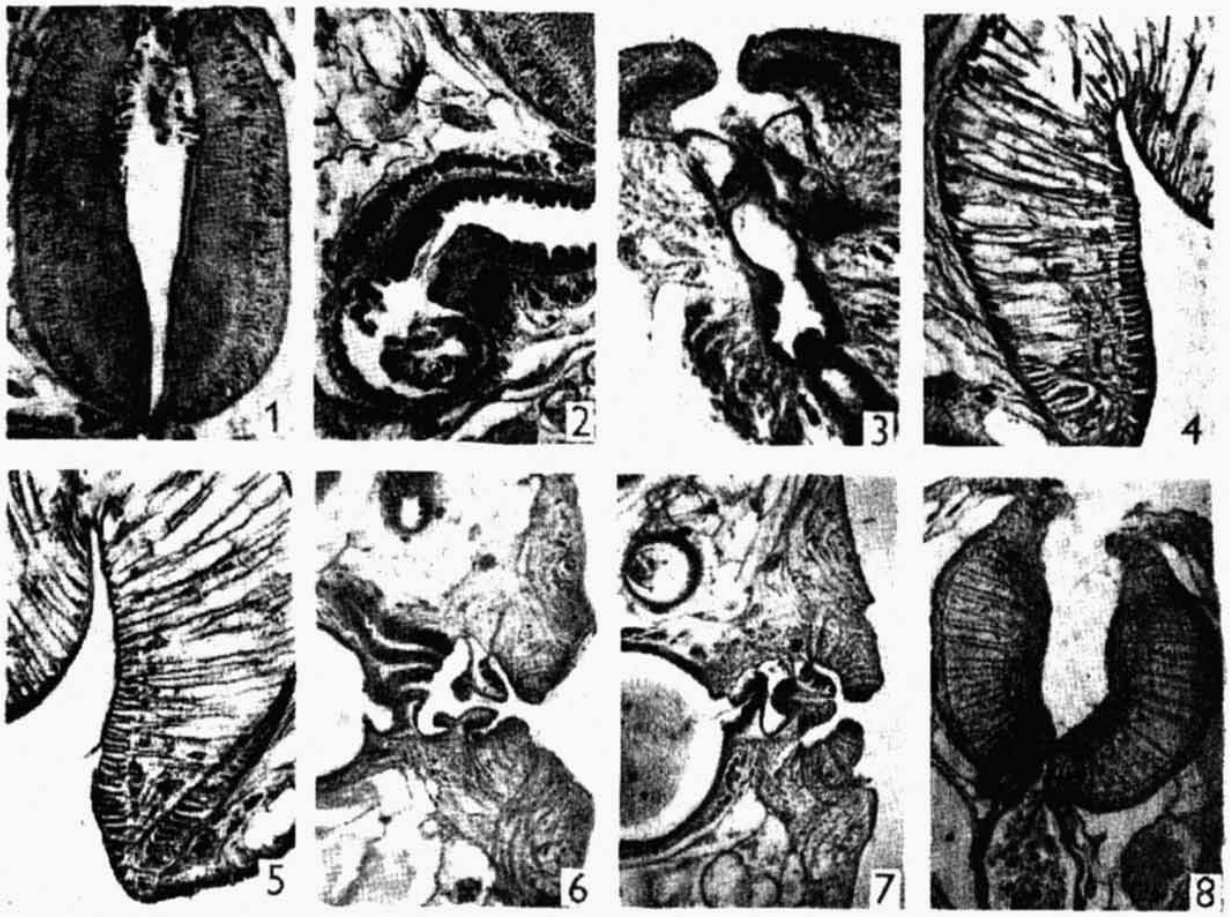
There are many interesting contributions devoted not only to faunistics of cercariae and life cycles of trematodes, but also to problems of specific differentiation in cercariae, relationship between the classification of cercariae and natural system of Digenea, main morphological characters of some groups of cercariae (e.g., Furcocercariae), sensory organs, nerve system, chaetotaxy and neurosecretory cells in cercariae.

As it is stressed in the concluding part of the volume, a deeper study of relationships between larval stages of trematodes and molluscs both from scientific and practical point of view is necessary. The knowledge of taxonomy is the basis of all studies of trematodes, including practical application, and the establishment of suitable keys is necessary to facilitate recognition of economically and hygienically important cercariae. However, this could not be done without a detailed knowledge of the morphology and histopathology of cercariae.

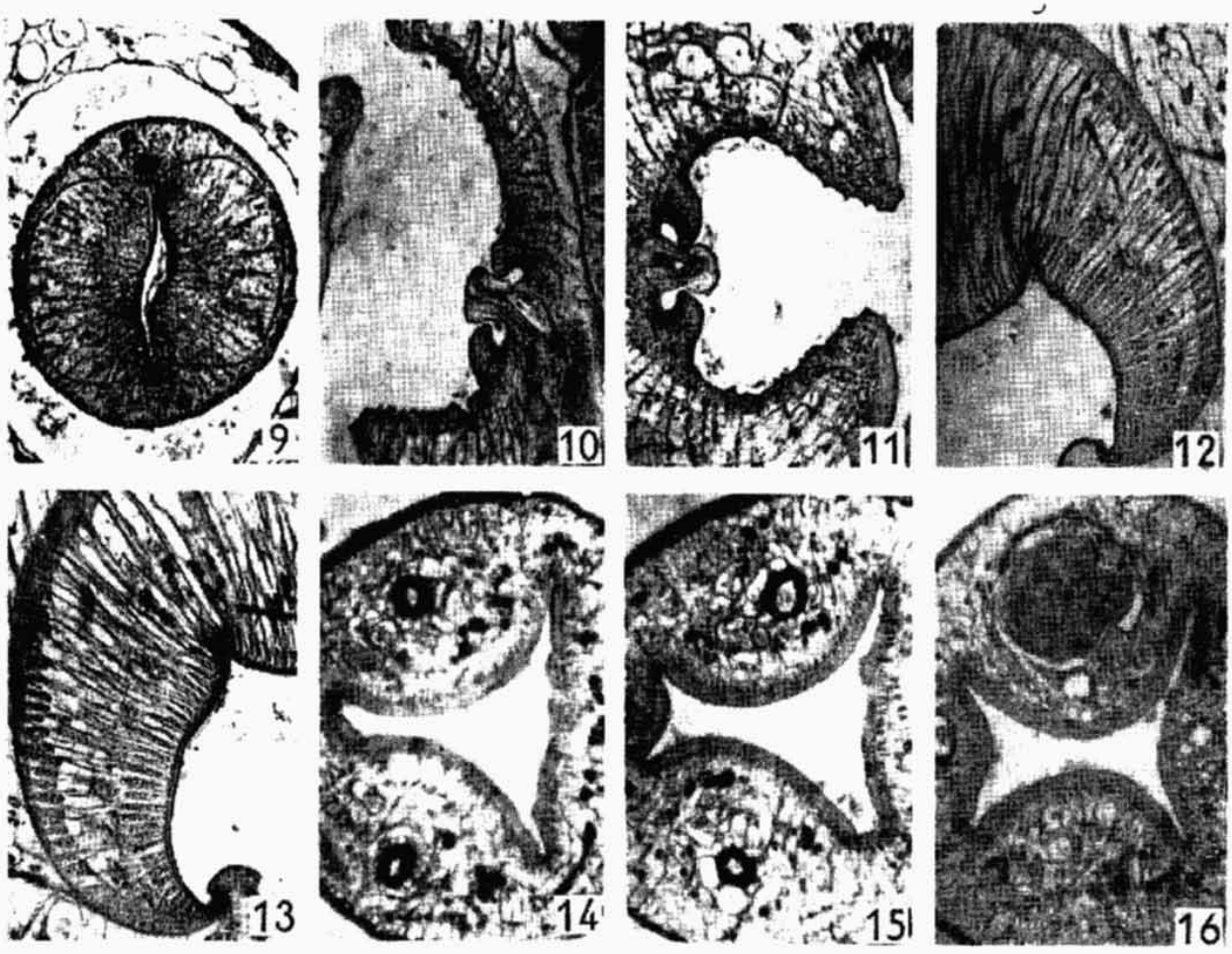
Besides the morphology also the biological-ecological, physiological and biochemical problems should be dealt with. It is necessary to elucidate so far unknown life cycles of trematodes in order to develop effective methods for the control of trematode infections both in human and veterinary medicine.

The book provides an information on the state of research of larval stages of trematodes, particularly cercariae. It will be helpful not only to specialists engaged in the study of this subject, but also to other parasitologists.

Dr. Z. Ždárská, C.Sc.



Figs. 1 – 5; Median sagittal sections of organs of *Paramphistomum gotoi*. 1 — pharynx; 2 — oesophagus; 3 — genital atrium; 4—5 — dorsal and ventral halves of acetabulum. Figs. 6—7; Median sagittal sections of genital atrium of *Paramphistomum microbothrium*. Fig. 8; Median sagittal section of pharynx of *Carmyerius gregarius*.



Figs. 1—8; Median sagittal and cross sections of organs of *Carmyerius gregarius*. 1 — cross section of pharynx; 2, 3 — median sagittal and cross sections of genital atrium; 4, 5 — ventral and dorsal halves of acetabulum; 6, 7, 8 — cross sections of ventral pouch in different heights.