

TAXONOMIC OBSERVATIONS ON *HETERONEBO* POCOCK (SCORPIONIDA, DIPLOCENTRIDAE)

Oscar F. Francke¹

Department of Zoology
Arizona State University
Tempe, Arizona 85281

ABSTRACT

Heteronebo granti Pocock, and *Heteronebo forbesii* Pocock are redescribed and lectotypes designated. The two subfamilies of Diplocentridae are recognized, and briefly diagnosed polythetically for the first time: Nebinae is monotypic, and apparently endemic to the Middle East; Diplocentrinae is polytypic, and apparently confined to the New World, with the exception of *Heteronebo* which is endemic to the small island of Abd-el-Kuri, Peoples Democratic Republic of Yemen. Taxonomic, systematic, and biogeographic problems presented by *Heteronebo* spp. are discussed.

INTRODUCTION

The genus *Heteronebo* was established by Pocock (1899) for two new species of diplocentrid scorpions presumably collected by the British Expedition to Sokotra and Abd-el-Kuri, led by Mr. W. R. O. Grant and Mr. H. O. Forbes in 1898. Pocock characterized the new genus as being intermediate between two other diplocentrid genera then known, *Nebo* (Simon, 1878) and *Diplocentrus* (Peters, 1861); giving brief descriptions of *Heteronebo granti* Pocock and *Heteronebo forbesii* Pocock, which are supposedly endemic to the small island of Abd-el-Kuri, Peoples Democratic Republic of Yemen, located at the entrance to the Gulf of Aden (Fig. 18). Subsequently, Pocock (1903) gave more detailed descriptions and a short key, clearly establishing that *Heteronebo* contains two valid species. However, Werner (1934) wrongly indicated that *Heteronebo* is monotypic, and gave Sokotra as the type locality. Rosin and Shulov (1963) following Werner made similar assertions.

Heteronebo is still only known from the original specimens examined by Pocock, and although his descriptions were adequate then, many other valuable taxonomic characters have been found since. Therefore, a redescription of the two species of *Heteronebo* has become necessary in order to clear the confusion existing in the literature, and to obtain some indication of the systematic position of this genus within the family Diplocentridae.

¹Present Address: Departments of Biological Sciences and Entomology, Texas Tech University, Lubbock, Texas 79409

Heteronebo Pocock, 1899

Heteronebo Pocock 1899, Liverpool Mus. Bull. 2:7-8; Pocock 1903, "Scorpiones" in H. O. Forbes (Ed.) "The Natural History of Sokotra and Abd-el-Kuri," pp. 202-204; Kraepelin 1905, Zool. Jahrb. Syst. 22(3):342; Birula 1917, Fauna of Russia and Adjacent Countries, Arachnoidea 1(1):39; Werner 1934, "Scorpiones" in H. G. Bronn (Ed.) "Klassen und Ordnungen des Tierreichs," Bd. 5, Abt. 4, Buch 8, p. 275; Rosin and Shulov 1963, Proc. Zool. Soc. London 140(4):548.

Diagnosis.—Carapace: median longitudinal furrow distinct, not suturiform: anteriorly lobed, emarginate; median notch rounded, moderately deep: three pairs of lateral eyes. Sternum pentagonal. Genital operculi: in male without median longitudinal membranous connection; in female with complete, median longitudinal membranous connection. Genital papillae present on male, absent on female. Metasomal segments I-IV with paired, longitudinal ventral submedian carinae. Metasomal segment V with single, longitudinal ventral median carina; ventral transverse keel absent, distal disc obsolete. Vesicle globose; subaculear tubercle well developed, broadly joined to vesicle. Cheliceral dentition typical diplocentrid (Fig. 7) (Vachon, 1963). Pedipalp orthobothriotaxia "C" (Vachon, 1974). Walking legs with exterior pedal spur present. Tarsomere II: distal ventral margins rectangular to slightly acutely angular, not lobed; ventrally two longitudinal submedian rows of strongly developed spines, distal spine directed ventrad rather than apically.

Type species.—*Heteronebo granti* Pocock, 1899.

Other species.—*Heteronebo forbesii* Pocock, 1899.

Heteronebo granti Pocock

Figs. 1-7, 13

Heteronebo granti Pocock 1899, Liverpool Mus. Bull. 2:7-8; Pocock 1903, "Scorpiones" in H. O. Forbes (Ed.) "The Natural History of Sokotra and Abd-el-Kuri," pp. 202-203; Werner 1934, "Scorpiones" in H. G. Bronn (Ed.) "Klassen und Ordnungen des Tierreichs," Bd. 5, Abt. 4, Buch 8, p. 275; Rosin and Shulov 1963, Proc. Zool. Soc. London 140(4):548.

Diagnosis.—This species is only known from two immature females, any diagnosis based on them alone is meaningless.

Lectotype.—Female, immature (measurements in Table 1). New designation.

Description.—*Prosoma*. Carapace ochreous; median and lateral eyes densely infuscate; surface fuscosity diffuse, variegated. Anterior emargination moderate; median notch rounded, approximately three times wider than deep, extending to level of first pair of lateral eyes. Anterior median furrow: submarginally shallow, broad; at base of ocular prominence vestigial. Median ocular prominence moderate; longitudinally feebly concave medially, superciliary ridges obsolete. Median eyes at anterior two-fifths of carapace length, separated by approximately their own diameter. Posterior median furrow: proximal three-fourths (immediately posterior to ocular prominence) shallow, moderately wide; distal one-fourth abruptly deeper into narrow longitudinal slit. Posterior marginal furrow moderately deep. Posterior lateral furrows originating at submedian one-third of posterior carapace width, arcuate; distal one-third moderately deep; proximal two-thirds strongly divergent, ending gradually at lateral one-fifth of posterior carapace width. Carapace surface: anterior submargin smooth, bare; laterad to ocular prominence smooth; lateral submargins with moderately dense, minute granulation. Left lateral margin with

Table 1.—Measurements (mm) of *Heteronebo granti* Pocock.

	Lectotype ♀	Paralectotype
Total length	44.05	35.20
Carapace:		
length	5.70	4.80
anterior width	3.20	2.65
width at median eyes	4.70	4.00
posterior width	5.70	4.95
Mesosoma:	length	15.50
Metasoma:	length	22.85
I:	length	2.70
	width	3.20
II:	length	3.00
	width	2.90
III:	length	3.10
	width	2.80
IV:	length	3.65
	width	2.70
V:	length	5.20
	width	2.65
Telson:	length	5.20
Vesicle:	length	4.20
	width	2.80
	depth	1.95
Aculeus:	length	1.00
Pedipalp:	length	17.90
Humerus:	length	4.20
	width	2.00
	depth	1.80
Brachium:	length	4.30
	width	2.10
Chela:	length	9.40
	width	4.50
	depth	3.10
Movable finger length	5.50	4.50
Fixed finger length	4.10	3.45
Chelicera:	chela length	1.80
	chela width	1.20
	fixed finger length	0.80
	movable finger length	1.50
Pectinal teeth	8-8	8-8

semicircular “scar” behind lateral eyes. Prosomal venter ochroleucus, vestigially hirsute. Sternum pentagonal; posterior submargin with two short, slightly divergent, deep furrows.

Mesosoma.—Tergites ochreous to ochroleucus; tergites I-VI anterior submarginal fuscosity diffuse, uniform; tergite VII fuscosity diffuse, variegated, density increasing distally. Tergites I-VI smooth. Tergite VII four-keeled: submedian carinae on distal one-fifth, moderately strong, subgranulose; lateral carinae on distal one-third, strong, subgranulose: median intercarina smooth; submedian and lateral intercarinal granulation minute, moderately dense. Mesosomal venter ochroleucus. Genital operculi paraboloid, median margins connected by short membrane throughout their length (“fused” *auct.*).

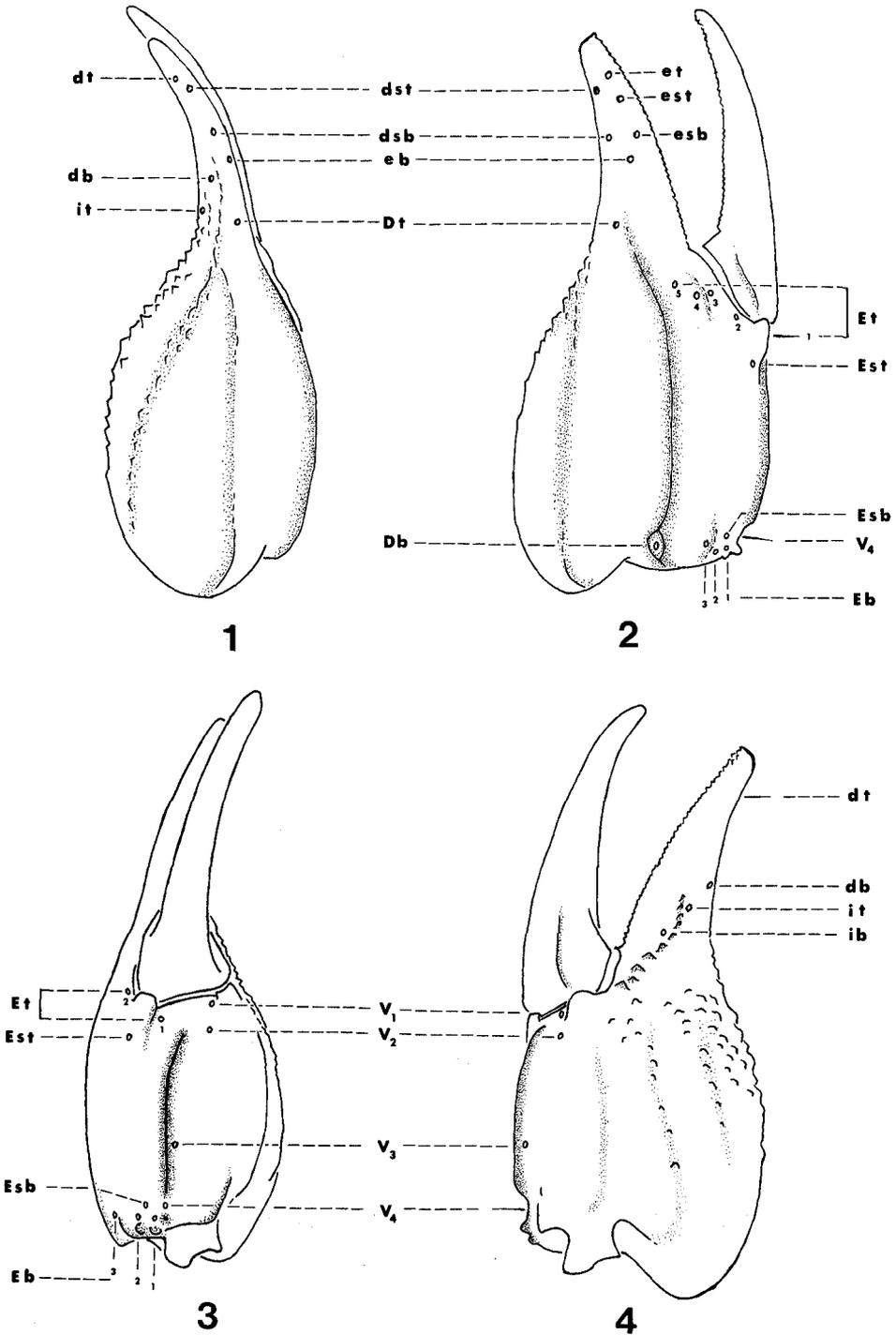
Pectinal basal piece approximately 1.6 times wider than long; anterior margin weakly bilobed, median notch shallow and broad. Pectines whitish: marginal lamellae anterior margins sparsely hirsute; middle lamellae bare, indistinct, 3-4 per side; fulcra subtriangular; pectinal tooth count 8-8, each tooth slightly less than twice longer than wide. Sternite margins and discs bare; stigmata small (approximately 0.3 mm long), thrice longer than wide. Sternite VII: submedian carinae obsolete; lateral carinae vestigial to obsolete, smooth; intercarinae smooth.

Metasoma.—Ochreous: intercarinal fuscidity moderate to dense, variegated; carinae uniformly fuscous; fuscidity density and extent increase distally between and within segments. Dorsally bare; laterally, ventrally sparsely hirsute along keels. Ventral submedian carinae (**V_{sm}**): I-II obsolete; III-IV vestigial, smooth, parallel. Ventral lateral carinae (**V_l**): I weak to moderate, smooth, parallel; II-III weak, smooth, slightly divergent distally; IV weak to moderate, subgranose, moderately divergent distally. Lateral infra-median carinae (**L_{im}**): I weak to moderate, smooth, complete; II weak to vestigial, smooth; III vestigial, smooth; IV obsolete. Lateral supramedian carinae (**L_{sm}**): I-III moderately strong, smooth, ending distally in sharp point; IV moderately strong, smooth, ending gradually. Dorsal lateral carinae (**D_l**): I-II weak, smooth, ending distally in sharp angle; III weak, subcrenate, ending in sharp angle; IV weak, smooth, ending in sharp angle. Segment V carinae: ventral median (**V_m**) strong, granulose, bifurcate distally and not reaching anal arc (Fig. 13); ventral lateral (**V_l**) strong, granulose; lateral median (**L_m**) on proximal half, vestigial, subgranose; dorsal lateral (**D_l**) moderately strong, subgranose; anal subterminal (**A_{st}**) moderately strong, with 14 small oblong granules; anal terminal (**A_t**) weak, subdentate. Intercarinae: dorsal I-V and lateral IV-V minute granules sparse to moderately dense, others smooth.

Telson densely infuscate, paired lateral-subdorsal and ventral-submedian narrow longitudinal ochreous bands. Dorsally bare, smooth, feebly convex. Laterally and ventrally sparsely hirsute; granules small, sparse; ventral submarginal clusters of 3-2-3 small to medium granules. Subaculear tubercle strong, rounded; erect, white microchaetae moderately dense. Aculeus dark brown, sharply curved.

Chelicera.—Chela and fingers ochroleucus, teeth medium brown. Ventral surfaces densely covered with long, anteriorly depressed, distally curved white hairs (chemoreceptors?). Chela width/chela length ratio 0.66. Fixed finger moderately curved distally, dentition typically diplocentrid (Fig. 7); fixed finger length/chela length ratio 0.44. Movable finger dentition typically diplocentrid (Fig. 7), inferior tine slightly over twice longer than superior tine; movable finger length/chela length ratio 0.83.

Pedipalps.—Humerus ochreous; fuscidity sparse to moderate, variegated: sparsely hirsute. Longer than metasomal segment IV; slightly wider than deep, humerus width/humerus depth ratio 1.11. Dorsal internal carina weak, coarsely granulose. Dorsal external carina: proximal one-third strong, granulose; distal two-thirds moderately strong, granules small. Ventral internal carina strong, coarsely granulose, curving dorsad distally. Ventral external keel: proximal one-fifth weak, subgranose; distal four-fifths vestigial to obsolete. Dorsal face flat, basally with poorly defined longitudinal row of large and medium granules. Internal face flat, minute granules dense. External face longitudinally and transversely convex; median longitudinal keel on distal two-thirds, weak, smooth. Ventral face longitudinally concave, inner margin weakly granulose. Orthobothriotaxia "C": **e** dorsally at proximal one-third of humeral length; **d** externally at proximal one-tenth of humeral length; **i** at dorso-proximal corner of internal face.



Figs. 1-4.—*Heteronebo granti* Pocock, lectotype female from the island of Abd-el-Kuri, Peoples Democratic Republic of Yemen, located at the entrance to the Gulf of Aden. Trichobothria on right pedipalp chela: 1, dorsal; 2, external; 3, ventral; 4, internal.

Brachium subtriangular in cross-section, sparsely hirsute, orthobothriotaxia "C" (Figs. 5-6). Ochreous; internal and carinal fuscidity moderately dense, variegated. Dorsal keel strong, smooth. Ventral internal carina moderately strong, smooth. Ventral external keel strong, smooth. Internal face densely, minutely granulose. External face smooth; two longitudinal, weak to vestigial carinae. Ventral face flat, smooth.

Chela light to medium brown; intercarinal fuscidity diffuse, variegated; carinal fuscidity dense, uniform; fingers fuscidity moderately dense, uniform. Orthobothriotaxia "C" (Figs. 1-4). Dorsal margin weakly to vestigially carinate, small granules extending to fixed finger base. Digital keel very strong, smooth, extending through fixed finger base. Ventral carina strong, smooth; subbasally interrupted by trichobothrium V_4 (Fig. 3); directed towards midpoint of movable finger articulation. Dorsal secondary keel weak, smooth; merging with dorsal marginal granules at fixed finger base. External secondary keel basally and distally weak to vestigial, medially obsolete. Dorsal face (dorsal margin to digital keel) smooth, bare. External face (digital keel to ventral keel) smooth, bare. Internal face smooth, dorsal submargin sparsely granulose: shallow longitudinal depression where chela flexes against brachium; dorsal margin of depression subcarinate, feebly granulose. Fixed finger base: externally minutely granulose; internal face granulation minute, dense; longitudinal row of medium sized granules extending from internal condyle of movable finger articulation to trichobothrium it (Fig. 4). Fixed finger sparsely hirsute; inner margin moderately, evenly arcuate. Movable finger sparsely hirsute; feebly, sparsely punctate.

Walking legs.—Ochroleucus. Femora II-IV dorsal margins vestigially granulose. Femora I-IV ventral margins feebly granulose. Tarsomere II spine formula: $5/5$ $4/5$: $6/6$ $5/6$: $6/6$ $6/6$: $5/7$ $6/6$ (anteriormost pair of legs first, right leg first, anterior spine count/posterior spine count).

Paralectotype.—Female, immature (measurements in Table 1). New designation.

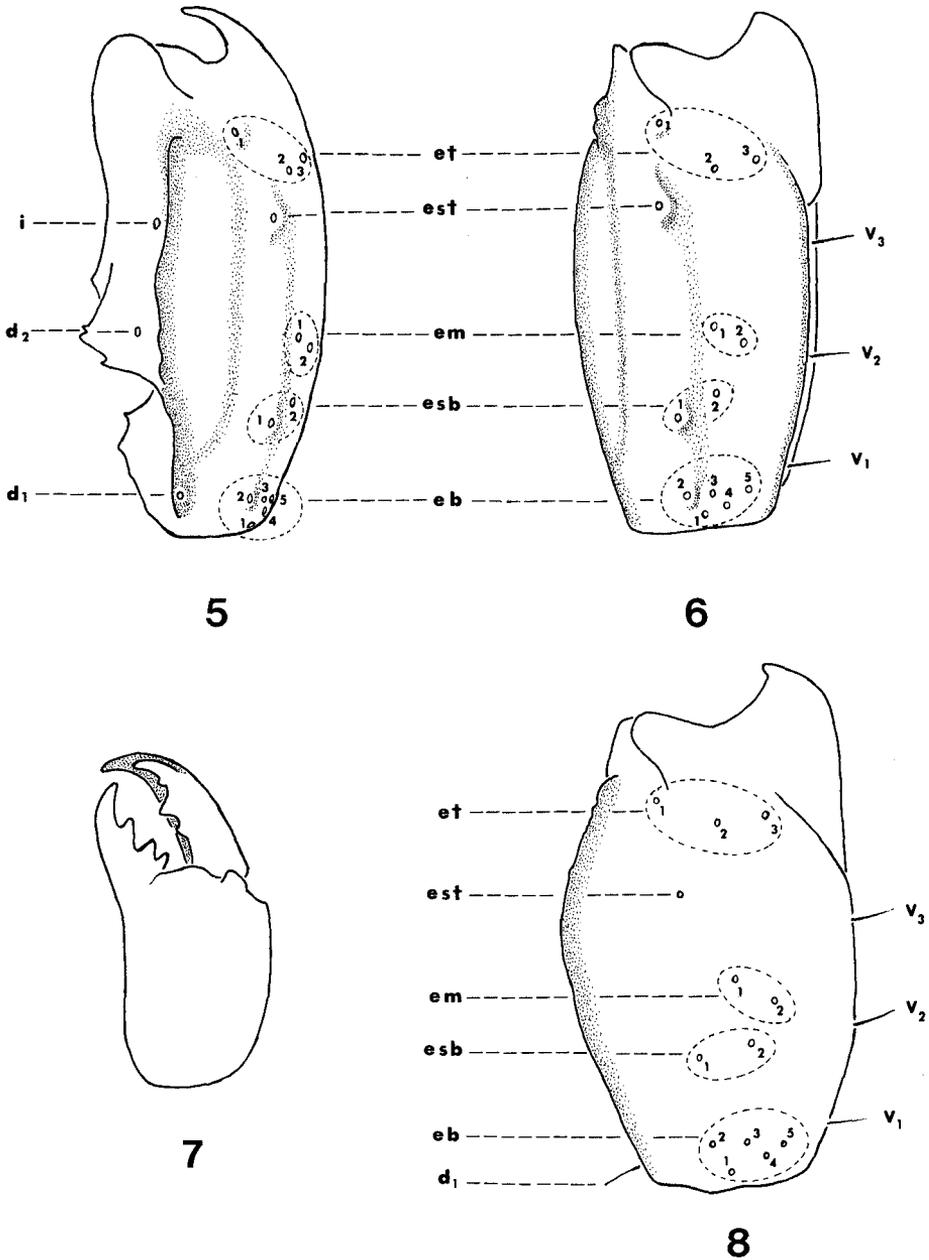
Does not differ significantly from lectotype. Fuscidity overall not as dense, but still distinctive. Tarsomere II spine formula: $5/5$ $5/5$: $5/6$ $6/6$: $*/*$ $6/6$: $6/6$ $6/6$ (* tarsomere II missing on that leg).

Type data.—Lectotype and paralectotype collected at Abd-el-Kuri (800 - 1500 ft.), Peoples Democratic Republic of Yemen, 5 December 1898 (W. R. O. Grant and H. O. Forbes). Deposited in the British Museum (Natural History), London.

Remarks.—In the original description Pocock (1899) mentions that two females (syntypes) were studied by him, and gives the type locality simply as Abd-el-Kuri. Subsequently, Pocock (1903) gives the type locality as: Abd-el-Kuri, Gebel Saleh (800 - 1500 ft.), and quotes a note from Mr. Grant indicating that the two specimens were collected under rocks at an elevation of "about 1000 ft."

I received from the British Museum the two specimens described above, neither of which appears to be mature. One of the syntypes has been labelled as a lectotype by H. L. Stahnke; however, this designation is not valid since it has not been published [International Code of Zoological Nomenclature, Art. 74 (a) (i)]. Pocock's description seems to be based on the larger specimen, which is the one I have designated and labelled as the lectotype. The smaller specimen has been designated and labelled as a paralectotype.

Distribution.—This species is known only from the two specimens mentioned, and is apparently endemic to the small island of Abd-el-Kuri, Peoples Democratic Republic of Yemen, located at the entrance of the Gulf of Aden (Fig. 18).



Figs. 5-7.—*Heteronebo granti* Pocock, lectotype female from the island of Abd-el-Kuri, Peoples Democratic Republic of Yemen, located at the entrance to the Gulf of Aden. Trichobothria on right pedipalp brachium: 5, dorsal; 6, external. Chelicera; 7, dorsal.

Fig. 8.—*Heteronebo forbesii* Pocock, lectotype female from Abd-el-Kuri. Trichobothria on right pedipalp brachium, external.

Heteronebo forbesii Pocock

Figs. 8-12, 14, 15

Heteronebo forbesii Pocock 1899, Liverpool Mus. Bull. 2:8; Pocock 1903, "Scorpiones" in H. O. Forbes (Ed.) "The Natural History of Sokotra and Abd-el-Kuri," p. 203.

Diagnosis.—This species is only known from three immature specimens, any diagnosis based on them is probably meaningless.

Lectotype.—Female, immature (measurements in Table 2). New designation.

Description.—*Prosoma.* Carapace ochreous: median and lateral eyes densely fuscous; anterior submarginal fuscosity moderately dense, with sparse, light colored maculations; fuscosity surrounding ocular prominence sparse to moderately dense, uniform; other carapacial areas with vestigial, reticular fuscosity. Anterior emargination moderate; median notch rounded, approximately 2.5 times wider than deep, extending to level of first pair of lateral eyes; lobes with four large, brown setae. Anterior median furrow: submarginal two-fifths vestigial, broad; distally (to anterior base of ocular prominence) moderately deep, wide. Median ocular prominence moderate; weakly sulcate, superciliary ridges weak to vestigial. Median eyes at anterior two-fifths of carapace length, separated by their own diameter. Posterior median furrow: proximal two-thirds moderately deep; distal one-third gradually deeper into narrow longitudinal slit, "lips" of slit meeting medially above furrow proper. Posterior marginal furrow moderately deep. Posterior lateral furrows arcuate, originating at submedian one-third of posterior carapace width; distal one-third moderately deep; proximal two-thirds strongly divergent, moderately deep, ending gradually at lateral submargin. Carapace surface: anterior submargin smooth; microchaetae sparse, creating maculations on fuscous field: laterally smooth; microchaetae sparse, maculations indistinct: postero-laterally densely, minutely granulate. Prosomal venter ochroleucus, macrochaetae sparse. Sternum pentagonal; distal one-fifth with deep, broad, biramous furrow.

Mesosoma.—Tergites ochreous; fuscosity vestigial, variegated. Tergites I-VI minute granulation sparse. Tergite VII four-keeled: submedian carinae on distal one-fifth, weak, smooth; lateral carinae on distal one-fourth, moderate to weak, smooth: intercarinae smooth. Mesosomal venter ochroleucus. Genital operculi paraboloid, median margins connected by short membrane throughout their length. Pectinal basal piece approximately 2.2 times wider than long, anterior margin feebly bilobed. Pectines whitish: marginal lamellae sparsely hirsute; middle lamellae bare, indistinct, 3-4 per side; fulcra subtriangular; pectinal tooth count 8-9, each tooth approximately twice as long as wide. Sternite lateral margins sparsely hirsute, discs bare, smooth; stigmata small, thrice longer than wide. Sternite VII: submedian carinae on distal one-third, vestigial, bifurcate submarginally; lateral carinae on distal one-fourth, vestigial, bifurcate submarginally; intercarinae smooth.

Metasoma.—Ochreous: segments I-II vestigially fuscous: segments III-V; intercarinal distal fuscosity diffuse, variegated; carinae uniformly fuscous; fuscosity density increases distally within segments. Dorsally bare, laterally and ventrally sparsely hirsute along carinae. **V_{sm}** carinae: I-II weak, smooth, subparallel; III weak to vestigial, smooth; IV vestigial. **V_l** carinae: I weak, smooth, subparallel; II moderately strong, smooth, feebly biconvex; III-IV weak, smooth, slightly divergent distally. **L_{im}** carinae: I-II vestigial, III-IV obsolete. **L_{sm}** carinae: I-II weak, smooth, ending gradually; III-IV moderately strong, smooth, ending gradually. **D_l** carinae: I-IV vestigial, smooth. Segment V carinae:

V_m moderately strong, basal one-third feebly granulose, distal two-thirds with large subconical granules, distal one-third tetrafurcate (vestigial ventral transverse keel?, Fig. 14); **V_l** carinae moderately strong, basal one-third feebly granular, distal two-thirds coarsely granular; **L_m** carinae on proximal one-third to one-half, vestigial, subgranose; **D_l** carinae moderately strong, smooth with small granules on ridge; **A_{st}** keel well developed, with 13 medium sized oblong granules; **A_t** keel weak, dentate. Intercarinae smooth.

Telson ochreous; ventral and lateral fuscosity diffuse, uniform. Dorsally bare, smooth, feebly convex. Laterally and ventrally sparsely hirsute, vestigially granulose; ventral submarginal clusters of 3-2-3 medium granules. Subaculear tubercle strong, rounded; erect, white microchaetae moderately dense. Aculeus dark reddish-brown; ventral margin basally moderately curved, medially shallowly curved, distally moderately curved (developmental anomaly?).

Chelicera.—Chela ochroleucus; fuscosity diffuse to moderate, variegated. Fingers ochreous; basal fuscosity dense, uniform. Teeth medium brown. Ventral surfaces densely covered with long, anteriorly depressed, distally curved white hairs. Chela width/chela length ratio 0.61. Fixed finger moderately curved distally, dentition typically diplo-centrid; fixed finger length/chela length ratio 0.47. Movable finger dentition typically diplo-centrid, inferior tine slightly less than three times longer than superior tine; movable finger length/chela length ratio 0.92.

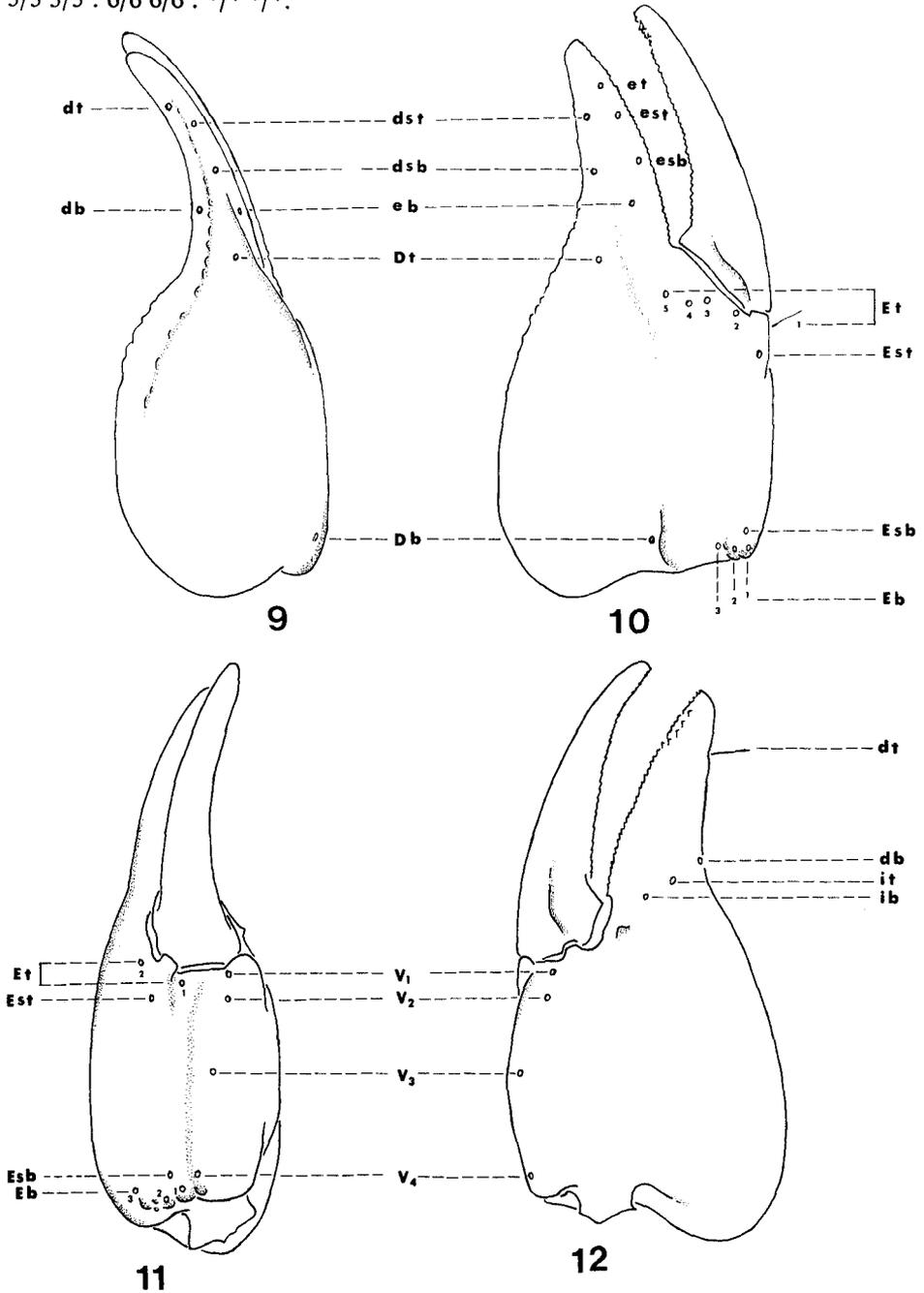
Pedipalps.—Humerus ochreous; dorsal and external faces distal fuscosity diffuse, uniform: sparsely hirsute. Slightly shorter than metasomal segment IV; narrower than deep, humerus width/humerus depth ratio 0.88. Dorsal internal carina; proximal one-half indistinct row of small and medium granules; medially curving ventrad, disappearing in granular field on internal face. Dorsal external keel: proximal two-thirds strong, coarsely granulose; distal one-third vestigial to obsolete. Ventral internal carina moderately strong, coarsely granulose; distally curving dorsad. Ventral external keel obsolete. Dorsal face: longitudinally moderately convex; transversely strongly convex, merging with internal face without abrupt angular or carinal division: granulation moderately dense, medium and small. Internal face flat; dorsal granulation moderately dense, medium sized; ventral granulation minute, dense. External face: proximal one-half flat; distal one-half longitudinally, transversely convex. Ventral face longitudinally concave, smooth. Orthobothriotaxia "C": e dorsally at proximal one-third of humeral length; d externally at proximal one-tenth of humeral length; i at dorso-proximal corner of internal face.

Brachium subtriangular in cross-section, sparsely hirsute, orthobothriotaxia "C" (Fig. 8). Ochreous; fuscosity vestigial, variegated, slightly more pronounced on dorsal keel. Dorsal carina strong, smooth. Ventral internal keel weak, subgranose. Ventral external keel obsolete. Internal face densely, minutely granulose. External face smooth; longitudinally moderately convex, transversely strongly convex. Ventral face smooth, flat.

Chela ochreous: dorsal margin fuscosity diffuse, variegated: fixed finger base internal face fuscosity diffuse, uniform; external face fuscosity moderately dense, ochreous maculations interspersed. Fingers reddish-brown; fixed finger dorsal and external fuscosity moderately dense, ochreous maculations interspersed; movable finger external face fuscosity moderate, uniform. Dorsal margin vestigially carinate; proximal two-thirds smooth, distal one-third and fixed finger base subgranose. Digital keel: proximal one-tenth weak to vestigial, smooth; median six-tenths obsolete; distal three-tenths vestigial; weak over fixed finger base, ending at level of trichobothrium **eb**. Ventral keel weak to moderate, smooth, directed to midpoint of movable finger articulation. Dorsal face sparsely, vestigially granulose. External face bare, smooth. Internal face smooth, bare;

shallow longitudinal depression where chela flexes against brachium. Fixed finger base internally and externally with moderately dense, minute granulation. Fixed finger sparsely hirsute, inner margin evenly arcuate. Movable finger sparsely hirsute.

Walking legs.—Ochreous to ochroleucus, smooth. Tarsomere II spine formula: 5/5 5/5 : 5/5 5/5 : 6/6 6/6 : */* */*.



Figs. 9-12.—*Heteronebo forbesii* Pocock, lectotype female from the island of **Abd-el-Kuri**, Peoples Democratic Republic of Yemen, located at the entrance to the Gulf of Aden. Trichobothria on right pedipalp chela: 9, dorsal; 10, external; 11, ventral; 12, internal.

Paralectotype.—Female, immature (measurements in Table 2). New designation.

Differs from lectotype as indicated below.

Prosoma.—Carapace fuscidity moderately dense, variegated. Posterior median furrow; distal longitudinal slit “lips” not meeting medially above furrow proper.

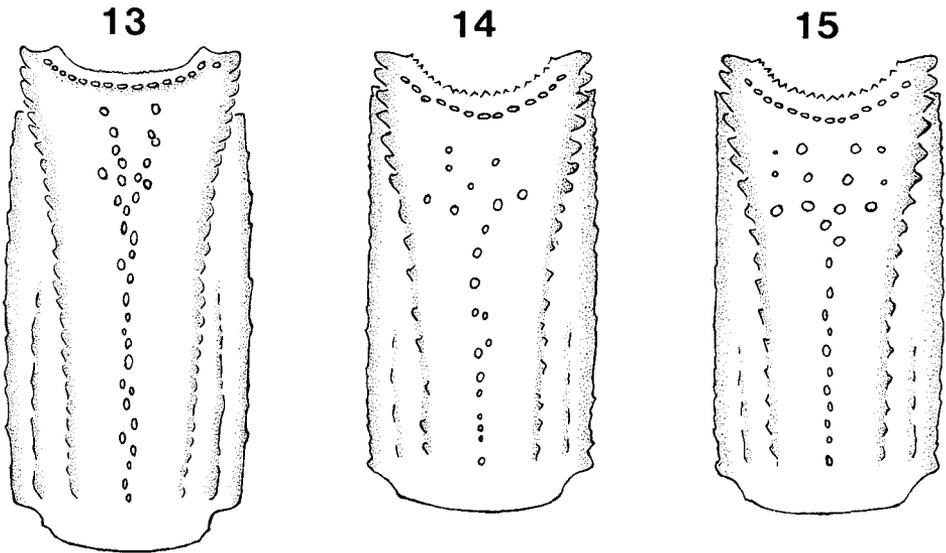
Mesosoma.—Tergites moderately infuscate: proximal halves variegated, distally uniform; density increasing distally between segments. Tergite VII submedian and lateral carinae vestigial. Pectinal tooth count 8-8.

Metasoma.—Segments I-IV intercarinal distal fuscidity uniform, moderately dense. Segment V ventral median carina distinctly tetrafurcate distally (Fig. 15). Telson fuscidity moderately dense. Aculeus ventral margin evenly curved.

Walking legs.—Tarsomere II spine formula: 5/5 5/5 : 5/5 */* : 6/6 */* : 6/6 6/6.

Table 2.—Measurements (mm) of *Heteronebo forbesii* Pocock.

	Lectotype ♀	Paralectotype ♀	Juvenile ♂
Total length	40.70	39.25	21.25
Carapace:			
length	5.30	5.30	3.10
anterior width	2.60	2.70	1.40
width at median eyes	4.05	4.30	2.25
posterior width	4.80	5.50	2.85
Mesosoma:			
length	13.80	12.65	7.30
Metasoma:			
length	21.60	21.30	10.85
I:			
length	2.80	2.80	1.40
width	3.10	3.10	1.75
II:			
length	3.00	3.00	1.50
width	2.80	2.85	1.60
III:			
length	3.20	3.20	1.55
width	2.75	2.80	1.55
IV:			
length	3.60	3.50	1.80
width	2.60	2.60	1.40
V:			
length	4.55	4.40	2.35
width	2.45	2.40	1.30
Telson:			
length	4.45	4.40	2.25
Vesicle:			
length	3.30	3.30	1.65
width	2.50	2.60	1.40
depth	1.80	1.75	0.95
Aculeus:			
length	1.15	1.10	0.60
Pedipalp:			
length	15.05	14.70	8.20
Humerus:			
length	3.50	3.40	1.90
width	1.55	1.50	0.85
depth	1.75	1.70	0.95
Brachium:			
length	3.55	3.50	2.00
width	1.70	1.70	0.85
Chela:			
length	8.00	7.80	4.30
width	4.05	4.00	1.55
depth	2.80	2.60	1.25
Movable finger length	4.75	4.70	2.65
Fixed finger length	3.40	3.40	1.95
Chelicera:			
chela length	1.80	1.60	1.05
chela width	1.10	1.15	0.75
fixed finger length	0.85	0.90	0.55
movable finger length	1.65	1.45	1.00
Pectinal teeth	8-9	8-8	9-10



Figs. 13-15.—Metasomal segment V showing longitudinal ventral median carina: 13, *Heteronebo granti* Pocock, lectotype female from the island of Abd-el-Kuri, showing distinct bifurcation distally; 14, *Heteronebo forbesii* Pocock, lectotype female from Abd-el-Kuri, showing tetrafurcation distally and incipient (?) ventral transverse carina; 15, *H. forbesii* Pocock, paralectotype female from Abd-el-Kuri, showing distinct tetrafurcation distally and incipient (?) ventral transverse carina.

Male.—Juvenile (measurements in Table 2). This specimen is not a syntype; therefore, it can not be designated as a paralectotype (see Remarks below).

Very conspicuous differences with respect to lectotype, and which could be due to: (1) ontogenetic variability and allometric growth rates, (2) sexual dimorphism, and (3) intraspecific variability. These sources of variability have been discussed and analyzed for two species of Diplocentridae elsewhere (Francke, 1975), but the sample available in this case is too small to allow any reasonable inferences to be made.

Prosoma.—Carapace fuscosity moderately dense, vestigially variegated. Posterior median furrow; distal longitudinal slit “lips” not meeting medially above furrow.

Mesosoma.—Tergites moderately infuscate, pattern as on paralectotype. Tergite VII; submedian carinae obsolete to vestigial, lateral carinae weak to vestigial. Genital operculi without median membranous connection (“not fused,” *auct.*); genital papillae present. Pectinal tooth count 9-10.

Metasoma.—Segments I-IV intercarinal distal fuscosity moderately dense, uniform. Segment V ventral median keel tetrafurcation indistinct.

Pedipalps.—Granulation obsolete to vestigial. Chela elongate, subcylindrical; ventral keel vestigial.

Walking legs.—Tarsomere II spine formula: 4/5 */* : 5/5 5/5 : 6/6 6/6 : 6/6 6/6.

Collection data.—Lectotype, paralectotype, and juvenile male collected at Abd-el-Kuri (800 - 1500 ft.), Peoples Democratic Republic of Yemen, 5 December 1898 (W. R. O. Grant and H. O. Forbes). Deposited in the British Museum (Natural History), London.

Remarks.—In the original description Pocock (1899) mentions that two females (syntypes) were examined, and the type locality appears simply as Abd-el-Kuri. Subsequently (Pocock, 1903) the type locality appears as: Abd-el-Kuri, Gebel Saleh (800 -

1500 ft.), and the quote from Mr. Grant's note indicates that the specimens were collected under rocks at an elevation of "about 1000 ft." The second sentence in Mr. Grant's note is very important, and reads as follows: "Both were apparently rare, as during several days' search only two examples of each species were met with." This is making reference of course to the lectotype and paralectotype of *Heteronebo granti*, and the lectotype and paralectotype of *H. forbesii*.

From the British Museum I received *three* specimens of *H. forbesii*, two immature females and a juvenile male. The male specimen has been labelled as the lectotype by H. L. Stahnke. Although this designation has not been published, and is therefore not valid, the selection of this specimen as the lectotype is a poor taxonomic decision by Stahnke. In the first place, the locality from where this specimen came is questionable since neither Mr. Grant (in his note), nor Pocock (1899, 1903) mention it at all. Secondly, for the same reason just given, this juvenile male can not be considered a syntype and is not eligible for lectotypic designation [International Code of Zoological Nomenclature, Art. 74 (a) (i)]. Finally, even if it were eligible for such a designation, due to its small size (Table 2) it can not be considered as the most representative specimen for this taxon. For these reasons I have designated and labelled as the lectotype of *H. forbesii* Pocock the female specimen on which the original description appears to be based (total length 42 mm, pectinal teeth 8-9; which compare with Table 2). I have designated and labelled the other immature female as a paralectotype. The juvenile male has been simply treated as an additional specimen of *H. forbesii*, which it is.

Distribution.—*H. forbesii* is only known from the three specimens mentioned above, and is apparently endemic to the small island of Abd-el-Kuri, Peoples Democratic Republic of Yemen, located at the entrance to the Gulf of Aden (Fig. 18).

COMPARATIVE DESCRIPTION

The most distinctive differences between *H. granti* and *H. forbesii* have been summarized in Table 3. In addition, it seems that the typical tarsomere II spine formula for *H. granti* is: 5/5 5/5 : 5/6 6/6 : 6/6 6/6 : 6/6 6/6, and that of *H. forbesii* is: 5/5 5/5 : 5/5 5/5 : 6/6 6/6 : 6/6 6/6, differing in the number of spines on the posterior row of the second pair of legs. However: In the first place, the samples available are too small for me to have any confidence on the validity of this differential character at this time; and secondly, this particular row of spines (2nd pair, posterior) has been found to have the highest intraspecific variability in spine counts (among the eight distinct groupings possible) on other species of Diplocentridae (Francke, 1975, Table 3), and to use it as a diagnostic character could prove to be misleading in this case.

In *H. granti* trichobothrium **Dt** occurs on the fixed finger, slightly beyond the movable finger articulation commisure (Fig. 2); and in *H. forbesii* trichobothrium **Dt** occurs at the fixed finger base, slightly before the movable finger articulation commisure (Fig. 10). I consider this positional difference to be of minor taxonomic importance, and should be used with care until more specimens are studied, particularly adults.

The fact that *H. granti* and *H. forbesii* are only known from two and three immature specimens respectively, and that they are sympatric on the small island of Abd-el-Kuri, may lead some taxonomists to question the validity of these two species (e.g. Werner, 1934). However, since the female specimens of *H. granti* and *H. forbesii* are of approximately the same size (Tables 1 and 2), ontogenic and sexual differences can be considered

to be minor in this case; and my conclusion is that both species are valid, and can be recognized by the differences summarized in Table 3.

DISCUSSION

Kraepelin (1905) recognized two subfamilies in the Diplocentrinae, based mainly on biogeographic considerations, as follows: Diplocentrinae, including the three New World genera then known; and Nebinae, including the two genera found in the Middle East, namely *Nebo* and *Heteronebo*. Birula (1917) separated the two subfamilies on the basis of the cheliceral dentition; and Werner (1934) gave the presence or absence of a transverse ventral carina on metasomal segment V as the distinguishing character.

Nebo and *Heteronebo* can be separated by a number of very distinctive characters, any one of which is highly reliable and can be used by itself. These characters are enumerated below, and I will be referring back to them throughout the following discussion.

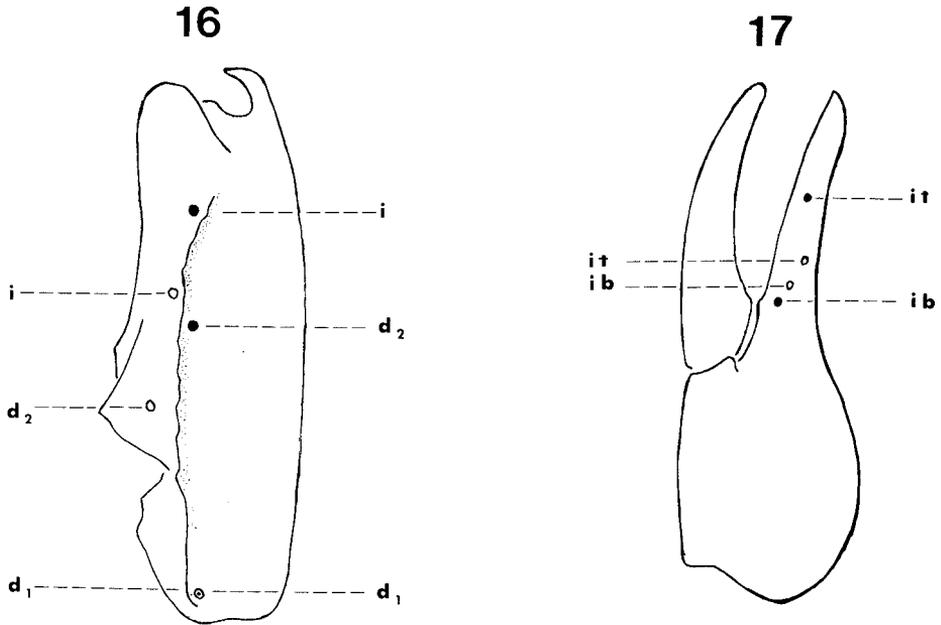
- 1 - *Nebo* has the carapacial median longitudinal furrow suturiform, i.e., deep and narrow throughout its length, and its limits can be clearly defined; this "suture" bifurcates at the anterior submargin. In *Heteronebo* the carapacial median longitudinal furrow is not suturiform, i.e., it is usually wide, and its limits can not be precisely defined; this furrow does not bifurcate at the anterior submargin of the carapace.
- 2 - The subaculear tubercle in *Nebo* appears as a finger-like, subcylindrical projection with a narrow base. In *Heteronebo* the subaculear tubercle is rounded, and has a broad base.
- 3 - In *Nebo* brachial trichobothrium **d₂** remains along the dorsal surface of the brachium. In *Heteronebo* brachial trichobothrium **d₂** has migrated to the internal face (Fig. 16).
- 4 - In *Nebo* trichobothrium **it** is found medially on fixed finger (Vachon 1965, 1974). In *Heteronebo* trichobothrium **it** is found on basal one-fourth of fixed finger (Fig. 17).
- 5 - In *Nebo* the longitudinal ventral median keel on metasomal segment V is never distinctly bifurcate distally. In *Heteronebo* this keel is distinctly bifurcate on one species (*H. granti*, Fig. 13), tetrafurcate on the other (*H. forbesii*, Figs. 14-15).
- 6 - In *Nebo* tarsomere II is distally lobed, the terminal spine is directed apically. In *Heteronebo* tarsomere II is distally rectangular, the terminal spine is directed ventrally.

The characters enumerated above to separate *Heteronebo* are present in the subfamily Diplocentrinae to variable extents. Characters 1-4 can be used to separate *Nebo* from all other diplocentrid genera, and do not need any further clarification. Among the characters needing clarification, I will first discuss Birula's subfamilial character: Birula (1917) stated that in the Diplocentrinae the cheliceral movable finger is bipartite subterminally, whereas in the Nebinae the cheliceral movable finger is undivided subterminally. I have examined representatives of all the diplocentrid genera, and have been unable to find any differences that will substantiate Birula's distinction, particularly with respect to *Heteronebo* (Fig. 7).

The second character needing clarification is Werner's (1934) subfamilial character (see my character 5), pertaining to the disposition of ventral carinae on metasomal segment V. Werner characterized the Diplocentrinae as having a ventral transverse keel, which delimits a distal disc, i.e., a depressed semilunar or crescentic region; and the Nebinae as lacking both a ventral transverse keel and a distal disc. Firstly, I have examined an undescribed species from the Caribbean region lacking the ventral transverse keel and the distal disc;

Table 3.—Differential characters observed between *Heteronebo granti* Pocock and *H. forbesii* Pocock.

	<i>H. granti</i>	<i>H. forbesii</i>
Prosoma:	ocular prominence	shallowly furrowed
Mesosoma:	sternite VII keels	weak to vestigial
Metasoma:	I-II ventral submedian keels	weak
	I-IV dorsal lateral keels	vestigial, gradual end
	I-III lateral supramedian keels	weak, gradual end
	V ventral median keel	tetrafurcate distally
Telson:	vesicle length/vesicle width	<1.35
	vesicle length/vesicle depth	<1.90
	vesicle length/aculeus length	≤3.00
Chelicera		ochreous, infusate
Pedipalps:	Humerus; relative length proportions	shorter than metasoma IV
	dorsal face	deeper than wide
	dorsal internal keel	transversely strongly convex
	Brachium; ventral external keel	obsolete
	external face	obsolete
	Chela;	smooth
	dorsal marginal keel	vestigial to obsolete
	digital keel	vestigial to obsolete
	fixed finger fuscous	with ochreous maculae



Figs. 16-17.—Diagrammatic representation of trichobothrial position differences between *Nebo* (solid circles, labels to the right) and *Heteronebo* (open circles, labels to the left): 16, right pedipalp brachium, dorsal; 17, right pedipalp chela, internal. See text for discussion.

however, this species is closely related to another species that does have these characters, and both undoubtedly belong in the Diplocentrinae. Secondly, *Heteronebo forbesii* seems to have a “rudimentary” ventral transverse keel, represented by four large granules on the lectotype and paralectotype (Figs. 14-15). On the basis of these observations, I maintain that Werner’s subfamilial character is no longer valid.

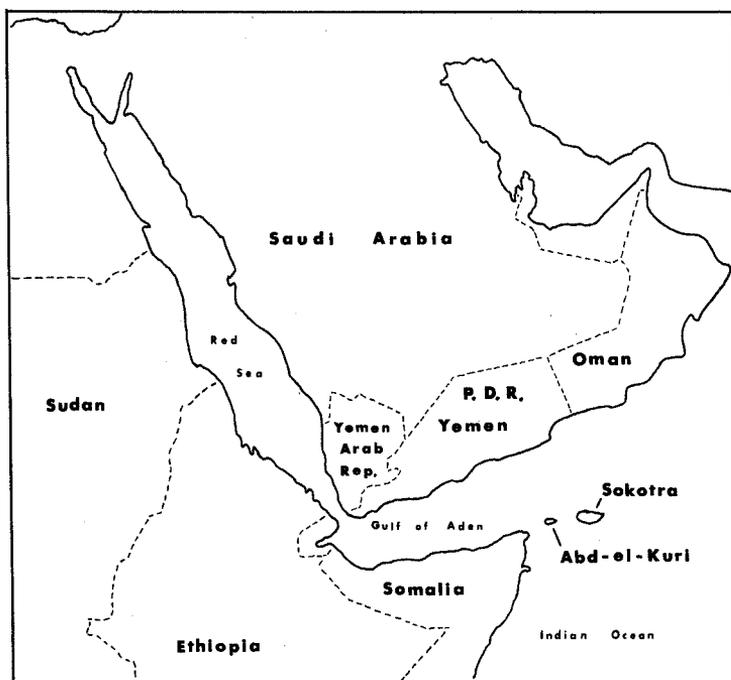
The third, and final, character needing clarification is character 6 above, and in this respect it is sufficient to indicate that the presence or absence of lobes on tarsomere II has been used as a generic character within the Diplocentrinae. Therefore, it is not useful at the subfamilial level either.

The fact that the basic differences between *Heteronebo* and *Nebo* given above, represent at the same time similarities between *Heteronebo* and the diplocentrine genera, have prompted me to remove *Heteronebo* from the subfamily Nebinae and to include it in the subfamily Diplocentrinae. These same characters become the basis for a polythetic diagnosis of the two subfamilies recognized in the Diplocentridae. The subfamily Nebinae is monotypic, and is diagnosed by characters 1-4 as enumerated above for *Nebo*. The subfamily Diplocentrinae is polytypic, and is diagnosed by characters 1-4 as enumerated above for *Heteronebo*. Although other promising characters have been explored, the lack of adequate *Heteronebo* material precludes their use for the time being.

The position of *Heteronebo* within the Diplocentrinae is very problematic, due to two fundamental reasons. First, I have been unable to find any character, which can be considered significant at the generic level, that will separate *Heteronebo* from the other diplocentrine genera. As has been pointed out already, I have an undescribed species in which metasomal segment V lacks a ventral transverse keel and a distal disc; furthermore, in this undescribed species the disposition of the ventral median carina resembles very

closely the tetrafurcate condition observed in *H. forbesii*, and tarsomere II is not lobed distally, as in *Heteronebo* spp. My failure to find valid generic characters for *Heteronebo* might be due to the fact that this genus is only known from five immature specimens. However, most scorpion genera are recognizable from immature specimens as well as from adults; therefore, I would personally question the validity of a genus based only on adult characters, which brings us to the second problem.

The systematics of *Heteronebo* are complicated by the geographical discontinuity in the distribution of the diplocentrine genera: *Heteronebo* is apparently endemic to Abd-el-Kuri, Peoples Democratic Republic of Yemen; and the other genera are found exclusively in the New World. This biogeographic problem immediately brought to my mind the possibility that Pocock's type locality data for *Heteronebo* could be erroneous. I wrote to Mr. Fred Wanless (British Museum) inquiring if there had ever been any reason to suspect the validity of Pocock's type locality data in this particular case; and according to him, until now, there had never been any reason whatsoever. Although I can neither prove nor disprove my suspicions, the possibility of a labelling error is still very real in my mind for the following reasons: first, and most important, is the overall similarity between *Heteronebo* and the undescribed species from the Caribbean region previously mentioned; secondly, because of the geographical discontinuity shown by its "known" distribution with respect to other diplocentrines; and finally, from indirect evidence derived from the knowledge of the concepts of island biogeography. Both Sokotra and Abd-el-Kuri (Fig. 18) are small, continental shelf islands located at the entrance to the Gulf of Aden, and offshore of Cape Guardafui (NE tip of Somalia); and whose faunal



Figs. 18.—Middle Eastern region, showing the location of the small island of Abd-el-Kuri, Peoples Democratic Republic of Yemen, located at the entrance to the Gulf of Aden, which is the type locality for *Heteronebo granti* Pocock and *H. forbesii* Pocock.

elements I would expect to be mainly derived from the Somalian mainland and to a lesser extent from the Arabian Peninsula. The following three scorpion species have been reported from Sokotra (Pocock 1899, 1903): *Hemiscorpion socotranus* Pocock (Scorpionidae, Hemiscorpioninae), *Butheolus insularis* Pocock (Buthidae), and *Orthochirus socotrensis* (Pocock) (Buthidae). These three species are endemic to Sokotra; *H. socotranus* is an Arabian element, while *B. insularis* and *O. socotrensis* appear to be Somalian elements since the two genera are well represented on the Somalian mainland. From Abd-el-Kuri the only scorpions known are *Heteronebo granti* and *H. forbesii*, and the genus is apparently endemic to that island; numerous localities have been sampled in Somalia, including Cape Guardafui (Vachon and Stockmann, 1968, Fig. 25), and no diplocentrid scorpions have been reported from there.

The Somalian elements on Sokotra could have arrived there (a) during a lowering of the sea level (glacial period), when Sokotra and Abd-el-Kuri could have been connected to the mainland, or (b) by "rafting," possibly using Abd-el-Kuri as a stepping stone during their dispersal. Regardless of how the Somalian elements arrived at Sokotra, it can be safely assumed that Sokotra has been isolated from the mainland at least since the time when Abd-el-Kuri became isolated, if not earlier due to the greater distance separating Sokotra from the Somalian mainland. These facts raise two basic questions: (a) why has this isolation resulted in the evolution of an endemic genus in Abd-el-Kuri, while only endemic species have evolved in Sokotra during the same time span? and (b) do *Heteronebo granti* and *H. forbesii* represent one of the few instances of sympatric speciation known in animals? It is impossible to answer satisfactorily these questions with the scant information currently available; but the probabilities of these events are at best minimal, indirectly supporting my suspicions on the accuracy of the type locality data for *Heteronebo*.

In conclusion, *Heteronebo* must be maintained as a valid genus of the subfamily Diplocentrinae, recognizable only on the basis of its geographical distribution, until the time when its presence in Abd-el-Kuri is either proved or disproved by an extensive collecting program on that island. If additional specimens are obtained from the type locality, hopefully adult specimens of *H. granti* and *H. forbesii* will appear in the samples, which will in turn provide one or more diagnostic characters for the genus.

ACKNOWLEDGEMENTS

I extend my sincere gratitude to Professor Max Vachon (Laboratoire de Zoologie, Museum National d'Histoire Naturelle, Paris) who was studying the specimens of *Heteronebo* when I became interested in the problem; he very kindly allowed me to make the redescriptions, and made the necessary arrangements for the loan transfer. Mr. Fred Wanless (Curator of Arachnida, British Museum, London) made the loan transfer possible, and promptly replied to my inquiry concerning the accuracy of the type locality data. Dr. Gisela Rack (Zoologisches Institut und Zoologisches Museum, Universität Hamburg) loaned me their entire diplocentrid collection, including *Nebo* spp. used for comparative purposes. Finally, Dr. Mont A. Cazier (Arizona State University) read the manuscript and made valuable suggestions.

LITERATURE CITED

- Birula, A. A. B. 1917. Fauna of Russia and adjacent countries, Scorpiones 1(1):1-225 (Translated from Russian by the Israeli Program for Scientific Translations, Jerusalem 1965, 154 pp.).

- Francke, O. F. 1975. A new species of *Diplocentrus* from New Mexico and Arizona. J. Arachnol. 2:107-118.
- Kraepelin, K. 1905. Die geographische verbreitung der Skorpione. Zool. Jahrb. Syst. 22(3):321-364.
- Peters, M. B. 1861. Ueber eine neue eintheilung der Skorpione und ueber die von ihm Mossambique gesammelten arten von Skorpionen, as welchen heir ein Auszug mitgetheilt wird. Akad. Wiss. Berlin, Monatsber. pp. 507-516.
- Pocock, R. I. 1899. The expedition to Sokotra III. Description of the new species of scorpions, centipedes, and millipedes. Liverpool Mus. Bull. 2:7-9.
- Pocock, R. I. 1903. Scorpions and spiders of Abd-el-Kuri, In H. O. Forbes (Ed.) "The Natural History of Sokotra and Abd-el-Kuri." H. Young and Sons, Liverpool. pp. 202-205.
- Rosin, R. and A. Shulov. 1963. Studies on the scorpion *Nebo hierochonticus*. Proc. Zool. Soc. London 140(4):547-575.
- Simon, E. 1878. Descriptions de deux nouveaux genres de l'ordre des scorpiones. Ann. Soc. Entomol. France. 8:399-400.
- Vachon, M. 1963. De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les scorpions. Bull. Mus. Nat. Hist. Nat. 2^e serie 35(2):161-166.
- Vachon, M. 1965. Remarques sur quelques scorpions appartenant aux genres *Nebo* Simon, 1878 (Diplocentridae) et *Hemiscorpion* Peters, 1861 (Scorpionidae). Bull. Mus. Nat. Hist. Nat. 2^e serie 37(2):308-317.
- Vachon, M. 1974. Etude des caractères utilisés pour classer les familles et les genres de scorpions. Bull. Mus. Nat. Hist. Nat. 3^e serie 104(140):857-958.
- Vachon, M. and R. Stockmann. 1968. Contribution à l'étude des scorpions africains appartenant au genre *Buthotus* Vachon 1949 et étude de la variabilité. Monitore Zool. Ital. (n.s.) 2(suppl.):81-149.
- Werner, F. 1934. Scorpiones, Pedipalpi, pp. 1-490. In H. G. Bronns Klassen und Ordnungen des Tierreichs, Bd. 5, Abt. 4, Buch 8, Lief. 1-3. Akademische Verlagsgesellschaft, Leipzig.