

TREMATODE GENUS *DOLICHOSACCUS* JOHNSTON, 1912, WITH THE DESCRIPTIONS OF TWO SPECIES

STEPHEN PRUDHOE *

ABSTRACT

The *Dolichosaccus*-complex of opisthioglyphine trematodes recorded from amphibians and reptiles is discussed and a new classification of its species proposed. A new species, *D. novaezelandiae*, is described from *Leiopelma* in New Zealand, together with a redescription of *D. rastellus* (Olsson) from *Rana temporaria* in England. The geographical distribution of *Dolichosaccus* is outlined, and the pattern it presents might suggest that the genus originated in Australia, and that a dominant species radiated from there into Africa, Europe and the Pacific Islands.

RESUMEN

Se hace la discusión del complejo *Dolichosaccus* de tremátodos opistoglifinos de los anfibios y reptiles, y se propone una nueva clasificación de sus especies. Se hace la descripción de una nueva especie, *D. novaezelandiae*, de *Leiopelma* de Nueva Zelanda, al mismo tiempo que la redescrípción de *D. rastellus* (Olsson), de *Rana temporaria* de Inglaterra. Se bosqueja la distribución geográfica de *Dolichosaccus*, cuyo patrón podría sugerir que el género se originó en Australia, y que una especie dominante irradió desde ahí hasta África, Europa y las islas del Pacífico.

During a study of the platyhelminth parasites of the Amphibia, the writer found in the helminthological collections of the British Museum (Natural History) two distorted specimens of an opisthioglyphine trematode from *Leiopelma archeyi* in New Zealand. Since *Leiopelma* is known only from New Zealand and is a primitive genus of frogs with no close relatives, except *Ascaphus* in the northwestern States of the U. S. A., the trematode aroused much interest. Through the kindness of Miss A. G. C. Grandison, the writer was permitted to dissect two preserved specimens of *Leiopelma hochstetteri* in the Museum's collections, and in these frogs further specimens of the trematode were found.

In the same helminthological collections there are also the type-specimens of the subspecies *Lecithopyge rastellum subulatum* Perkins and *Lecithopyge rastellum cylindriciforme* Perkins, and as a result of an examination of these specimens it has been thought necessary to redescribe some specimens from *Rana temporaria* from English localities and considered to be *Dolichosaccus rastellus* (Olsson, 1876), to which the form from New Zealand bears a very close resemblance.

Before describing the flukes, it would perhaps be advisable to mention that there are differing opinions as to classification within the plagiiorchiid subfamily Opisthioglyphinae Dollfus, 1949,

* Department of Zoology, British Museum (Natural History), London, England.

the species of which occur in Amphibia, Reptilia and the mammalian orders Insectivora and Rodentia. Controversial views apply particularly to the genus *Dolichosaccus* Johnston, 1912, which some authors consider to be a distinct genus with *Distomum rastellum* Olsson, 1876, as one of its constituents (Yamaguti, 1958), some on the other hand accept the validity of the genus, but exclude *D. rastellum*, which is placed in the genus *Opisthioglyphe* Looss, 1896 (Dollfus, 1960), whilst others consider *Dolichosaccus* to be synonymous with *Opisthioglyphe* (Joyeux & Baer, 1961). There is, however, the fact that the opisthioglyphine species recorded from Amphibia and Reptilia may be divided into two groups. In one group, the *Dolichosaccus*-complex, the seminal vesicle is constricted into two distinct chambers lying in a very elongate cirrus-sac, whilst in the other group, the *Opisthioglyphe*-complex, the relatively small cirrus-sac contains a convoluted or sigmoid seminal vesicle. On this basis, the two forms to be described may be assigned to the *Dolichosaccus*-complex.

The species of this complex occurring in Amphibia and Reptilia may be arranged into three groups representing the genera *Dolichosaccus* Johnston, 1912, *Brachysaccus* Johnston, 1912, and *Lecithopyge* Perkins, 1928. *Brachysaccus* differs from the other genera by the fact that its genital pore lies ventrally to the intestinal bifurcation or oesophagus, instead of occurring well behind the bifurcation. *Dolichosaccus* and *Lecithopyge* are clearly very closely related morphologically, and their only differentiating feature seems to be that in *Lecithopyge* the vitelline follicles are confluent in the median line in front of the ventral sucker, whereas in *Dolichosaccus* they are not, although the follicles may extend anteriorly beyond the ventral suckers. At present, the morphological differences seem to be somewhat arbitrary

at generic level, and until morphological variation among the opisthioglyphine trematodes, particularly those occurring in Australian frogs, is better known, it seems more satisfactory to indicate the very close relationship of these three genera by relegating them to the position of subgenera of the genus *Dolichosaccus* Johnston, at least provisionally. Thus, the specific structure of the *Dolichosaccus*-complex recorded from amphibians and reptiles may be given as follows:

- Dolichosaccus* (*Dolichosaccus*) *trypherus* Johnston, 1912, from *Limnodynastes peronii* and *Hyla aurea* in New South Wales, Australia.
- Dolichosaccus* (*Dolichosaccus*) *ischyrus* Johnston, 1912, from *Limnodynastes dorsalis* and *Hyla coerulea* in N. S. W. and Queensland, Australia.
- Dolichosaccus* (*Dolichosaccus*) *diamesus* Johnston, 1912, from *Hyla freycineti* in N. S. W., Australia.
- Dolichosaccus* (*Brachysaccus*) *anartius* (Johnston, 1912) from *Hyla aurea* and *Limnodynastes peronii* in N. S. W., Australia.
- Dolichosaccus* (*Brachysaccus*) *symmetrus* (Johnston, 1912) from *Hyla aurea* in N. S. W., Australia.
- Dolichosaccus* (*Brachysaccus*) *juvenilis* (Nicoll, 1918) from *Chiroleptes brevipalmatus* in Queensland, Australia.
- Dolichosaccus* (*Lecithopyges*) *rastellus* (Olsson, 1876) from various anurans in Europe and Africa.
- Dolichosaccus* (*Lecithopyge*) *lygosomae* Fischthal and Kuntz, 1967, from *Lygosoma noctua*, New Hebrides.
- Dolichosaccus* (*Lecithopyge*) *novaezealandiae* sp. nov. from *Leiopelma archeyi* and *L. hochstetteri*, New Zealand.

As already indicated, the two forms now to be described fall into *Dolichosaccus* (*Lecithopyge*).

Dolichosaccus (Lecithopyge) novaezealandiae sp. nov. (Fig. 1 a-b)

The material of this trematode consists of two specimens from the ileum of *Leiopelma archeyi* captured on the Tokatea Ridge, near Coronandel, North Island, New Zealand, one specimen from the intestine of *Leiopelma hochstetteri* in "New Zealand" and three specimens from *L. hochstetteri* from Mangakakariki Stream, inland from Te Araroa, East Cape Province, North Island, New Zealand. Unfortunately, five of the specimens are rather distorted in form, but the sixth specimen is in a reasonable condition for description. Nevertheless, information obtained from a study of all the specimens available is included in the following account.

The body is fusiform, somewhat rounded anteriorly and tapering noticeably posteriorly. In size the mature specimens are variable, the smallest being about 1.4 mm. in length and 0.46 mm. in maximum width, and the largest about 2.8 mm and 1 mm., respectively. The integument is provided with small scale-like spines, which are disposed in transverse rows, extending to the posterior region of the body. The oral sucker is subterminal and varies from 0.24 mm. to 0.38 mm. in diameter. The ventral sucker is smaller, ranging from 0.2 mm. to 0.36 mm. in diameter, and situated at about the anterior third of the total length of the body. The ratio of oral sucker to ventral sucker is 1: 0.8-0.9. The oral sucker leads into a short prepharynx, opening into a muscular pharynx, which may be globular, about 0.87 mm. in diameter, or a little longer than wide, 1-1.2 mm. by 0.8-1.1 mm. In all instances the diameter of the pharynx is a little less than one-third of that of the oral sucker. The oesophagus is about as long as the pharynx and bifurcates at about midway between the suckers. The

intestinal caeca are relatively narrow, lined with a tall epithelium, and extending to about the hinder fifth of the body. The right caecum may reach a little further posteriorly than the left. The extent of the excretory vesicle has not been made out.

The genital pore is situated more or less in the median line, close in front of the ventral sucker. The cirrus-sac is elongate, lying dorsally or latero-dorsally to the ventral sucker and extending posteriorly to near the hinder margin of the sucker. It contains a smooth cirrus, a moderately-developed pars prostatica and a comparatively large seminal vesicle, which is constricted into two chambers, the posterior being distinctly larger than the anterior. The cirrus-sac varies in size from 0.2 mm. long and 0.044 mm. wide to 0.32 mm. and 0.056 mm., respectively.

The testes are situated in the median field at about the hinder fifth of the body-length, between or a little in front of the ends of the intestinal caeca. They are smooth and more or less rounded, usually disposed obliquely one behind the other, the left testis being the foremost. Sometimes, however, the testes are arranged one directly behind the other, in which case they are transversely oval or longitudinally elongate, the former condition being the result of contraction and the latter of excessive relaxation of the body. When rounded, the testes are between 0.12 mm. to 0.16 mm. in diameter, when transversely oval 0.18-0.2 mm. by 0.32-0.34 mm., when elongate 0.23-0.32 mm. by 0.12-0.14 mm. The ovary lies usually to the right of the median line, overlapping the postero-lateral margin of the ventral sucker. It is globular and measures between 0.08 mm. to 0.24 mm. in diameter. In the younger specimens the ovary is a little smaller than the testes, but in older specimens it is larger. There is an elongate receptaculum seminis lying in or

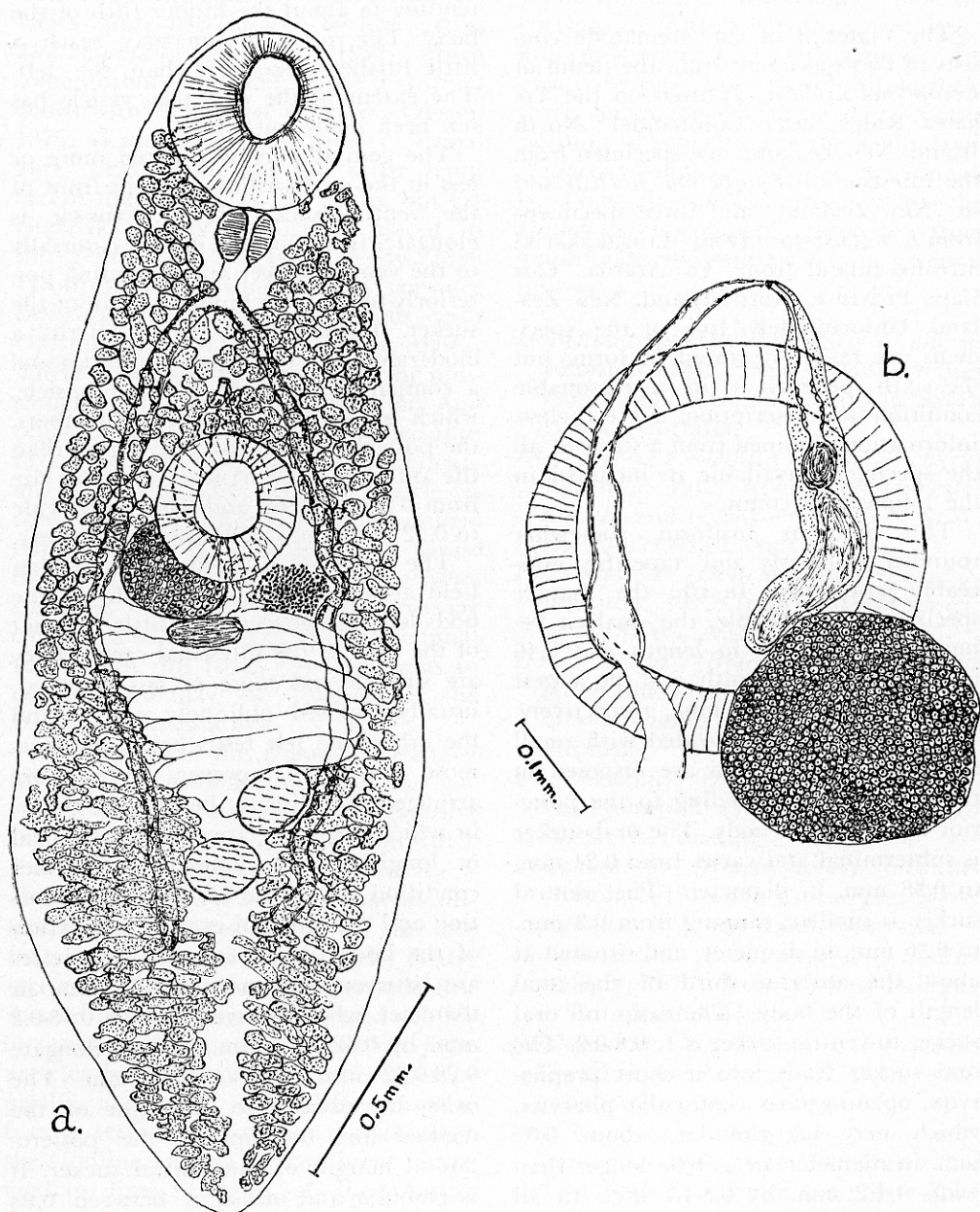


Fig. 1. *Dolichosaccus* (*L.*) *novaezealandiae*, sp. nov. (a) complete worm; (b) copulatory complex (dorsal view).

near the median line behind the ovary. The oötype is very indistinct in the present specimens and lies to the left of the ovary. The vitelline glands consist of irregularly-shaped follicles, disposed laterally, but also overlying the intestinal caeca dorsally and ventrally, and extending from the oral sucker to the posterior end of the body, or near to it. In front of the ventral sucker and behind the posterior testis the follicles are confluent in the median line. Occasionally, the median area behind the posterior testis is free of follicles. The uterine coils lie between the ovary and the testes, frequently extending laterally beyond the intestinal caeca to the margins of the body. The vagina is long and thin walled. The eggs measure 0.042-0.047 mm. x 0.025-0.030 mm. The egg-shell is relatively thick and its surface is covered with small tubercles. In many of the eggs the shell has a thickening at the anopercular pole, which often appears as a very small cylindrical boss.

The new form resembles very closely *D. (L.) lygosomae* Fischthal and Kuntz and *D. (L.) rastellus* (Olsson) in that the vitelline follicles in the anterior region of the body are confluent in the median line, at least in the dorsal parenchyma. It differs from *D. lygosomae* in its larger eggs, and from *D. rastellus* in its smaller cirrus-sac, which does not reach posteriorly beyond the ventral sucker. Nevertheless, its most readily definable character appears to be the small tubercles on the egg-shell, a feature not described hitherto in any species of *Dolichosaccus*.

Unfortunately, it is not yet possible to say whether *D. (L.) novaezealandiae* is specific to *Leiopelma*, because three species of the genus *Hyla* appear to have been introduced into New Zealand from Australia in recent times, and the parasites of these frogs might have included this trematode, which was able to adapt

itself to new intermediate hosts and become established satisfactorily in the new locality.

Dolichosaccus (Lecithopyge) rastellus
(Olsson, 1876)

Synonymy: *Distomum rastellum* Olsson, 1876; *Opisthioglyphe rastellus* Looss, 1907; *Lecithopyge rastellum* Perkins, 1928.

(Fig. 2 a-b)

The following description is based on the examination of over 40 specimens from the intestine of *Rana temporaria* from various English localities, and 4 specimens from the duodenum of *Rana temporaria parvipalmata* from the Province of Alva, Spain.

The body is fusiform or elongate oval, rounded anteriorly and tapering posteriorly. Mature specimens vary considerably in size, ranging from 1.3 mm. long and 0.5 mm. wide to 4.2 mm. and 1.2 mm., respectively. Cuticular spines are arranged quincuncially in transverse rows extending to the hinder end of the body. The oral sucker is subterminal and measures 0.18 mm. to 0.38 mm. in diameter. The ventral sucker is situated at or somewhat behind the middle of the anterior half of the body and has a diameter varying between 0.11 mm. and 0.29 mm. The ventral sucker/oral sucker ratio is 1: 1.2-1.5. A short prepharynx is often distinguishable and the pharynx is more or less globular, measuring 0.12 mm. to 0.24 mm. in transverse diameter. The pharynx/oral is 1: 1.5-2.0. The pharynx in uncontracted specimens is campanulate, with a crenate margin showing six scollops, and even in some contracted specimens indications of the scollops may be recognized. The oesophagus is about as long as the pharynx and its walls are composed of an inner

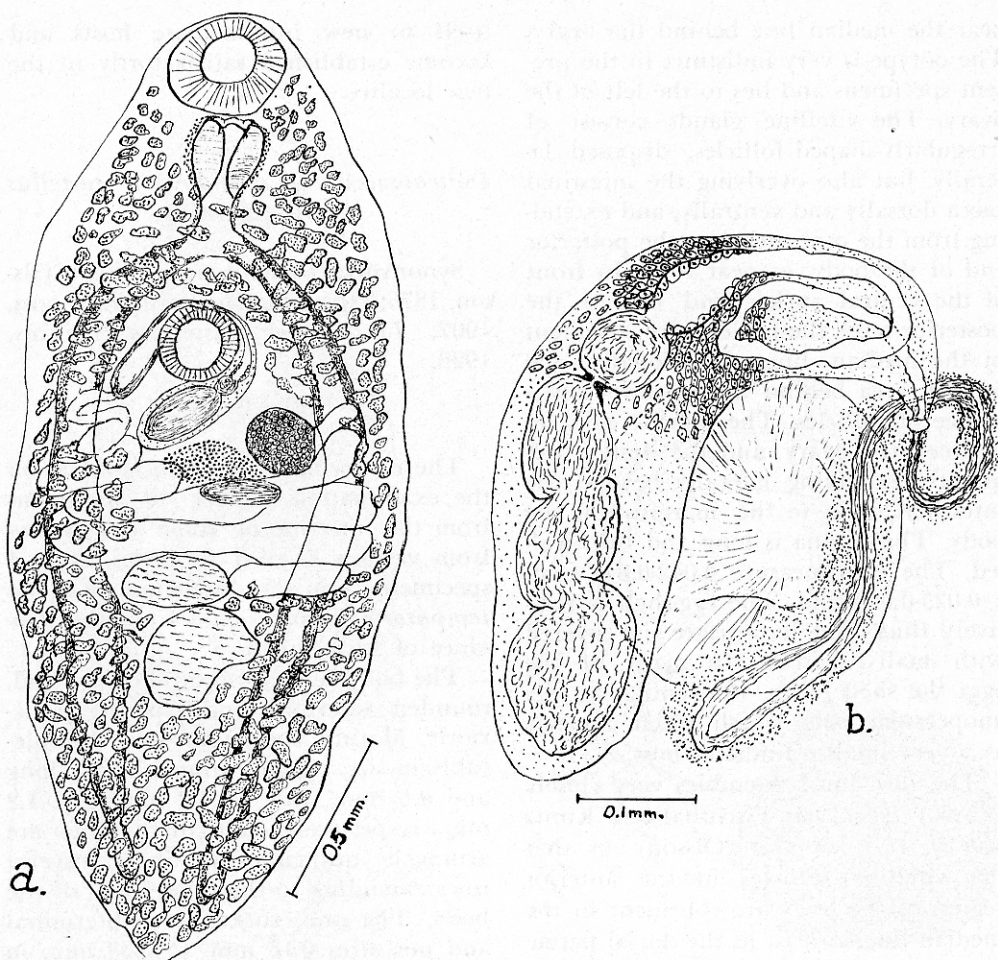


Fig. 2. *Dolichosaccus* (L.) *rastellus* (Olson, 1876). (a) complete worm; (b) copulatory complex (dorsal view).

layer of strong longitudinal muscle-fibres and an outer layer of strong circular fibres. It appears to be lined with a thin cuticle. Often the oesophagus and pharynx appear to be invested with a thick nucleated tissue. The oesophagus bifurcates about midway between the suckers and opens into a pair of intestinal caeca, which extend in to the hinder region of the body, where one caecum often extends further posteriorly than the other. The caeca are lined with a tall epithelium.

The genital pore may be situated in

the median line immediately in front of the ventral sucker, but much more often it lies to the left on the antero-lateral border of the ventral sucker. The cirrus-sac is a well-developed, usually arcuate structure, extending posteriorly well beyond the hinder margin of the ventral sucker to reach the ovary. It contains a voluminous seminal vesicle, which is constricted into a broadly cylindrical hinder portion and a relatively small bulbous anterior portion opening into a thick-walled prostatic organ surrounded by numerous prostatic glands. The latter or-

gan is followed by a narrow ejaculatory duct that soon becomes modified into a smooth cirrus, often found protruding through the genital opening and sometimes reaching a length of 0.5 mm. The cirrus-sac varies in size from 0.34 mm. long and 0.12 mm. wide to 0.64 mm. long and 0.18 mm. wide.

The testes are globular, 0.16 mm. to 0.4 mm. in diameter. In some specimens the anterior testis has a greater diameter than the posterior, whilst in other specimens the latter testis is the larger. They lie one behind the other, either directly or somewhat diagonally, between the intestinal caeca at about midway between the ventral sucker and the posterior end of the body. The ovary is situated to the right of the median line, laterally to the hinder region of the cirrus-sac, which passes between the ovary and the ventral sucker. It is rounded and has a diameter varying between 0.1 mm. and 0.3 mm., usually being smaller than either of the testes. An elongate receptaculum seminis lies at about midway between the ovary and the testes. The oötype is quite distinct in some specimens and is situated in the median region, close behind the ovary and the cirrus-sac. The irregularly-shaped vitelline follicles extend from the oral sucker to the posterior end of the body in the lateral regions, overlapping the intestinal caeca dorsally and ventrally. Behind the testes the follicles are confluent in the median line, and in the oesophageal region they are confluent dorsally, only occasionally ventrally. The uterine coils are disposed in transverse slings, mainly between the ovary and the testes, and extending to the lateral margins of the body in this region. The coils may also encroach into the fields lateral to the testes. The muscular metratrem is invested with numerous gland-cells and is almost as long as the cirrus-sac. The eggs measure 0.045-0.050 mm. x 0.022-0.025 mm. The shell is smooth and often

there is a blunt boss at the anopercular pole.

As stated above, the writer has had the opportunity of studying the holotype and paratype specimens of the subspecies *Dolichosaccus (Lecithopyge) rastellus subulatus* (Perkins), from *Rana temporaria* and *Bufo bufo* in England, and the holotype of *D. (L.) rastellus cylindriciformis* (Perkins) from *Rana temporaria* in England or France. Although allocating subspecific names to these forms, Perkins (1928) merely regarded them as geographical races of the typical form described by Olsson (1876) from *Rana temporaria* and *Bufo bufo* in Sweden. On the other hand, Perkins did indicate morphological differences between the subspecies, and the specimens described above agree with his subspecies *subulatus*. The type-specimen of *D. (L.) r. cylindriciformis* appears to have been much flattened, and this condition probably accounts for the size of the body, suckers and eggs appearing to be larger than that normally found in *D. (L.) r. subulatus*. The typical form of *D. rastellus* from Sweden is, by modern standards, inadequately described, but it appears to differ, according to Perkins, from the subspecies *subulatus* in having a distinctly smaller cirrus-sac, as well as smaller eggs, but until further specimens are described from Sweden, the question of whether or not the British and Swedish forms are really distinct subspecifically cannot yet be resolved with any certainty.

Manter and Pritchard (1964) have recorded and described *D. (L.) rastellus subulatus* from *Bufo regularis* in the Congo. Their specimens appear to agree in almost every respect morphologically with the English specimens described above. There is, however, an important difference, for the Congolese specimens are said to possess a cirrus covered with minute spines. In none of the well-preserved English specimens has this feature

been seen, so if the observation of Manter and Pritchard be correct, then it suggests that the English and Congolese specimens are taxonomically distinct from one another. To settle this question satisfactorily a first-hand comparative study of specimens from both localities seems to be necessary, perhaps more particularly because no other opisthioglyphine trematode is known to possess a spiny cirrus.

Yamaguti (1958) listed 8 species of the genus *Dolichosaccus* and these included *D. amplicava* Travassos, 1924, from frogs in South America. Travassos (1930), however, transferred this species to the genus *Opisthioglyphis*, and there seems to be no reason why this later assignation should not be accepted, especially as the species does not possess the principle feature of *Dolichosaccus*, namely, a bipartite seminal vesicle. Subsequently to 1958, a further species, *D. lygosomae* Fischthal and Kuntz, was described from a scincid reptile in the New Hebrides.

The known geographical distribution of *Dolichosaccus* presents a rather interesting pattern, for of its 9 recorded species, six occur in Australia, one, *D. rastellus*, in Africa and Europe, one, *D. lygosomae*, in the New Hebrides and one, *D. novaezealandiae*, in New Zealand. These three latter species show a much closer morphological resemblance to each

other than they do to the Australian species and constitute the subgenus (*Lecithopyge*).

These facts might suggest that the genus *Dolichosaccus* evolved in Australia, where its greatest morphological diversity appears to have occurred, and that a dominant species radiated from there into regions now known as southern Africa and the Pacific Islands. If such were the case, then it is also conceivable that this dominant species still exists in the form of *Dolichosaccus* (*L.*) *rastellus*, which reached southern Africa and, after the separation of the southern continents in Cretaceous times, spread northwards into the western Palaearctic region, while its representatives in the Pacific underwent speciation through geographical isolation. The indication that a form belonging to *Dolichosaccus* (*Lecithopyge*) does not occur in Australia, but does in the surrounding areas, appears to qualify a principle of zoogeographers that centres of evolution and dispersal are also likely to be centres of extinction (Darlington, 1957). Nevertheless, it must be realized that relatively little is known of the helminths of amphibians and their distribution in the southern hemisphere, and until much more information on this subject becomes available it seems pointless to conjecture further on the origin of *Dolichosaccus* or on the evolutionary pattern of its distribution.

LITERATURE

- DARLINGTON, P. J., JR., 1957. *Zoogeography: the geographical distribution of animals*. xvi + 675 pp., illus., New York.
- DOLLFUS, R. P., 1949. *Distoma rubens* F. Dujardin, 1845 (= *exasperatum* Rudolphi, 1819) retrouvé en France et redécrit. *Annls. Parasit. Hum. Comp.* 24: 436-442.
- , 1960. Groupement des espèces dans le sous-famille Opisthioglyphinae R. Ph. Dollfus, 1949. In: *Libro homenaje al Dr. Eduardo Caballero y Caballero, Jubileo 1930-1960*. México, D. F. (Instituto Politécnico Nacional): 113-117.
- FISCHTHAL, J. H. and R. E. KUNTZ, 1967. Digeneic trematodes of amphibians and reptiles from Fiji, New Hebrides and British Solomon Islands. *Proc. helminth. Soc. Wash.* 34: 244-251.
- JOHNSTON, S. J., 1912. On some trematode parasites of Australian frogs. *Proc. Linn. Soc. N. S. W.* 37: 285-362.
- JOYEUX, C. and J. G. BAER, 1961. Classe des Trématodes. (Trematoda Rudolphi). In: Grassé, P. P., *Traité de Zoologie; anatomie, systématique, biologie*. 4: Fasc. 1: 561-692.

- MANTER, H. W. and M. H. PRITCHARD, 1964. Mission de Zoologie médicale au Maniema (Congo Léopoldville) (P. L. G. Benoit, 1959) 5 — Vermes Trematoda, *Annls. Mus. r. Afr. cent.* (8 to), (Zool.) No. 132: 75-101.
- NICOLL, W. 1918. The trematode parasites of North Queensland. 4. Parasites of reptiles and frogs. *Parasitology* 10: 368-374.
- OLSSON, P., 1876. Bidrag till skandinavians helminthfauna. 1. K. *Svenska Vetensk.-Akad. Handl.*, Stockholm (1875) 14: Art. 1, 35 pp.
- PERKINS, M., 1928. A review of the Telorchinae, a group of distomid trematodes. *Parasitology* 20: 336-356.
- TRAVASSOS, L. 1930. Pesquisas helminthologicas realizadas em Hamburgo. IV. Notas sobre o genero *Opisthioglyphe* Looss, 1899 e genero proximos. *Mem. Inst. Oswaldo Cruz.* 24: 1-17.
- YAMAGUTI, S., 1958. *Systema Helminthum. Vol. I. pts. I-II. The digenetic trematodes of vertebrates.* New York & London (Interscience Publishers), pp. xi, 1575.