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Examination of amphistomes *(Trematoda : Paramphistomidae)* of some Africain mammals

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RÉSUMÉ

Les auteurs donnent la liste des diverses espèces d'amphistomes recueillies dans l'estomac d'éléphants, d'hippopotames et de divers ruminants de pays d'Afrique centrale (Tchad, Cameroun, Centrafrique) du Niger, du Congo et de l'Ethiopie, dont certaines font l'objet d'une étude histologique détaillée. Ils donnent également des précisions sur les hôtes nouveaux ainsi que sur leur répartition géographique.

Helminth parasites of domestic ruminants and games of the countries situated in the central and north-east regions of Africa were scantily studied up to 1950. In the last decades, however, an intensive research work has been carried out and several papers (6, 9, 10, 11, 12, 13, 15, 14, 16, 17) reported on helminths, among others, on amphistomes as well from the area of the scope of this paper.

Test material of this paper was collected by one of us in the period of 1954-1976 in the Central African Republic (C. A. R.), Republic of Chad (R. C.), Republic of Niger (R. N.), Republic of Cameroon (R. Cm.), Popular Republic of Congo (R. Cg.) and Socialist Republic of Ethiopia.

Flukes after removal from the rumina were fixed on the spot and preserved in 5 per cent formalin. Median sagittal sections and whole mounts were prepared by the usual methods.

The present paper does not only intend to increase our knowledge on amphistome fauna of the countries in question but is also a further contribution to the explanation of the geographical distribution of some amphistomes.

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RESULTS AND DISCUSSION

In the collection at the disposal for the examination, the following species have been recovered :

1. PARAMPHISTOMIDAE Fischoeder, 1901.

1.1. Paramphistomum bothriophoron (Braun, 1892) Fischoeder, 1901

This species was found in *Bos indicus* (R. Cm.). In the territory including the scope of this paper, it was found earlier in R. C. (9) and in R. Cm. (15).

On the basis of existence of a large genital opening, this species is easily recognizable. The histo-morphological structure of the genital opening agreed in full length with that of NÄSMARK's description (30).

1.2. Paramphistomum clavula Näsmark, 1937.

This species was found in *Bos indicus* and *Syncerus caffer* in C. A. R. and R. N. Specimens of *Paramphistomum clavula* were found by Näsmark (30) under this name in Looss' collection. According to NASMARK (30), *Paramphistomum cervi* of STUNKARD (37) is also identical with this species. Later, SOBRERO (36)

DINNIK (53) and STRYDONCK (39) found it in some of other african countries.

Outside Africa, its occurrence was mentioned in Cuba (19, 21) and Bulgaria (29) ; these findings, however, need reexamination.

PRUDHOE (34), after examination of amphistome material collected in Zaire came to the conclusion that *Paramphistomum clavula* is a synonym of *Paramphistomum microbothrium* Fischoeder, 1901.

In identification of the two species, NASMARK (30) emphasized the presence of an enormously developed genital sphincter of *Paramphistomum clavula* (*Clavula* type) to the contrary with a moderately developed one of the *Paramphistomum microbothrium* (*Microbothrium* type). PRUDHOE (34) regarded the former type to be a functional condition of the latter and, accordingly, the *Clavula* type is identical with the *Microbothrium* type of genital atrium.

We can agree with PRUDHOE's supposition (34) referring to the mechanism of copulatory apparatus, transformation of the penis-papilla (= genital papilla sensu Näsmark), but it is not clear whether or not the process of transformation of the penis-papilla is accompanied with an increase and decrease of measurements of the genital sphincter which, otherwise, seems to be the most important difference between the two species in question. If PRUDHOE's arguments (34) are true means that the measurement of the genital sphincter in « resting » condition (indicated by PRUDHOE on fig. 7A) ought to have been several times larger (characterized by *Clavula* type) than in other conditions of the penis-papilla (characterized by *Microbothrium* type).

Having examined a great number of *Microbothrium* of genital atria (*Paramphistomum microbothrium* and *Paramphistomum daubneyi*) exhibiting different conditions of the penis-papilla, it was found that the measurement of the genital sphincter did not altere significantly (figs. 1-3) and, at the same time, the bigger size of the genital sphincter was experienced in the *Clavula* type in other conditions than the « resting » one (fig. 5), e. g. active condition (fig. 4).

These observations indicate that the differences of measurement of the genital sphincter in species *Paramphistomum clavula* and *Paramphistomum microbothrium* are rather a specific than a functional peculiarity, supporting the validity of *Paramphistomum clavula*.

*1.3. **Paramphistomum phillerouxi*** Dinnik, 1961.

It was found in *Syncerus caffer* (C. A. R.) and in *Bos indicus* (R. N.).

The distribution of this species is known in some East and South-East african countries (2, 4, 35). The present findings represent newer data to the range of its distribution.

*1.4. **Buxifrons buxifrons*** (Leiper, 1910) Näsmark, 1937

It was found in a great number in *Hippopotamus* (R. C.).

Our specimens were also immatures, similarly to the ones of earlier authors. Its occurrence in R. C. seems to be a new item of data to its geographical distribution.

*1.5. **Buxifrons maxima*** Näsmark, 1937

Together with the preceding species, it was collected from *Hippopotamus* (R. C.). Specimens of our collection were also immature. This species was recovered from this country by DOLLFUS (6) and GRABER (9).

*1.6. **Gigantocotyle symmeri*** Näsmark, 1937

It was recovered in *Syncerus caffer* (C. A. R.). Earlier, it was reported from R. C. (9) and R. Cm. (15).

This species was described for the first time from the Sudan cattle sacrificed at the Cairo slaughter house. Our finding is a new host record.

In the histo-morphological structure of the genital opening and in the acetabulum, some deviations were discovered which might be in connection with the fact that the test material at

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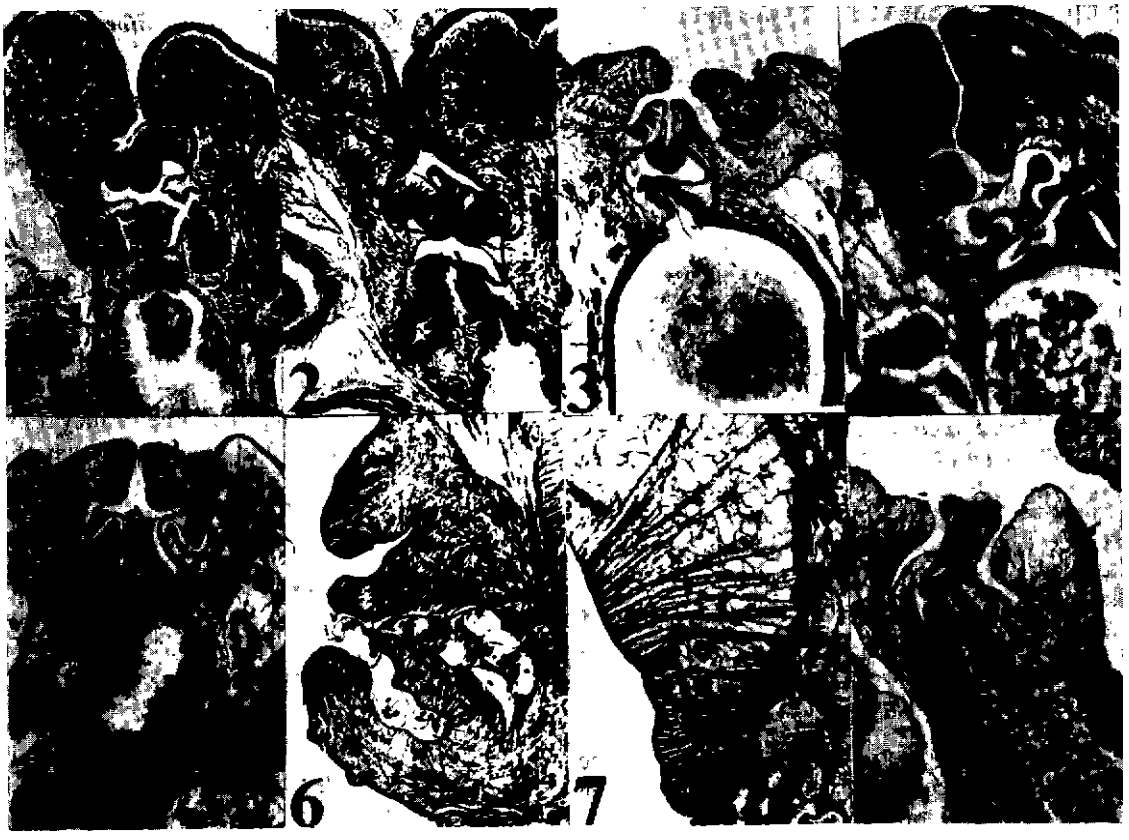
Figs 1-9. — Median sagittal sections, 1-3 *Microbothrium* type of genital atria showing different condition ; 4-5 Clavula type of genital atria showing different condition ; 6-7 genital atrium and dorsal half of acetabulum of *Gigantocotyle symmeri* ; 8 genital atrium of *Carmyerius exoporus* ; 9 genital atrium of *Brumtia bicaudata*.

Figs 10-15. — Cross sections of pharyngeal sac of *Stephanopharynx coilos*, 10 upper arch of pharyngeal sac ; 11 mouth opening with beginning of tissue pillar situated in pharyngeal cavity ; 12-14 position of tissue pillar in different level ; 15 attaching of tissue pillar to bottom of pharyngeal sac.

Fig. 16. — Median sagittal section of genital atrium of *Stephanopharynx coilos*.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disposal of NASMARK (30) was not in the best condition.

The genital opening is of *Gigancotyle* type and our observations agree with NASMARK's (30), but the genital sphincter was found less developed (about 100 × 50 µ) than that of the *Clavula* type (fig. 6) that it resembled to.

The acetabulum is of *Symmeri* type, the number of the muscular units in the muscle layers, however, differ from that of NASMARK's (30) : d. e. I. 10 (18) (*), d. e. 2. 14 (10), d. i. 51 (33), v. e. 13 (16), v. i. 51 (31) (fig. 7).

*1.7. **Glyptamphistoma paradoxus*** (Näsmark, 1937) Yamaguti, 1958

It was found in *Hippopotamus* sacrificed in R. C. (Dougia). Specimens of our collection were immature.

This species was described for the first time in the Sudan (30) and recently in R. C. (9).

*1.8. **Nilocotyle hippopotami*** Näsmark, 1937

A great number of specimens were recovered in the sample collected from *Hippopotamus* in Ethiopia (Lake of Boyé, Jimma, Kaffa) and in R. C. (Dougia).

For the first time, it was described from the Sudan (30) and later from R. C. (9).

*1.9. **Nilocotyle minuta*** (Leiper, 1910) Näsmark, 1937

In our collection, there were some specimens found in *Hippopotamus* in R. C. (Mendelia, Dougia). This finding is a new distributional record. In other african countries, its occurrence is known in the Sudan (30) and in Uganda (5, 23).

*1.10. **Nilocotyle praesphinctris*** Näsmark, 1937

This species was found in *Hippopotamus* in R. C. (Dougia). Beside this area, it was recovered in the Sudan (30) and in Republic of South Africa (38).

*1.11. **Nilocotyle pygmaea*** Näsmark, 1937

It was found in Hippopotamus (R. C.). Our finding is a further contribution to its distribution. For the first time, it was recovered in the Nile Valley (30).

*1.12. **Platyamphistoma polycladiformis*** (Näsmark, 1937) Yamaguti 1958

Several specimens were found in the sample derived from *Hippopotamus* from R. C. (Mendelia, Dougia). For the first time, it was described from the Sudan (30). In R. C., its occurrence was pointed out earlier (9).

*1.13. **Ugandocotyle pisum*** (Leiper, 1910) Näsmark, 1937

Single specimen was found in the stomach of *Hippopotamus*, R. C. This species has been recovered so far along the Nile Valley (The Sudan, Uganda). Our finding indicates that this species has been living in other african water bodies, as the Lake of Chad and its rivers

*2. **GASTROTHYLACIDAE*** Stiles et Goldberger, 1910

*2.1. **Carmyerius cruciformis*** (Leiper, 1910) Fukui, 1923

This species was found for the first time in Uganda by LEIPER (23). Later, it was recovered in other African countries : Dahomey (20), Kenya (26). In our collection, this species was found in *Hippopotamus* killed in R. C. (Dougia). It is a new distributional record.

*2.2. **Carmyerius exoporus*** Maplestone, 1923

In our collection, there was a sample of this species derived from the R. Cg. cattle. In other african countries, it was recovered in Malawi (26), in Zaire (34), in R. C. and C. A. R. (13).

One of the characteristic feature of its own is that the genital opening is situated outside of the ventral pouch (fig. 8).

*2.3. **Carmyerius graberi*** Gretillat, 1960

This species was described for the first time from a collection derived from R. C. Later, it was repeatedly found in this country (9) and other african ones : C. A. R. (12), R. Cm. (15).

In our collection, there was a sample collected from *Redunca redunca*, C. A. R.

*2.4. **Carmyerius spatiosus*** (Brandes, 1898) Stiles et Goldberger, 1910

It seems that this species is one of the commonest species of this genus found in our collection. It was recovered in samples collected in *Redunca redunca*, C. A. R., *Syncerus caffer*, C A. R. and *Bos indicus*, R. N.

(*) Number in brackets refer to NASMARK's data (30).

In the territory forming the scope of this paper, it was recovered in R. C. (9, 13), in C. A. R. (12, 14), in R. Cm. (15). In other african countries, its occurrence was reported in Zambia (22, 25), in R. Cg. (18), in the Sudan (1), in Zimbabwé (32) and in the Giza zoological garden (8).

3. *BRUMPTIIDAE* Skryabin, 1949

Brumptia bicaudata (Poirier, 1909) Strunkard, 1926

Several specimens were found in a sample collected from elephant in C. A. R. It is the second time that this parasite is collected in C. A. R., the first one being at Dinga in 1964 (*). Beside this, *Brumptia bicaudata* occurs in Zaire (6, 2, 37), in R. C. (9, 33) and in Zambia (28).

The morphology and anatomy of this species were studied by Mac CALLUM (24), STUNKARD (37), MAPLESTONE (26) and WILLMOT (40), without carrying out of the typifying of genital opening.

This species has the unique feature that the male and the female genital end-parts are surrounded by a muscular capsule (hermaphrodite pouch) enclosing an internal seminal vesicle, *pars prostatica*, *ductus ejaculatorius* and metraterm. The later two parts, after uniting, run to the muscular hermaphrodite bulb and its apex projects into a triangular place which is bordered by two large papillae, like segments of an orange, which we regard to be genital papilla on the basis of the analogy of NÄSMARK's nomenclature (Fig. 9). These papillae are almost composed of lymph channels with poorly developed radial and somewhat more developed circular muscle units along the borders of these papillae without forming a sphincter. The genital atrium is moderately developed (fig. 9).

On the basis of both measurement and structure of the genital opening of this species, we regard it to be a new one, called *Bicaudata* type.

4. *STEPHANOPHARYNGIDAE* Skryabin, 1949

4.1. *Stephanopharynx coilos* Dollfus, 1963

This species was described for the first time in the Zaire from *Hippotragus equinus* by DOLLFUS (7).

In our collection, it was found in a sample derived from C. A. R. in *Syncerus caffer*. Earlier, it was recovered in R. C. (9). Our finding is a new host and distributional records.

The mouth opening of *Stephanopharynx coilos* is ventral in position (fig. 11) and an enormously developed pharyngeal sac attaches to the posterior end of the pharynx. This cavity extends to both anteriorly (fig. 10) and dorsally, but the more voluminous part is found posterior to the pharynx.

The structure of this organ was studied by NASMARK (30), GRETILLAT (17) and DOLLFUS (7). The latter authors found this cavity as an empty sac with furrows and tissue folds along its inner surface. NASMARK (30) examined sagittal sections of this species and found that there is a dividing wall in it running in the median sagittal plane and accordingly, in the pharyngeal sac, there are two, chiefly dorsally, oriented cavities which communicate with each other and the oesophagus by a lower-lying ventral cavity.

The clarification of the structure of this organ seems to be easier by examination of cross sections than that of median sagittal ones. Such examinations revealed that the furrows and tissue folds exist as they were indicated by DOLLFUS (7). Beside these elements, there was found a centrally located colum-like tissue growing out of the bottom of the cavity and elevates up to the level of the mouth opening (fig.11-15). Around this column, different parts of the pharyngeal sac communicate with each other and the oesophagus. Probably, this column-like structure is identical with NÄSMARK's dividing wall seen on the media sagittal plane. This column, however, does not seem to be a constant component of the pharyngeal sac : in our collection, there were specimens without this.

The structure of the genital opening is entirely the same as described by NASMARK (30) under the name of *Stephanopharynx* (fig. 16).

4.2. *Stephanopharynx compactus* Fischoeder, 1901

This species was also found in C. A. R. in *Syncerus caffer*. Histo-morphology of the muscular organs of it agreed well with the classical description of this species (17, 30).

In other african countries, its occurrence was reported from Uganda (27), Zambia (22, 26), Republic of South Africa (31), R. C. (9), R. Cm. (15) and the Giza zoological garden (8).

(*) GRABER, unpublished.

SUPPLEMENT

Although this paper deals with studies of amphistomes in mammals of countries determining the geographical scope, our collection also contains two non-amphistome species, *Parafasciola robusta* (Lorenz, 1881) Odhner, 1926 found in elephant (C. A. R.) and *Ogmocotyle* sp. found in *Hippopotamus* (Dougia, R. C.).

The species of *Ogmocotyle* deserves more attention because this is the second report on the occurrence of the species of this genus in Africa. The first *Ogmocotyle* sp. was found by McCULLY *et al.* (25) in the same host in the Kruger National Park (South Africa). They regarded their species as a new one, but they neither designated the name of the species, nor gave a description of it.

On the basis of examination of whole mounts and sections, it was found that the specimens of our sample were identical with the species *Ogmocotyle indica* (Bhalerao, 1942) Ruiz, 1946. This finding represents new records for both the host and its distribution.

CONCLUSIONS

In conclusion, we cite DOLLFUS (6) : « il est possible de dire que la faune trématodologique de l'Afrique tropicale et subtropicale paraît assez homogène ; les espèces décrites d'abord de la vallée du Nil, du Soudan et de l'Ouganda sont peu à peu retrouvées vers le centre et vers l'ouest jusqu'à l'Atlantique et vers le sud jusqu'à l'Union Sud-Africaine chez les mêmes hôtes ou chez des hôtes vicariants... »

The present study corroborates this opinion.

SUMMARY

Examination of Amphistomes *(Trematoda : Paramphistomidae)* of some african mammals

The authors report on amphistomes found in a collection derived from different mammals, mainly ruminants of central and North-east african countries.

They were as follows : *Paramphistomum bothriophoron* Braun, 1892 ; *Paramphistomum clavula* Näsmark, 1937 ; *Paramphistomum phillerouxi* Dinnik, 1961 ; *Buxifrons buxifrons* Leiper, 1910 ; *Buxifrons maxima* Näsmark, 1937 ; *Gigantocotyle symmeri* Näsmark, 1937 ; *Glypamphistoma paradoxus* Näsmark, 1937 ; *Nilocotyle hippopotami* Näsmark, 1937 ; *Nilocotyle minuta* Leiper, 1910 ; *Nilocotyle praesphinctris* Näsmark, 1937 ; *Nilocotyle pygmaea* Näsmark, 1937 ; *Platyamphistoma polycladiformis* Näsmark, 1937 ; *Ugandocotyle pisum* Leiper, 1910 ; *Carmyerius cruciformis* Leiper, 1910 ; *Carmyerius exoporus* Maplestone, 1923 ; *Carmyerius graberi* Gretillat, 1960 ; *Carmyerius spatiosus* Brandes, 1898 ; *Brumptia bicaudata* Poirier, 1909 ; *Stephanopharynx coilos* Dollfus, 1963 ; *Stephanopharynx compactus* Fischoeder, 1901 ; *Protofasciola robusta* Lorenz, 1881 and *Ogmocotyle indica* Bhalerao, 1942.

Histo-morphological details have also been discussed in connection with some species as well as newer hosts and distributional records have been reported.

RESUMEN

Observación de los Amfistomos *(Trematoda : Paramphistomidae)* de algunos mamíferos de Africa

Los autores dan la lista de las varias especies de Amfistomos recogidas en el estómago de elefantes, de hipopótamos y de varios rumiantes de Africa Central (Chad, Camerún, Centroafrica) del Niger, del Congo y del Etiopia, de que algunas son objeto de un estudio histologico detallado. Dan tambien precisiones sobre los nuevos huespedes así como sobre su repartición geográfica.

BIBLIOGRAPHIE

1. BAER (J. G.). Résultats zoologiques du voyage du Dr P. A. Chappuis au Nil supérieur. III. Helminthes. *Revue suisse Zool.*, 1923, **30** (13) : 337-352.
2. DINNIK (J. A.). *Paramphistomum phillerouxi* sp. nov. (*Trematoda : Paramphistomatidae*) and its development in *Bulinus forskalii*. *J. Helminth.*, 1961, **35** (1/2) : 69-90.
3. DINNIK (J. A.). Intestinal paramphistomiasis and *Paramphistomum microbothrium*, Fischoeder in Africa. *Bull. epizoot. Dis. Afr.*, 1964, **12** (4) : 439-454.
4. DINNIK (J. A.). The snail hosts of certain *Paramphistomidae* and *Gastrothylacidae* (Trematoda) discovered by the late Dr P. L. Le Roux in Africa. *J. Helminth.*, 1965, **39** (2/3) : 141-150.

5. DINNIK (J. A.), WALKER (J. B.), BARNETT (S. F.) BROCKLESBY (D. W.). Some parasites obtained from game animals in western Uganda. *Bull. epizoot. Dis. Afr.*, 1963, **11** (1) : 37-44.
6. DOLLFUS (R. P.). Trématodes récoltés au Congo Belge par le Professeur Paul Brien (mai-août 1937). *Ann. Mud. r., Congo Belge, C. Zoologie* (sér. 5), 1950, **1** (1) : 1-136.
7. DOLLFUS (R. P.). Hôtes et lieux de récolte de quelques Trématodes digénétiques de vertébrés de la collection du Musée Royal de l'Afrique centrale. *Revue Zool. Bot. afr.*, 1963, **68** (3/4) : 323-357.
8. EZZAT (M. A. E.). Helminth parasites of some ungulates from the Giza Zoological gardens, Egypt, with an appendix on some Nematodes from the African Rhinoceros. Le Caire, Min. Agric., *Tech. Sci. Serv. (Vet. Sect.)* 1943, Bull. 241, I-104.
9. GRABER (M.). Helminthes parasites de certains animaux domestiques et sauvages du Tchad. *Bull. epizoot. Dis. Afr.*, 1969, **17** (4) ; 403-428.
10. GRABER (M.). Helminthes et helminthiases des animaux domestiques et sauvages d'Ethiopie. Rap. Mission Gouv. Ethiop., Maisons-Alfort, France, I. E. M. V. T., 1973(a), **1** : 1-201.
11. GRABER (M.). Helminthes et helminthiases des animaux domestiques et sauvages d'Ethiopie. Rap. Mission Gouv. Ethiop., Maisons-Alfort, France, I. E. M. V. T., 1973(b), **2** : 1-80.
12. GRABER (M.). Les Trématodoses hépatiques et gastriques des zébus d'Afrique centrale. *Rev. Elev. Méd. vét. Pays trop.*, 1975, **28** (3) : 311-314.
13. GRABER (M.), DOUTRE (M.), FINELLE (P.), KERAVEC (J.), DUCROZ (G.), MOKOTAINGAR (P.). Les Helminthes de quelques Artiodactyles sauvages appartenant aux familles des Bovidés et des Suidés. Ces mammifères, en République du Tchad et en R. C. A., sont-ils des réservoirs de parasites pour les animaux domestiques vivant à leur contact ? *Rev. Elev. Méd. vét. Pays trop.*, 1964, **17** (3) : 377-420.
14. GRABER (M.), BOUCHET (A.), FINELLE (P.), DESROTOUR (J.), GRENGDABO (A.). Le parasitisme du Zébu dans l'Ouest de la République Centrafricaine. 2. Parasitisme des bouvillons et des adultes. *Rev. Elev. Méd. vét. Pays trop.*, 1969, **22** (4) : 509-519.
15. GRABER (M.), FERNAGUT (R.), OUMATIE (O.) Helminthes des zébus adultes de la région de Maroua (Nord-Cameroun). *Rev. Elev. Méd. vét. Pays trop.*, 1966, **19** (2) : 149-162.
16. GRETILLAT (S.). Amphistomes (*Trematoda*) des ruminants domestiques de la République du Tchad. Description d'un *Gastrothylacidae* nouveau *Carmyerius graberi* n. sp. *Annls. Parasit. hum. comp.*, 1960, **35** (4) : 509-527.
17. GRETILLAT (S.). Structure anatomique du diverticule pharyngien dans l'espèce *Stephanopharynx compactus* Fischoeder, 1901 (*Trematoda : Paramphistomidae*). *C. r. hebd. Séanc. Acad. Sci., Paris*, 1960, **250** : 4064-4066.
18. GRETILLAT (S.). *Carmyerius papillatus* n. sp. et *Carmyerius parvipapillatus* n. sp. (*Trematoda : Gastrothylacidae*) parasites des réservoirs gastriques de l'antilope *Kobus defassa* (Rüppl.). *Annls. Parasit. hum. comp.*, 1962, **37** (1/2) : 121-139.
19. HOVORKA (J.), PACENOVSKY (J.), MITTERPAK (J.). Druhové zastupenie trematodov podradu *Paramphistomata* na Kube. *Vet. Med., Praha*, 1974, **19** (47) : 265-270.
20. JOYEUX (C.), BAER (J. G.). Trématodes. *In* : JOYEUX (C.), GENDRE (E.), BAER (J. G.). Recherches sur les helminthes d'A. O. F. Paris, Mason, 1928, p. 9-15. (Coll. Soc. Path. exot., Monographie II.)
21. KOTRLA (B.), PROKOPIC (J.). Paramphistomiasis of cattle in Cuba. *Acta vet., Brno*, 1973, **42** (1) : 35-44.
22. LE ROUX (P. L.). Report of the assistant veterinary research officer. *A. Rep. Dept. Hlth., Northern Rhodesia*, 1933-1934, p. 28-71.
23. LEIPER (R. T.). The *entozoa* of *Hippopotamus*. — *Proc. zool. Soc. Lond.*, 1910-1 (15-16) : 233-251.
24. MAC CALLUM (G. A.). A new species of Trématode (*Cladorchis gigas*) parasitic in elephant. *Bull. Am. Mus. nat. Hist.*, 1917, **37** (36) : 865-871.
25. MC CULLY (R. M.), VAN NIEKERK (J. W.), KRUGER (S. P.). Observations on the pathology of Bilharziasis and other parasitic infections of *Hippopotamus amphibius, Linnaeus* 1758, from the Kruger National Park. *Onderstepoort J. vet. Res.*, 1967, **34** (2) : 563-618.
26. MAPLESTONE (P. A.). A revision of the *Amphistomata* of Mammals. *Ann. trop. Med. Parasit.* 1923, **17** (2) : 113-212.
27. METTAM (R. W. M.). Identification list of helminths from Departmental collection 1920-1931. *A Rep. Vet. Dept., Uganda*, 1931, Appendix 1 B, 1932, p. 1-36.
28. METTRICK (D. F.). Some Trematodes and Cestodes from mammals of Central Africa. *Revta. Biol., Lisboa*, 1962, **3** (2/4) : 149-170.
29. MIHAILOVA (P.), GATEVA (S.), NEDEVA (L.). Studies on the family *Paramphistomidae* Fischoeder, 1901 (*Paramphistomata*, Szidat, 1936). A study on the Paramphistomid fauna — sub-family *Paramphistominae* Fischoeder, 1901 in *Bos taurus brachyceros* in Bulgaria. *Godishnik Sofiys. Univ.*, 1974, **66** : 55-66.
30. NASMARK (K. E.). A revision of the Trematode family *Paramphistomidae*. *Zool. Bidr. Uppsala*, 1937, **16** : 301-566.
31. ORTLEPP (R. J.). Noorsig van Suif-afrikaanse helminte veral met verwysing na die wat in ons wildherkouers voorkom. *Tydskr. Natuurwet.*, 1961, **1** (2) : 203-212.
32. PIKE (A. W.), CONDY (J. B.). *Fasciola tragelaphi* sp. nov. from the Sitatunga, *Tragelaphus spekei* Rothschild, with a note on the prepharyngeal pouch in the genus *Fasciola* L. *Parasitology*, 1966, **56** (3) : 511-520.
33. POIRIER (J.). Trématodes parasites de l'éléphant d'Afrique. *C. R. Soc. fr. Avanc. Sci.*, 1909 : 580-582 (3e session, 1908).
34. PRUDHOE (S.). *Trematoda*. Explor. Parc natn. Upemba Miss. G. F. de Witte. 1957 (Fasc. 48) 1-28.
35. SACHS (R.), SACHS (C.). A survey of parasitic infestation of wild herbivores in the Serengeti region in Northern Tanzania and the lake Rukwa in Southern Tanzania. *Bull. epizoot. Dis. Afr.*, 1968, **16** (4) : 455-472.
36. SOBRERO (R.). Ricostruzione del ciclo de vita di *Paramphistomum clavula* (Näsmark, 1937), parassita dei ruminanti in Somalia. *Parassitologia*, 1962, **4** (2/3) : 165-167.
37. STUNKARD (H. W.). — The parasitic worms collected by the American Museum of Natural History expedition to the Belgian Congo 1909-1914. Part. I. *Trematoda. Bull. Am. Mus. nat Hist.*, 1929, **58** (6) : 233-289.
38. SWART (P. J.). A redescription of *Nilocotyle (Nilocotyle) praesphinctris* Näsmark, 1937 (*Trematoda : Paramphistomidae*) from *Hippopotamus amphibius. Onderstepoort J. vet. Res.*, 1966 **33** (1) : 73-86.
39. VAN STRYDONCK (D.). Contribution à l'étude de l'anatomie, de la morphologie et de la systématique des *Paramphistomidae* africains (Plathelminthes : *Trematoda*). *Annls. Mus. r. Afr. cent., Sér. in* 8°, 1970 (183) : 1-56.
40. WILLMOTT (S.). The morphology of *Brumptia bicaudata* (Poirier, 1908), Odhner, 1926 (*Trematoda, Paramphistomoidea*). *Proc. Zool. Soc., London*, 1960, **134** (4) : 623-634.