



The proposed synonymy of *Parakontikia ventrolineata* (Dendy, 1892) and *Kontikia mexicana* (Hyman, 1939): what is a penis papilla?

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Abstract

Geoplanid land planarians found near Johannesburg, South Africa, and in a hothouse in Liverpool, UK, could be identified either as *Parakontikia ventrolineata* (Dendy, 1892) or as *Kontikia mexicana* (Hyman, 1939). Comparison of the specimens with *P. ventrolineata* type specimens and other material and with published descriptions of *K. mexicana* shows no significant consistent difference between the species, other than the apparent presence of a penis papilla in *K. mexicana*. It is suggested that, in this case, the penis papilla is not a well-defined structure and that its presence in some specimens may be the result of differential contraction or eversion of the penial musculature at fixation. Accordingly it is proposed that the two species names are synonymous, and thus *Parakontikia* Winsor, 1991 is to be considered a junior synonym of *Kontikia* Froehlich, 1955. This is only the second geoplanid species to be recorded from Africa. It has also been found in Australia, New Zealand and the U.S.A.

Introduction

The native African land planarians are nearly all rhynchodemids (worms with two anterior eyes). The only previous record of a geoplanid (worms with multiple lateral eyes) from Africa is of *Australopacifica buetneri* (Graff, 1899) from Togo, but there have been no further records of this species since the original record in about 1890. A collection of terrestrial planarians from Roodeport, South Africa, contained several black geoplanids initially identified as *Parakontikia ventrolineata* (Dendy, 1892). Specimens apparently of the same species were subsequently found in a hothouse in Liverpool, U.K.

Parakontikia ventrolineata was described by Dendy (1892a) on external features only, from specimens found in a nursery near Melbourne, Australia, though Dendy commented that they probably originated elsewhere. Dendy (1892a) provided no illustrations though Dendy (1892b) figured the ventral surface of the anterior end. Graff (1899) figures one of Dendy's specimens and Winsor (1979) figures the external striation pattern of later specimens from Melbourne. There are no published details of the internal

anatomy. However, the specimens also conform to the description of *Kontikia mexicana* (Hyman, 1939). Hyman (1943) added more detail, and Ogren (1990, 1991) has provided a full redescription. The similarity of the two species has prompted us to re-examine descriptions and specimens of both.

Materials and methods

The South African land planarians were found in March 1993 by Mrs Astri Le Roy, Roodeport (26° 10' S, 27° 53' E), under bricks and plastic flower bags on a paved washing area behind her house. The collection contained two species, "ordinary and much more common black ones (19 specimens), and rather fatter sick-green ones" (three specimens, *Othelosoma* sp.). Specimens were preserved in 70% alcohol.

The planarians from Liverpool (four specimens) were collected on 14 August 1994 by searching under plant pots in the City of Liverpool hothouses at Garston, Liverpool, U.K. (53° 25' N, 3° W), killed in hot 4% glutaraldehyde and preserved in 80% ethanol. A further specimen was found on 29 February 1996.

All of the above specimens have been examined under a stereo microscope after clearing in cedarwood oil. This allows some internal anatomy to be discerned particularly the position of the pharynx and copulatory apparatus (if mature). One specimen each from South Africa and Liverpool has been sectioned, the posterior half (including pharynx and copulatory apparatus) and anterior third sectioned longitudinally, and the central portion sectioned transversely. Sections are stained in haematoxylin/eosin. Specimens and slides are retained in the collection of HDJ.

Comparisons have been made with one of Dendy's *P. ventrolineata* specimens from the type locality (Smith and Convey, 1970, 'syntypes', Museum of Victoria, Melbourne, Specimen number G1477, sectioned by LW) and with sections of specimens identified as *K. mexicana* and loaned by R.E. Ogren.

Systematic section

Kontikia Froehlich, 1955.

Type species (by original designation) *Kontikia orana* Froehlich, 1955.

Kontikia ventrolineata (Dendy, 1892):

Geoplana ventrolineata (Dendy, 1892a,b; Graff, 1899; Smith & Convey, 1970; Winsor, 1979; Barker, 1989; Johns, 1993);

Geoplana mexicana (Hyman, 1939; New synonymy);

Geoplana mexicana (Hyman, 1943);

Kontikia mexicana (Froehlich, 1955; Marcus & Marcus, 1959; Sluys, 1983; Ogren, 1990, 1991; Ogren et al., 1993);

Parakontikia ventrolineata (Winsor, 1991)

Kontikia (Laubenfelsia) (Ogren et al., 1993; New synonymy). Type species (by original designation) *Geoplana mexicana* (Hyman, 1939)

The black South African planarians have multiple lateral eyes. They range in length (preserved) from 7.4 to 18.7 mm. On close examination, two narrow pale stripes are visible dorsally, enclosing a very narrow central black line. The ventral surface has four darker stripes on a pale background. The ratio between body length and the distance from anterior to the pharyngeal aperture, Ph/L, ranges from 0.47 to 0.72, mean 0.64). The pharynx is cylindrical. Two specimens (14.4 and 16.5 mm long) are mature. In both the ratio between body length and distance from anterior end to the gonopore, Gp/L, is 0.79.

In transverse section the ciliated creeping sole is 53% of the body width. In a section 1.2 mm high, the

Table 1. Cutaneous muscle index (CMI) and parenchymal muscle index (PMI) (see text for explanation of both terms) of various specimens *Kontikia ventrolineata*

	South Africa	Liverpool	Ogren (1990)	Winsor (1991)	Syntype	Bunya (Winsor)
CMI (%)	12	7	8	6.7–13	7.2	12.9
PMI (%)	13	9	8	5.5–13.8	20	10.6

cutaneous longitudinal muscle is about 70 μm thick both dorsally and ventrally. Thus the cutaneous muscle index (CMI, the proportion of cutaneous muscle thickness to body height, see Winsor, 1983, 1991) is 12% (Table 1). There is an annular layer of parenchymal longitudinal muscle, about 80 μm thick dorsally and ventrally (similarly the parenchymal muscle index, PMI, is about 13%).

The copulatory apparatus (Figure 1a) consists of a muscular penis bulb with a sinuous ejaculatory duct. The penis is blunt with no papilla. A region of less dense musculature surrounds the apparent distal end of the penis. The vagina is horizontal and formed from the fusion of the two ovo-vitelline ducts posteriorly. Testes are ventral and lateral to the ventral nerve cord on either side.

All the specimens from Liverpool show some signs of sexual maturity. External colour and striation as the South African specimens. Length (preserved) ranges from 14 to 19 mm, Ph/L ratio is between 0.66 and 0.85 (mean 0.75), and Gp/L ratio between 0.82 and 0.91 (mean 0.87). Ciliated creeping sole 62% of the body width. CMI is 7%, PMI is 9%. Figure 1b shows the copulatory apparatus. Figure 1c shows the copulatory apparatus of one of the syntypes of *K. ventrolineata*. The position of the pharyngeal aperture and of the gonopore of various specimens is compared in Figure 2. There is no difference between the South African or Liverpool specimens or other specimens identified as *P. ventrolineata* or as *K. mexicana*. The mean Ph/L ratio of all specimens is 0.69; the mean Gp/L ratio is 0.80.

Geographical distribution

K. ventrolineata is a species associated from its first recognition (as either *K. ventrolineata* or *K. mexicana*) with the transportation of plants through horticultural activity and has a widespread distribution which is clearly man-derived. The type specimens were found

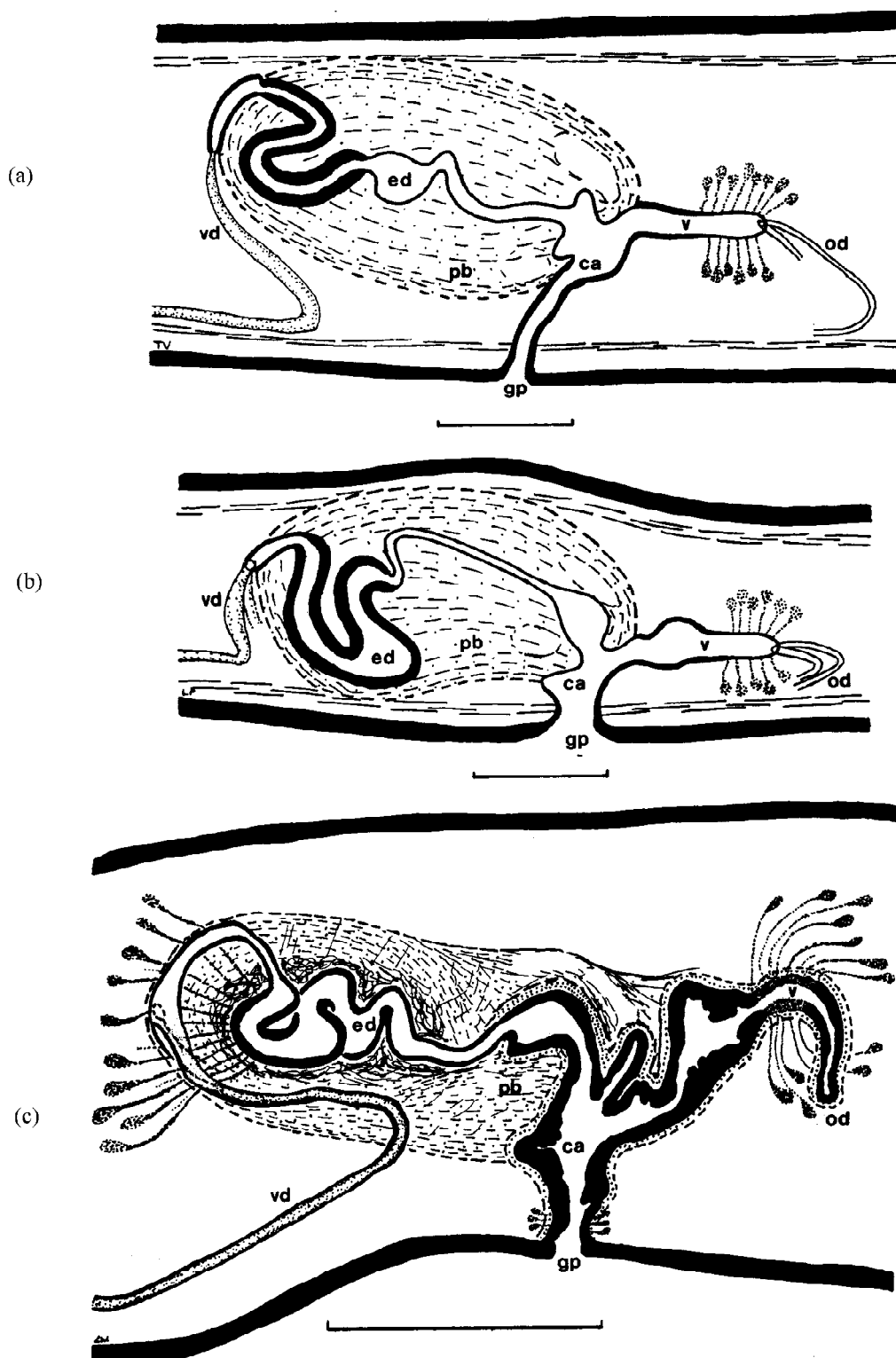


Figure 1. *Kontikia ventrolineata*: reconstruction of the copulatory apparatus in sagittal view of specimens from (a) Roodeport, Transvaal; (b) Liverpool and (c) the lectotype (National Museum of Victoria, No. 1477). Anterior is to the left. ca, common atrium; ed, ejaculatory duct; gp, gonopore; od, oviduct; pb, penis bulb; vd, vas deferens. Scale lines 0.5 mm.

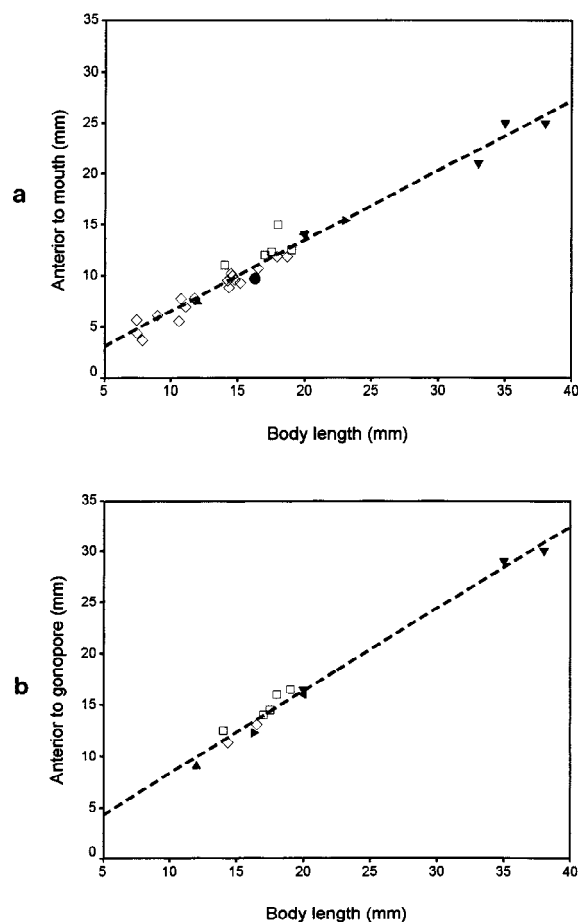


Figure 2. *Kontikia ventrolineata*. Graphs of the relationship between body length and (a) the distance from the anterior end to the pharyngeal aperture ($y = 0.69x - 0.33$, $r = 0.98$), and (b) the distance from the anterior end to the gonopore ($y = 0.80x + 0.29$, $r = 0.99$). Results are from direct measurement of specimens and literature values as follows: (▲) Winsor (1979); (◇) Roodepoort specimens; (▼) Ogren (1990; 1991); (□) Liverpool specimens; (●) Hyman (1943); (●) Graff (1899); (▶) Dendy (1892).

in Brunning's Nursery Garden, St Kilda, Melbourne, but Dendy (1892a) commented even then that it was probably introduced. It has also been recorded from the Royal Botanic Gardens, Melbourne, from private gardens in Melbourne and in Hobart and Launceston, Tasmania (Winsor, 1979), from Hawaii (Winsor, in Waterhouse & Norris, 1987) and from New Zealand (Barker, 1989). Winsor has additional records from South Australia; Victoria (19 localities); Queensland (10 localities – Toowoomba area, Bunya Mountains, considered by him to be the possible natural region of the species, Gympie area); Norfolk Island (Australia); The Isles of Scilly (U.K.). Hyman's (1939)

specimens were found in Laredo, Texas, U.S.A., but in a cargo of violets originating from Mexico. Populations have subsequently been found in gardens in Pasadena, Carmel Valley, Berkeley and Malibu (Los Flores canyon), California; Tuscon, Arizona; California and Seattle, Washington (Hyman, 1943; Ogren, 1990). *K. ventrolineata* is only the second geoplanid species to be recorded from any part of Africa.

Discussion

The only slight difference between the specimens from South Africa and Liverpool is in the CMI and PMI (Table 1). Table 1 also shows the CMI and PMI of other specimens of *K. ventrolineata* and of specimens identified as *K. mexicana*. There are some differences, but these are not great, and until the effects of different methods of preservation are known, these should be considered of limited taxonomic value.

The similarity in the position of the pharyngeal aperture and of the gonopore of various specimens (Figure 2) at least shows that the various specimens are not different in this respect, though does not prove the identity of all the specimens.

The specimens conform to the available descriptions of *K. ventrolineata* (Dendy, 1892a; Graff, 1899; Winsor, 1979). In most respects, they also conform to the various descriptions of *K. mexicana* (Hyman, 1939, 1943; Ogren, 1990, 1991). One discrepancy is that Ogren (1990) gives the ciliated creeping sole as occupying 67% of the ventral surface, whereas it is 52% in the sectioned African specimen and 62% in the Liverpool specimen. The sections of *K. mexicana* loaned by Ogren shows the transverse section to be almost quadrangular, rather than oval, making comparisons of the proportionate width of the sole, or of the CMI and PMI, of limited value. However, the most significant discrepancy is the apparent absence of a penis papilla in these specimens, but the presence of a penis papilla in *K. mexicana* (Hyman, 1943; Ogren, 1990, 1991). A penis papilla is also the only distinguishing characteristic between the genera *Kontikia* as defined by Ogren & Kawakatsu (1991) (penis papilla present) and *Parakontikia* (Winsor, 1991) (penis papilla absent). But what is a penis papilla? Many species of land planarian possess a distinct, long, conical penis papilla, even when fully retracted, for example *Microplana scharffi* (Graff, 1899). Such penises are of the protrusible type. Other species have a penis apparently with a short or blunt papilla (e.g., *Kontikia*

orana, Froehlich 1955) and other species have a penis apparently without any papilla (e.g., *Rhynchodemus* spp). Penises of the latter type are generally described as of the eversible type. Neither the type material *P. ventrolineata* nor the South African or Liverpool specimens possess a penis papilla (Figure 1).

Two problems in comparing such structures are the variable state of maturity or of contraction. The penis is probably fully developed in the sectioned South African and Liverpool specimens since the sperm ducts contain sperm. Hyman (1943) and Ogren (1990) figure the penis of the same specimen of *K. mexicana*, Hyman (1943) describing the papilla as "very short, consisting of a short truncate projection into the genital atrium". Ogren (1991) illustrated four stages in a developmental sequence of *K. mexicana*. The first two, immature, stages lack a penis papilla. The third stage is shown with a prominent, even conical, penis papilla and the fourth stage is shown with a short papilla. But are these real and consistent differences? It is suggested that in species with an eversible penis, it is normally retracted or inverted (without a papilla), but that variable muscle contraction at fixation may cause it to be partially and variously everted. An apparent blunt or short penis papilla could be the first stage of penis eversion. The difference between the third and fourth maturation stages in Ogren (1991) could equally well be explained by differential contraction at fixation as by state of maturity. Some confirmation that the form of the penis of land planarians is variable is provided by Marcus (1951) and Fyfe (1956) who describe and figure the penis of various species in both retracted and extended states, and discuss the protrusion of the penis and the variable appearance of the penis papilla. Unless conditions of fixation are absolutely standard, penial protrusion must be regarded at best as an unreliable character. The conclusion is that there is no justification for maintaining the distinction between the species *P. ventrolineata* and *K. mexicana* on the basis of presence or absence of a penis papilla. Accordingly they are here considered synonymous, with the former name taking precedence.

If this synonymy is accepted, it has consequences in the higher taxonomy, not the least because the two species were previously placed in different genera. The diagnostic characters of *Kontikia* as defined by Froehlich (1955) and Sluys (1983) excludes any details of the copulatory apparatus. Ogren & Kawakatsu (1991) amended the definition to include "male copulatory apparatus of the type species (*K. orana*) has the penis papilla" (our italics). However, Froehlich (1955)

figures this as extremely short and blunt, as does Winsor (1986), and the same comments and reservations about muscular contraction and penis form must apply. Winsor (1991) designated *P. ventrolineata* as the type species of the new genus *Parakontikia*. This is distinguished by the absence of a penis papilla in *Parakontikia* and the presence of a penis papilla in *Kontikia*. If the remarks concerning contraction are accepted then the distinction between *Parakontikia* and *Kontikia* is also no longer valid and the genera are considered synonyms, *Kontikia* having priority.

Ogren et al. (1993) propose two subgenera within the genus *Kontikia*, *Kontikia* (dorsal entrance of female canal into atrium; posterior diverticulum; type species, *K. orana*) and *Kontikia*, *Laubenfelsia* (horizontal entrance of female canal into atrium; no posterior diverticulum; type species *Geoplana mexicana*). If this is accepted, the name of the species is thus *Kontikia* (*Laubenfelsia*) *ventrolineata* (Dendy, 1892).

In the type locality, Dendy (1892a) found *K. ventrolineata* in association with *Caenoplana coerulea* (Moseley, 1877), also thought by Dendy to be introduced. In the Liverpool hothouse *K. ventrolineata* is also found with *C. coerulea* (erroneously identified as *C. purpurea* by Jones, 1988), and *Bipalium kewense*, a cosmopolitan species known to be distributed through human activity (Winsor, 1983). These three species and *Kontikia atrata* (Steel, 1897) are common and occur together in agricultural/horticultural areas and in household gardens throughout much of the North Island of New Zealand (Johns & Boag, unpublished). *C. coerulea* has also been found in California, U.S.A. (Ogren, 1989), but not apparently in direct association with *K. ventrolineata*.

The hothouse staff in Liverpool have observed that *K. ventrolineata* feeds on snails which are common in the hothouses. These snails are also an exotic species, *Subulina octona* (Brugière, 1789) originating from tropical America and found in the U.K. only in hothouses (Kerney and Cameron, 1979). In South Africa, the species was associated with empty small snail shells, and it would appear that small snails are the preferred prey species of *K. ventrolineata*. Barker (1989) records *K. ventrolineata* feeding in introduced slugs in New Zealand.

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