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REVISION OF THE GENUS *NEBO* SIMON (SCORPIONES: DIPLOCENTRIDAE)

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ABSTRACT

A taxonomic revision of the genus *Nebo* Simon, based largely on adult morphometric characters is presented. *Nebo hierichonticus* (Simon) and *Nebo flavipes* Simon are recognized as valid species: *Nebo hierichonticus pallidimanus* Pocock is a junior synonym of *N. flavipes; Nebo grandis*, n. sp., *Nebo henjamicus*, n. sp., *Nebo omanensis*, n. sp. and *Nebo yemenensis*, n. sp. are described.

INTRODUCTION

The family Diplocentridae Karsch contains two subfamilies: Diplocentrinae Kraepelin with six genera found almost exclusively in the New World, and Nebinae Kraepelin with the genus *Nebo* Simon from the Middle East and the Arabian Peninsula (Francke 1977a, 1978b).

Four nominal taxa have been assigned to *Nebo* in the past: *Hemiscorpio hierichonticus* Simon, type species of the genus, from Egypt, Israel and Jordania is a fairly well known species; *Nebo hierichonticus pallidimanus* Pocock, from Yemen has received little attention since its description; *Nebo flavipes* Simon, also from Yemen and regarded by many previous authors as a junior synonym of *N. hierichonticus*; and finally, *Diplocentrus sulcatus* Karsch, from "Africa", long regarded a junior synonym of *N. hierichonticus*. The type specimens of *D. sulcatus* could not be located for this study and are presumably lost or destroyed; this taxon is listed as a junior synonym of *N. hierichonticus* following earlier authors. The type specimens of *N. hierichonticus pallidimanus* apparently were never labelled as such; however, two specimens mentioned in the original description were studied and one has been designated lectotype. The type specimens of *N. hierichonticus* and *N. flavipes* were studied by Vachon (1965), who noted some differences between them, and made the following remarks:

> "Il est donc probable, dans le cadre de l'espèce *hierochonticus*, que d'importantes variations relatives à la taille, à la coloration, aux indices morphométriques peuvent être mises en évidence; seule l'étude de populations (et surtout la comparaison de spécimens de même âge) habitant diverses stations allant de la Syrie à l'Arabie orientale, apportera la solution d'un probleme de taxonomie qui, dès maintenant, nous paraît être complexe."

This study is based on the examination of about 100 specimens of *Nebo* available to me, and attempts to provide a solution to the complex taxonomic problem alluded to by Vachon.

METHODS

The genus *Nebo* is very homogeneous in the overall external appearance of its members. Characters that have been successfully used in taxonomic studies of members of the subfamily Diplocentrinae (Francke 1977a, 1977b, 1977c, 1978a, 1978b) proved taxonomically worthless for *Nebo*. Meristic characters, such as pectinal tooth counts and tarsomere II spine counts, show as much, or more, intrapopulation variation as interpopulation variation. Direct comparisons of specimens, however, indicated conspicuous as well as subtle morphometric differences between specimens from various localities. Therefore, a morphometric analysis such as that of Francke (1975) was undertaken.

Initially 20 morphometric ratios based on 24 measurable characters (measured at 10X) were calculated for each specimen. Analyses of these ratios for 45 *N. hierichonticus* from Israel revealed considerable allometry and moderate to extensive sexual dimorphism. The lack of adequate samples from other parts of the range of *Nebo*, and a recurring inability to accurately determine stadia in scorpions forced me to eliminate all but mature specimens from further analyses. Sexual maturity in males was established by the presence of fully developed paraxial organs, and was found to be perfectly correlated with the presence of prominent scallops on the pedipalp chela fingers. Females lack scallops on the pedipalp chela fingers, and sexual maturity was established by examination of the reproductive system in some cases, or was assumed on the basis of size. Considerable allometry was detected between adult and subadult males, whereas there appeared to be little or none between adult and subadult females, making accurate aging less critical. The results presented herein, therefore, apply only to adults in the case of males (unless otherwise indicated), and to adults and subadults in the case of females.

The 20 morphometric ratios initially calculated were progressively reduced as some of them showed little variability within and between populations or phena, and others showed as much variability within populations or phena as was observed between them. Periodically all specimens were compared directly against each other at low to medium magnification (6X to 60X) to determine whether relative proportions differed conspicuously or not. Nine morphometric ratios based on 13 structures were finally found to exhibit conspicuous, apparently discontinuous, measurable differences between various phena. Those 13 structures were re-measured (at 15X), and the morphometric ratios recalculated as a check of the preliminary findings. Seven morphometric ratios based on nine measurable structures revealed the greatest discontinuities between phena, and have been chosen to diagnose and separate the taxa they represent.

In order to minimize the risk of misidentifications resulting from the usage of measuring procedures and landmarks different from those used in this study, the following guidelines as to how each structure was measured are given below:

Carapace length—maximum linear anteroposterior distance from anteriormost projections of lateral lobes to posterior margin.

Metasoma segment II length—maximum linear anteroposterior distance along frontal plane (=dorsoventral plane) from anterior apophysis of lateral submedian carina to posterior margin of segment.

Metasoma segment II width–maximum straight distance on frontal plane, and perpendicular to sagittal plane, from one lateral submedian carina to its counterpart.
Metasoma segment V length–maximum linear distance along frontal plane from anterior apophysis of lateral median carina to lateral apophysis of anal arc.
Pedipalp femur length–maximum linear distance measured along frontal plane from axial pivot of trochanter-femur articulation to dorsoexternal condyle of femur-tibia articulation.
Pedipalp femur width–maximum linear distance along frontal plane measured perpendicularly from plane tangent to internal fact to the widest point on external face (usually subdistally).
Pedipalp chela length–maximum straight distance from base of digital carina (marked by a conspicuous inflection) to tip of fixed finger.
Pedipalp chela width–maximum straight distance between dorsal margin of manus and ventral margin (=ventromedian carina). Care should be exercised to ensure that both landmarks are level along the plane of measurement.
Pedipalp chela movable finger length–maximum straight distance between internal condyle of movable finger articulation and tip of finger.

To simplify cross-referencing of morphometric ratios between the various taxa, the seven ratios used below have been designated as ratios #1 through #7, and for each ratio the same designation is conserved throughout the paper.

GEOGRAPHICAL GAZETTEER

Determination of the source of origin of many of the specimens studied proved almost as challenging as the taxonomic study itself. The main source of confusion appears to be related to transliteration of Arabic names by the British and German collectors responsible for obtaining the bulk of the material examined. Existing maps and gazetteers often give different spellings for these locality names, and some names are referred to one country in the collecting labels but are in a different country at present (due to changing political boundaries in the region).

The following gazetteer (Table 1) is based largely on the Official Standard Name Gazetteer's of the various countries published by the U.S. Board on Geographic Names (U.S. Department of Interior, Washington, D.C.), and indicates: (a) locality as given in label(s) accompaning specimen(s), (b) locality as given in source above, and (c) geographical coordinates for each locality as given in the source above.

Nebo Simon

Hemiscorpio: Simon 1872:255, Karsch 1879a:15 (not *Hemiscorpio* Peters 1861).
Diplocentrus: Karsch 1879b:99 (not *Diplocentrus* Peters 1861).
Cyphocentrus Karsch 1880:408, Simon 1880b:397 (in part).
Nebo Simon 1878:399, 1879:115, 1880a:29, 1880b:398, 1883:249, 1902:254, 1910:80, Karsch 1879:22, Kraepelin 1894:14, 1899:98, 1901:270, 1905:342, Pocock 1894:357, 1896a:295, 1896b:316, 1903a:214, 1903b:202, Lonnberg 1897:197, Arldt 1908:421, Borelli 1915:462, Schenkel 1932:381, Werner 1935a:275, 1935b:211, Bodenheimer 1937:235, Shulov 1939:253, 1966:97, Vachon 1940:248, 1965:308, 1966a:766, 1966b:214, 1974:914, 1976:7, 1977:209, Whittick 1941:44, Roewer 1943:224, Shulov and Amitai 1958:351, Shulov, Rosin and Amitai 1960:65, Bucherl 1960:269, 1964:59, Rosin and Shulov 1964:547, Dresco-Derouet 1964:97, Rosin 1964:177, 1965:111, 1969a:225, 1969b:71, 1969c:75, 1972:246, 1973:107, Nitzan and Shulov 1966:17, Perez 1974:35, Williams and Lee 1975:3, Schmidt 1975:2899, Francke 1977a:95, 1978b:3.

Table 1.—Gazetteer of geographic localities where *Nebo* has been collected.

EGYPT			
Dj. Ataka	Jabal Atāqah	29° 55' N	32° 20' E
IRAN			
Henjam	Henjām	26° 39' N	55° 53' E
ISRAEL (West Bank of Jordan River included)			
Kaifa	Haifa	32° 50' N	35° 00' E
Nabulus	Nābulus	32° 13' N	35° 17' E
Wadi Jureir	Wadi Al Juraynah	32° 12' N	35° 27' E
Maale Hachamisha	Ma 'ale Ḥahamisha	31° 49' N	35° 07' E
Jerusalem	Yerushalayim	31° 46' N	35° 14' E
Marsaba	Mār Sābā	31° 43' N	35° 23' E
'Ein Geddi	'En Gedi	31° 27' N	35° 23' E
Asluj (Beer Sheva)	Asludj (Mash'Abbin Be'er)	31° 01' N	34° 46' E
Yeruham	Yeroḥam	31° 00' N	34° 55' E
Wadi Abyad	Wādī Abyad	30° 57' N	34° 24' E
Wadi Nafkh	Wādī Nafkh (Naḥal Zin)	30° 57' N	35° 19' E
Wadi Haleigim	Wādī Haleiqim	30° 54' N	34° 45' E
Sde Boker or Sde Boger	Sede Boqer	30° 52' N	34° 47' E
Ras Umm Jurfan	Rās Umm Jurfān	30° 42' N	34° 53' E
J. Khurashe	Khurāsha (=Ḥoresha)	30° 32' N	34° 35' E
J. Maghara	Jebel Maghara	30° 20' N	34° 34' E
Wadi Ajram	Wādī 'Ajramīya	30° 22' N	34° 44' E
Aqua Bella	?	?	?
JORDAN			
Wadi Rum	Ramm, Khawr (=Wadi)	29° 41' N	35° 27' E
OMAN			
Dibba	Dibā	25° 38' N	56° 18' E
Rostaq	Ar Rustāq	23° 24' N	57° 27' E
Bait El Faley	Bayt Al Falaj	23° 37' N	58° 33' E
Muscat or Mascate	Masqat	23° 37' N	58° 35' E
Saiq Jekel	Sayq Jabal	16° 43' N	53° 08' E
PEOPLES DEMOCRATIC REPUBLIC OF YEMEN (ADEN)			
Dthala	? Dal 'ah (Pass)	14° 20' N	47° 02' E
	? Dhala (= Aḍ Ḍālī) (pop.)	13° 42' N	44° 44' E
	? Dthala under Yemen Arab Republic		
Jebel Harir	Jabal Ḥarīr	13° 45' N	44° 54' E
Shaik Othman	Shaykh 'Uthmān	12° 52' N	44° 59' E
Aden	'Adan	12° 46' N	45° 01' E
Shum-Shum (Sugarloaf Mt.)	Jabal al Muzalqam	12° 45' N	44° 52' E
SAUDI ARABIA			
Buraiman	Burayman	21° 39' N	39° 14' E
Qunfidan	Al Qunfudhah	19° 08' N	41° 05' E
YEMEN ARAB REPUBLIC			
Dthala	? Thal'ah (Wādī)	16° 35' N	43° 08' E
	? Dthala under Peoples Democratic Republic of Yemen		
Huka Hazz (or Hugga & Haz)	? Ḥāz	15° 31' N	44° 00' E
	? Ḥuqqah	14° 24' N	44° 30' E
San'a (=Sanaa)	Sana	15° 21' N	44° 12' E
Ghaiman	Ghayman	15° 16' N	44° 21' E
Taizz	Ta'izz	14° 47' N	44° 02' E
Gerba	Ghirbām	14° 00' N	45° 31' E

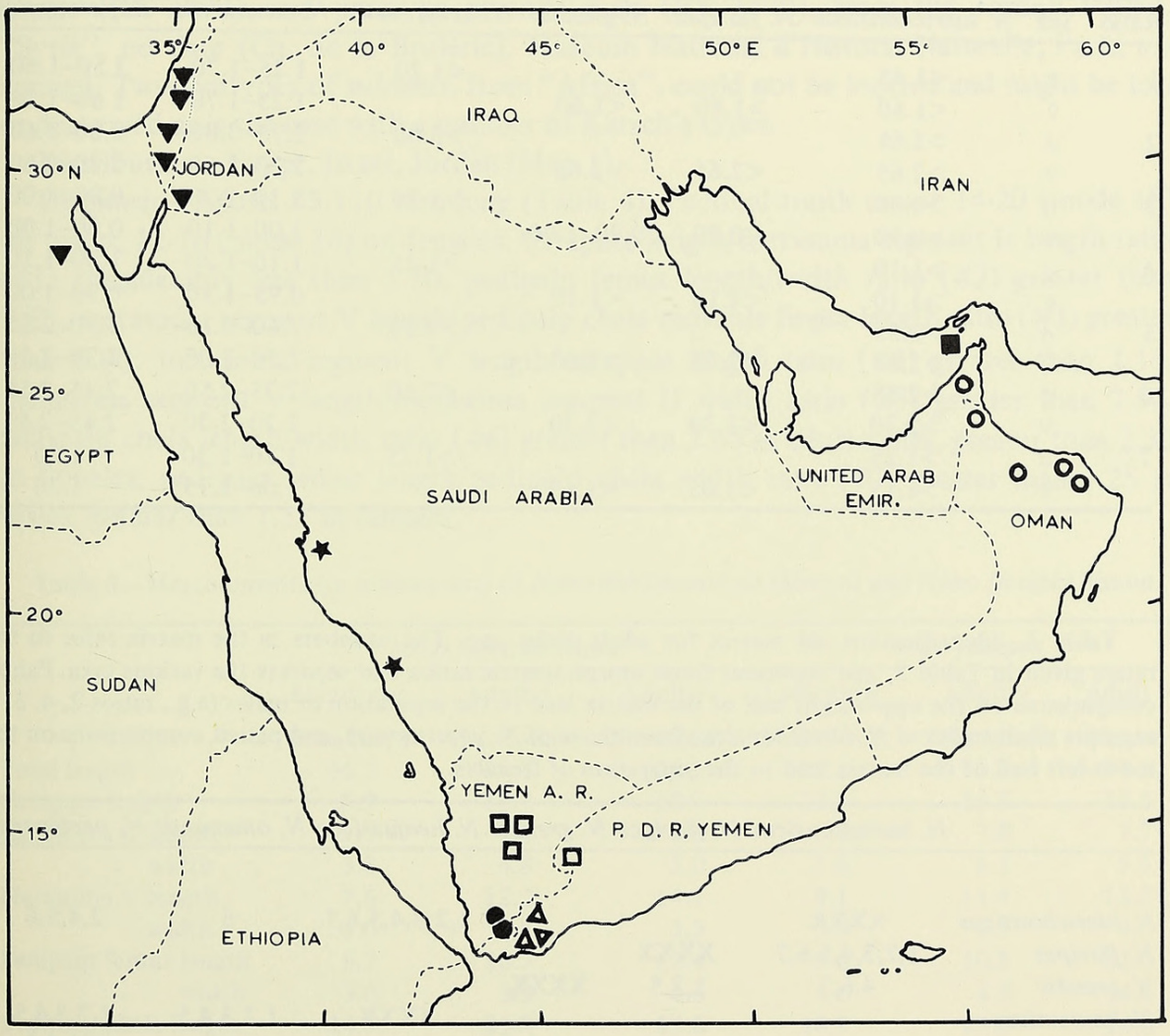
Type species.–*Hemiscorpio hierichonticus* Simon, 1872, by original designation.

Distribution.–Egypt, Iran, Israel, Jordania, Oman, Peoples Democratic Republic of Yemen, Saudi Arabia, Yemen Arab Republic (Map 1).

Diagnosis.–Sternum pentagonal. Retrolateral pedal spurs absent. Subaculear tubercle well developed, subcylindrical. Carapace with median longitudinal furrow suturiform. Orthobothriotaxia C (Vachon 1965:313, 1974:917): tibial trichobothrium d_2 on dorsal face, chelal trichobothrium *it* medially on fixed finger length (Francke 1977a:110).

Subordinate taxa.–*Nebo hierichonticus* (Simon), *Nebo flavipes* Simon, *Nebo grandis*, n. sp., *Nebo henjamicus*, n. sp., *Nebo omanensis*, n. sp., and *Nebo yemenensis*, n. sp.

Identification Aids.–Dichotomous keys have been avoided in this contribution for several reasons. First, due the fact that adult males are not known for two of the six species and adult females are not known for another species, and also due to the fact that considerable sexual dimorphism can occur, a single key would be very incomplete and difficult to use. Two keys, one for males and one for females, were rejected (a) because erroneous identifications could result if the unknown sex of a taxon was "forced" through the available key, and (b) because such keys tend to be monothetic or oligothetic in their characterization of the taxa. The taxa recognized below are based on a variable



Map 1.–Geographical distribution of *Nebo* spp.: *N. hierichonticus*, solid triangles; *N. flavipes*, solid circles; *N. grandis*, open triangles; *N. henjamicus*, solid square; *N. omanensis*, open circles; *N. yemenensis*, open squares; *Nebo* sp. undet., stars.

number of morphometric differences, and accurate identifications are more likely if all available differences are carefully analyzed, including geographical distributions (some taxa that are morphometrically quite similar occur at great distances from each other, while taxa that are geographically nearer to each other show considerable morphometric differences).

The morphometric characterization, based on seven ratios, of the phena (separated by sex and taxon) available appear in Table 2. Ratios useful in separating individuals of the same sex from other taxa known also from that sex appear in Table 3. Paired comparisons on the upper-right half of the matrix lead to the separation of males, while paired comparisons on the lower-left half of the matrix lead to the separation of females.

Table 2.–Morphometric characterization of adult *Nebo* spp. The seven morphometric ratios given are: 1= carapace length/metasoma segment II length, 2= pedipalp femur length/width, 3= metasoma segment V length/pedipalp chela movable finger length, 4= metasoma segment V length/carapace length, 5= metasoma segment V length/metasoma segment II width, 6= pedipalp chela length/width, 7= pedipalp femur length/pedipalp chela width.

Ratio	Sex	*N. hierichonticus*	*N. flavipes*	*N. grandis*	*N. henjamicus*	*N. omanensis*	*N. yemenensis*
1	♂	<1.45			<1.20	1.25–1.70	1.50–1.60
	♀	<1.60	>1.60	<1.60		1.25–1.70	1.60–1.70
2	♂	>2.65			>3.00	2.75–3.00	2.30–2.60
	♀	>2.65	<2.65	>2.65		2.30–2.60	2.30–2.60
3	♂	>0.90			>1.20	1.10–1.20	0.90–1.00
	♀	>0.90	<0.90	0.90–1.00		1.00–1.10	0.90–1.00
4	♂	>1.10			>1.25	1.10–1.20	1.00–1.10
	♀	>1.10	<1.10	<1.10		0.95–1.10	0.90–1.00
5	♂	>2.55			>3.10	2.60–3.10	2.30–2.55
	♀	>2.55	<2.25	>2.60		2.50–3.00	2.30–2.55
6	♂	>2.65			<2.60	2.35–2.50	2.45–2.55
	♀	>2.30	<2.30	<2.30		2.20–2.30	2.45–2.55
7	♂	>1.25			>1.25	1.20–1.30	1.20
	♀	>1.15	<1.05	<1.15		1.05–1.15	1.20

Table 3.–Identification aid matrix for adult *Nebo* spp. The numbers in the matrix refer to the ratios given in Table 2, and represent those morphometric ratios that separate the various taxa. Paired comparisons on the upper-right half of the matrix lead to the separation of males (e.g., ratios 2, 4, 5, 6 separate adult males of *N. hierichonticus* from those of *N. yemenensis*), and paired comparisons on the lower-left half of the matrix lead to the separation of females.

	N. hierichonticus	*N. flavipes*	*N. grandis*	*N. henjamicus*	*N. omanensis*	*N. yemenensis*
N. hierichonticus	XXXX			1,2,3,4,5,6,7	6	2,4,5,6
N. flavipes	1,2,3,4,5,6,7	XXXX				
N. grandis	4,6,7	1,3,5	XXXX			
N. henjamicus				XXXX	1,2,3,4,5	1,2,3,4,5
N. omanensis	6,7	1,3,5,7	2,3		XXX	2,3,4,5
N. yemenensis	2,4,5	3,5,6,7	1,2,5,6,7		3,6,7	XXXX

Nebo hierichonticus (Simon)
Figs. 1-2.

Hemiscorpio hierichonticus Simon 1872:255, Karsch 1879a:15.
Nebo hierichonticus: Simon 1878:399, 1880a:29, *nec* 1902:254, 1910:81, Karsch 1879a:22, Pocock 1903:214, *nec* Whittick 1941:44, Shulov and Amitai 1958:351, Rosin 1964:177, 1969a:225, 1969b:71, 1969c:75, 1972:246, 1973:107, Nitzan and Shulov 1966:17, Vachon 1966a:766, 1966b:214 (in part), 1974:915, 1976:7, *nec* Vachon 1977:211, Schimdt 1975:2899.
Nebo hierochonticus (sic): Kraepelin 1894:14 (in part), 1899:98 (in part), *nec* 1901:270, Borelli 1915:462 (in part ?), Schenkel 1932:381, Werner 1935a:275 (in part), 1935b:211, Bodenheimer 1937:235, *nec* Finnegan 1932:92, *nec* Roewer 1943:224, Bücherl 1960:269, Shulov et al. 1960:65, Rosin and Shulov 1963:547 (in part), Dresco-Derouet 1964:97, Vachon 1965:308 (in part), Rosin 1965:111, Shulov 1966:97, Perez 1975:35 (in part).
Nebo hierochunticus (sic): Simon 1879:115.
Nebo hiericonticus (sic): Shulov 1939:253.
Nebo hieronchonticus (sic): Bücherl 1964:59.
Nebo hierichanticus (sic): Abushama 1968:37.
? *Diplocentrus sulcatus* Karsch 1879b:99.
? *Cyphocentrus sulcatus*: Karsch 1880:407.

Type data.–Holotype of *hierichonticus*, juvenile male (RS 1181), allotype juvenile female (RS 3493), and paratype juvenile male (RS 3490), from the Jordan Valley, "Syrie", no date (Ch. de la Brulerie), Museum National d'Historie Naturelle, Paris, examined. Two syntypes of *sulcatus*, from "Africa", could not be located and might be lost or destroyed as is the case with a number of Karsch's types.

Distribution.–Egypt, Israel, Jordan (Map 1).

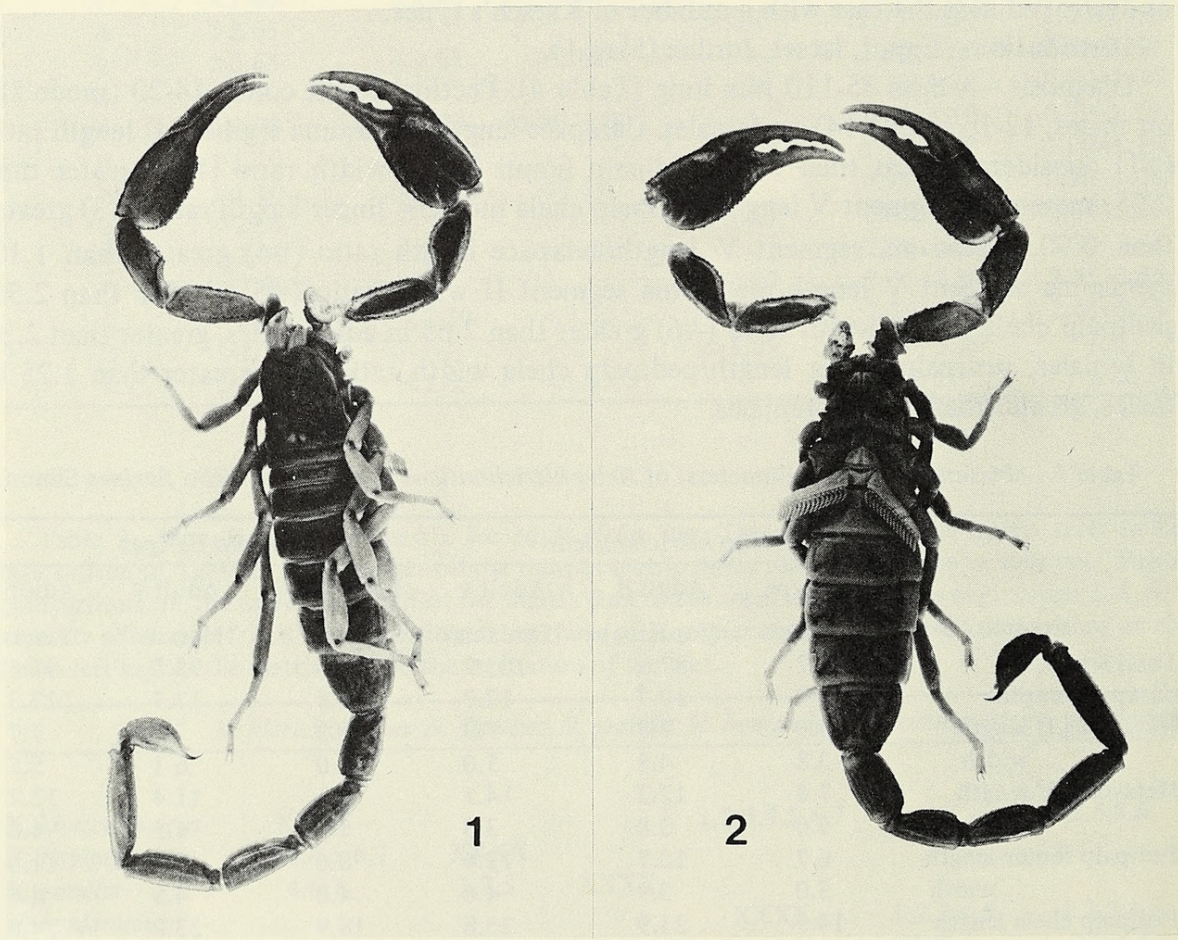
Diagnosis.–Adults 85-110 mm long (Table 4). Pectinal tooth count 14-20 (mode 18) on males, 12-16 (mode 14) on females. Carapace length/metasoma segment II length ratio (#1) considerably less than 1.70, pedipalp femur length/width ratio (#2) greater than 2.65, metasoma segment V length/pedipalp chela movable finger length ratio (#3) greater than 0.90, metasoma segment V length/carapace length ratio (#4) greater than 1.10, metasoma segment V length/metasoma segment II width ratio (#5) greater than 2.50, pedipalp chela length/width ratio (#6) greater than 2.65 in adult males, greater than 2.30 in females, pedipalp femur length/pedipalp chela width ratio (#7) greater than 1.25 in males, greater than 1.15 in females.

Table 4.–Measurements (in millimeters) of *Nebo hierichonticus* (Simon) and *Nebo flavipes* Simon.

	Nebo hierichonticus			*Nebo flavipes*		
	Lectotype Subadult ♂	Adult ♂ (Jordania)	Adult ♀ (Jordania)	Lectotype Subadult ♂	Adult ♀ "Marsaba"	Adult ♀ Yemen
Total length	64.2	87.8	105.2	79.1	95.8	97.5
Carapace length	8.9	10.7	12.7	10.5	13.7	13.3
Metasoma II length	5.0	7.8	7.9	6.3	7.8	7.7
width	3.8	4.8	5.0	5.0	6.1	5.5
Metasoma V length	7.6	12.2	14.1	9.1	11.4	12.2
width	3.0	3.8	3.3	3.9	4.5	4.0
Pedipalp femur length	6.7	10.7	12.4	8.6	10.8	11.0
width	3.0	3.9	4.6	4.0	4.9	4.6
Pedipalp chela length	14.5	21.9	23.8	18.9	23.8	24.0
width	5.4	7.7	10.0	7.7	11.0	11.0
Movable finger length	8.8	13.0	13.5	11.6	14.8	13.7
Pectinal tooth count	15–16	15–16	14–14	18–18	15–14	16–15

Comparisons.—Ratios #4 and #6 above, singly or in combination, will separate *N. hierichonticus* from all other congeneric species. Additional differences with specific taxa will be given as those taxa are treated.

Specimens examined.—**EGYPT:** Jabal Atāqah, February 1889 (no coll.), 1 imm. male (MNHN). **ISRAEL**: Jordan Valley, no date (Ch. de la Brulerie), 2 imm. males, 1 imm. female (MNHN), Haifa, 1 February 1901 (no coll.), 1 male (ZMH), Nabulus, 21 February 1897 (P. Born), 1 female (ZMH), Wadi Al Juraynah, 1 April 1955 (Levitas), 1 imm. female (MNHN), Ma'ale Ḥahamisha, 3 November 1958 (P. Amitai), 1 imm. male (AMNH), Jerusalem, 1873 (Schneller), 1 female (ZMH), Mār Sābā, no date (M. A. Letourneux), 1 male (MNHN), 'En Gedi, 8 April 1951 (J. Warhman), 1 female, 14 March 1953 (J. Warhman), 5 imm. males, 3 imm. females (MNHN), Asludj, 30 January 1954 (Werner), 1 imm. male (MNHN), Yeroḥam, 5 April 1954 (Werner), 1 imm. female (MNHN), Wādī Abyad, 25 March 1952 (J. Warhman), 1 female, 3 imm. males, 3 imm. females (MNHN), Wādī Nafkh, 25 February 1949 (J. Warhman), 1 female (MNHN), Wādī Haleiqim, 25 September 1952 (J. Warhman), 1 imm. male (MNHN), Sede Boqer, March 1953 (J. Warhman), 1 female (MNHN), 2 March 1955 (Werner), 2 imm. males, 1 imm. female (MNHN), Rās Umm Jurfān, 28 November 1949 (J. Warhman), 1 imm. male, 1 imm. female (MNHN), Khurāsha, 1 April 1955 (Levitas), 2 imm. males, 2 imm. females (MNHN), Jebel Maghara, 1 April 1955 (Levitas), 1 imm. male (MNHN), Wādī 'Ajramīya, 29 February 1949 (J. Warhman), 1 imm. male (MNHN), Aqua Bella, 10 May 1950 (J. Warhman), 1 imm. male (MNHN), Negev, 1952 (J. Warhman), 1 imm. male (MNHN). **JORDAN**: Jordan, no date (no coll), 1 imm. male (MNHN), Ramm Khawr, April 1975 (B. and P. Lanza), 1 female, 1 imm. male, 1 imm. female (Firenze), Avdat, Negev Desert, no date (no coll.), one imm. male (ENKW).



Figs. 1-2.—*Nebo hierichonticus* (Simon), adult male from Mar Saba, Israel: 1, dorsal view; 2, ventral view.

Nebo flavipes Simon
Figs. 3-4

Nebo flavipes Simon 1883:249, *nec* Pocock 1896a:295, 1896b:316, 1903a:214 (in part), Kraepelin 1899:98, *nec* 1901:270, Werner 1935b:211, *nec* Bodenheimer 1937:235, Vachon 1940:250 (in part ?), 1965:308.

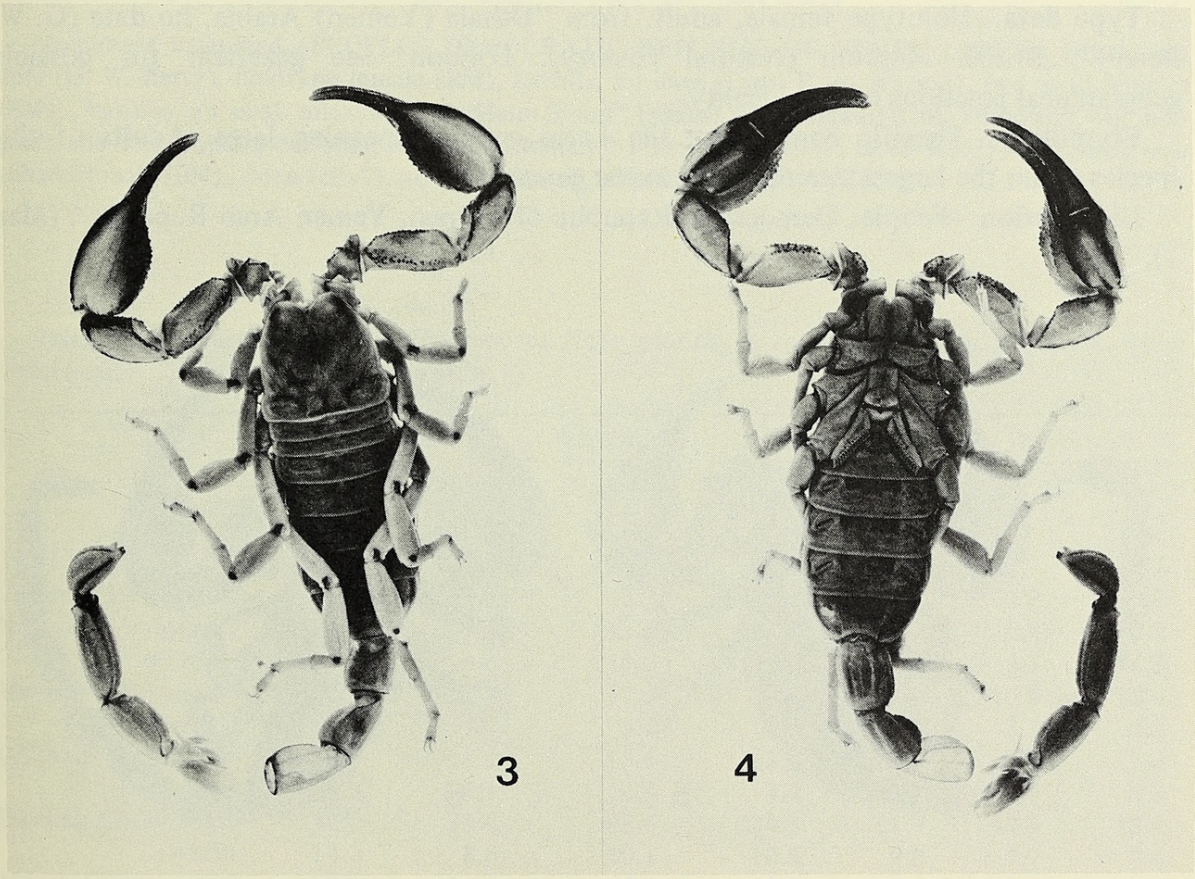
Nebo hierichonticus (in part): Kraepelin 1894:14, Werner 1935a:275, Whittick 1941:44, Roewer 1943:224, Rosin and Shulov 1963:547, Vachon, 1966b:214, Perez 1974:35.

Nebo hierichonticus pallidimanus Pocock 1903a:214, Perez 1974:35. **NEW SYNONYMY.**

Type data.–Holotype of *flavipes*, immature male, from Ta'izz, Yemen Arab Republic, no date (R. Manzoni), Museum National d'Historie Naturelle, Paris, examined. Lectotype of *hierichonticus pallidimanus*, adult female hereby designated, from Ghirbām, Yemen Arab Republic, no date (G. W. Berry), British Museum (Natural History), London, examined.

Distribution.–Yemen Arab Republic, Peoples Democratic Republic of Yemen? (Map 1). See Remarks.

Diagnosis.–Adult females 90-100 mm long (Table 4), adult males unknown. Pectinal tooth count 16-20 (mode 18) on males, 14-16 (mode 15) on females. Carapace length/metasoma segment II length ratio (#1) greater than 1.70, metasoma segment V length/pedipalp chela movable finger length ratio (#3) less than 0.90, metasoma segment V length/metasoma segment II width ratio (#5) less than 2.25, pedipalp femur length/pedipalp chela width ratio (#7) less than 1.20 in males, less than 1.05 in females.



Figs. 3-4.–*Nebo flavipes* Simon, adult female from Mar Saba, Israel (see discussion in text): 3, dorsal view; 4, ventral view.

Comparisons.—Ratios #1, #3, #5, and #7 above separate *N. flavipes* from all other congeneric species. Ratios #2, #4, and #6, given in the diagnosis of *N. hierichonticus* also separate this taxon from *N. flavipes*. Additional differences between *N. flavipes* and the new species described below appear in the comparisons' sections of the latter.

Specimens examined.—**YEMEN ARAB REPUBLIC**: Ta'izz, no date (R. Manzoni), holotype male and immature male paratype of *flavipes* (MNHN), Ghirbām, no date (G. W. Berry), one adult female (designated lectotype) and one subadult female of *hierichonticus pallidimanus* (BM). **P. D. R. of YEMEN** (?): Aden, no date (Marquis G. Doria), subadult male and subadult female "co-types" of *flavipes* (BM). OTHERS: Syrie, Mār Sābā (M. Letourneux), one adult female (MNHN), no locality, no date (F. W. Townsend), one subadult male (BM), no locality, October 1912 (no coll., Mus. Calcutta), one imm. male (ZMH).

Remarks.—Only the specimens from Yemen Arab Republic seem to have accurate locality data. The "co-types" of *flavipes* from "Aden" could be from the city of that name (although it is doubtful since a different species occurs there), or from the country of P. D. R. of Yemen (formerly known as Aden). The female from Mār Sābā, Syrie, is accompanied by an adult male *N. hierichonticus*, to whom the locality data most likely applies; the female was probably collected somewhere else, considered conspecific to the male and subsequently placed in the same jar.

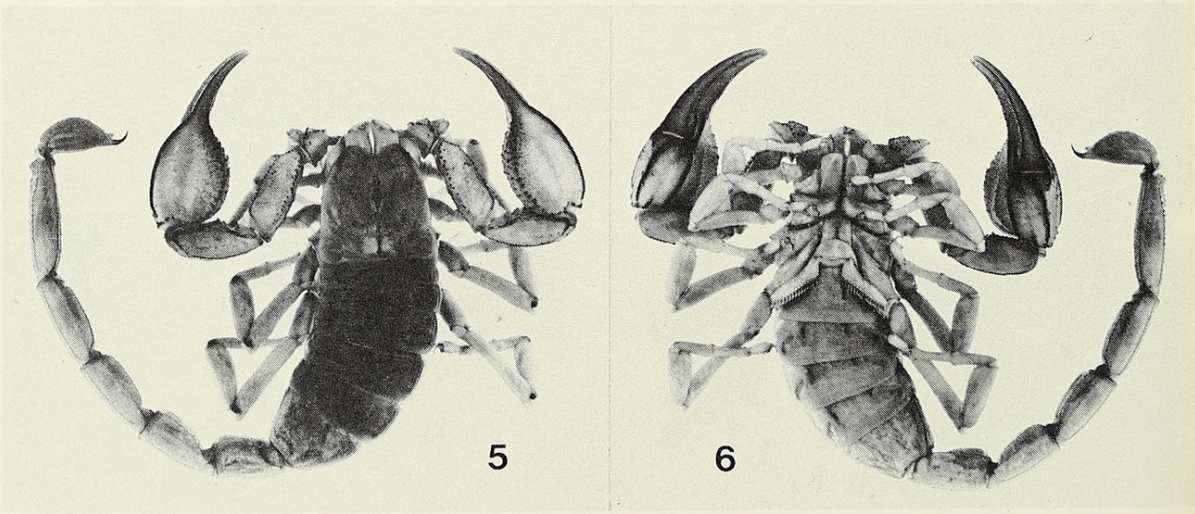
Nebo grandis, new species
Figs. 5-6

Nebo hierichonticus: Whittick 1941:44 [misidentification; specimens from Dhala, Western Aden Protectorate (=Yemen Arab Republic) only].
Nebo flavipes: Pocock 1896b:316 [misidentification].

Type data.—Holotype female, adult, from "Dthala (Yemen) Arabia, no date (G. W. Berry)"; British Museum (Natural History), London. See gazetteer for possible geographical positions of this locality.

Etymology.—Specific name from the Latin *grandis*, meaning large. Adults of this species attain the largest size observed in the genus.

Distribution.—Peoples Democratic Republic of Yemen, Yemen Arab Republic ? (Map 1).



Figs. 5-6.—*Nebo grandis*, n. sp., adult female from Dthalla, P. D. R. Yemen: 5, dorsal view; 6, ventral view.

Diagnosis.–Adult females 120-145 mm long (Table 5), adult males unknown. Pectinal tooth counts 17-19 in males, 14-16 in females. Carapace length/metasoma segment II length ratio (#1) less than 1.60, metasoma segment V length/pedipalp chela movable finger length ratio (#3) greater than 0.90, less than 1.00; metasoma segment V length/metasoma segment II width ratio (#5) greater than 2.60, pedipalp chela length/width ratio (#6) less than 2.30, pedipalp femur length/pedipalp chela width ratio (#7) less than 1.15.

Comparisons.–Adult females of *N. grandis* can be separated from adult *N. hierichonticus* females by ratios #6 and #7 as indicated in their respective diagnoses. Presumed subadult males of *N. grandis* (92 mm and 81 mm long respectively) differ from adult and subadult *N. hierichonticus* as follows (morphometric statements refer to *grandis*, the alternate condition occurs in *hierichonticus*): metasoma segment V length/pedipalp chela movable finger length ratio (#3) less than 0.90, metasoma segment V length/metasoma segment II width ratio (#5) less than 2.55, and pedipalp chela length/width ratio (#6) less than 2.65.

Adult females of *N. grandis* can be separated from adult *N. flavipes* females by ratios #1, #3 and #5 as indicated in their respective diagnoses. In addition, the pedipalp femur length/width ratio (#2) in *N. flavipes* is less than 2.45, and in *N. grandis* is greater than 2.45. Subadult males of these two species differ as follows (morphometric statements refer to *N. grandis*, the alternate condition occurs in *N. flavipes*): metasoma segment V length/pedipalp chela movable finger length ratio (#3) greater than 0.80, metasoma segment V length/carapace length ratio (#4) greater than 0.90, and metasoma segment V length/metasoma segment II width ratio (#5) greater than 2.25.

Specimens examined.–PEOPLES DEMOCRATIC REPUBLIC OF YEMEN (ADEN): Dthala, no date (G. W. Berry), holotype female (BM), Dthalla, no date (Capt. H. R. Watson), two adult females (BM), "halfway up small mt. summit of Shum Shum" (=Jabal al Muzalqam) (Col. Yerbourg), one subadult and one imm. male (BM), Shaykh 'Uthmān, 9 February 1895 (?, label=9.2.95) (no coll.), one subadult male (BM), Aden (city?), no date (no coll.) one imm. male (MNHN).

Table 5.–Measurements (in millimeters) of *Nebo grandis*, n. sp., *Nebo henjamicus*, n. sp., *Nebo omanensis*, n. sp., and *Nebo yemenensis*, n. sp.

	grandis		*henjamicus*	*omanensis*		*yemenensis*	
	Holotype	Subadult ♂	Holotype	Holotype	Adult ♀	Holotype	Adult ♂
	Adult ♀	Aden	Adult ♂	Adult ♂	Oman	Adult ♀	Yemen
Total length	142.4	92.6	122.3	111.0	101.0	88.2	80.2
Carapace length	18.4	11.6	13.2	12.9	12.2	11.2	10.2
Metasoma II length	11.7	7.5	11.2	9.4	8.2	6.8	6.8
width	6.9	4.8	5.0	5.2	4.4	4.3	4.3
Metasoma V length	18.4	11.5	17.3	14.9	13.0	10.9	10.4
width	4.9	3.7	3.7	4.1	3.4	3.3	3.3
Pedipalp femur length	14.9	10.1	13.6	12.9	10.9	9.5	9.6
width	6.2	4.1	4.4	4.4	4.2	3.9	3.8
Pedipalp chela length	32.0	21.0	25.6	24.8	21.9	19.1	18.5
width	14.2	8.6	10.1	10.5	9.8	7.7	7.4
Movable finger length	19.6	13.0	14.0	13.0	12.4	10.9	10.4
Pectinal tooth count	14–15	18–19	19–20	21–22	14–14	13–13	15– ?

Nebo henjamicus, new species
Figs. 7-8

Nebo hierichonticus: Whittick 1941:44 [misidentification; specimen from "Henjam on the Persian Gulf" only].

Type data.—Holotype, adult male from Iran, island of Henjam in the Persian Gulf, 8 March 1931 (Lt. Commander R. A. Stephens), British Museum (Natural History), London.

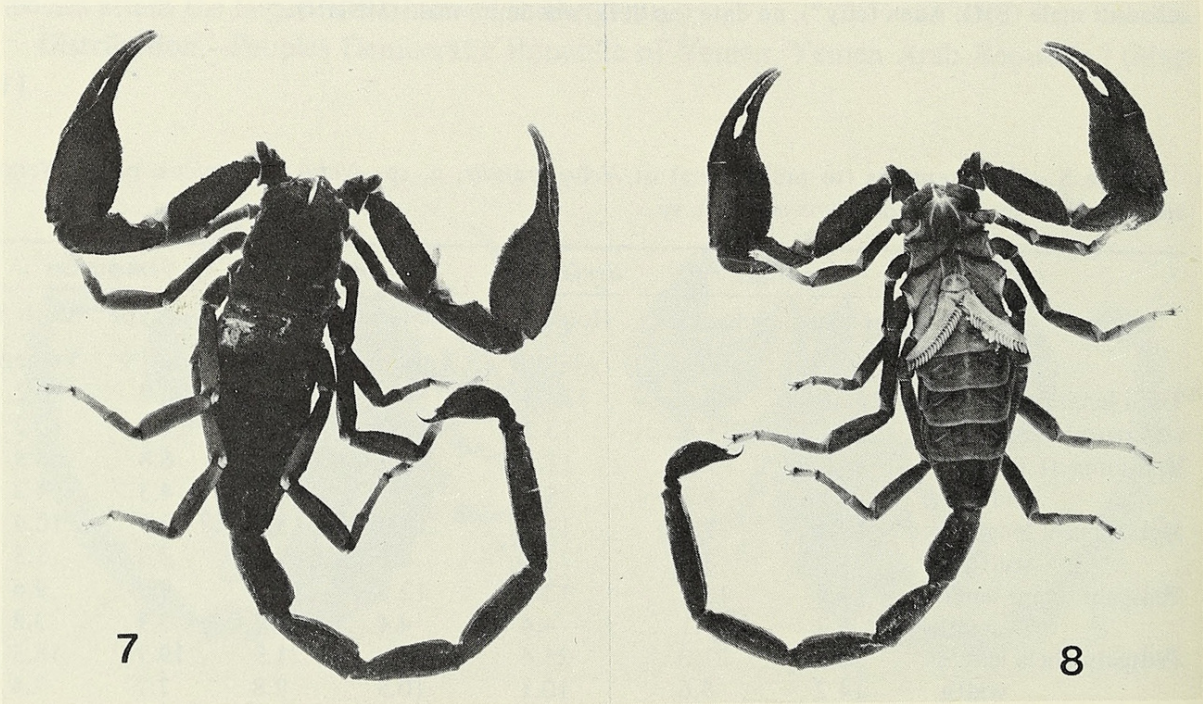
Etymology.—Specific name based on the type locality.

Distribution.—Known only from the type locality (Map 1).

Diagnosis.—Holotype, and only known specimen, 122 mm long (Table 5). Pectinal tooth count 19-20. Carapace length/metasoma segment II length ratio (#1) less than 1.20, pedipalp femur length/width ratio (#2) greater than 3.00, metasoma segment V length/pedipalp chela movable finger length ratio (#3) greater than 1.20, metasoma segment V length/carapace length ratio (#4) greater than 1.25, metasoma segment V length/metasoma segment II width ratio (#5) considerably greater than 3.00, pedipalp femur length/pedipalp chela width ratio (#7) greater than 1.25.

Comparisons.—*Nebo henjamicus* can be separated from adult *N. hierichonticus* males by ratios #1, #2, #3, #4, #5, and #7 as given above. Furthermore, the pedipalp chela length/width ratio (#6) in *N. henjamicus* is less than 2.60, while it is greater than 2.65 in *N. hierichonticus*. It differs from *N. flavipes* by ratios #1, #2, #3, #4, #5 and #7 as given above. Finally, it differs considerably from subadult *N. grandis* males in ratios #3 (less than 0.90 in *grandis*), #4 (less than 1.00 in *grandis*) and #5 (less than 2.55 in *grandis*).

Specimens Examined.—**IRAN**: island of Henjam in the Persian Gulf, 8 March 1931 (Late Lt. Commander R. A. Stephens, R. N. on HMS "Ormande"), holotype male (BM).



Figs. 7-8.—*Nebo henjamicus*, n. sp., holotype male from Henjam, Iran: 7, dorsal view; 8, ventral view.

Nebo omanensis, new species
Figs. 9-10

Nebo hierichonticus: Kraepelin 1901:270, Simon 1902:254, Vachon 1977:211 (misidentifications).
Nebo flavipes: Pocock 1896a:295 (part), 1903a:214 (part), Kraepelin 1901:270 (part) (misidentifications).

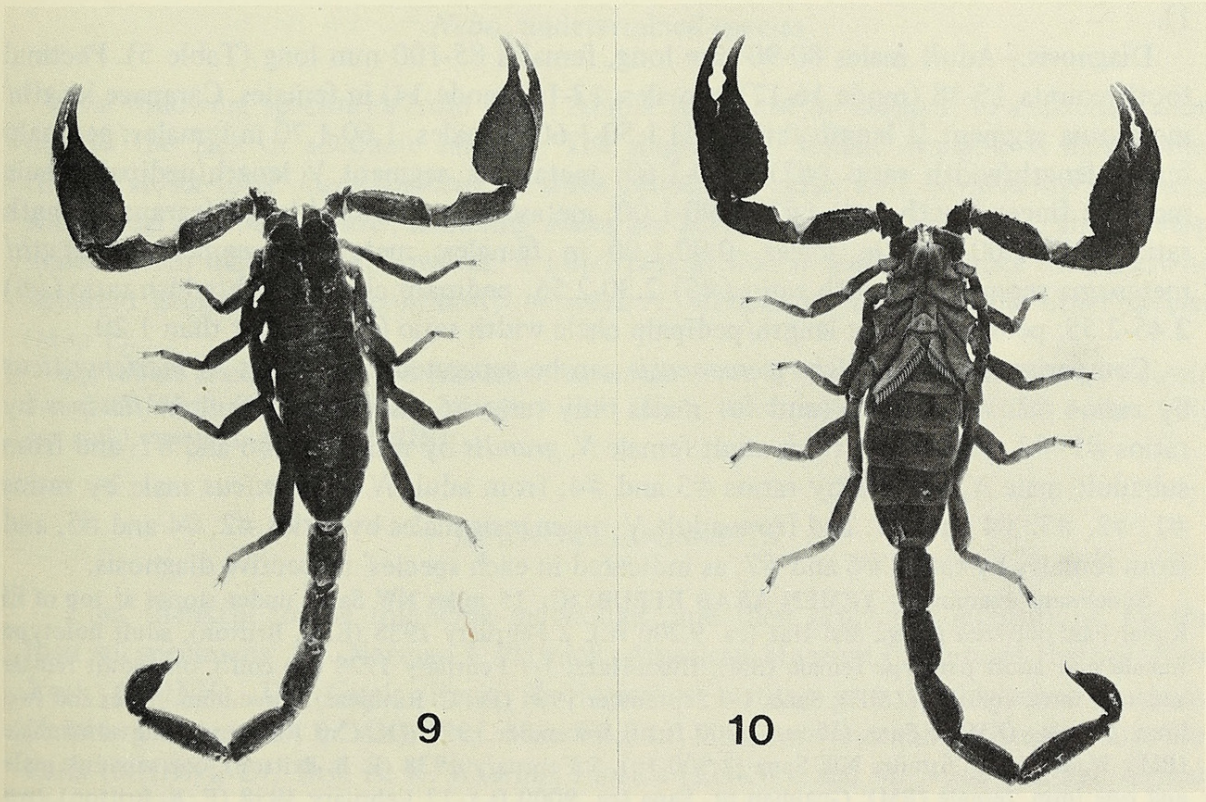
Type data.–Holotype, adult male, from Oman, Bayt Al Falaj, August 1916 (Maj. Burton); British Museum (Natural History), London.

Etymology.–Specific name based on the country in which this species occurs.

Distribution.–Oman, United Arab Emirates ? (Map 1).

Diagnosis.–Adult males 95-115 mm long, adult females 90-105 mm long (Table 5). Pectinal tooth counts 17-22 (mode 20) in males, 14-17 (mode 15) in females. Carapace length/metasoma segment II length ratio (#1) greater than 1.25, less than 1.70; pedipalp femur length/width ratio (#2) 2.75-3.00 in males, 2.30-2.60 in females; metasoma segment V length/pedipalp chela movable finger length ratio (#3) 1.10-1.20 in males, 1.00-1.10 in females; metasoma segment V length/carapace length ratio (#4) 1.10-1.20 in males, 0.95-1.10 in females; metasoma segment V length/metasoma segment II width ratio (#5) 2.60-3.10 in males, 2.50-3.00 in females; pedipalp chela length/width ratio (#6) 2.35-2.50 in males, 2.20-2.30 in females; pedipalp femur length/pedipalp chela width ratio (#7) 1.20-1.30 in males, 1.05-1.15 in females.

Comparisons.–Morphometrically *N. omanensis* is very close to *N. hierichonticus*, the most significant difference lying in the relative width of the pedipalp chela: adult males can be separated by ratio #6, and adult females by ratios #6 and #7 as indicated in their respective diagnoses. Adult *N. omanensis* can be separated from adult *N. flavipes* by ratios



Figs. 9-10.–*Nebo omanensis*, n. sp., adult male from Sayq Jabal, Oman: 9, dorsal view; 10, ventral view.

#1, #3, #5 and #7 as indicated in their respective diagnoses. Adult females of *N. omanensis* differ from adult females of *N. grandis* in size and in ratio #3 as indicated in their respective diagnoses. Subadult males of *N. grandis* differ from adult *N. omanensis* males in ratios #3 and #5 as indicated above and in the comparisons' section of *N. grandis*. Finally, adult *N. omanensis* males differ from *N. henjamicus* in ratios #1, #2, #3, #4 and #5 as indicated in their respective diagnoses.

Specimens examined.–**OMAN**: Bayt Al Falaj, August 1916 (Maj. Burton), holotype male and subadult female (BM); near Ar Rustāq, 12 April 1975 (M. S. and J. Baddeley), one adult male and one adult female (Mus. Oman); Sayq Jabal (Persian Gulf), 16 July ???? (Major M. D. Gallagher), one adult male, two females, one imm. male (BM); Muscat, no date (A. G. Jayakar), one adult male and one imm. female (BM); Dibā (Persian Gulf), March-April 1901 (no coll.), one imm. female (MNHN); Mascate, October-November 1896 (no coll.), one adult male, three imm. males, five imm. females (MNHN). Additional locality records in Oman appear in Vachon (1977:211).

Nebo yemensis, new species
Figs. 11-12

Nebo hierichonticus: Kraepelin 1894:14 (in part), Whittick 1941:44 (in part), Roewer 1943:224 (misidentifications).

Type data.–Holotype, adult female, from Yemen Arab Republic, 15 miles NW Sana, under stones at top of El Kabar Pass between Hugga and Haz (ca. 9,200 ft.), 2 February 1938 (E. B. Britton; British Museum Expedition to SW Arabia); British Museum (Natural History), London.

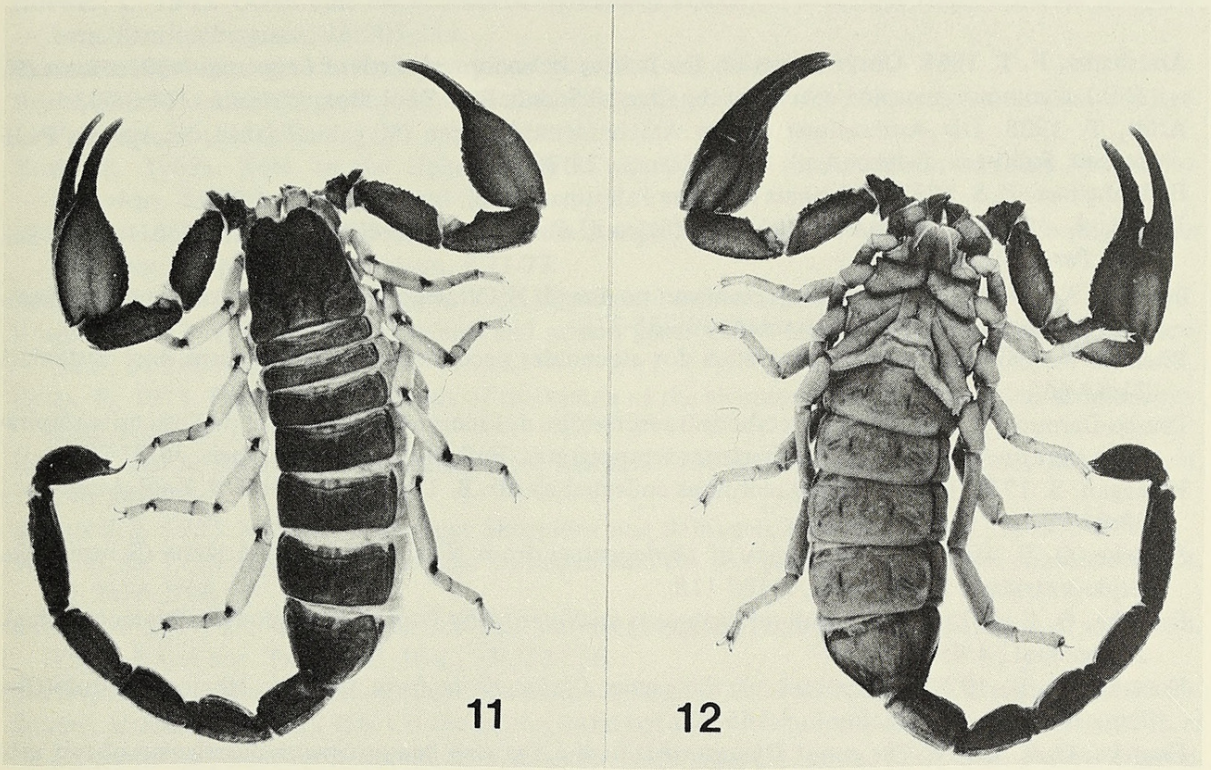
Etymology.–Specific name based on the countries in which this species occurs.

Distribution.–Peoples Democratic Republic of Yemen, Yemen Arab Republic (Map 1).

Diagnosis.–Adult males 80-90 mm long, females 85-100 mm long (Table 5). Pectinal tooth counts 15-18 (mode 16-17) in males, 13-16 (mode 14) in females. Carapace length/metasoma segment II length ratio (#1) 1.50-1.60 in males, 1.60-1.70 in females; pedipalp femur length/width ratio (#2) 2.30-2.60; metasoma segment V length/pedipalp chela movable finger length ratio (#3) 0.90-1.00; metasoma segment V length/carapace length ratio (#4) 1.00-1.10 in males, 0.90-1.00 in females; metasoma segment V length/metasoma segment II width ratio (#5) 2.30-2.55; pedipalp chela length/width ratio (#6) 2.45-2.55; pedipalp femur length/pedipalp chela width ratio (#7) greater than 1.20.

Comparisons.–Adult *Nebo yemenensis* can be separated from adult *N. hierichonticus* by ratios #2, #4 and #5 (and for males only ratio #6 also); from adult *N. flavipes* by ratios #1, #3, #5 and #7; from adult female *N. grandis* by ratios #5, #6 and #7, and from subadult male *N. grandis* by ratios #3 and #4; from adult *N. henjamicus* male by ratios #1, #2, #3, #4 and #5; and from adult *N. omanensis* males by ratios #2, #4 and #5, and from females by ratios #6 and #7, as indicated in each species' respective diagnosis.

Specimens examined.–**YEMEN ARAB REPUBLIC**: 15 miles NW Sana, under stones at top of El Kabar Pass between Hugga and Haz (ca. 9,200 ft.), 2 February 1938 (E. B. Britton), adult holotype female and adult paratype female (BM); Huka-Hazz, 1-7 February 1928 (no coll.), one adult female and two imm. females (ZMH); Sana, 1-7 September 1931 (Dr. C. Rathjens), three imm. males and two imm. females (ZMH); Sana (about 7,900 ft.) 8 December 1937 (Dr. Carl Rathjens), one adult male (BM); Wadi Dhahr, 6 miles NW Sana (7,900 ft.), 5 February 1938 (E. B. Britton), one subadult male and one imm. female (BM); Ghaiman nr. Sana (ca. 9000 ft.), 17 February 1938 (E. B. Britton), two imm. males (BM). **PEOPLES DEMOCRATIC REPUBLIC OF YEMEN**: Jebel Harir, October 1937 (E. B. Britton and H. Scott), one imm. male and two imm. females (BM).



Figs. 11-12.–*Nebo yemenensis*, n. sp., holotype female from El Kabar Pass, Yemen Arab Rebuplic: 11, dorsal view; 12, ventral view.

Nebo, undetermined species

The following specimens from Saudi Arabia could not be assigned to a specific taxon due to the lack of adequate samples. The single adult female available is morphometrically closer to *N. hierichonticus* on some ratios, and closer to *N. yemenensis* in others. Additional adult specimens, including males are needed before their status can be determined. Their distribution, however, is important in that it tends to reduce the otherwise apparent geographical discontinuity between *N. hierichonticus* and all the other species (Map 1).

Specimens examined.–SAUDI ARABIA: Buraiman, north of Jiddah, 2 August 1949 (J. Hewitt), one adult female (BM), Qunfidan, 7 January 1945 (L. A. Tillin), one imm. male (BM), Arabie, 1884 (no coll.), one imm. female (MNHN).

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