

## A new species of *Glyphidrilus* (Microchaetidae : Oligochaeta) from East Africa

B. G. M. JAMIESON

Zoology Department, University of Queensland

### Introduction

During taxonomic investigations of the aquatic megadrile genus *Glyphidrilus* (in preparation) a new species of the genus, from Uganda, East Africa, has been recognized. This constitutes the first record of the genus from Africa since the description of *G. stuhlmanni* Michaelsen, 1897, from Tanzania. The other species, making a generic total of 16 species, occur in India as far north as Nepal, Burma, the Malay Peninsula and the Indonesian islands eastwards to Celebes. The known distribution of the genus thus skirts the Indian Ocean with an extension along the Ganges, into low sub-tropical latitudes. As no species are known from Arabia, the East African species appear isolated from the remainder of the genus. Nevertheless, the Indian species are said to form morphological as well as geographical intermediates between *G. stuhlmanni*, in Tanzania, and the Malayan species (Michaelsen, 1909). This congruence of distribution and morphology requires confirmation and will be examined, together with the overall phenetic affinities of the species, in the taxonomic revision. The present paper will be restricted to a description of the morphology of the new East African species in an attempt to provide a firmer basis than at present exists for the revision.

### Systematics

#### *Glyphidrilus ugandaensis* sp. nov.

**TYPE LOCALITY.** Swamp-mud in the vicinity of the north shore of Lake Victoria (Jinja), Uganda ; collector B. G. M. Jamieson, 1956. Three clitellate specimens : the holotype and 2 paratypes, British Museum (Natural History) 1967. 7. 1-3, of which (1) and (3) are posterior amputees, lacking the hindbody, and (2) is a posterior regenerate. In the following account specimens 1 to 3 are referred to as H (Holotype), P<sub>1</sub> (Paratype 1) and P<sub>2</sub> (Paratype 2) respectively.

**DIAGNOSIS.** Zyglous. Setae with oblique encircling ridges. Clitellum annular, 11, 12-38,  $\frac{1}{2}$ 39 (= 27 to 28 $\frac{1}{2}$  segments.) Male pores immediately behind the prostatic pores in setal lines *b*, both pores of each side on an irregular papilla in 17. Longitudinal tubercula pubertatis in 17-20 or 21 lateral to setal lines *b* ; 'wings' absent. Paired lateral papillae in *bc* in 15-18 or some of these. Transverse rows of postsetal papillae in 13 and 14. Spermathecae numerous (more than 20) in intersegmental furrows (12/13), 13/14 and 14/15 ; adiverticulate pouches concealed in the body wall musculature. Dorsoventral hearts in 7-12 (6 pairs). Holonephridia commencing in 12 or 13 ; pores in *ab*. Oesophageal gizzards in 7-9, that in 8 the largest. Intestine beginning in 15, with dorsal typhlosole from 22 ; anus

dorsal. Holandric; seminal vesicles four pairs, in 9–12; no testis sacs. Ovaries in 13. Non-muscular prostate glands, with branched system of ducts, a pair in 17.

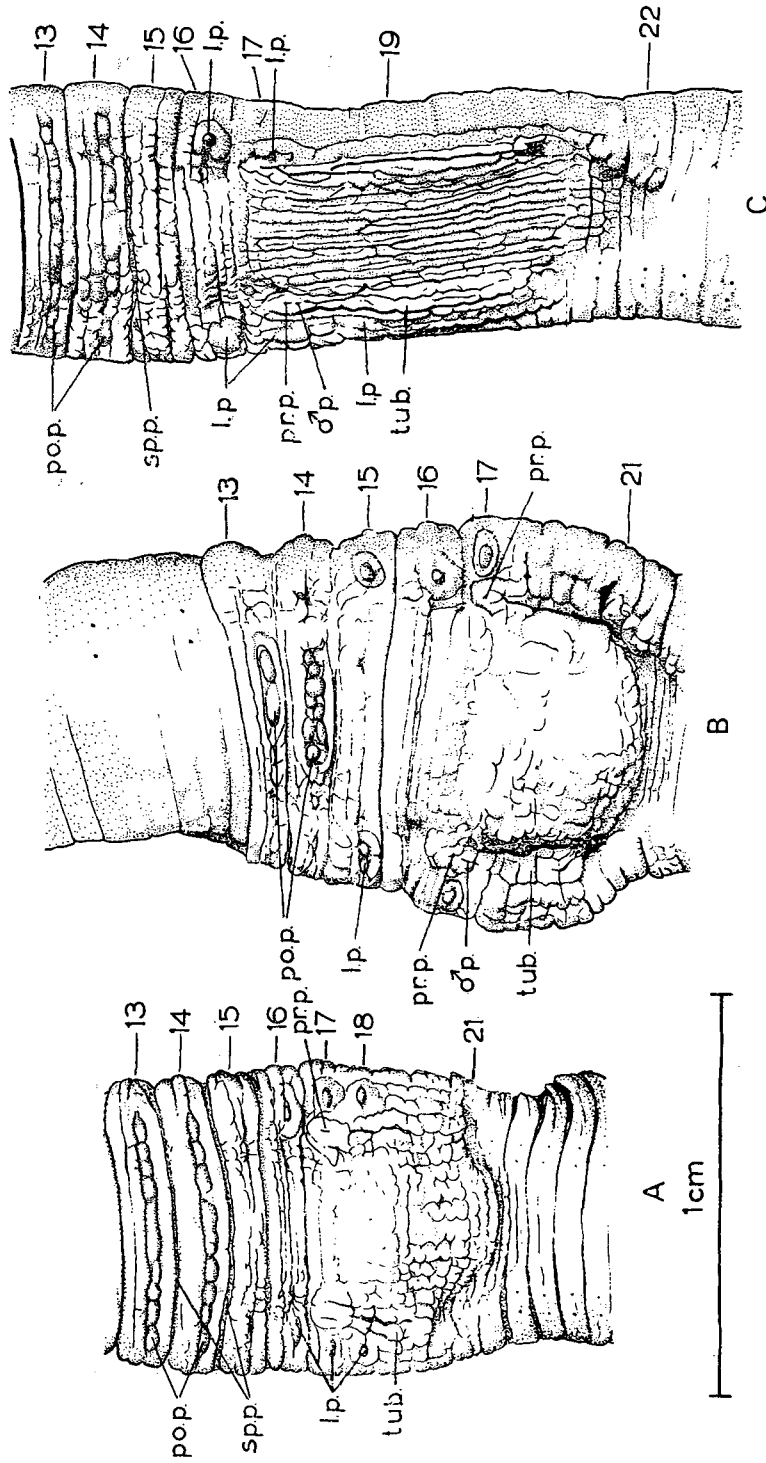
DESCRIPTION. Length 295 mm (H, posterior regenerate); maximum width (genital region) 7–10 mm; number of segments 291 + ( $P_1$ ; a regenerate tail end about twice the length of a normal segment is not sufficiently differentiated for its segments to be counted); anus a broad orifice wholly dorsal on the regenerated portion, bounded posteriorly by the upturned, knob-like pygidium. Form cylindrical in 11 or 12 anteriorly (H,  $P_1$ ) from here to 22 flattened ventrally. A dorsal insinking of the body wall begins in segment 24 (H,  $P_1$ ); this continues to the caudal extremity as a wide, deep groove, its walls surmounted by the lateral setal couples ( $P_1$ ). From about segment 30 posteriorly the cross section of the body is an approximately equal sided quadrangle (H,  $P_1$ ). Secondary annulation is well developed in front of the genital region (anteriorly from segment 12), weakly developed within it (about segments 15 to 22) and becomes unrecognizable a short distance behind this (H,  $P_1$ ,  $P_2$ ). Colour in alcohol, pigmentless buff. Prostomium small and rounded, zygolobous, the demarcation from the peristomium poorly marked, especially in the holotype; a second transverse furrow bisects the peristomium (H.,  $P_1$ ). Setae closely paired throughout, the couples narrowing posteriorly. Widths of ventral and lateral setal couples ( $ab$  and  $cd$ ) in segment 12 are approximately equal; the ventral median intersetal distance ( $aa$ ) is approximately equal to the lateral intersetal distance ( $bc$ ) and is equal to or a little larger than the dorsal median intersetal distance ( $dd$ );  $dd = 0.2$  to  $0.3$  of the circumference of the body ( $u$ ) (see table 1). A postclitellar seta is sigmoid with well-developed node; it is dorsally ornamented by some six widely spaced oblique ridges traversing the whole circumference and giving the profile of the seta a minutely notched appearance (H).

Table 1  
*Glyphidrilus ugandaensis*. Intersetal ratios in segment 12

	$aa$	$ab$	$bc$	$cd$	$dd$	$dd : u$
Holotype	6.1	1.0	7.1	1.0	6.1	0.20
Paratype 1	6.5	1.4	6.7	1.0	9.8	0.28

The clitellum is annular, inappreciably protuberant, with intersegmental furrows obscured only in the genital field, ventrally. Median section of the body wall reveals the limits of clitellar thickening as 11 to  $\frac{1}{2}39$  (= 28½ segments) in the holotype and 12–38 (= 27 segments) in paratype 1 but externally its limits are indefinite. In the holotype lateral and ventral tumescence is apparent as far posteriorly as segment 44, with no precise posterior limit.

A significant part of the variation in the appearance of the genital field in the three specimens (fig. 1) is related to differences in the degree of contraction of the specimens as evidenced by relative lengths and widths of the segments of the genital region and the conformation of the fields. Paratype 2 presents the relaxed condition, paratype 1 a strongly contracted condition, and the holotype an intermediate condition. The appearance in the holotype is as follows: In segment 17 there is a pair of low, flat-topped protuberances of irregular outline in which the ventral setal couples of the segment are deeply



*Glyphidrilus ugandaensis* sp. nov. Camera lucida drawings of the genital fields of (A) the holotype (partly contracted); (B) paratype 1 (strongly contracted); and (C) paratype 2 (relaxed). lp., lateral papilla;  $\sigma$ : p., male pore; po.p., transverse post-setal papillae; pr.p., prostate pore; sp.p., spermathecal pores; tub, tuberculum pubertatis.

embedded. Seta *b* lies in a short longitudinal slit which, from internal examination, appears to be the pore of the corresponding prostate gland. Each of these 'prostatic papillae' forms the anterior limit of a longitudinal ridge-like tuberculum pubertatis. Each tuberculum, though highly tumescent and bounded by deep furrows, is not conspicuously differentiated from the remainder of the genital field because the latter is also tumescent and is divided into a wavy reticulum by numerous deep, longitudinal and transverse furrows. Each tuberculum extends from the papilla on 17 to a short distance into segment 21; the ventral setae *b* of segments 18 to 20 lie in the longitudinal furrow bounding the tuberculum medially. Setae *a* lie in an adjacent furrow. Lateral to each prostatic papilla, in 17, there is a mammillary papilla differentiated into a central dome and a broad rim; two similar papillae occur in 18, less distinctly in 16 and barely recognizably in 15. In segments 13 and 14 there are transverse rows of papillae. They lie immediately behind the setal arcs and extend a little lateral of setal lines *b*. The outermost of these transverse post setal papillae on each side is distinctly demarcated from its fellows and resembles a lateral papilla of 17; the others are less discrete as they unite at their margins, but all are clearly visible because their margins are deeply recessed into the ventral surface of the body and are bordered anteriorly by the pronounced setal annulus. There are approximately nine papillae in a transverse row, no precise number being determinable owing to fusion, particularly of the median ones. Almost concealed in the intersegmental furrows (13/14 and 14/15) behind each row of the papillae are rows of small oval swellings with the appearance of minute beads extending dorsally as far as setal lines *d*. Each protuberance corresponds internally with a spermatheca, the minute pore of which is visible on the external surface in some cases (H, P<sub>1</sub>).

The gross appearance of the field in paratype 1 is similar to that in the holotype. As in the latter, contraction has caused the development of a puckered cushionlike swelling ventrally which is delimited posteriorly by a U-shaped depression, the posterior limit of which is segment 22. In paratype 2, on the other hand, the ventral region from segment 16 to 22 is deeply recessed. As far as segment 20 this depression includes the ventral setal couples, but in 21 and 22, the depressed region narrows in the form of a triangle with apex posterior. It is evident that contraction of the worms decreases the length of the depressed area in such a way that its more anterior segments become ventrally protuberant as a cushion bounded posteriorly by the sunken triangular region in 21 and 22. In the relaxed condition the longitudinal tubercula pubertatis are straight and narrow; in the contracted state they become shorter and thicker and are bowed laterally.

Differences in detail, which cannot be ascribed to differential contraction are considerable. The postsetal transverse rows of papillae in paratype 2 are similar in form and extent to those of the holotype. In paratype 1, however, in each segment an indistinct oval rim surrounds the more medianly situated papillae. In segment 14 these papillae are duplicated longitudinally. The lateral papillae are less numerous in the paratypes, involving only three segments (table 2). The tubercula, including the prostatic papillae, extend from 17-20 or 21 (P<sub>2</sub>, P<sub>1</sub> respectively). In each of the three specimens each prostate papilla bears an obliquely longitudinal slit-like pore. From serial sections of paratype 2 in conjunction with probing of the body wall in the

Table 2  
*Glyphidrilus ugandaensis*. Distribution of lateral papillae

Segment	Holotype		Paratype 1		Paratype 2	
	Right	Left	Right	Left	Right	Left
15	(+)	(+)	+	+	-	-
16	+	+	-	+	+	+
17	+	+	+	+	(+)	(+)
18	+	+	-	-	(+)	(+)

+ = present, (+) = rudimentary, - = absent.

holotype, it appears that this is the prostate pore. A pore visible shortly behind it, on the papilla, in the specimens is evidently the opening of the vas deferens (fig. 1 C).

Septa: 3/4 and 4/5 delicate and doubtfully complete; 5/6 to 14/15 moderately but not strongly thickened; 15/16 and one or two of the next septa thin but slightly thicker than the remainder (H, P<sub>1</sub>, P<sub>2</sub>). In longitudinal sections (paratype 2) the centres of septa 7/8 and 8/9 are greatly displaced posteriad by the gizzards.

Dorsal and ventral blood vessels single, well developed. Dorsoventral hearts six pairs, in segments 7-12 (H, P<sub>1</sub>; connections with the dorsal and ventral vessels verified for all pairs in the holotype); the last two pairs of hearts link, at their origins, with the supraoesophageal vessel (i.e. are latero-oesophageal hearts); in other segments some hearts were seen to be supplied with very slender vessels from the supraoesophageal, one reaching each heart well distal to the origin of the latter, but these vessels apparently serve only the connective tissue sheaths of the hearts (paratype 1). Dorsal vessel in 13 and 14 lacking branches. The dorsal vessel receives in segment 15 (H, P<sub>1</sub>) and in 16 and 17 also (holotype) a single pair of vessels from the wall of the intestine. In 16 (P<sub>1</sub>) or 18 (H) two such vessels are received posteriorly on each side in each segment. In the holotype a supraoesophageal vessel, lying below the dorsal vessel, is visible in 8-13 only and a wide subneural vessel runs below the ventral nerve cord as far forward as 19. In 17 and 18 it diverges unilaterally to the right sufficiently to be fully visible from above, and in 16 and a few anterior segments it diverges widely and obliquely antero-laterally. By segment 15 it is a thin vessel running longitudinally forward immediately lateral to the ventral setal couples. There is no median subneural vessel anterior to the divergence in 18.

Nephridia holonephridia, the first very reduced in 12 (H) or 13 (P<sub>1</sub>). They have the appearance of much coiled slender tubes, the peritoneal investment being relatively poorly developed. The slender duct enters a deep pit in the internal body wall in the floor of which the ventral setae are situated. The pit extends the length of the segment and the nephridial duct enters the body wall between the setae and the anterior septum of the segment. All the ducts of a side (examined as far posteriorly as segment 45 in the holotype) lie in the same straight line; they are avesculate.

There is a well-developed oesophageal gizzard, with large lumen, in each of segments 7 and 8; they are separated at septum 7/8 by a slight constriction

Table 3  
Some characters distinguishing *G. ugandensis* sp. nov. from other species of *Glyphidivius*  
(All characters listed are differential with the exception of those in the last column marked by an asterisk)

	Clitellum	'Wings' or ridges	Spermathecal pores		Genital markings		Male pores	Prostates	Intestinal origin
			No./side	Location	Paired	Unpaired median			
<i>G. ugandensis</i> sp. nov.	11, 12-38, ‡39	17-20, 21	c. 10-20	(12/13), 13/14-14/15	15-18	13-14	17	Present, 17	15
<i>G. annandalei</i> Michaelsen, 1910	17, 18-35, 36, 41	26, 27, 28-32, 33	1-6	13/14-16/17, 17/18	15-26 & 33-37	11-26 & 35-38	29	Absent	15*
<i>G. birmanicus</i> Gates, 1958	12, 13-43, 44	21-29	2-8	13/14-17/18	12-21, 22, 23 & 30-31, 33, 34	Absent	?	Absent	15*
<i>G. buttkoferi</i> Michaelsen, 1922	12-30	‡25, 25-30	1-6	14/15-17/18	17-24	12-24 & 29-31	?	Absent	?
<i>G. ceylonensis</i> Gates, 1945	?	16-19 to 32-35	2(?)	13/14-16/17	16-25 & 31-35	Absent	?	Absent	16
<i>G. gangeticus</i> Gates, 1958	13, 14-34(?)	17-19 to 25-26	?	12/13-16/17	12-18(19, 23), 24-27(28, 30)	(10)11-14(15-16) 17-18(19, 28-32)	?	Absent	16
<i>G. horsti</i> Stephenson, 1930	17-28	‡23-‡, ‡, ‡27	2	(13/14), 14/15-16/17	23 & 27	16, 17, 18-20, 22, 27, 28	?	Absent	16

<i>G. jacobsoni</i> Michaelsen, 1922	18-30	?	?	18-20 & 27-29	Absent	?	Absent ?	?
<i>G. leukenthalis</i> Michaelsen, 1896	18-?	3-6	13/14-17/18	13-14	Absent	?	Absent ?	?
<i>G. malayanus</i> Michaelsen, 1902	?- <del>23</del> , <del>24</del> ? 14-40	2	14/16-16/17	14 & 21, or 15-17 & 22	12-15 or 21-25	?	Absent ?	18?
<i>G. papillatus</i> (Rosa) 1890	14-40	5	13/14-16/17	13, 14, 15-17 (24, 25)	11-18 (& 26-30)	?	Absent	15*
<i>G. quadrangulus</i> (Horst) 1893	?	2-5	13/14-15/16 (14/15-16/17?)	Absent	Absent	21/22	Absent	?
<i>G. spelaeotes</i> Stephenson, 1924	(14, 15?)16-30	5	13/14-15/16	(14, 15, 16, 19) 25, 27(28)	11, or 17-18	?	Absent	15*
<i>G. stuhlmanni</i> Michaelsen, 1897	22, 23-66, 67	1-5	9/10-10/11, 12/13-21/22	16/17, 18/19- 26/27, 27/28	46/47-50/51 (64/65-67/68)	?	Absent	18
<i>G. tuberosus</i> Stephenson, 1916	14, 15, 16-28, 29 (30 dorsally)	3-4	13/14-14/15	10-12 & 17, 18-19 & 24-28; 1 to 6 papillae/segment	10-12	?	Absent ?	15*
<i>G. weberi</i> Horst, 1889	(13), 18-32	1-3	13/14-18/19	18, 19, 20, 22, 32, 34 or some of these	Absent	27/28	Present, 27/28	?

but there is no intervening nonmuscular or otherwise modified region. The oesophagus in segment 9 is equally muscular but is more nearly tubular owing to constriction of the lumen; the extreme thickening of its musculature merits regarding it as a third gizzard (H, P<sub>1</sub>, P<sub>2</sub>). Oesophagus soft-walled and slender in 10 to 14, lacking appendages or diverticula. Intestine beginning abruptly at the anterior limit of 15, some three times the width of the oesophagus, relatively very thin walled, individual sand grains in the gut contents being clearly visible through its walls (holotype); commencing less abruptly at  $\frac{1}{2}$ 15 in the paratypes. Oesophageal valve, with very narrowly constricted lumen, projecting into the intestine for about half the length of segment 15; a rounded dorsal typhlosole beginning at approximately 22 but so low throughout that it is not possible to determine precisely the segment of origin (holotype).

Testes paired on the anterior walls of 10 and 11; sperm funnels large and folded with spermatozoal iridescence, on the posterior walls. Seminal vesicles four pairs of very large several-lobed masses filling their segments and meeting above the gut in segments 9, 10, 11 and 12; those in 12 somewhat larger than the others but none displacing the septa of the segments in which they lie; those of 9 and 10 being anterior diverticula of the testis segments; those of 11 and 12 being posterior diverticula of these segments; ovaries folded, ribbonlike masses on the anterior wall of 13 (H, P<sub>1</sub>, P<sub>2</sub>). Oviducal funnels and ovisacs not certainly seen; apparent rosettes with inflated lobes on the posterior wall of 13 are duplicated but are larger, on the posterior wall of 14. They are probably, therefore, lymph nodes. Similar masses occur on the anterior wall of segment 14; evidence of the existence, nevertheless, of oviducal funnels is the pair of oviducts running posterolaterally from septum 13/14 to penetrate the body wall anteriorly in 14 (holotype). In paratype 2 corpuscle-filled septal pouches are posterior evaginations of septa 12/13 to 14/15. A pair of dorsoventrally depressed, lobed but compact and spindle-shaped prostate glands lies in segment 17. Each is restricted to this segment and enters the body wall immediately lateral to the corresponding seta *b* (H, P<sub>1</sub>) without the intervention of a distinct duct. In longitudinal sections of paratype 2, each prostate is seen to consist of masses of glandular cells permeated by ramifying ducts of circular cross section. Each duct is lined by a low, apparently cuboidal, epithelium which lacks cilia. Around each duct are grouped greatly enlarged cells, each with a distinct nucleus and numerous eosinophil secretory granules. The attenuated proximal ends of these cells appear to arise individually from the duct. The glandular elements are thus similar to those in the Alluroididae; muscle fibres are totally absent, however. The entire gland is invested in a very low peritoneum. Within the body wall the single ectal duct of each prostate dilates slightly but does not form a definite terminal chamber. The vas deferens is deeply embedded in the longitudinal muscle of the body wall, at least in several segments in the posterior portion of its course; it opens to the exterior through a capacious chamber very shortly behind, but quite separately from, the prostate aperture, in segment 17. The terminal chamber, though large, is confined to the circular muscle of the body wall and has no separate musculature. Its walls are composed of a tall columnar epithelium which is ciliated dorsally, where the vas deferens enters it.



Spermathecae occur in two or three transverse rows, one row in each of intersegmental furrows 13/14 and 14/15 (holotype and paratype 1) or 12/13 to 14/15 (paratype 2). In the holotype there are 41 spermathecae in 13/14 and 27 in 14/15 (counts  $\pm 1$  or 2 owing to concealment of the spermathecae); they are simple rounded pouches elongated in the anteroposterior axis of the worm. All contain white opaque masses which, in serial sections of paratype 2 (in 12/13–14/15) are seen to be spermatozoa. The ampullae are largely or wholly concealed under the longitudinal muscle of the body wall. There is considerable variation in size; the length of the ampulla of a larger spermatheca is  $570 \mu$ . The spermathecae are numerous in the paratypes but the necessity to minimise dissection of the specimens precludes precise counts.

### Discussion

Some features of the other species of *Glyphidrilus* which distinguish them from *G. ugandaensis* are listed in table 3. Especially noteworthy is the divergence between *G. ugandaensis* and the only other African species, *G. stuhlmanni*, which is as extreme as that between any other two species. The intestinal origin in segment 18, in *G. stuhlmanni*, is seen elsewhere only in an otherwise very different species, *G. malayanus*. *G. stuhlmanni* was considered by Michaelsen (1918) to be the most primitive Microchaetid, at least in terms of the location of the spermathecae in the testis segments. On the other hand, intestinal origin in segment 15, seen in *G. ugandaensis*, is considered by Gates (1958) to be the primitive condition. It is known for five other species but in other respects this species is strikingly distinct, as is particularly evident in the large number of spermathecae. Prostate glands are known elsewhere in the genus only in *G. weberi* but the latter species is clearly distinguished in Table 3, notably by the more posterior location of the combined male and prostatic pores.

The new species requires no modification of the generic definition given by Gates (1958). It should be noted, however, that the "longitudinal lamellar ridge ('wing')" with which Gates characterizes the genus is represented in *G. ugandaensis* only by a low, ridge-like, longitudinal tuberculum pubertatis, which cannot be termed lamellar. Lamellar 'wings' are also absent from *G. tuberosus* and their elevation and slenderness is only dubiously specified in most descriptions. Characteristic elevated lamellae are illustrated by Nair (1938) for *G. annandalei*.

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