REDESCRIPTION OF *XEROXYURIS PARALLELA* (LINSTOW, 1908) N. GEN., N. COMB., PARASITE OF *XERUS INAURIS*

HUGOT J.P.*

Summary :

In 1908, von Linstow described *Oxyuris parallela* from a *Xerus capensis* captured in the Kalahari desert. In 1909, the same author described *Oxyuris polyoon* from a *Xerus setosus* captured in South West Africa. Inglis (1961), studying the syntypes, concluded that the specimens belonged to the same species, which he transferred to *Enterobius parallela* (Linstow, 1908). After re-description of this species, it appears that these parasites share with the oxyurids in the genus *Enterobius* a number of morphological characteristics which are common to all the Oxyuridae genera parasites in Primates which consequently does not justify keeping the species in this genus. In addition this species differs from the known species in the genus *Enterobius* by the following characteristics: pairs 2 and 3 of genital papillae farther from the cloacal opening and surrounded by weak chitinated rings not fusing posterior to cloaca; egg asymmetry less marked; egg non-embryonated and without operculum; lateral alae differently shaped. Finally the parasites of *Xerus* present original characteristics : genital apparatus prodelphic whereas the general type is amphidelphic; cloacal opening covered by a hood-shaped flap whereas it is a longitudinal slit in all the related taxa; extremity of the spicular pouch protruding from the cloaca; ring-shaped gubernaculum present. Consequently it is proposed to transfer the species to a new genus : *Xeroxyuris*. The type and only species is *Xeroxyuris parallela* (Linstow, 1908), parasite of *Xerus inauris* in South-Africa.

KEY WORDS : taxonomy. *Oxyuris parallela*. *Enterobius parallela*. *Xeroxyuris parallela* n. gen., n. comb. *Oxyuris polyoon*. *Enterobius polyoon*. *Enterobius polyoon*. *Dermatoxys polyoon*. *Xerus inauris*. Primates. Sciurids. Oxyurida. Nematoda.

Résumé : REDESCRIPTION DE *XEROXYURIS PARALLELA* (LINSTOW, 1908) N. GEN., N. COMB., PARASITE DE *XERUS INAURIS*

En 1908, von Linstow décrit *Oxyuris parallela* du caecum d'un *Xerus capensis* capturé dans le Kalahari. En 1909, le même auteur décrit *Oxyuris polyoon* chez *Xerus setosus* en provenance du Sud-Ouest Africain. En 1961, Inglis, après avoir réétudié les syntypes des deux espèces, conclut en mettant *Oxyuris polyoon* en synonymie avec *Oxyuris parallela* qu'il transfère dans le genre *Enterobius*. Après avoir redécrit ce parasite, nous proposons de le classer dans un genre nouveau : *Xeroxyuris*. L'espèce-type unique, *Xeroxyuris parallela* (Linstow, 1908), partage avec les espèces décrites dans le genre *Enterobius* certains caractères qui, étant également observés chez tous les autres Oxyuridae parasites de Primates, ne peuvent constituer des arguments permettant de la maintenir dans ce genre. D'autre part *X. parallela* se distingue du genre *Enterobius* pour les caractères suivants : les papilles génitales des paires 2 et 3 sont plus éloignées de l'ouverture cloacale, les anneaux chitinoïdes qui les entourent sont moins épais et ne se rejoignent pas en arrière du cloaque; l'asymétrie des œufs est moins marquée, ils ne sont pas embryonnés et ne possèdent pas d'opercule; les ailes latérales ont une forme différente. Enfin *X. parallela* possède également des caractères originaux qui permettent de la distinguer : appareil génital prodelphe, alors que le type généralisé est amphidelphe; ouverture cloacale recouverte par un rabat cuticulaire en forme de hotte de cheminée; poche spiculaire faisant saillie hors du cloaque; présence d'un gubernaculum de forme annulaire.

MOTS CLÉS : taxonomie. *Oxyuris parallela*. *Enterobius parallela*. *Xeroxyuris parallela* n. gen., n. comb. *Oxyuris polyoon*. *Enterobius polyoon*. *Enterobius polyoon*. *Dermatoxys polyoon*. *Xerus inauris*. Primates. Sciuridés. Oxyurida. Nematoda.

INTRODUCTION

In 1908, von Linstow described *Oxyuris parallela* from the caecum of a *Xerus capensis* Kerr, captured in the Kalahari desert. In 1909, the same author described *Oxyuris polyoon* from the caecum and colon of a *Xerus setosus* Forst (*sic*), captured in the then German South West Africa. During the next fifty years the description of *O. parallela* was overlooked. In 1916, Hall expressed the view that *O. polyoon* should probably be transferred to the genus *Dermatoxys* Schneider, 1866. This opinion was accep-

ted by Yorke & Maplestone (1926) who listed *D. polyoon* as a doubtful species of *Dermatoxys*. In 1930, Le Roux redescribed the species as *Enterobius polyoon* (Linstow, 1909) from a *Geosciurus capensis* shot in the district of Bloemhof (Transvaal). In a general review of the genus *Enterobius* Leach, 1853, Sandosham (1950) erroneously spelled the specific name "polyzoon". Finally, Inglis (1961), studying the syntypes of both *O. parallela* and *O. polyoon*, concluded that the specimens were indistinguishable and that "therefore the second name falls as a synonym of the first". He left the species in the genus *Enterobius* as *Enterobius parallela* (Linstow, 1908). In the present work after redescription of the parasites, it is proposed to transfer the species to a new genus: *Xeroxyuris*.

*Muséum national d'Histoire Naturelle, Laboratoire de Biologie Parasitaire-Protistologie-Helminthologie, CNRS URA n° 114, 61, rue Buffon, 75231 Paris cedex 05, France (hugot@mnhn.fr).

Fig. 1. – *Xeroxyuris parallela* (Linstow, 1908) n. gen., n. comb. males : A, caudal bursa in a ventro-lateral view; B, left lateral view of another male, view along the sagittal plate; C, ventral view of caudal bursa of another male; D, ventral view of the extremity of the spicule and gubernaculum; E, left lateral view of the spicule of A; F, spicule ventral view of another male; G, ventral view of the spicule of C; H, left lateral view of the extremity of the spicule and gubernaculum of F. Scale bar: A, C, D, H, 50 µm; B, E, F, G, 100 µm.

MATERIALS AND METHODS

Observations. Specimens stored in 70 % ethanol were studied under the light microscope as temporary wet mounts, first in water and later in lactophenol. We studied cross-sections made "free-hand" using small pieces of razor blade and a small brush. Drawings were made with the aid of a drawing tube.

Materials. Specimens used for the present redescription were sampled from lots MNHN 89KB, 90 KB, 123 KB & 21 KH, Laboratoire de Biologie Parasitaire – Protistologie – Helminthologie, Muséum National d'Histoire Naturelle, Paris.

RESULTS

XEROXYURIS N. GEN.

TYPE SPECIES : *Xeroxyuris parallela* (Linstow, 1908) n. comb.

DESCRIPTION

General. Buccal aperture delimited by three lips, each partly covering the corresponding oesophageal tooth; oesophageal teeth triangular (Fig. 3C, D, E), each with a small sharp denticule; four cephalic papillae readily visible with ventral papillae closer to amphids; cephalic vesicle present. Oesophageal bulb spherical.

Male. Lateral alae consisting of a simple triangular crest beginning half-way between anterior extremity and nerve ring, and ending anterior to caudal bursa. Ventral cuticle posterior to excretory pore exhibiting area rugosa represented by a split in the ventral region of each annulus. Four pairs of caudal papillae present, 1st and 4th pairs pedunculated, 2d and 3rd pairs sessile, flanking longitudinal cloacal aperture (Fig. 1A, C). Phasmidial tubes beginning near the origin of peduncles of 4th pair. Second and 3rd pairs surrounded by weak chitinized rings. Spicules highly variable in size and shape (Fig. 1B, E, F, G), but always with a strongly marked dorsal angular bend located at the junction between the posterior and median thirds of the spicule and clearly visible in lateral view (Fig. 1B, E). Cloacal opening covered by a cuticular hood-shaped fold. Spicular pouch protruding outwardly posterior to cloaca (Fig. 1A, B, C). Its extremity, strongly cuticularized, constitutes an irregularly ring-shaped gubernaculum (Fig. 1B, D, E).

Female. Lateral alae with a cervical part consisting of a simple triangular crest beginning close behind the nerve ring and ending at the middle of oesophagus, and a posterior part with two fused parallel crests,

triangular in cross section, running along the body and ending halfway between the anus and caudal extremity (Fig. 2A, E, F, G). A complete hiatus can be observed between the two parts (Fig. 2A, F). Vulva prominent, situated between the first and second third of the body, followed by a muscular vagina posteriorly directed, then a uterine tube divided into two parts by a cellular wall forming a diaphragm (Fig. 3A). The posterior part of this uterus opens into two prodelphic uterine branches (Fig. 3B). Eggs oblong, weakly asymmetrical, non-embryonated, thin shelled, non-operculated (Fig. 3C).

MEASUREMENTS. Table I.

DIAGNOSIS

General : oesophageal bulb spherical. **Males :** Second and 3rd pairs of genital papillae surrounded by chitinized rings not fusing posterior to cloaca. Spicule with a strongly marked dorsal angular bend. Cloacal opening covered by a cuticular hood-shaped fold. Spicular pouch protruding. Ring-shaped gubernaculum. **Females.** Genital tract prodelphic. Eggs non-embryonated, thin shelled, non-operculated. Ratio of egg length to width >2,15.

SYNONYMS: [*Oxyuris parallela* Linstow, 1908], [*Enterobius parallela* (Linstow, 1908) Inglis, 1961], [*Oxyuris polyoon* Linstow, 1909], [*Dermatoxys polyoon* (Linstow, 1909) Yorke & Maplestone, 1926], [*Enterobius polyoon* (Linstow, 1909) Le Roux, 1930].

HOST : *Xerus (Geosciurus) inauris* (Zimmermann, 1780). In agreement with Ellerman, Morrison-Scott & Hayman (1953) and Honacki, Kinman & Koepl (1982), *Xerus capensis* Kerr and *Xerus setosus* Smuts are considered synonymous with *G. inauris*.

SITE IN HOST : Caecum and colon.

LOCALITY & DATE OF COLLECTION : Cat. Nos. 4722, vicinity of Sekgoma, Kalahari desert (Linstow, 1908). Cat. Nos. 4723, Rehoboth, German South West Africa (Linstow, 1909). District of Bloemhof, Transvaal, Republic of South Africa (Le Roux 1930). MNHN 89KB, MNHN 90 KB & MNHN 123 KB, numerous specimens collected in the vicinity of Onderstepoort (Republic of South Africa), in 1937. MNHN 21 KH, 25 males and 24 females collected on the 16th of September 1976, in the vicinity of Onderstepoort.

SPECIMENS DEPOSITED : Cat. Nos. 4722 and 4723, Zoologisches Museum der Humbolt-Universität zu Berlin. MNHN 89KB, 90 KB, 123 KB & 21 KH, Laboratoire de Biologie Parasitaire - Protistologie - Helminthologie, Muséum National d'Histoire Naturelle, Paris. Inglis (1961) selected one female of Cat. Nos. 4722 as a lectotype.

Fig. 2. — *Xeroxyuris parallela* (Linstow, 1908) n. gen., n. comb.: A, left lateral view of a mature female; B, ventral view of the excretory pore; C, ventral view of the vulva; D, ventral view of the anus. Views of the lateral alae on a cross section: E, in the cervical part, F, at the junction of the cervical and post cervical parts, G, at mid body. H, egg. Scale bar: A, 1050 μ m; B, C, D, E, F, G, H, 50 μ m.

Fig. 3. – *Xeroxyuris parallela* (Linstow, 1908) n. gen., n. comb. : A & B, ventral view of the vulva and genital tract of an immature female after dissection. Head of another female : C, ventral view, optical cut through the amphids; D, apical view; E, lateral view. Scale bar: A, B, 250 μ m; C, D, E, 50 μ m.

	MALES				IMMATURE FEMALES				GRAVID FEMALES			
	M	min.	max.	CV(%)	M	min.	max.	CV(%)	M	min.	max.	CV(%)
body L	3024	2088	3900	19	3870	3100	4500	14	5643	5088	5976	5
W(max)	220	110	300	17	224	190	250	12	341	290	375	8
ospg L	812	389	910	6	936	875	990	5	1060	1010	1100	3
blb D	114	50	135	12	136	130	140	3	144	130	165	7
apex to:												
- nv	145	120	180	11	161	145	180	8	167	130	200	13
- ex	832	540	960	8	832	740	920	8	878	626	980	13
- test	1258	910	1560	13	-	-	-	-	-	-	-	-
vulva	-	-	-	-	1283	1025	1350	11	1604	1418	1800	8
T	35	18	75	25	700	580	800	14	1048	875	1250	13
spc L	232	168	260	7	-	-	-	-	-	-	-	-
gub L	19	16	24	9	-	-	-	-	-	-	-	-
egg L	-	-	-	-	-	-	-	-	59	55	62	3
egg W	-	-	-	-	-	-	-	-	26	24	28	4
Ratios:												
L-T/W(max)	15.1	10.3	21.6	16.1	14.2	12.8	15.5	7.1	13.6	12.1	16.5	9
ospg L/L-T	0.3	0.2	0.4	13	0.30	0.26	0.35	11	0.23	0.22	0.25	4
blb L/ospg L	0.14	0.09	0.16	11	0.15	0.14	0.15	3	0.14	0.13	0.15	6
L-T/spc L	14.11	9.56	16.02	11	-	-	-	-	-	-	-	-
apex (vlv)/L-T	-	-	-	-	0.41	0.36	0.44	7	0.35	0.30	0.41	10
apex(vlv)/L	-	-	-	-	0.33	0.30	0.36	7	0.28	0.24	0.33	9
T/L-T	-	-	-	-	0.22	0.20	0.23	6	0.23	0.19	0.28	13
eggL/egg W	-	-	-	-	-	-	-	-	2.30	2.14	2.42	4

Table I. – Measurements of *Xeroxyuris parallela* (Linstow, 1908) n. gen., n. comb (in micrometers).

"X" = mean; "min." = minimum; "max." = maximum; "CV" = coefficient of variation. Number of specimens measured: males = 30, immature females = 10, gravid females = 10. List of abbreviations : body L = body length; W(max) = maximum body width; ospg L = length of oesophagus; blb D = oesophageal bulb diameter; apex to: nv, ex or vlv = distance from anterior end to nerve ring, excretory pore or vulva, respectively; T = tail length; spc L = length of spicule; egg L = length of egg; egg W = width of egg; L-T = total body length minus tail length.

DISCUSSION

The parasites of *Xerus inauris* share with the oxyurids in the genus *Enterobius* a number of morphological characteristics such as the arrangement of organs surrounding the oral opening (nerve ends, lips, and oesophageal teeth), the uterine tube which is divided by a cellular wall forming a diaphragm, and the number and general arrangement of the nerve papillae surrounding the cloacal aperture in the male. However, the same cephalic and buccal characters are observed in the genus *Lemuricola* Chabaud & Petter, 1959, and the same male and female genital characters appear in genera *Rodentoxoyuris* Quentin & Tenora, 1975, *Trypanoxyuris* Vevers, 1923, *Colobenterobius* Quentin, Betterton & Krishnasamy, 1979 and *Lemuricola* (see Hugot, 1984, 1985, 1987; Hugot & Tourte-Schaeffer, 1985). Consequently, these characters do not justify keeping the species we have redescribed here in the genus *Enterobius*. In fact, this species differs from this genus by the following characteristics : in the genus

Enterobius, the pairs 2 and 3 of the genital papillae are much closer to the cloacal opening and they are surrounded by much thicker chitinated rings; these chitinated rings fuse together posterior to the cloaca into a small rectangular plaque which has two symmetrical extensions with species characteristic shape (Hugot & Tourte-Schaeffer, 1985); the egg is more markedly asymmetrical (the ratio length to width of the egg is ≤ 2 in *Enterobius*, but ≥ 2.5 in *Xeroxyuris*), it is often embryonated, and it has an operculum; the lateral alae are differently shaped. In males, the oesophageal bulb is clearly longer than wide, and the spicule is relatively shorter. Moreover, the parasites from *Xerus* present original characteristics which differentiate them from all of the above mentioned genera : genital system prodelphic, whereas the general type is amphidelphic; extremity of the spicular pouch protruding outward; presence of a ring-shaped gubernaculum.

In conclusion, the general morphology of these parasites allows to consider them closely related to a group reassembling the whole Oxyuridae known in

Primates hosts but the other characteristics of their morphology make them the most divergent forms in this group. We propose to place them in a new taxon, the genus *Xeroxyuris*, named after the generic name of its host. The genus includes a single species: *Xeroxyuris parallela* (Linstow, 1908).

ACKNOWLEDGEMENTS

We thank Dr Anna Verster from the Veterinary Institute of Onderstepoort who kindly allowed us to examine the South African specimens. This work was supported in part by the work group Morphométrie et Analyse de Forme of the Muséum National d'Histoire Naturelle.

REFERENCES

- CHABAUD A. G. & PETTER A. J. Les Nématodes parasites de Lémuriens Malgaches. II. Un nouvel Oxyure : *Lemuricola contagiosus*. *Mémoires de l'Institut Scientifique de Madagascar*, série A, 1959, 13, 127-132.
- ELLERMAN J. R., MORRISON-SCOTT T.C.S. & HAYMAN, R.W. *Southern African Mammals. 1758 to 1951 : a reclassification*. British Museum (Natural History), London, 1953, 363 p.
- HALL M. C. Nematode Parasites of Mammals of the Orders Rodentia, Lagomorpha and Hyracoidea. *Proceedings of the U.S. Natural Museum of Washington*, 1916, 50, 1-258.
- HONACKI J.H., KINMAN K.E. & KOEPL J.W. *Mammal species of the World. A taxonomic and geographic reference*. Allen Press, Inc., and Ass. of Syst. Coll., Lawrence, Kansas, U. S. A., 1982, 694 p.
- HUGOT J.P. Sur le genre *Trypanoxyuris* (Oxyuridae, Nematoda). I. Parasites de Sciuridae : sous-genre *Rodentoxyuris*. *Bulletin du Muséum National d'Histoire Naturelle*, Série A, Zoologie, 1984, 6, 711-720.
- HUGOT J.P. Sur le genre *Trypanoxyuris* (Oxyuridae, Nematoda). III. Sous-genre *Trypanoxyuris* parasite de Primates Cebidae et Atelidae. *Bulletin du Muséum National d'Histoire Naturelle*, Série A, Zoologie, 1985, 7, 131-155.
- HUGOT J.P. Sur le genre *Enterobius* : s. g. *Colobenterobius*. I. Oxyures parasites de Singes Colobinae en région éthiopienne. *Bulletin du Muséum National d'Histoire Naturelle*, Série A, Zoologie, 1987, 9, 341-352.
- HUGOT J.P. & TOURTE-SCHAFER C. Etude morphologique des deux oxyures parasites de l'Homme : *Enterobius vermicularis* et *E. gregorii*. *Annales de Parasitologie Humaine et Comparée*, 1985, 60, 57-64.
- INGLIS W.G. The oxyurids parasites (Nematoda) of Primates. *Proceedings of the Zoological Society of London*, 1961, 136, 103-122.
- LE ROUX P.L. The generic position of *Oxyuris polyoon* Linstow, 1909 in the subfamily Oxyurinae Hall, 1916. *Reports of the Director of Veterinary Services and Animal Industry, Union of South Africa*, Pretoria, 1930, 16, 205-210.
- LEACH (ms.) in W. Baird : Catalogue of the species of entozoa, or intestinal worms, contained in the collection of the British Museum. Wa, 1853, 132 pp.
- LINSTOW O.F.B. Zoologische und Anthropologische Ergebnisse einer Forschungsreise im Westlichen und Zentralen Südafrika ausgeführt in den Jahren 1903-1905. II. Helminthes. Nematoden und Acanthocephalen. *Denkschriften Medizin-naturwissenschaftliche Gesellschaft Jenia*, 1908, 13, 19-28.
- LINSTOW O.F.B. Neue helminthen aus Deutsch Südwest Afrika. *Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene*, 1909, 50, 448-451.
- QUENTIN J.C. & TENORA F. Morphologie et position systématique de *Lemuricola (Rodentoxyuris) sciuri* (Cameron, 1932) nov. comb. nov. subgen., et *Syphacia (Syphatineria) funambuli* Johnson, 1967. Oxyures (Nematoda) parasites de Rongeurs Sciuridés. *Bulletin du Muséum National d'Histoire Naturelle*, 3^e série, Zoologie, 1975, 178, 1525-1535.
- QUENTIN J.C., BETTERTON C. & KRISHNASAMY M. Oxyures nouveaux ou peu connus, parasites de Primates, de Rongeurs et de Dermoptères en Malaisie. Création du sous-genre *Colobenterobius* n. subgen. *Bulletin du Muséum National d'Histoire Naturelle*, Série A, Zoologie, 1979, 1, 1031-1050.
- SANDOSHAM A.A. On *Enterobius vermicularis* (Linnaeus, 1758) and some related species from Primates and Rodents. *Journal of Helminthology*, 1950, 24, 171-204.
- SCHNEIDER A. Monographie der Nematoden. Berlin, 1866, xiii + 357 p.
- VEEVERS C.M. Some new and little known helminthes from British Guyana. *Journal of Helminthology*, 1925, 1, 35-45.
- YORKE W. & MAPLESTONE J.W.S. *The Nematodes Parasites of Vertebrates*. J. and A. Churchill, London, 1926, p.

Accepté le 8 février 1995