

A NEW GENUS OF PSAMMOPHILE SCORPION AND NEW SPECIES OF *OPISTHOPHTHALMUS* FROM THE NAMIB DESERT

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(With 4 figures)

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INTRODUCTION

The scorpion fauna of South West Africa, especially the litoral region, seems to be still very incompletely known.

In the following pages a new sand-living scorpion from the Namib Desert is described which is probably the first scorpion of the family Scorpionidae with well marked psammophile characters to be recorded although these are known in a number of dune scorpions of the family Buthidae from Asia Minor, Transcaspia and North Africa.

These so-called "adaptations" can be seen in an extreme form in the Namib scorpion *Protophthalmus* where the anterior legs are completely fringed

with a brush of setae, the claws of the legs are longer than in any known scorpion and the pectines and their lamellae drastically reduced in size and number. It is hoped that some observations on the biology of this scorpion will be made in the near future; they should prove to be of the greatest interest.

The opportunity has been taken here to present some notes on two other little known forms of *Opisthophthalmus* from the Namib and to describe two new species from Ohopoho in the Kaokoveld and from Rehoboth respectively.

I tender my warm thanks to Dr. C. Koch and Mr. E. Holm of the Namib Desert Research Station at Gobabeb, where the discovery of *Protophthalmus* was made.

I am also extremely grateful to Mr. Gerald Newlands of the Transvaal Museum Pretoria, for sending me a number of little known forms of *Opisthophthalmus* from South West Africa and for the photographs which comprise Figure 4 of this paper.

Family SCORPIONIDAE

PROTOPHTHALMUS gen. nov.

Carapace much longer than wide, median eyes well in front of the middle, almost twice as far from the posterior as from anterior margin.

Legs. The two anterior pairs flattened, with a regular linear series of very long slender setae and some shorter clavate setae, Fig. 1 *d*, on the posterior and anterior edges of the five distal segments, being

more or less equally developed on these, Fig. 1 *c*; the lateral flattened surfaces of these legs quite smooth and without setation. Outer claw of leg I only a little more than half the length of the inner, those of leg IV much longer than the tarsus itself, equal and almost straight, Fig. 2 *f*; tarsi with reduced lateral lobes, these somewhat rounded, resembling those of the Scorpioninae rather than the Ischnurinae, the inner with 3-5, the outer with 1-2 long slender cylindrical spines; superior lobe very short; post-tarsus obsolete, represented by a small rounded projection lacking a claw (Gehstachel); inferior surfaces of all tarsi without rows of spines, these replaced by long setae.

Pectines much reduced, simple, extremely small relative to the sternum and operculum, Fig. 2 *b-d*, with 1-3 teeth, these extremely large relative to the remainder of the pectine.

Body size small to moderate.

Type species, *Protophthalmus holmi* Lawrence.

REMARKS ON THE RELATIONSHIPS OF THE GENUS.

The genus is certainly a member of the Scorpioninae rather than the Ischnurinae which, with the exception of the rupicolous genus *Hadogenes*, are not represented in South West Africa; it is most closely related to the group of *Opisthophthalmus* represented by *O. wahlbergi* (Thorell) in which the anterior legs carry a brush-like row of setae instead of spines and the eyes are more anteriorly situated than in other species of *Opisthophthalmus*; in *wahlbergi* and allied species however the brush-like structure, though in general resembling that found in *Protophthalmus*, is much less strongly developed; the setae are much shorter, less regular and are confined to the tibia and protarsus (basitarsus) instead of being equally developed on the five distal segments of the anterior legs.

Both short clavate and long slender setae, developed on both sides of the second pair of legs, are also characteristic of certain litoral genera of Solifugae in South West Africa, e.g. *Prosolfuga* and *Metasolfuga*, Fig. 1*a*; they also occur on the same leg in South African genera of the largely arenicolous Hexisopidae where the legs and body are much reduced and incrassate (*Mossamedessa*, *Chelypus*, *Hexisopus*); as far as I am aware they are not found in the two North African families, Galeodidae and Rhagodidae, many of which occupy the same desert biotype as the South West African genera mentioned above.

The characters which distinguish this scorpion from *Opisthophthalmus* are for the most part negative ones. It is noteworthy that not only is there a general absence of granulation throughout the entire body (the caudal segments have some weak granu-

ation) but strong conical spines are lacking on the tarsi of all the legs, only the lateral lobes being provided with some rather weak modified ones, the rows of spines always present on the inferior surfaces of the tarsi in *Opisthophthalmus* being absent or replaced by bristles and setae, Fig. 2 *f-g*.

The strong reduction of the superior tarsal lobe of the legs must also be regarded as a primitive character as well as the absence of a post-tarsus in the form of a small inferior or third claw (Gehstachel). Birula (1926, p. 62) remarks that the first named structure is also practically absent in the Carboniferous scorpion *Eobuthus* Fritsch as well as in the sand inhabiting species of the Transcaspian and Persian deserts, *Liobuthus kessleri* Birula and *Plesiobuthus paradoxus* Pocock.

The most striking negative character is perhaps the reduction of the pectines which are composed of a few small and simple segments while the teeth are drastically reduced in number and have only a few sensory tubules. The role of the pectines and their importance as sense organs must be greatly reduced in this scorpion; there can be little doubt that there is a connection between this and the ecological background of the animal which has adopted a psammophilous habit of life.

Hewitt regarded *Karasbergia* as the most primitive member of the South African Buthidae while *Lisposoma* and *Protophthalmus* are doubtless the most primitive of the South African Scorpionidae. It is probably not chance that three of the four scorpion genera peculiar to the South African region are found in South West Africa; all of them are of small size and with a reduced number of pectinal teeth.

A character which separates *Protophthalmus* from all species of *Opisthophthalmus*, the position of the eyes far forward on the carapace, was also regarded by Hewitt (1925, p. 258) as primitive, while Birula mentions that this feature is found in his psammophilous species *Psammobuthus zarudnyi* from the sand deserts of Turkestan (1911, p. 72).

Protophthalmus must then be considered as being more primitive than *Opisthophthalmus* which is itself more primitive than the two African genera of Scorpioninae, *Scorpio* in North Africa and *Pandinus* in Central Africa.

PROTOPHTHALMUS HOLMI sp. nov.

(Figs. 1 *c-d* and 2 *a-f*.)

Holotype ♀, paratype ♀, Gobabeb, South West Africa, collected by E. Holm, June, 1968. The two female specimens, presumably adult, were found at the foot of a sand dune near gravelly patches of an inter-dune valley.

Colour in general yellow, abdominal tergites light olive green, caudal segment IV light brown, V dark

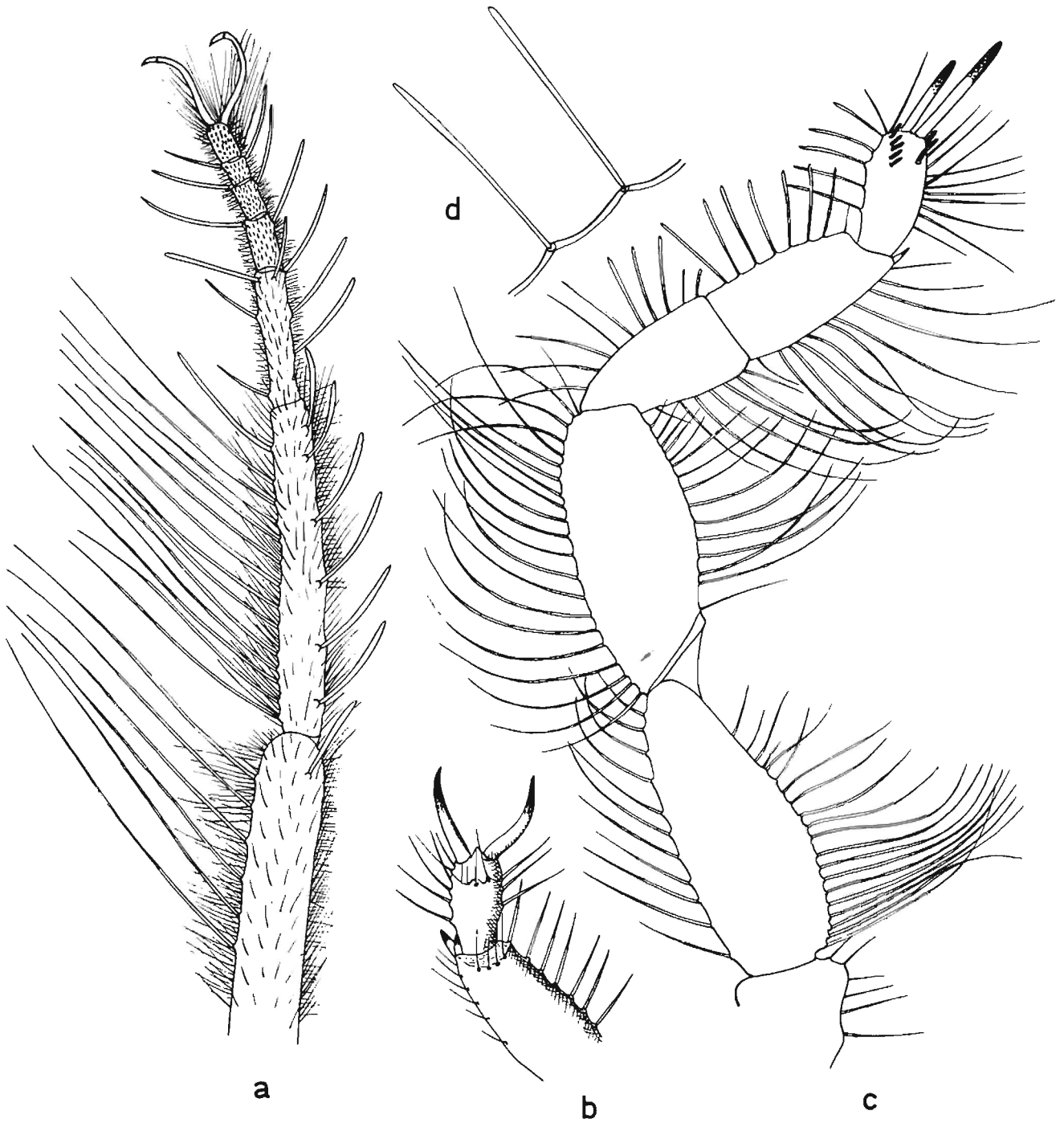


Figure 1: *a*, Leg. II of the Solpugid, *Metasolpuga picta* (Kraepelin);
b, basitarsus and tarsus of leg II of the psammophile Transcaspian scorpion *Liobuthus kessleri* Birula, from above;
c, leg I of *Protophthalmus holmi* sp. n., holotype ♀, from the side and below;
d, two bacilliform setae of the basitarsus enlarged.

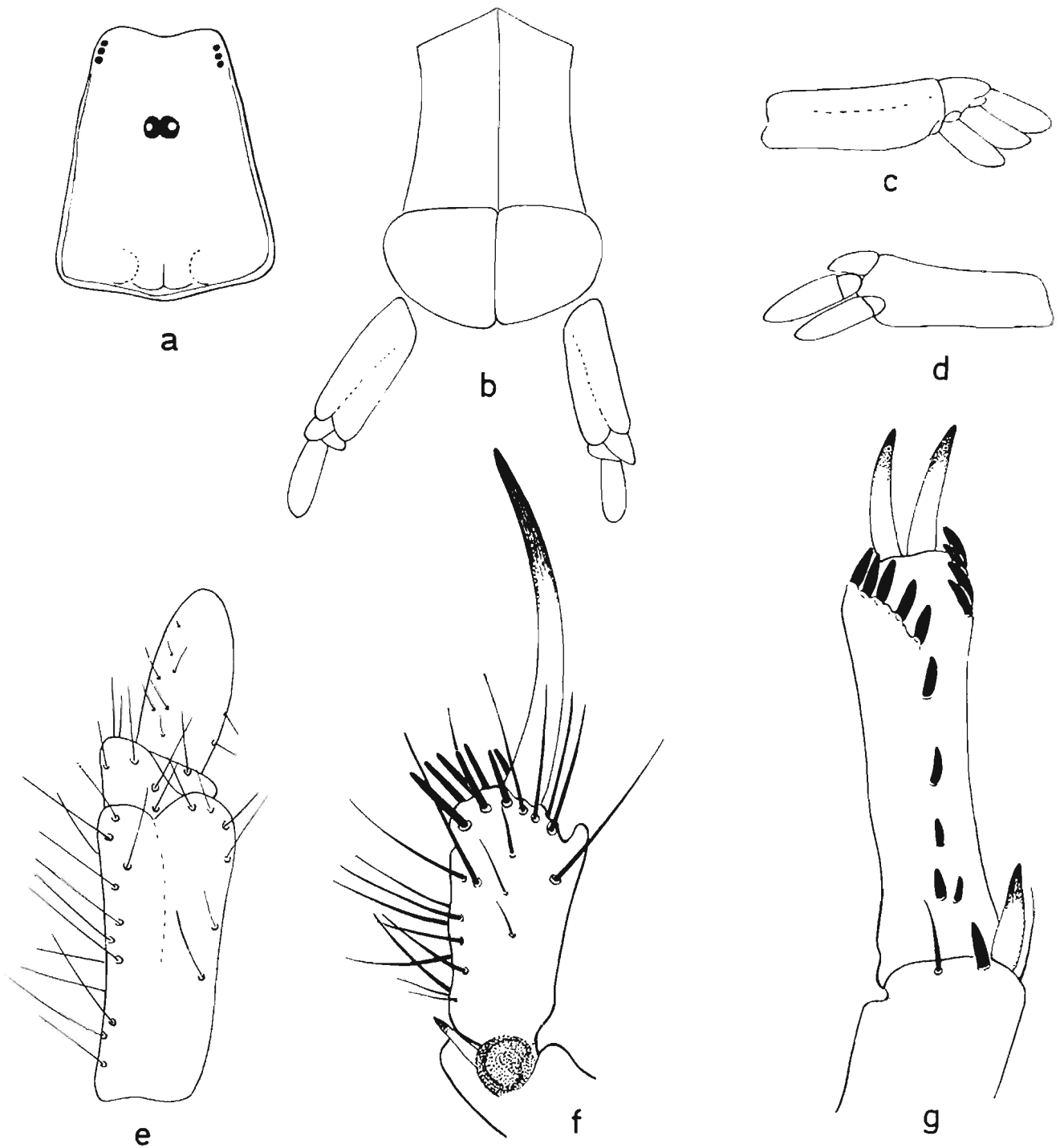


Figure 2: *Protophthalmus holmi* sp. n.

a, Carapace;

b, sternum, genital operculum and pectines of holotype;

c, d, left and right pectines of paratype;

e, a pectine enlarged to show setal arrangement of ventral surface;

f, tarsus IV. lateral view;

g, tarsus IV of *Opisthophthalmus wahlbergi* (Thorell), ventral view.

brown; fingers of hands reddish brown; inferior surface of trunk yellow, legs pale yellow.

Carapace, Fig. 2a, quite smooth and shiny with a few small indistinct rugosities; a weak median groove present; median eyes in the middle of a black pigmented spot, twice their diameter apart, the superciliary ridges very weak; chelicerae without a stridulatory mechanism, the area occupied by this structure in *Opisthophthalmus* greatly reduced in size, with long weak unmodified setae.

Abdomen. Tergites quite smooth, with close-set microscopic punctures, the last segment with scattered dust-like granulation at the sides; all sternites quite smooth and shiny, their posterior margins with numerous weak setae.

Cauda without well-defined keels, the upper surface of I and II with scattered dust-like granulation at the sides; the dorso-median and dorso-lateral crests of II-IV represented by rather irregular rows of very small weak granules; sides of IV evenly covered with minute granules; only the inferolateral keels of V distinct, composed of a regular straight row of 25-30 small tooth-like granules, its inferior surface evenly but not thickly covered with minute granules. Vesicle long and slender, the aculeus not much shorter than the bulb, with a few minute granules inferiorly at its base, otherwise smooth and shiny, the inferior surface with fairly numerous long, fine setae.

Pedipalp. Humerus and brachium smooth and shiny above with very weak supero-anterior crests composed of a few small obsolete granules; superior surface of hand fairly convex, shiny but covered with minute granuliform tubercles; no vestige of a finger keel or a keel separating the upper and lateral surfaces; ventral surface of hand quite smooth, shiny, inner and outer boundaries of the hand sharp, their edges defined on each side by a very regular row of about 22 small equal-sized granules, the row of the inner side merging with the immovable finger distally; hand-back distinctly longer than width of hand, fingers short, only a little longer than hand-back.

Legs. The two anterior legs with the segments from prefemur to basitarsus compressed, seen from above the anterior and posterior margins of these segments (especially in tibia and basitarsus) forming a fairly sharp weakly chitinized edge on which a single serial row of long stiff setae is implanted, the whole with the appearance of a regular brush-like structure, Fig. 1 c; most of the setae long and finely tapering but those on the dorsal surface of tibia and basitarsus thickened and bacilliform, some slightly clavate in distal half and bluntly rounded at apex, Fig. 1 d; the flattened surfaces of these legs quite smooth except for a few weak setae.

Claws of legs long, slender and straight, the outer (posterior) claw of tarsus I only a little more than

half the length of inner, this discrepancy becoming progressively less in tarsi II-IV, those of fourth leg the longest (almost $1\frac{1}{2}$ times as long as the tarsus itself) equal in length; tarsi without rows of spines below, these replaced by long setae; lateral lobes feebly developed but usually with 4 inner, 2 or 3 outer long cylindrical spines, Fig. 2 f.

Pectines much reduced and simplified, not divided into lamellae by sutures except rather indistinctly at distal apex; the ventral (exposed) surface with fairly numerous long fine setae springing from large sockets, Fig. 2 e; 1 pectinal tooth on each side in the holotype, Fig. 2 b; 2 and 3 in the paratype, Figs. 2 c-d; the sensory areas not clearly outlined, the sensory tubules few in number, small and irregularly arranged.

Dimensions. Total length 45, trunk 22, tail 25; length-width of carapace, 8-6; hand-back 4.1, width of hand 3.4 mm.

According to Mr. Holm's report, the two specimens were collected approximately 1 mile south of the Kuiseb river-bed, between the *caravan* and the so-called "fossilized dune", on June 23 and June 24 during 24 hours of hourly census. They were found between 1500 and 1800 hours, being active on the surface just when the dominant primary species of that specific micro-habitat and time, viz. *Stenocara phalangium* (Tenebrionidae, Adesmiini) becomes inactive. These tenebrionids sleep on the surface and would constitute a easy prey for the scorpion. The one scorpion was found in a shallow, typical oval and slanted burrow in loose dune sand temporarily semi-consolidated by high air moisture. The specimens were collected during an extremely cold spell during the period of the first winter east winds.

Temperatures at time and place of collecting specimens were:

Time and date	Temp. $\frac{1}{2}$ cm above surface	Temp. $\frac{1}{2}$ cm below surface
On surface: 15.00 hr., 24-6-1968	23.8 C	29.3 C
17.00 hr., 24-6-1968	19.7 C	22.2 C

The micro-habitat is described as "dune-foot" (i.e. the transitional area between solid dune slopes and inter-dune valleys) which in this particular area is exceptionally wide. The sand is a mixture of dune sand and coarse quartz sand, with patches of occasional quartz pebbles. Vegetation consisted of sparse remains of *Stipagrostis* grasses of previous rain seasons; no green vegetation in the environment.

A very small, pale pink specimen taken at the foot of another dune about a mile from the type locality by Mr. E. Holm is undoubtedly a young stage of this form; it does not differ in any way from the adult except that of size; pectines very short, with 3-4 teeth. Total length 19 mm.

A NOTE ON THE PSAMMOPHILOUS HABIT IN SCORPIONS

A number of scorpions have been recorded as being psammophilous in habit and various specializations appropriate to this manner of life have been described in them; although exact observations on the habits and ecology of sand or dune-living scorpions are few, it is presumed that, as stated by Gertsch and Alldred in their paper on the scorpions of the Nevada Test Site, "some species lie buried in the sand, by this activity pattern they escape the heat of the day" (1965, p. 1).

In the Buthidae, digging in sand is carried out with the three anterior pairs of legs which rapidly throw the sand backwards while the body is supported and raised above the substratum by the pedipalps anteriorly and the fourth pair of legs posteriorly. This is illustrated by Pavlovsky in the case of *Liobuthus kessleri* Birula and his drawing of the process is reproduced by Werner (1935, p. 247, fig. 301); it is probably the method of digging employed by most Buthidae although in some cases (*Buthus australis citrina*) the pedipalpi may also be used for scooping sand.

Up to the present no scorpions in southern Africa have been observed to practise such a habit and no structures which could be correlated with a psammophilous manner of life have been described in them.

The most conspicuous modification in sand-living scorpions is the lateral compression of the two or three anterior pairs of legs and the provision along the fairly sharp edges of some segments of a serial row of long stiff setae or bristles forming a comb or brush-like organ. Rather exceptionally a similar structure is found in a single species of the family Vejovidae, *Vejovis hirsuticauda* from California, where a thick brush of long soft hairs is found on the ventral surface of the vesicle (Gertsch and Alldred, 1965, p. 8, fig. 13); though occupying a different position it probably serves the same purpose as the brushes on the legs of the desert scorpions of the Old World.

The writer after search through the literature has been able to find ten other species in which these modifications occur though there are doubtless a number of others which have been overlooked. The sweep-like structures of the anterior legs is developed to a greater or less extent in these species, varying from one to another, but in none of them

is it carried to such extremes as in *Protophthalmus*; nine of them belong to a single large family with a world-wide distribution, the Buthidae; one to the small neotropical family Bothriuridae, while *Protophthalmus* is a member of another large old-world family with its head-quarters in Africa, the Scorpionidae.

In many desert scorpions the habitat is either sandy or with a hardened barren surface of clayey soil and some rocks or stones of various sizes are often available. In the case of *Protophthalmus* however the substratum is entirely dune sand, without rocks, stones or scrub vegetation to provide even a modicum of shelter. Though nothing is yet known of its background, the weak slender claws and strongly reduced spination of the tarsi in *P. holmi* makes it very improbable that this scorpion would be able to excavate burrows in firm hard soil.

A brief account of the sweep-like modifications of the legs and various other characteristics of psammophilous species from Turkestan, Arabia, Iran and North Africa would not be out of place here for purposes of comparison with the South West African form; in all except one of these examples the genera are themselves peculiar and monotypic.

1) *Apistobuthus pterygocerus* Finnegan 1932. South Arabia.

In this peculiar Buthid genus brushes occur on the three anterior pairs of legs but only on the tibia, basitarsus and tarsus (1932, fig. 2, p. 94); they are much less strongly developed than in *Protophthalmus*; the three distal segments of these legs are flattened; the claws of leg IV appear to be long, slender and straight (*loc. cit.* fig. 8); the upwardly curved anterior half of the carapace (*loc. cit.* Text fig. 1) may also be a psammophilous character. According to Finnegan *Apistobuthus* is most nearly related to *Plesiobuthus*, a genus which possesses the same modifications of the anterior legs.

2) *Trichobuthus grubleri* Vachon 1914. Algeria.

In the three anterior pairs of legs the "article médian" (basitarsus) is laterally flattened, its dorsal crest provided with long hairs in the form of a comb. The granulation in general appears to be weak. The claws of leg IV are elongate, slender and almost straight.

3) *Liobuthus kessleri* Birula 1898, Ashqubad (Aschabad) Turkmen, Transcaspia.

The author in a later paper (1926, p. 61) gives a figure of the protarsus and tarsus of the second leg, reproduced as Fig. 1 *b* in this paper. The first three pairs of legs from femur to metatarsus (Birula

says "femur and metatarsus") are provided with stout setae (Borsten). The pectines of the ♀ are remarkably short and "erreichen nur kaum die Hälfte des ersten Bauchsegmentes" but the pectinal teeth are fairly numerous 14 (♀), 27 (♂). The granulation of the trunk and cauda is in general reduced or obsolete, the sternum relatively elongate. Vachon has recorded examples of the species from Iran (1958, p. 425) and makes the following comment "les pattes ambulatoires, surtout les 3 premières paires, sont très nettement "adaptées" ou fouissage et en balayage du sable; des farses sont très aplatis et ont une rangée de longues soies formant peigne".

4) *Buthiscus bicalcaratus* Birula 1905, Tunisian Sahara.

According to the author there are 4-5 long setae arranged in a row on each side, only on the tarsi; the tibia and basitarsus is flattened in legs I-III; granulation is reduced, being very fine and dense but absent on the carapace.

Vachon (1942, p. 420) says of this species: "articles distal et median des tarses des pattes 1-3 aplatis et munis de soies longues formant peigne". Thus, as in all other psammophilous species, a brush of stiff setae is not found on the segments of the fourth leg.

5) *Anomalobuthus rickmersi* Kraepelin 1900. Bokhara, Turkestan.

I have not been able to see Kraepelin's original description but Vachon (1958, p. 426) says it occupies the same biotype as *Buthiscus*, *Liobuthus* and *Psammobuthus*.

6) *Psammobuthus zarudnyi* Birula 1911. Turkestan.

Birula (1911, p. 69-74), says that in this species, which is found in the interior sand deserts of Turkestan, the median eyes are shifted forwards beyond the middle of the carapace (p. 70); the tibiae and basitarsi of all the legs are flattened, the basitarsi of I-III on the outer expanded margin with 7-9 fairly strong setae; "die Tarsen sind mit wenig gebogenen (nicht hakenförmigen) Klauen... bewaffnet" (p. 72). In the last named character the species agrees with a number of South West African members of the genus *Opisthophthalmus* living in the sand dunes of the litoral, *O. flavescens* Purcell, *longiceps* Lawrence and *chrysites* Lawrence. The shifting forwards of the median eyes may also be a characteristic of psammophilous scorpions, of course particularly marked in *Protophthalmus*.

7) *Buthus atlantis* Pocock 1889, Mogador, Morocco.

The form is regarded by later authors as a subspecies of *Buthus occitanus*. Vachon (1951, p. 260)

remarks that this species, the "dune scorpion", frequents the banks of rivers and the margins of the sea but is found exclusively on a sand dune substratum to the south of Mogador.

Although the fact is not mentioned by Pocock in his description, the tibiae of the anterior legs, judging by his figure of the whole animal (1889, Pl. XV, Fig. 4), appear to be somewhat flattened; these legs also have a serial row of rather short setae on both sides of the segments from femur to tarsus.

8) *Plesiobuthus paradoxus* Pocock 1900, North Baluchistan.

Although its ecological background is not mentioned the psammophile characters of this scorpion are clearly described and figured by Pocock: "Protarsus of 1st, 2nd and 3rd legs strongly depressed with sharp fringed posterior edge; tarsi also depressed, though to a lesser extent, and hairy; claw lobe (superior tarsal lobe?) very short and tuberculiform; claws very long, nearly as long as the tarsus and nearly straight" (p. 43).

9) *Buthus australis citrina* (H. & E.), Egypt.

Lankester (1882, p. 95) remarks on the sand living habits of this scorpion under the name of *Prionurus citrinus* and includes a description of the manner of digging which differs somewhat from that of Birula's *Liobuthus kessleri*. In *citrinus* the pedipalps as well as the three anterior pairs of legs are used for throwing the sand backwards, while in *kessleri* only the legs are used for this purpose.

10) *Brachio sternus ehrenbergi* (Gervais), Chile and Peru.

Pavlovsky in his paper of 1924, p. 128, draws attention to Kraepelin's figure (1899, p. 191, fig. 60) and surmises that this species may also have modified structures on the anterior legs in accordance with a life on sand. Kraepelin (*loc. cit.*) in his description of the genus says "Tarsenendglied... auf dem Rücken mit kammförmigen Wimpern. Gehstachel groß".

To sum up, the flattening of the anterior legs and the brushes of serially arranged stiff setae is evidently a character held in common to a greater or less degree by all the psammophilous species of scorpions which have been cited in this paper. There appears to be little essential difference in the structure when found in the Buthidae and Bothriuridae as represented by the ten non-South African species, and the Scorpionidae as represented by the single South West African species of *Protophthalmus* except that the sweep-like structure is much more strikingly developed in the latter. In some Buthidae it is found on the three anterior legs but in *Protophthalmus* is strictly confined to the two anterior ones.

In the Buthid and Bothriurid species it is usually limited to the two distal segments of these legs or to the tarsus alone; in *Liobuthus* it ranges from the femur to metatarsus, in *Buthiscus* and *Apistobuthus* on the tibia as well as the two tarsal segments; although the tibia and distal segments are flattened in *Buthiscus*, only the tarsi are provided with modified setae; in *Liobuthus* and *Trichobuthus* they are implanted only on one side (the anterior or dorsal edge).

A reduction in the size of the tarsal lobe of the fourth leg is characteristic of *Liobuthus* and *Plesiobuthus* according to Birula (1926, p. 62). In another species on the other hand, such as *Trichobuthus grubleri* Vachon, it is extremely large (Vachon 1941, p. 343, fig. 14); in South West Africa the litoral species *Opisthophthalmus flavescens* Purcell differs from all other species of *Opisthophthalmus* in the great size of this lobe; the median eyes on the other hand, lie far back on the carapace.

The shifting forwards of the median eyes is a characteristic of at least one genus of psammophile scorpions, *Psammobuthus* Birula.

A straightening and elongation of the claws, especially those of the posterior legs, is a feature of *Apistobuthus*, *Psammobuthus*, *Plesiobuthus* and *Trichobuthus* as well as a number of species of the genus *Opisthophthalmus* inhabiting sand dunes in South West Africa, *adustus*, *longiceps* and *chrysites*.

Reduction of the pectines has been noted only in *Liobuthus* where the pectinal teeth (lamellae), unlike those of *Protophthalmus*, are fairly numerous.

Granulation of the trunk and tail is in general diminished or represented often by a shagreen of minute granules while absent on some parts of the exoskeleton; such a reduction has been noted in varying degrees in *Buthiscus*, *Apistobuthus*, *Liobuthus*, *Psammobuthus* (?) and *Plesiobuthus*.

Genus OPISTHOPHTHALMUS C. L. Koch

OPISTHOPHTHALMUS VIVIANUS sp. nov.

Holotype, 1 ♀, Gebiet of Rehoboth, South West Africa, Albany Museum, collected by H. W. Bell-Marley (N. 8225), December, 1932.

Colour in general clay yellow; an anterior V-shaped portion of the carapace distinctly lighter than the rest; chelicerae light reddish brown; tergites a little darker than the remainder except for a narrow yellowish median band, a posterior marginal band also lighter; sternites a little darker in the middle of each; hands a little darker in the middle, fingers light orange, legs yellow.

Carapace a little longer than its posterior width, its length equal to caudal segments I and II with $\frac{1}{4}$ of III; anterior margin quite straight; interocular

area almost completely smooth, shiny, rest of carapace with small rather sparse widely separated granules.

Abdomen. Tergites with fine dust-like granulation, VI and VII with some large ones at the sides; all sternites except a small anterior part of I uniformly covered with large round contiguous tubercles, those on segments IV and V tending to become transversely elongate, those on the posterior half of V most elongate and larger than the others which are of almost uniform size throughout.

Cauda. Caudal segment I wider than long, the superior keels represented by an ill-defined row of 5-7 granules, those of II by a more regular row of 7-9 granules; dorsal surface between the keels of all segments smooth, but a few granules on I; segments I-III entirely rounded below, without keels, uniformly covered with large shiny granules similar to those of the sternites, those of I in 7-8 irregular transverse rows; infero-lateral keels present in III and IV but very weak and irregular; inferior surface of V sparsely but fairly uniformly covered with large sharp, saw teeth, the dorso-lateral keels irregularly duplicated, the dorsal surface between them smooth and shiny. Vesicle shorter than segment V but subequal in width, a few obsolete granules at extreme base inferiorly.

Pedipalp. Outer and inner margins of hand fairly strongly pilose, outer and upper surfaces not forming an angle, separated by a finger keel which is only present in distal half where it is composed of smooth confluent granules; superior surface of hand uniformly covered with distinct, well separated shiny granules of different sizes, not all of them round; accessory finger keel composed of an irregular row of separate granules; hand-back about two-thirds width of hand.

Pectines. Basal $\frac{2}{5}$ of scape free of teeth, the base not angular, 14-14 teeth.

Legs. Claws equal sized, well curved, superior lobe not much shorter than lateral lobes, both internal and external lobes with 4 spines, inner side of tarsus with 4, outer with 0 inferior spines.

Dimensions. Tail 42, trunk 33.5, total length 75; length of carapace 12.5, width 11.5; width of hand 9, hand-back 6.5 mm.

The species keys down to *granicauda* Purcell in Hewitt's group I but the granules of the sternites and caudal segments are much finer in *granicauda* so that these surfaces appear granular while in *vivianus* they are composed of very much larger, transversely elongate, shiny tubercles which are distinctly separate and far fewer in number; in their size and number these granules resemble *pictus* and *setifrons* Lawrence rather than *granicauda*.

It belongs to the *pictus* group but differs from *pictus* in the wider hand, somewhat smaller granules

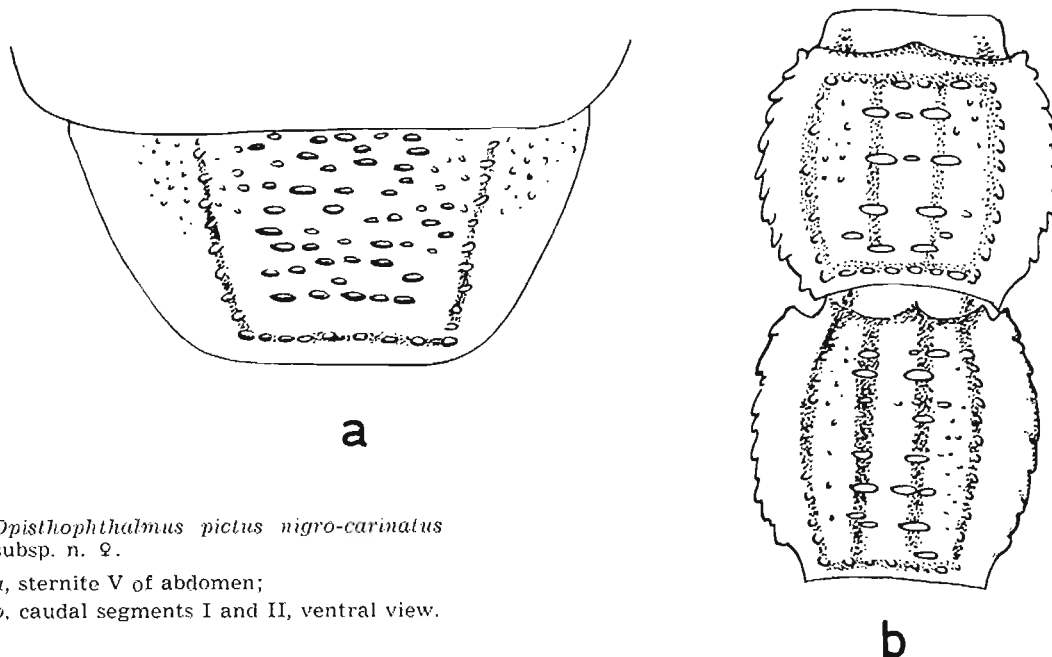


Figure 3: *Opisthophthalmus pictus nigro-carinatus* subsp. n. ♀.

a, sternite V of abdomen;

b, caudal segments I and II, ventral view.

of the sternites, the fewer pectinal teeth (a much larger proportion of the pectines untoothed at the base), and the lighter colouring; the granules of the inferior surfaces of caudal segments I and II are not arranged in four rows, with the two median ones very irregular, but are uniformly distributed over the whole of these surfaces. From *setifrons* it can be distinguished by the carapace which is longer than wide instead of the reverse, the larger number of pectinal teeth, the antero-inferior crest of pedipalp humerus being regular and strong as in *pictus*, with 9 distinct granules, the absence of inferior median or lateral keels on caudal segments I-IV.

The species is named in honour of my friend and colleague of many years, Dr. Vivian FitzSimons, South Africa's foremost herpetologist.

**OPISTHOPHTHALMUS PICTUS
NIGRO-CARINATUS ssp. nov.**

Figs. 3 a, b and Plate I

Holotype 1 ♀, 30 miles S. of Ohopoho, Kaokoveld, South West Africa, collected by A. van der Merwe, December 1967.

Colour. Carapace yellow with some ill defined blackish markings, the most conspicuous being a U-shaped figure, the base of the U just behind the median eyes, the arms extending to the lateral eyes on each side; chelicerae blackened except at their bases. Tergites dark brown, a narrow posterior margination and some indistinct spots, yellow, the posterior half of V also yellow; whole of inferior

surface pale yellow, but sternite V light brown; tail in general yellow but the keels, especially the inferior ones, strongly blackened; legs pale yellow, pedipalp yellow but all the keels black, Fig. 4 a, while the blackened individual granules of the hand surface give it a speckled appearance; the inner and outer edges of the fingers blackish or reddish brown.

Carapace a little longer than wide, median eyes a little more than $1\frac{1}{2}$ times as far from the anterior as from the posterior margin; a clearly defined anterior fork; granules weak, small and well separated, interocular area quite smooth except for a few granules bordering the median groove and some dust-like ones enclosed by the anterior fork, anterior margin very weakly incised in the middle.

Abdomen. Tergites fairly uniformly covered with minute dust-like granules giving them a finely shagreened appearance; last tergite laterally in posterior half with inconspicuous granules not much larger than elsewhere. All sternites completely covered with large, shiny, closely packed or contiguous granules, Fig. 3 b, except anterior to the stigmatal slit in segments I and II, those of I-III round, of IV becoming transversely elongate, a quadrilateral area in the middle of V with still larger granules considerably wider transversely than long, Fig. 3a.

Cauda. Segment I distinctly wider than long, II as wide as long. No continuous inferior keels, these represented by rows of separate granules, the infero-median keels of I and II, Fig. 3b, consisting of very irregular rows of smooth, shiny and transversely elongate granules, especially in I where they are

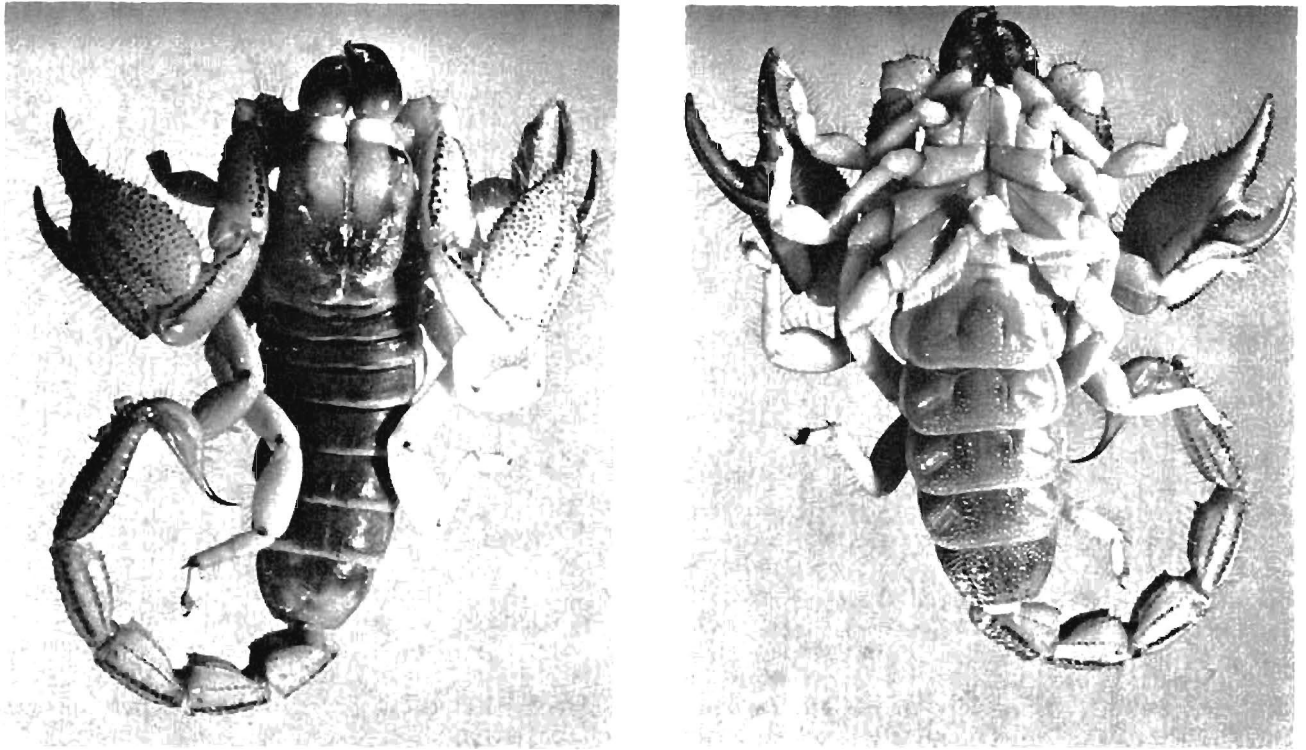


Figure 4: *Opisthophthalmus pictus nigro-carinatus* subsp. n.
Holotype ♀.
Left, dorsal, right ventral view.

(photo: G. Newlands).

3-4 times as wide as long (0.7-0.8 in transverse measurement and distinctly larger than the largest similar granules of sternite V); the infero-lateral rows consisting of much smaller, more rounded granules, some a little longer than wide, especially in I; areas between the rows and the lateral surfaces of all segments smooth or with a few small scattered granules; inferior median keels of III and IV consisting of irregular rows of coarse round granules, V inferiorly with 3 rows of strong tooth-like granules some others scattered between these; vesicle below at its extreme base with a few small granules. All caudal segments quite smooth dorsally, superior keels of II-IV consisting of distinct rows of tooth-like granules, the posterior one somewhat enlarged, more so in IV; superior granular keels of V strong but irregularly duplicated in basal half of segment; middle of the lateral surface with a distinct row of about 10 granules in its basal half.

Pedipalp. Dorsal surface of humerus with a few minute scattered granules in the middle, some larger ones near the posterior crest which is a row about 12 large granules; dorso-anterior crest absent, represented by a strip of weak granules differing in size, inferior surface with a weak anterior, strong posterior row of granules. Hand convex, the outer

surface not or hardly separated from the dorsal surface by the finger keel which is low with irregularly duplicated granules, an ill-defined accessory keel; surface or hand entirely covered with fairly large, mixed elongate and round, almost contiguous tubercles; outer margin of hand bounded by two regular and parallel rows of granules, the lower (of about 16 granules) defining its outer edge; hand about $1\frac{1}{4}$ times as wide as hand-back.

Legs. Protarsi of anterior legs as in the typical form; tarsus III and IV with 5 inner and 0 outer spines inferiorly, 4 spines on both of the lateral lobes.

Pectines with 15-15 teeth, its basal fifth untoothed.

Dimensions. Length of trunk 39, of tail 47.5; width of carapace 12, length 12.8; hand-back 8, width of hand 10 mm.

This form is certainly closely related to *O. pictus* Kraepelin but can easily be distinguished by its much lighter colouration, the background being yellow contrasting strongly with stripes of black pigmentation, mostly on the keels. This colouring is quite different from the uniformly dark colouring of *pictus* but the Kaokoveld form also differs in a large number of minor characters when compared with specimens of *pictus* from Port Elizabeth.

The granulation of carapace is stronger, the tergites finely shagreened, not smooth and shiny; the tuberculation of the sternites is distinctly stronger, corresponding in its degree of coarseness with the male of *pictus* where it is much stronger than in the female. Hand of pedipalp considerably narrower, the dorsal and outer surfaces continuous and not sharply separated by the finger keel into two opposing surfaces, the outer margin with two separate parallel keels of distinct granules (a single smooth keel in *pictus*); the inner side of inferior surface of the posterior tarsi with 5 instead of 4 spines.

The form can be further distinguished by the granulation of the last sternite where it is confined to a trapeziform area bounded posteriorly and at the sides by regular rows of round granules; outside this area there are only a few small granules and only in the anterior half of the segment; in *pictus* this granulation is more or less distributed over the whole surface of the segment. The average size of the subspecies is probably also larger than in *pictus*.

OPISTHOPHTHALMUS CAVIMANUS UGABENSIS (Hewitt)

O. undulatus ugabensis Hewitt 1934, *Ann. Transv. Mus.* 15, p. 408.

Two males and two females, from the Tin mine at Uis, Brandberg area, South West Africa, collected by J. J. Nel under a steel plate lying near the mine.

The colouring is even darker than in Hewitt's description of individuals found in the same locality (*loc. cit.* 1934, p. 409), being blackish green or dark bronze like that of an *Opisthacanthus*, the legs only a little lighter than the trunk. Unlike the types described by Hewitt from the Ugab River there is no difference at all in the colouring of the sexes. The fine rugosity of the sternites of the male is extremely similar to that of the type specimen in the Albany Museum.

OPISTHOPHTHALMUS LITORALIS Lawrence

O. wahlbergi litoralis Lawrence 1955, *S. Afr. Animal Life*, Vol. I, p. 216.

This form differs in such a large number of characters from the typical form that in the opinion of the writer it merits specific separation from *wahlbergi*.

It differs in the following respects when compared with inland specimens of *wahlbergi* from Okahandja, South West Africa.

1. The sides of the carapace and keels of the pedipalp blackish brown, the legs yellow contrasting with the pedipalps and trunk while in *wahlbergi* the whole animal is more or less orange coloured without blackish markings.

2. Hand of the ♂ considerably more convex above, smooth, shiny, not roughened with minute granules as in *wahlbergi*, hand much narrower.

3. Vesicle without granules below at base.

4. Tarsi III and IV with 2 well developed spines on outer side inferiorly.

5. The angle at the base of the pectines acute, while in *wahlbergi* it is $<90^\circ$; the number of teeth a little larger, 29-31.

6. Body size distinctly smaller.

The Albany Museum has a ♂ collected 2 miles inland from the mouth of the Unjab River, South West Africa, by C. G. Coetzee, November 1967 (pectinal teeth 31-31); 2 ♂♂ 1 juvenile, Torra Bay, South West Africa, collected Mrs. Jean Labuschagne, January, 1968; all these specimens were found at 10 feet above high water mark, each under a separate piece of drift-wood, thus in the same situation as the type (*loc. cit.*, 1955, p. 126); all specimens found thus far have been males. It is possible that this litoral species, which has not yet been collected at inland localities, may feed on shore-living organisms such as marine isopods and amphipods living under drift wood and sea weed thrown up by the sea.

OPISTHOPHTHALMUS SETIVENTER sp. nov.

Holotype, 1♀ (perhaps not fully mature), 8 miles W. of Aus, collected by V. FitzSimons, 31-VII-1937.

Colour pattern of dorsum of carapace and abdomen in general similar to that of *adustus longiceps* Lawrence (1942, p. 401, fig. 1a) but the blackened portion of carapace not so dark, dark brown with its anterior margin blackish; chelicerae blackish brown distally, light brown proximally; pedipalps dark brown, fingers of hand blackish brown, maxillary process of legs II with a blackish oval spot at base; sternites yellow brown, the last a little darker; tail yellow brown above, dark brown below, the keels blackish; legs yellow with an orange tinge.

Carapace much longer than wide; interocular area quite smooth, shiny, remainder with fine dust-like granules, few in number; no anterior fork but its position indicated by faint obsolete grooves.

Abdomen. Tergites smooth, shiny, their posterior margins roughened with fine granulation, the last fairly regularly covered at the sides with small to moderate, well separated granules; sternites quite smooth, shiny, in the middle of each a transverse row of 4-6 long, fine, widely separated setae.

Cauda. Segment I as long as wide above; caudal segment IV with distinct granular infero-median keels, these obsolete in III; I and II quite smooth ventrally and laterally; ventral surface of V with

very fine dust-like granulation, 3 pairs of granules flanking the median keel, the middle pair much more widely separated than the others; base of vesicle roughened with granules; segments I-V smooth dorsally between the keels, superior keels of I obsolete, of II weak but distinct, of III and IV well defined, of V weak and rather irregular, those of II-IV without an enlarged terminal tooth posteriorly; vesicle subequal to segments V in length and width. Tail segments and vesicle with rather numerous long setae ventrally but not dorsally.

Pedipalps. Superior surface of hand rounded, whole of upper and outer surface thickly covered with moderate sized clearly defined granules which, though closely and uniformly set, are for the most part not contiguous; finger keel clearly defined but not strong, the basal half consisting of separate granules; accessory keel obsolete except at base of immovable finger. Hand-back subequal to width of hand, fingers short, only a little longer than hand-back.

Pectines. Basal 2/5 of scape free of teeth, sloping at the base, not rectangular, 12-12 teeth.

Legs. Claws normal, but not strongly curved, both lateral lobes with 4 spines, inner margin of tarsus III and IV with 6, outer margin with 0 spines.

Dimensions. Trunk 30, tail 30.5, total length 61; length of carapace 10.5, width 9; width of hand 6.2, hand-back 6 mm.

The species falls into the first section of Hewitt's group 2 with *wahlbergi* and its relatives; it differs from this species chiefly in the strong regular granulation of the superior surface of the pedipalp hand, from *adustus longiceps* in having all the sternites quite smooth, in the curved claws and in having 10 instead of 9 spines on the inner margin of tarsus IV. It differs from both these species in the smaller number of pectinal teeth.

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