POLYMORPHISM OF LARVAE OF THE GENUS
APOPARAKSIS CLERC, 1903 (HYMENOLEPIDIDAE)

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Abstract. The larvae of 12 cestode species of the genus *Apolarakis* have been studied. In order to confirm the determination, the definitive hosts, birds, were experimentally infected with 5 species and the intermediate hosts, oligochaetes, with 6 species of cestodes. A great variability was observed in the morphology of bulb appendix of cysticercoids belonging to five types of larvae. It is assumed that the polymorphism of larvae of the genus *Apolarakis* results from the morphological adaptation to the development under arctic conditions.

The genus *Apolarakis* (Hymenolepoidae) prevails in Charadriiformes in arctic and subarctic regions. Some species parasitize Anseriformes and Lariformes. Although several species of *Apolarakis* have been found in birds in temperate and even southern latitudes, there is every reason to consider these cestodes an arctic group of helminths. The genus *Apolarakis* includes about 40 species and most of them have apparently helarctic distribution.

There are only limited data on the biology of *Apolarakis* available in the literature. The first report was published by Mrázek (1907), who recovered cestode larvae from the body cavity of *Lumbriculus variegatus* in Czechoslovakia. He identified them as *A. crassiostrostris*. However, our studies revealed that the larvae of *A. crassiostrostris* are of different morphology and that those recovered by Mrázek were most probably *A. polystictae* Schiller, 1955.

*Harper* (1930) found a cysticeroid of *A. furcigera* (Rud., 1819) in the same host in England, Jarecka (1960) recovered the same cysticeroids from *Limnodrilus* sp. in Poland and Karmanova (1962) from *L. variegatus* collected from the Volga River delta (U.S.S.R.). Demshin (1966) studied experimentally the life cycle of *A. furcigera* in Primorye (U.S.S.R.), where *L. variegatus* serves as the intermediate host of this cestode. Karmanova (1968) found a larva of *A. filum* (Gecee, 1782) in *Limnodrilus nevaensis* in the Volga River delta.

Chibichenko and Tokobaev (1972) recorded a finding of cysticercoids of *A. filum* in *Limnodrilus udelemianus* and *A. furcigera* in *L. goffmani* in the Issyk-Kul hollow (U.S.S.R.), but the diagnoses of these authors give rise to doubt, since the hooks figured in their paper do not correspond to the hooks of the respective species and the determination was not confirmed experimentally. In all cases a cysticercoid of diplocyst type was found.

We studied the life cycle of *Apolarakis* in the region of the Chaun River estuary (coast of the East-Siberian Sea, 69° N) in the years 1971—1973. The region
<table>
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<td>1. <em>A. birulai</em> Linstow, 1905</td>
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<td>11. <em>A. zemys</em> Schiller, 1951</td>
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<td>12. <em>Aploparaxis</em> sp.</td>
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*) Young strobilae
investigated is a plain, marsh-ridden tundra, abounding in birds, in which 24 *Aplolarakis* species were found. Preliminary results of these investigations were published in a previous paper (Bondarenko 1973).

**MATERIAL AND METHODS**

Our studies were conducted in three lines:

a) examination of oligochaetes from natural biotopes;

b) experimental infection of birds with cysticeroids from spontaneously infected oligochaetes;

c) experimental infection of oligochaetes with eggs of known cestode species.

In order to get larvae of *Aplolarakis*, the oligochaetes collected at feeding places of birds were examined. The species to which the cysticeroids belonged were determined according to the structure of hooks and by experimental infection of nestlings (definitive hosts). In our experiments we used the nestlings of wild birds hatched in the thermostat from eggs collected in nests. The nestlings were fed with larvae obtained from spontaneously infected oligochaetes.

The oligochaetes for experiments were collected from natural water reservoirs and kept in the laboratory. Live specimens were examined with a microscope for cestode larvae and placed on a Petri dish for 12—24 hours to get into contact with the eggs recovered from strobilae of a definite species of *Aplolarakis*. Live or fixed cysticeroids were observed under the microscope. The polyvinylalcohol or a mixture of the same volumes of water, lactic acid and glycerine were used for the fixation.

**RESULTS**

A total of 24 species of *Aplolarakis* have hitherto been reported from birds of the Chaun River lowland; the larvae of 12 species were found and the intermediate hosts were established. The results are summarized in Table 1.

The larvae of *Aplolarakis* are of various forms; besides the typical diploecyst there exist at least four other modifications of the cysticeroid, a brief characteristic of which is mentioned below.

1. **Typical diploecyst** (Plate I). The scolex is surrounded by two concentric envelopes which are united both one with another and with the scolex. The outer envelope is a derivative of the tail appendix.

   Larvae of this type were found in the species *A. bulborinus*, *A. groenlandica*, *A. furcigera*, *A. polystictae* and *A. taimyrensis*. The identification of larvae was verified by experimental infection of nestlings (except *A. groenlandica*) and intermediate hosts (except *A. bulborinus* and *A. taimyrensis*).

2. **Tailed diploecyst** (Plate II). Unlike in the typical diploecyst, the outer envelope the derivative of the tail, is elongated at the poles. The anterior pole has a distinct discharging opening. The posterior end of the outer envelope is widened and covered with embryonal hooks. Its length depends on the stage of maturity of the cysticeroid and intensity of infection of the intermediate host. Similar larvae were found in the parasites of Charadriiformes, namely *A. brachyphallos*, *A. crassirostris* and *Aplolarakis* sp.

   The determination of the first two species was verified experimentally by infection of oligochaetes with cestode eggs.

3. **Floricercus** (Plate III Fig. 1). The proliferating tail does not form a closed outer envelope as in the two preceding types. The cysticeroid is by a half submerged in bed formed by a proliferated tail appendix. The larva has a form resembling a closed flower, hence it is called “floricercus”. This type of cysticeroid was found in cestodes parasitizing Anatidae, namely *A. birulai* (the determination was verified by experimental infection of a nestling). In our opinion, the larvae found by Hrabě (1957) in the body cavity of *Lumbriculus variegatus* from Iceland and determined as *Cysticerus* sp. are identical with the cysticeroids recovered by us.
4. Ramicercus (Plate IV). The tail appendix of these larvae is relatively short and has 6—10 digitate processes in its basal part. The distal end of the tail is widened. This type of larva was determined by Skryabin and Matevosyan (1945) as Cysticerus sp. and Mrázek (1907) found it in the body cavity of L. variegatus. We have found similar larvae in the body cavity of Stylodrilus sp. (Plate IV, Fig. 1). An experimental infection of the oligochaetes Stylodrilus sp. with the eggs of A. orientalis confirmed our determination.

This type of larvae was recorded also with A. secernivus (Plate IV, Fig. 2). Unfortunately, the distal end of the tail appendix of the single specimen was damaged during the extraction from the body cavity of the intermediate host. There are 6 digitate processes at the base of the tail. The species was determined on the basis of the size and shape of hooks.

5. Autotomicercus (Plate III, Fig. 2). This peculiar type of larva was found with the cestode A. xemaet parasitizing Lariformes and Charadiiformes. The larvae were found in the body cavity of the oligochaetes Mesenchactraeus sp. collected from a small island in the lake where herring-gulls were nesting. An experimental infection of nestlings of this gull confirmed the determination.

In contrast to ramicercus, the tail appendix of this type is 2—9 times longer than the body of the cysticeroid, according to the stage of maturity of the larva. Moreover, the body cavity of the oligochaete contains not only adult larvae with a long tail capable of forming several processes in the basal part and a number of constrictions along the tail length, but also numerous young larvae at different stages of development. It is characteristic that the embryonal hooks are not preserved on the tails of mature cysticeroids (2 hooks were found in one case), whereas in young larvae they are either lacking or their number varies from one to four. It may be therefore assumed that in the larvae of A. xemaet, parts of tail appendix are budding off, which may give rise to new larvae; that means that an asexual reproduction occurs. However, in contrast to the known modifications of larvocysts of Hymenolepididae, i.e. the staphylocyst and urocyst reproducing by budding, the larvae of A. xemaet lose the connection with the mother specimen at early stages of development. As it is known, the staphylocyst does not lose the connection with the daughter specimens, taking a character of mycelium, whereas the urocyst loses this connection as soon as the daughter larva is fully formed. These facts allow us to regard the larvae of A. xemaet as a special type of larvocyst and propose to call it “autotomicercus”.

DISCUSSION

Skryabin and Matevosyan (1945) proposed a classification of larvae of Hymenolepididae and they divided them into 7 types: diploecyst, monocercus, cercocyst, microcercus, ramicercus, urocyst and staphylocyst. Of them, the diploecyst and ramicercus were found among the larvae of Aploparaksis. However, some larvae of Aploparaksis do not belong to any of these types and we propose for them the terms “tailed diploecyst”, “floricercus” (Bondarenko and Kontrimavichus in lit.) and “autotomicercus”. All these “types”, of course, are in fact modifications of one type of larvae of Hymenolepididae. Though the form of their tail appendices is stable and practically does not change with the growth, we assume that special terms used for these modifications are useful for simplification of their descriptions.

The polymorphism of Aploparaksis larvae is a very interesting phenomenon. Vittate stages of these cestodes are characterized by a monotony of their structure. At present it is difficult to speak about the polymorphism of larvae as an index
of the inner structure of the genus Aploparaksis and it is not known, whether it reflects any phylogenetic lines inside it.

We may propose a single elucidation of this phenomenon. Aploparaksis is a northern group of cestodes, which are most numerous and of the highest variety of species in the high latitudes. As is generally known, the development at lower temperatures of the inner structure of the genus Aploparaksis and it is not known, whether it reflects any phylogenetic lines inside it.

We may propose a single elucidation of this phenomenon. Aploparaksis is a northern group of cestodes, which are most numerous and of the highest variety of species in the high latitudes. As is generally known, the development at lower temperatures leads to lower intensity of the metabolism. Unpublished results of G. P. Krasnoshechkova and S. K. Bondarenko showed that succinate dehydrogenase is located in the tail envelope of Aploparaksis larvae and glycogen is accumulated in the tail itself. The enlargement of the surface and volume of the tail in the arctic forms of larvae may be thus regarded as a morphological adaptation contributing to the intensification of the metabolism and, consequently, to speeding up of the growth and development.

ПОЛИМОРФИЗМ ЛИЧИНКЛ BEOBISH DE APOBARAKSIS CLERC, 1903 (HUMENOLEPIDIDAE)

C. K. Bondarenko и B. I. Kontrimavicius

Резюме. Научены личинки 12 видов гостод рода Aploparaksis. Определение няти видов подтверждено экспериментальным зарождением дефинитивных хозяев — инги, а пищи видов — медленным зарождением промежуточных хозяев — оленьют. Отмечена большая вариабельность в морфологии хвостового придатка цестод, которые отмечаются нити типов личинок. Выдвигается предположение, что полиморфизм личинок р. Aploparaksis является результатом морфологической адаптации к развитию в арктических условиях.

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—, (Water oligochaetes as hosts of helminths), Tr. Astrakhan. zapov. 11: 141—176, 1968. (In Russian.)
Fig. 1. Typical diploceyst — cysticercoid of *A. paparaksis ballurcius*.
Fig. 2. Typical diploceyst — cysticercoid of *A. furcigera*.
Fig. 3. Typical diploceyst — cysticercoid of *A. groenlandica*.
Fig. 4. Typical diploceyst — cysticercoid of *A. polydien*.
Fig. 1. Tailed diplocyst — cysticercoid of *Aplopurpuriksis bruckshiphalos*.

Fig. 2. Tailed diplocyst — cysticercoid of *A. crassirostris*.

Fig. 3. Tailed diplocyst — cysticercoid of *Aplopurparaksis sp.*
Fig. 1. Floricercus - cystieercoid of *Aploparaxis birulai*.
Fig. 2. Autotomicercus — cystieercoid of *A. xenae*. 
Fig. 1. Ramieerus — cysticercoid of *Aplolarakis orientalis*.

Fig. 2. Ramieerus — cysticercoid of *A. secessius*. 
SKRYABIN K. I., MATEVOSYAN E. M.,
Lentochnye gelmity — gimenolepididy —
parazity domashnikh i okhotnichie-promyslo-
vykh ptits. (Tapeworms — Hymenolepidae — parasites of domestic and game-birds)
Sel'chozizdat, pp. 1—486, 1945. (In Russian.)

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J. Grober, H. Horn, F. Oberdoerster: Gesundheitstaschenbuch für die warmen Länder
(Tropenärztlicher Ratgeber für Reise und Beruf). VEB Verlag Volk u. Gesundheit, Berlin,
351 pp. Price 18.80 M.

The present lively political, business, tourist,
scientific, cultural, sport and other contacts of
countries of the moderate zone with the Tropics
and Subtropics make it necessary to inform the
public about some specific problems related to
the influence of warm climate on man, including
some endemic diseases. The Grober-Horn-Ober-
doerster Manual published in the German Demo-
cratic Republic intended for workers travelling
to the Tropics and Subtropics, is therefore to be
welcomed. It is a worthy addition to the manuals published all over the world for the
above-mentioned purpose. It contains concrete
information valuable to laymen as well as physi-
cians who do not specialize in tropical medicine.
It is a new edition of the manual.

The book is of pocket size and divided into
the following main chapters. Hygiene of tropical
countries dealing with the suitable selection of
workers for activity in the warm climate, with
the suitable daily habits, social life as well as
hygiene, supply of water etc. The subsequent
chapter briefly discusses disinfection. The
chapter on arthropods outlines the character-
istics of individual groups with instructions for
their eradication and preventive measures
against on man. The most extensive
chapter is devoted to tropical diseases, both the
infectious and parasitic (invasive) diseases, as
well as afflictions induced by biophysical factors
(stroke, heat apoplexy), malnutrition and
deficiency of some dietary elements.

Of utmost importance is the chapter dealing
with problems of correct diagnosis of acute
diseases, with preliminary treatment and first
aid in accidents. Although diagnostic stumbling
blocks of various tropical diseases are well known,
I consider this chapter to be very useful to those
who work in locations distant from possibilities
of medical care.

A supplement to main chapters of the book
offers much helpful information: advise to suit-
able clothes, equipment of first aid box, insu-
rance, a table of non-metric measures and
weights, explanations of professional vocabulary
etc. The section dealing with insurance and legal
measures provided by the G.D.R. and showing
the care of the Socialist state for its citizens,
is of great importance.

It stands to reason that in a manual of this
scope inaccuracies could not be avoided. This
applies to some map appendices. For example
the chart depicting the malaria distribution can
hardly represent "Gebiete in denen Malaria
endemisch vorkommt" as part of Bulgaria, part
of USSR, including part of Yakutia, and some
other errors. Certain corrections are also neces-
sary in other charts depicting the distribution of
Chagas disease, leishmaniases, leprosy (India
should be added as an important region). The
authors have taken no account of the theory of
natural focality of diseases elaborated by
E. N. Pavlovsky and his co-workers.

However, these inaccuracies do not diminish
the qualities of the manual. Its value consists
primarily in reliable advice to all who travel
to the Tropics, who are assigned for work there,
are often thrown upon their own resources or
a small working team. It also offers a quick
information to all who do not specialize in
various fields of tropical medicine and wish to be
promptly informed about some problems.

Prof. Dr. B. Rosický, Dr. Sc.