

SOME ECNOMINAE FROM THE TRANSVAAL AND SOUTH WEST  
AFRICA  
(TRICHOPTERA: PSYCHOMYIDAE)

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(With 5 plates and 1 map)

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INTRODUCTION

During the past few years extensive collections of aquatic insects have been made in the Transvaal during river surveys carried out by Dr. A. D. Harrison\* *et al.* (1960 and in press), Dr. B. R. Allanson† (1961), Mr. F. M. Chutter (in press), Mr. J. D. Agnew and other members of the staff of the National Institute for Water Research. The parts of the rivers concerned are situated in the Highveld region of the Transvaal. A small collection was also made in the Transvaal Lowveld by Dr. G. H. Frank of the Bilharzia Research Unit of the C.S.I.R. The caddis collected during these surveys were sent to the author for identification, and the present paper is the first of a series based on this material.

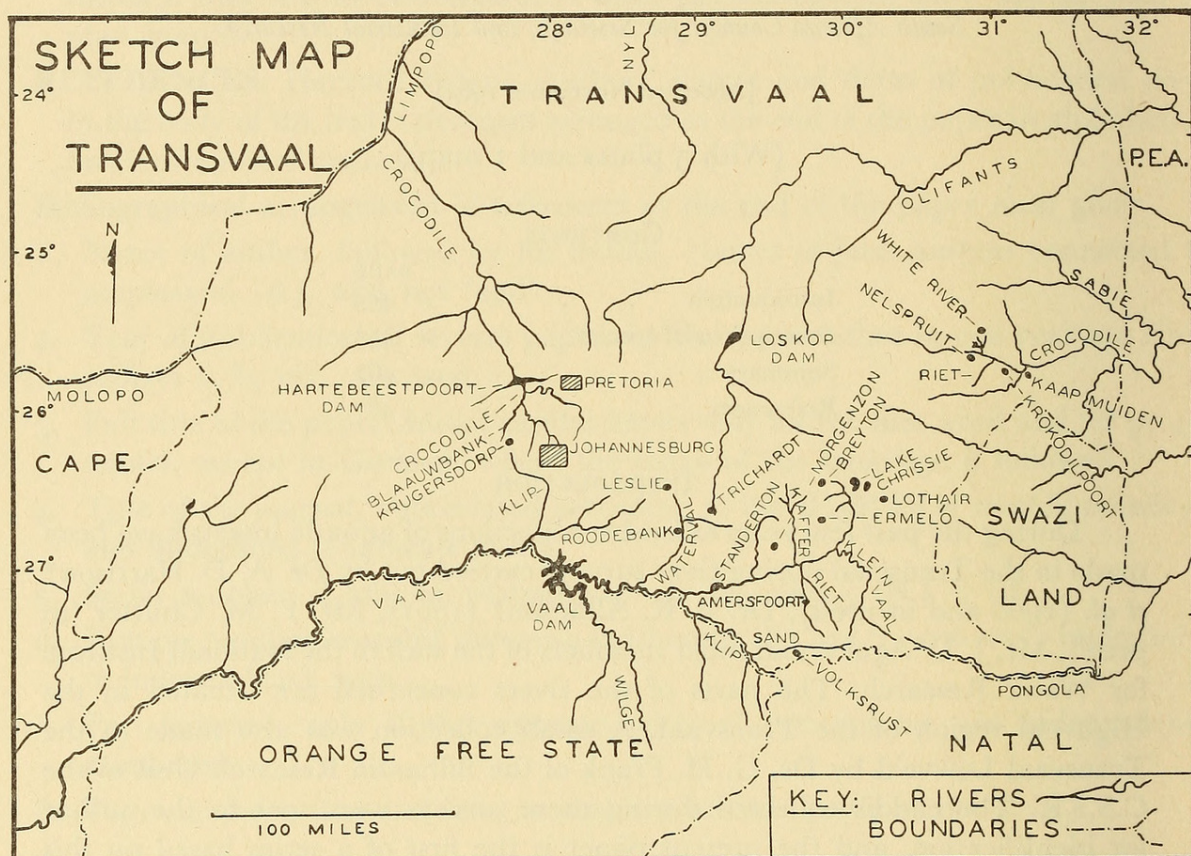
Grateful thanks are due to Dr. A. D. Harrison, Dr. B. R. Allanson, Dr. G. H. Frank and Messrs. F. M. Chutter and J. D. Agnew for permission to study and describe their collections of caddis, and for the trouble they have taken in the provision of extra material, maps and information; also to the South African Museum for the loan of type material, to Mr. D. E. Kimmins of the British Museum (Natural History) for his very kind assistance, and to Professor J. H. Day of the Zoology Department of the University of Cape Town in whose Department the work was carried out.

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In the present paper an account is given of the *Ecnomus* species found in the Transvaal collections. These include one new species, *E. kimminsi* sp. n., fresh material of a little-known species, *E. oppidanus* Barnard, and records of several other species. Some of the species have been correlated with their larvae, descriptions of which are given. Descriptions of females are also given where possible, because the female genitalia show well-marked differences which render identification from drawings and descriptions feasible. A map is given, on which the localities mentioned in this paper can be approximately located.



South African *Ecnomus* larvae fall into two groups, one plain yellow, the other patterned with brown, and it is difficult to distinguish the species from others in the same group as they are very similar. The species considered in this paper all fall into the patterned group, in which the head pattern (clypeus and genae particularly) has been found most useful for identification purposes, since patterns on the thoracic nota vary considerably in intensity with age and other factors, being darker in later instars than in earlier, and also darker and clearer in entire larvae than in larval sclerites taken from pupal cases. The mandibles are also helpful in identification; they are usually much alike in shape but show differences in the development of internal spines. Two types of yellow larva also occur in the area considered, but have not been described as they have not yet been correlated; this also applies to two of the patterned species.



## DESCRIPTIONS OF SPECIES

*Ecnomus oppidanus* Barnard

(Plate XVI, A-H; plate XVII, A-G)

One of the new species described by Dr. K. H. Barnard in 1934 was *Ecnomus oppidanus*. The material then available consisted of two very old and mildewed specimens in the South African Museum collection, labelled Cape Town 1885, and Dr. Barnard suggested that their place of origin be accepted with caution until more specimens were discovered. None appears to have been found, however, until the collections of caddis from the Transvaal were studied, when, among those from the Vaal River area and the Lowveld, many specimens were found which apparently belonged to Dr. Barnard's species.

Through the kindness of Dr. A. J. Hesse of the South African Museum, the author was able to compare these new imagos with Barnard's type material, and found that these males from the Transvaal do correspond very closely to Barnard's specimens. They show, however, a range of variation from the type in minor details, as indicated in the drawings and descriptions. *Ecnomus oppidanus* Barnard may therefore be regarded either as a somewhat variable species, or as a species embracing a number of subspecies or varieties, and whose habitat includes the Transvaal. As the original description was not very full, a new description and drawings of the type material are given here for comparison with those of the Transvaal specimens.

*Imagos*: Barnard 1934, p. 378, fig. 45, *a-d*.

Locality 'Cape T. 1-1-85'. 2 ♂♂.

Neither of the two specimens in the South African Museum was designated as type by Dr. Barnard, so the better one has been selected by the author and labelled holotype ♂. Both are pinned specimens, old, fragile and in poor condition; the paratype lacks a head and its anterior portion is enveloped in cobweb. In both cases balsam preparations have been made of the genitalia after clearing and drawing them, and in the case of the paratype one forewing has also been mounted; both specimens lack hind wings.

Tibial spurs 3, 4, 4; length of forewing 5.0 mm.; general colouring yellowish, forewings yellowish chequered with slightly darker markings. Wings as figured by Barnard (1934, fig. 45 *a*).

*Genitalia of holotype* ♂ (pl. XVI, A-F): Lobes of tenth segment stout, shorter than the claspers, bluntly rounded, slightly upturned and dorsally keeled; internal apical teeth large, numerous, yellowish, some projecting apically. Between the lobes the median part of the tenth segment is membranous and difficult to distinguish, apparently forming a raised area, posterior to which are paired transparent projections with a depressed emargination between them (according to Nielsen—1957—these are the bilobed lips which lie just below the anus). Beneath these projections lie the paired internal processes of the tenth segment ('spiniform processes'; 'paraprocts' of Nielsen), oval in



lateral view and armed with stout spines which curve upwards and outwards round them; the inner and lower parts of the processes are pubescent, and each ends posteriorly in a short apical projection tipped with three bristles. The spines on the processes show slight differences in number and position between holotype and paratype and between left and right sides (pl. XVI, B, C, G). Ninth tergite strongly rounded dorso-laterally; side-pieces deeply incised; sternite long, slightly wider than tergite. Claspers almost oblong in lateral view, bluntly triangular and turned slightly outwards in dorsal or ventral view, the dorso-lateral margins inturned and bearing long, recurved setae. Aedeagus (phallus of Nielsen) with narrow apodeme, then widely expanded, narrowing again to form a trough filled by membranous folds; above this lies a median sclerotized process, bifid for much of its length and ending apically in a pair of heavily sclerotized tips. The aedeagus then tapers to a long, slender, downcurved point.

This bifid sclerotized process presumably represents a pair of spines or titillators, as is indicated by its origin from the dorsal side of the aedeagus. This must be remembered when using Mr. Kimmins's key to the genus *Ecnomus* (Kimmins, 1957), as it may be mistaken for an upper part of the aedeagus, as was suggested in Barnard's original description, which reads 'penis divided into an upper portion which is apically bifid, and a lower portion which ends in a fine point; no curved titillators' (Barnard, 1934, p. 378). The bifid process corresponds to the 'upper beak' of Nielsen (1957, p. 60), which in *E. tenellus* is undivided.

*New material (in spirit):*

*Transvaal (Highveld) males* (numbers cited throughout the paper are catalogue numbers from the collections of the National Institute for Water Research): Olifantsvlei outlet, 1 ♂ (OLF 73 B, A.D.H., 17/1/55); Sandspruit near Volksrust, 1 ♂ (VAL 456 G, F.M.C., 20/11/58); headwater stream of Vaal River between Breyton and Lake Chrissie, 1 ♂ (VAL 516 C, F.M.C., 15/1/59); Vaal River where crossed by Ermelo-Lothair road, 1 ♂ (VAL 851 B, F.M.C., 8/11/59); Lake Chrissie, 4 ♂♂ (VAL 906 X (1-4), F.M.C., 21/1/60); Waterval River (tributary of the Vaal), below confluence of streams from Leslie and Trichardt, 1 ♂ (VAL 1253 A, F.M.C., 6/12/60).

*Other Highveld material:* 1 ♀ (VAL 988 P) was taken at Roodebank on the Waterval River, and larvae from the same place and also from Lake Chrissie and Olifantsvlei.

These males closely resemble the type material described above and appear to be the same species (see pl. XVI, J-M, of the male from Sandspruit). The flies have prettily mottled brownish-yellow forewings (length 5.0 mm.); palps clearly annulate, antennae faintly so. The Lake Chrissie specimens have very widely expanded genitalia which show some of the structures more clearly, so drawings of one of them have been included (pl. XVII, A, B). These Lake Chrissie males have slightly differently proportioned genitalia and the claspers are turned inwards instead of outwards. It is possible to distinguish the median



part of X more clearly; it consists of a raised, transverse portion fused to IX, below which is a pair of thin, diagonally placed plates, projecting visibly in both dorsal and lateral view. These plates appear to have hinge-like sclerotized thickenings on their outer corners, partly dividing each into two portions and enabling them to be tucked downwards. Beneath them lie the internal processes, which in expanded specimens are definitely upcurved; this may also cause difficulty in the use of Kimmins's key to *Ecnomus* males (Kimmins, 1957). The difficulties can be resolved by amending couplets 12 and 13 of the key as follows:

12. Internal processes of tenth segment plain, upcurved, tipped with about 3 setae; titillators expanded apically, toothed, and with a basal branch.

*E. aequatorialis* Marlier

- Internal processes with teeth or spines; titillators without basal branch. . . . 13

13. Internal processes slender, terminating in 3 teeth; titillators in form of sharp spines arising dorso-laterally from the aedeagus.

*E. ulmeri* Mosely

- Internal processes oval, spiny, basally pubescent, apex truncate and tipped with about three long setae; titillators broad with bluntly pointed tips, arising from a wide common base dorsal to the aedeagus.

*E. oppidanus* Barnard

The paired median processes of X are reminiscent of those figured for *E. tridens* (Marlier, 1958, fig. 5). *E. tridens* appears to be related to the *natalensis* group of *Ecnomus* with spurs, 2, 4, 4, however, and could not be confused with *E. oppidanus*. In any case, as the processes represent flaps beneath the anus (Nielsen, 1957), it is probable that they occur in many species of *Ecnomus*. *Transvaal (Lowveld) males* (pl. XVII, c, d): A number of specimens collected by Dr. G. H. Frank in the environs of Nelspruit also appear to belong to Barnard's species. The data concerning them can be summarized as follows:

Nelspruit district, taken from January to March 1957, 35 ♂♂ and 48 ♀♀. All but one of the collections made were small, and in them *E. oppidanus* was the only species of *Ecnomus* collected. The large batch (LOW 179 B) included, however, 14 ♂♂ and 5 ♀♀ of *E. natalensis* Ulmer in addition to 22 ♂♂ and 33 ♀♀ of *E. oppidanus*; also 1 ♀ of a new species of *Ecnomus* from Komatipoort (which will be described when more material is available). The *E. natalensis* ♀♀ were recognizable from the drawings given by Barnard (1934, fig. 45, h, i), and are the same as two ♀ paratypes of *E. natalensis* in the British Museum (Natural History); personal communication from Mr. Kimmins, who very kindly compared them with Ulmer's paratypes there. Besides the differences in the genitalia, the *oppidanus* ♀♀ can be distinguished from the other two species by the tibial spurs (3, 4, 4 in *oppidanus* and 2, 4, 4 in *natalensis* and the Komatipoort species).

The above-mentioned specimens were all collected from a small ground dam (Friedenheim Farm dam) on the Nelspruit-White River road, about 6 miles from Nelspruit. The dam is fed by a tributary of the Crocodile River, and most



of the specimens were collected either in a floating trap designed by Dr. Frank or in a Brundin Cone trap, set either over the shallow fringe of the dam or over deeper water (about 3 feet in depth); bottom flocculent mud. A few imagoes were also taken during random sampling with a hand-net. Recently Dr. Frank collected some *Ecnomus* larvae from a shady pool feeding the dam; conditions had changed in the dam itself which was silting up. Some of the adult *oppidanus* (LOW 159 A) were taken at the same shady pool in 1957.

In addition to the above specimens, a male and three female *E. oppidanus* were taken from the upper Krokodilpoort dam in the Kaapmuiden district (LOW 30 D, 25/10/55), and many *Ecnomus* larvae were collected from the Rietspruit, a small stream with grassy banks, clear, slow flow and muddy bottom, situated on the Krokodilpoort range about 10 miles south of Nelspruit. Both dam and stream connect with tributaries of the Crocodile River. All the larvae except one are similar to those collected in the shady pool, the exception being a larva of the new species described in this paper (*E. kimminsi* sp. n.). It cannot be definitely stated that the larvae collected are those of *E. oppidanus*, as the larvae of *natalensis* and the Komatipoort species are also unknown, and no mature ♂ pupae were found. Identification is, however, reasonably certain as similar larvae were also collected in Olifantsvlei, an acid vlei where the pH range was from 4.2 to 5.4 at the stations and seasons when the *Ecnomus* larvae were collected (Harrison *et al.*, 1960); Olifantsvlei lies on the Klip River some 14 miles SW. of Johannesburg. Very few caddis were able to tolerate the acid conditions, and *oppidanus* ♂♂ were the only adult *Ecnomus* found there. Similar larvae were also found in Lake Chrissie, a shallow eutrophic lake, where *oppidanus* was again the only species of *Ecnomus* found. A description of the larva is therefore given below.

The Lowveld males are on the whole slightly smaller than the rest (w. 4.5 mm.), and have genitalia very similar to the Lake Chrissie specimens, with short, rather humped, upper lobes. The small inner lobes are clear and easily visible; the spiniform processes are somewhat sinuous, with fewer teeth, and are hairier and more granular in appearance underneath (pl. XVII, d); the narrowed tips of the titillators are longer than in the type, and the lobes of X are frequently tucked inwards, with the central processes of X turned down, and sometimes with the ends of the spiniform processes showing (pl. XVII, c).

The yellow teeth arming the upper lobes of X vary in number from about 18 in the Lowveld and Olifantsvlei specimens, to about 28 in many Highveld specimens. The general appearance of the genitalia is however always much the same, and, while it might be possible to separate the material into two varieties or subspecies, it does not seem necessary, at least until the species is better known and more specimens have been collected.

*E. oppidanus* ♀♀ (pl. XVII, E, F, G):

Seventh segment normal; eighth and ninth segments with tergites normal, the ninth thickened posteriorly and fringed with setae. The eighth sternite



forms a subgenital plate almost completely divided into two large leaf-like lobes connected proximally by a bridge; the lobes are setose with about three long marginal bristles and are thickened along their inner margins. Dorsal to the subgenital plate lie thinner flaps, possibly representing IX; proximal to these, and connecting with the subgenital plate, is a sclerotized bridge, seen as triangular in ventral view, in which the genital opening lies. The thin flaps are much folded posteriorly, curling round and connecting apically by way of a thickened collar with a pair of rounded, seta-studded projections, each tipped with three soft, finger-like papillae. The central papilla on each side stands on a small boss and has a narrowed tip. These projections and papillae possibly represent the tenth sternite; between them on the dorsal side the tenth tergite appears to be represented by a pair of small, rounded humps fringed with strong setae.

Females with their genitalia much expanded present a somewhat different appearance, so a figure of one has been included for comparison (pl. XVII, F).

The wide separation of the subgenital lobes is reminiscent of the female designated *E. kunenensis* by Barnard (1934, p. 380 and fig. 45, r; see also pl. XIX, K, of this paper). In *E. natalensis* Ulmer the subgenital plate is deeply cleft, with divergent lobes separated by a V-shaped incision (Barnard, 1934, p. 379 and figs. 45, h, i); a drawing of one is given here for comparison (pl. XX, D, d).

Probable larva of *E. oppidanus* (pl. XIX, B-D): larvae collected from the Nelspruit district (2/8/55, 7/3/62, G.H.F.); from Olifantsvlei (23/6/54, 21/7/54, 18/8/54, 6/10/55, A.D.H.); from Lake Chrissie (16/9/58, F.M.C.). (*Ecnomus* larvae have also been collected from many other localities all over South Africa, but many are too small to identify further, and many have not yet been identified to species as the differences between them are only now being recognized.)

Larva of the usual *Ecnomus* type described by Ulmer (1957); campodeiform, 8-10 mm. in length, all three thoracic tergites sclerotized. Head yellowish, patterned with brown (pl. XIX, B); the patterning on the clypeus consists of lateral strips on the anterior part only, the rest being plain yellow; the patterning on the genae, while darkest along the posterior part of the clypeus, continues back to the occipital foramen; there is also a small brown mark alongside the clypeus above each eye. Anteclypeus divided into four parts; gular sclerite short, widely triangular, with curved sides. Antennae minute, close to anterior margin of head. Eyes large, black, placed well forward in white areas beneath lens-like thickenings of the cuticle. Labrum (pl. XIX, C) rounded, yellowish, with median indentation flanked by a pair of slender bristles; six pairs of dorsal setae. Mandibles (pl. XIX, D) strong, dark, unequal, the right mandible with several blunt teeth and a number of short, stout, internal spines, the left mandible larger, with about five blunt teeth and a number of long, slender, internal spines. Maxillae and labium whitish, prominent; maxillary palp well developed, longer than lobe; labium broad basally, narrowing to a slender shaft, labial palps present, long, two-jointed.



Thoracic tergites (pl. XIX, B) sclerotized, with posterior margins dark; pronotum yellowish, unpatterned, with long posterolateral points which curl round ventrally; meso- and metanota yellowish with more or less clear brownish pattern and diagonal brown stripes in the anterolateral corners; lateral margins of mesonotum also darkened.

Legs strong, subequal; claws long, each with basal bristle. Anal appendages long, slender; anal claws large, strongly curved to form a right angle, a comb of small teeth along the central third of the inner edge, no dorsal hooks.

Abdomen somewhat flattened, no lateral gills, no lateral line, a few hairs along each side (there is a broad lateral tract of fuzzy hairs there in young larvae); five anal gills present.

*Ecnomus kimminsi* sp. n.

(Plate XVIII, A-M; plate XIX, A)

*Imagos* (in spirit): Vaal River shortly above confluence with Klein Vaal, holotype ♂ (VAL 860 F (2), 9/11/59, F.M.C.); Zwartkoppies on the Blaauwbank River, an unpolluted tributary of the Crocodile River, near Krugersdorp, 2 ♂ paratypes (ALL 13 G (1) and (2), 7/4/57, B.R.A.) (this is not the Lowveld Crocodile, but flows northwards through the Hartebeestpoort Dam to join the Limpopo). Klein Vaal near confluence with Vaal River, 1 ♂ pupa with pupal case containing larval sclerites (VAL 1022 L, 9/2/60, F.M.C.); Klein Vaal near confluence with Vaal River, 2 larvae (VAL 1022 M, 9/2/60, F.M.C.). Larvae were also found at several stations on the Vaal River, and higher up the Klein Vaal.

The above specimens all belong to the same species (larvae correlated via larval sclerites in pupal case together with mature ♂ pupa), which does not appear to be any of the species hitherto described from Africa. It belongs to the *natalensis* group of *Ecnomus*, and is nearest to *E. ugandanus* Kimmins. None of the females found could definitely be assigned to this species.

Tibial spurs 2, 4, 4; general colouring of head and thorax chestnut brown; antennae and legs yellowish, anterior face of forelegs browner, fore-tarsi and palps obscurely annulate. Forewings plain golden-brown, traces of irrorations present but wings largely denuded, membrane brownish, a white line along the anastomosis and the anterior edge of the median and thyridial cells. Wing length 5.0 mm., wings of the usual *Ecnomus* type (pl. XIX, A). Abdominal tergites purplish brown.

♂ *genitalia* (pl. XVIII, A-F): lobes of tenth segment long, narrowly oval in dorsal view, broadly so in lateral view, a little shorter than the claspers; internal apical teeth long, slender, dark, forming a band along the apical margin; proximal to them the inner surface of the lobe is set with long setae arising from tall papillae (as is the case in a number of *Ecnomus* species). The median part of the tenth segment forms a raised, semicircular membranous area, partly bounded anteriorly by narrow sclerotized strips. The paired



internal processes of the tenth segment are almost as long as the lobes, stout, slightly sinuous and rodlike, set with small spines and tipped with about three bristles; the processes slope downwards for three-quarters of their length, then turn upwards near the apices. The ninth tergite has a T-shaped median suture-like sclerotization, the ninth sternite is long, with a median point. Claspers of the same type as in the *natalensis* group of species, with a curved apical finger which in dorsal view has an inturned beak-like point; the incision beneath it is rounded and bounded ventrally by a blunt incurved process; base of clasper about four-fifths of the depth of the part to which it is attached. In the Zwartkoppies specimens the apex of the clasper is more rounded than in the type. In lateral view the aedeagus has a triangular apodeme; posterior to this it is constricted, then expanded again to form a bulb which has a ventral membranous portion and is apically bifid to form upcurved, flattened plates with rounded apices, slightly toothed on the dorsal edge. The paired titillators are longer than the aedeagus, stout, spinelike, somewhat sinuous and terminally upcurved.

Holotype ♂ (VAL 860 F (2)) in spirit (genitalia cleared), in the South African Museum; one paratype (ALL 13 G (1)) in the British Museum (Natural History); rest of material in the National Institute for Water Research collection. I have much pleasure in naming the species after Mr. D. E. Kimmins.

Mr. Kimmins has informed me (personal communication) that the internal processes of X in *E. ugandanus* Kimmins are not entirely glabrous as they appear in the figures, but that under a  $\frac{1}{4}$ " objective they show a sparse clothing of minute spines and a variable number of apical setae; the titillators are stouter and a little shorter than in *kimminsi*, and curved but not sinuous. *E. kimminsi* therefore differs from *E. ugandanus* in the more spiny internal processes, the longer, sinuous titillators, and the shape of the apex of the aedeagus and of the claspers. It runs down to the first part of couplet 6 on Kimmins's key (1957, p. 262), and can be keyed out from that point as 6A as follows:

- 6A. Internal processes set with small spines; titillators slightly longer than aedeagus, sinuous; apex of aedeagus in side view rounded, slightly toothed dorsally.

*E. kimminsi* sp. n.

- Internal processes glabrous or sparsely set with minute spinules; titillators slightly shorter than aedeagus, upcurved but not sinuous; apex of aedeagus in side view triangularly pointed. . . . . 7
- 7. Apical finger of clasper elongate, the excision beneath it in side view narrow. Apex of aedeagus in side view forming an acute spine (fig. 2, N); internal processes glabrous. *E. natalensis* Ulmer
- Apical finger shorter, slightly more downcurved, the excision beneath it widely rounded. Apex of aedeagus in side view forming a broad, acute triangle (fig. 2 U); internal processes sparsely set with minute spinules. . . . . *E. ugandanus* Kimmins

Larva of *E. kimminsi* sp. n. (VAL 1022 M, pl. XVIII, G-M):

Larva very similar to that of *E. oppidanus*. Length 9-11 mm. Head yellowish, patterned with brown (pl. XVIII, G); the lateral brown patches on the clypeus



join or almost join centrally, and there is a patterned brown band crossing the middle of the head, interrupted by the plain yellow posterior part of the clypeus; back of head plain yellow. Anteclypeus, gular sclerite (pl. XVIII, m), eyes and antennae as in *oppidanus*. Mandibles strong, dark, each with about 5 blunt teeth and 2 dorsal bristles, the right mandible smaller than the left, with some very short inner spines; the left without inner spines. Labrum brownish, maxillae and labium whitish, very prominent, all very like those of *oppidanus* (pl. XVIII, j, m).

Thoracic tergites all sclerotized (pl. XVIII, g), yellow with brown pattern, posterior borders dark. Pronotum with a large triangular brown mark, meso- and metanota with well-marked pattern and dark diagonal stripes.

Legs, abdomen and claws (pl. XVIII, h) as in *oppidanus*.

*Ecnomus thomasseti* Mosely

(Plate XIX, E-K)

*Ecnomus thomasseti* Mosely 1932.

*Imagos and larvae* (in spirit): Standerton, 1 ♂, 1 ♀ (VAL 985, E 23/3/60), caught on wing; Vaal River near Standerton, 1 ♂ (VAL 1251 E, 6/12/60); Kafferspruit, tributary of Vaal River, near Ermelo, larvae (VAL 1107 L, 12/8/60), some of these larvae being bred out in the laboratory as follows: 2 ♂♂, 1 ♀ (VAL 1159 E, 12/10/60), 1 ♂ (VAL 1159 F, 12/10/60), 1 ♂ (VAL 1160 G, 12/10/60). Crocodile River, shortly before entry into the Hartebeestpoort Dam, 3 ♂♂ (ALL 1 A-C, 5/4/51), 3 ♂♂, 1 ♀ (ALL 5, 10/3/57). The VAL specimens were all collected by Mr. F. M. Chutter, the ALL specimens by Dr. B. R. Allanson. The larvae collected from the Kafferspruit and reared in the laboratory by Mr. Chutter made possible the correlation of the larva with both male and female imagos. The males are all typical *E. thomasseti*; the female and larva are described below. Larvae were also collected at several stations on the Vaal and Waterval rivers.

The ♀, as will be seen from the drawing (pl. XIX, κ), greatly resembles Barnard's '*E. kunenensis*' ♀ from South West Africa. Owing to Kimmins's description of part of Barnard's S.W.A. material as *E. barnardi* (Kimmins, 1957), it was of course possible that the '*kunenensis*' ♀ might in reality be the ♀ of *E. barnardi*, or even of *E. thomasseti*, since Barnard did suggest (1934, p. 380) that one of his ♂ *Ecnomus* might be *E. thomasseti*. The latter possibility was supported by the resemblance of Barnard's ♀ to the *E. thomasseti* ♀♀ from the Transvaal.

Dr. Hesse kindly made Barnard's type material from S.W.A. available for comparison; it consisted of 9 pinned specimens, whose genitalia had in most cases been cleared and then mounted in gum arabic on card. The genitalia were removed from the cards and studied in clove oil before mounting in balsam. The specimens proved to be as follows (all localities given as Otjim-



bumbe, Kunene River, except in the case of No. 6, where the locality was Erikson's Drift, Kunene River; date in each case March 1923):

- (1) *E. kunenensis* Barnard, 1 ♂. W. 4.0 mm. Specimen rather broken up, but parts present. This has been labelled *holotype* because it is the only ♂ of this species in the collection. A figure of it is given (pl. XX, A), to show the narrowing of the internal processes of X. Otherwise it agrees with Kimmins's drawings and description (Kimmins, 1957, p. 265 and fig. 2, κ).
- (2) *E. thomasseti* Mosely, 1 ♂. W. 3.5 mm. Also damaged, but genitalia typical.
- (3) *E. barnardi* Kimmins, 1 ♂. W. 4.0 mm. Much damaged, only forewings and head remaining apart from genitalia, which however agree exactly with Kimmins's drawings and description (1957, p. 265, and fig. 2 B).
- (4) *E. barnardi* Kimmins, 1 ♂. As (3); the hind-legs and 2 wings which were loose have also been mounted in balsam.
- (5) *E. 'kunenensis'* Barnard, 1 ♀. W. 4.0 mm.
- (6) *E. 'kunenensis'* Barnard, 1 ♀. W. 4.0 mm. Genitalia of both (5) and (6) as illustrated in plate XIX, κ (which is actually an *E. thomasseti* ♀).
- (7) *Ecnomus* sp. A, 1 ♀. W. 4.5 mm. (pl. XX, B). Head and right forewing which were loose have been mounted in balsam together with the abdomen.
- (8) *Ecnomus* sp. A, 1 ♀. W. 4.5 mm. (as no. 7). A brief description of this species is given elsewhere in this paper.
- (9) *Ecnomus* sp. Specimen with wings spread, rather broken, genitalia missing.

The new material of *E. thomasseti* from the Transvaal has provided correlation of the '*kunenensis*' ♀ with its larva and thence also with the ♂ of *thomasseti*, besides which the other Transvaal ♀♀ of this type were in each case caught with ♂♂ of *E. thomasseti* only. Thus, since *E. thomasseti* was also present in Barnard's S.W.A. collection, these ♀♀ may be regarded as almost undoubtedly being the ♀♀ of *E. thomasseti* Mosely. There is as yet no final proof of this, however, as none appears to have been taken *in copula*.

*Description of ♀ genitalia* (pl. XIX, κ):

Seventh segment, and eighth and ninth tergites, normal. Eighth sternite forms a subgenital plate divided to form a pair of leaf-like lobes, each of which is laterally rounded, apically bilobed, tipped with three long bristles and studded with small setae; the lobes are widely separated by a squarish indentation with a triangular median point, which is actually the bridge bearing the genital opening, seen end-on. Dorsal to the subgenital plate are the flaps formed by the ninth sternite; these have rugose bands near the midline in their proximal portions, the rugose bands vary somewhat in extent in different specimens and appear to connect basally with a pair of oblong 'pockets', visible through the subgenital plate in a cleared specimen. The genitalia end apically in a pair of soft, rounded projections, each bearing three papillae.



In general appearance the ♀♀ are reminiscent of the ♀♀ of *oppidanus*, but the subgenital plate has definitely bifid lobes, and the space between them is squarer and less deep than in that species; the ninth sternite is less folded distally, and the 'pockets' visible through the plates are quite different from the small triangular slits of *oppidanus*. The two species are in fact distinguishable without clearing, even without considering the tibial spur count (3, 4, 4 in *oppidanus*, 2, 4, 4 in *thomasseti*).

*Larva* (pl. XIX, E, H):

Larva of the usual *Ecnomus* type, length 7–8 mm. Head yellowish, with brown patterning as indicated in the figure (pl. XIX, E); note that the patterning is less extensive than in *kimminsi* or *oppidanus*, the lateral bands on the clypeus being separated by a wide yellow area, and the patterned patches on the genae small, not extending as far as the sides of the head as seen in dorsal view. Anteclypeus, eyes, labrum and gular sclerite as in *kimminsi*, mandibles very similar to those of *oppidanus* in shape, the right smaller than the left; the inner spines on the right mandible are well marked, and two or three long spines arise from the deeply indented inner face of the left mandible. Condyles small, as is usual in *Ecnomus* larvae. Maxillae and labium of the same type as in other species. Patterning of the thoracic nota is much fainter, the pronotum being scarcely darkened, and the meso- and metanota having faint brownish marks and pale brownish diagonal stripes; all have a dark posterior band. Legs and anal appendages as in the other species. Abdomen rather strongly segmentally constricted, lateral tracts of fuzzy hairs well developed.

*Pupal case* (pl. XIX, J):

The pupal case of *E. thomasseti* has been figured as being typical of these *Ecnomus* species; it is composed of comparatively large sand grains with a few minute ones filling interstices, and is lined with thick, soft, semitransparent felt-like material. There are sieve plates at each end, allowing the passage of water currents, and the larval sclerites are found within the case, caught up in the soft lining. Length of case about 8 mm. One case, where the substratum had been of very fine sand, was composed entirely of minute sand grains, so the larva can evidently make use of whatever size is available, preferring however, to use larger sand grains when possible.

*Ecnomus* sp. A ♀

(Plate XX, B)

*Ecnomus kunenensis* Barnard, 1934: 380 (*partim*, ♀ paratypes in the South African Museum).

Otjimbembe, Kunene River, South West Africa, March 1923, 2 ♀♀ (K. H. Barnard and R. F. Lawrence).

A brief description of the second species of ♀ associated with Barnard's S.W.A. material is given here; it is easily distinguished from the other species described in this paper by the genitalia.



Specimens old and fragile, body colour reddish brown with pale gold setae; eyes black; antennae slightly ringed; legs yellowish, tibial spurs 2, 4, 4. Wings pale gold, showing traces of a few darker flecks (the lack of patterning may be due to fading), length of forewings 4.5 and 5.0 mm.

*Genitalia* (pl. XX, B):

The subgenital plate is completely divided into a pair of subtriangular lobes, contiguous or slightly overlapping in the mid-ventral line; each bears 3-4 long, strong bristles and sparsely scattered small setae. Dorsal to the lobes are the flaps of the ninth sternite, each bearing a crescent-shaped tract which at first sight appears to be hairy; the 'hairs', however, seem actually to be small sclerotized ridges. These tracts are concealed by the subgenital plate but are visible by transparency in cleared genitalia. The papillae etc. of the tenth segment are much crushed and distorted in both specimens.

*Ecnomus natalensis* Ulmer

(Plate XX, D, d)

*Ecnomus natalensis* Ulmer 1931.

Friedenheim Farm dam, on tributary of Crocodile River, 6 miles from Nelspruit (LOW 179 B (2), LOW 179 B (4), 25/3/57, G.H.F.), 14 ♂♂, 5 ♀♀.

♂ specimens typical of *E. natalensis*. The ♀ of this species has been briefly described already (Barnard, 1934, p. 378 and fig. 45, h). A figure of it is, however, given here (pl. XX, D) for comparison with those of the other species described. The genitalia differ considerably in appearance from those of the ♀♀ of *oppidanus* and *kunenensis*, showing more affinity with the ♀♀ of species A and C described in this paper. The lobes of the subgenital plate are separated by a deep V-shaped incision, almost the full depth of the plate. Each lobe is traversed by a longitudinal dent or furrow, and bears a number of long setae and three strong marginal bristles. Between the lobes the fold bearing the genital opening can be seen, and dorsal to it the thin flaps of IX. Behind the lobes of the subgenital plate, and only visible in a cleared specimen, these flaps are thrown into raised, sclerotized folds which lie in the angles made by the dents on the subgenital plate. It is difficult to make out the structure of these folds; each appears to have strong, ridged walls enclosing a pocket or space (pl. XX, d). The vaginal apparatus is lightly sclerotized, and there is a sclerotized collar round each of the projections that bear the usual three papillae.

*Ecnomus ugandanus* Kimmins var.

*Ecnomus ugandanus* Kimmins 1957.

Volksrust (VAL 541 G (2), 11/2/59, F.M.C.), 1 ♂. Mr. Kimmins kindly identified this specimen as being a variety of his species.



*Ecnomus* sp., near *E. complex* Mosely*Ecnomus complex* Mosely 1932.

Vaal River (VAL 899 D, 20/1/60, F.M.C.). Two ♂ pupae were found in the Vaal River between Morgenzon and Amersfoort. The pupae have well-developed ♂ genitalia with straight, out-turned upper lobes like *E. similis* Mosely (1932), but have the inner branches characteristic of *E. complex*. The pupal cases contain larval sclerites with almost plain clypeus, genae with a broad band of patterning, and thoracic nota faintly patterned, without dark diagonal bars. Definite identification must await further material.

*Ecnomus* sp. B ♀

(Plate XX, E-H)

Two ♀♀ spurs 3, 4, 4 were bred out from larvae taken from the upper part of the Klein Vaal River (VAL 1158 AK, larvae; VAL 1158 AL, ♀; VAL 1158 AM, ♀; all 20/7/60, F.M.C.). These ♀♀ appear to have lateral slits on abdominal segment V, rather like those of some Hydropsychidae though smaller and less obvious.

*Genitalia* (pl. XX, E):

The subgenital plate is reminiscent of *E. natalensis*, but the V-shaped indentation between the lobes is short, and the lobes are broader and turned farther outwards apically, with four long marginal bristles, and the ninth sternite is soft, there being no heavily sclerotized folds as in *natalensis*. There is a median point visible between the lobes, which appears to pertain to the vaginal apparatus and to lie dorsal to the subgenital plate. The usual apical papillae are present.

*Larva* (pl. XX, F-H):

Length 9–10 mm. Head capsule strongly patterned, particularly on the genae; 'muscle spots' very strongly marked; pattern on clypeus paler than that on the epicranial sclerites, consisting of pale greyish-brown lateral strips which extend back onto the triangular posterior part of the clypeus. The strong patterning on the epicranial sclerites is reminiscent of that in the larva of *oppidanus*, but is even darker except on the clypeus, which is much paler and differently shaped. The mandibles greatly resemble those of *thomasseti* and *oppidanus*, but are particularly large and strong (pl. XX, G, H); the spines in the right mandible are well developed, but the left mandible appears to lack spines entirely. Pronotum with faint brownish pattern, meso- and metanota with definite brown and yellow pattern, but lacking darker diagonal bars (pl. XX, F).

Similar larvae were also collected below the creamery and sewage outflows at Standerton on the Vaal River; also higher up the Vaal, and in a southern tributary, the Wilge River.



*Ecnomus* sp. C ♀

(Plate XX, c)

Three ♀♀, spurs 2, 4, 4, were bred out from larvae collected from the Waterval River at Roodebank, between Standerton and Leslie (VAL 1161 A, ♀; VAL 1161 B, ♀; VAL 1161 C, ♀; July 1960, F.M.C.). Four ♀♀ of the same species were collected in Amersfoort at light (VAL 977 C (2), 22/3/60, F.M.C.).

*Genitalia* (pl. XX, c):

Subgenital plate bluntly triangular, nearest to that of *natalensis* in shape, but with the apical points blunt and slightly bifid, each with four long bristles. The indentation between the lobes is also deeper and is basally squared; through it the small, rounded apex of the vaginal apparatus is visible. Dorsal to the subgenital plate a pair of sinuous, rugose tracts is visible by transparency in cleared specimens; these appear hairy at first sight, somewhat resembling those of *Ecnomus* sp. A. The subgenital plates of the two species are, however, quite different in shape. The rugose tracts appear to be connected with the ninth sternite and the vaginal apparatus, as in sp. A and *natalensis* ♀♀; these species all belong to the *natalensis* group of *Ecnomus* with spurs 2, 4, 4. The ♀♀ of *thomasseti*, belonging to the same group, also have rugose tracts, though somewhat different in appearance.

Only larval sclerites are available in this species, so a description of the larva will be postponed until entire specimens have been found. The sclerites resemble those of *thomasseti*, but are rather more strongly patterned.

The *Ecnomus* larvae described in this paper show resemblances to the larva of *E. relictus* Vaillant (1953), and to one of the larvae described by Corbet (1958, fig. 4, c). Several other patterned species of *Ecnomus* have been discovered in South Africa (two of them in the Transvaal); they will be described as they are correlated.

## SUMMARY

An account is given of the *Ecnomus* species found in the Transvaal collections of the National Institute for Water Research. These include *E. kimminsi* sp. n. and new material of *E. oppidanus* Barnard. Females and larvae of several of the species are also described, and an account given of Barnard's *Ecnomus* material from South West Africa, now in the South African Museum.

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