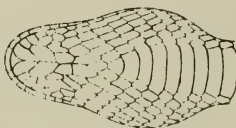
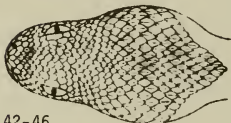




NEW FACTS ON THE TAXONOMY OF SNAKES  
OF THE  
GENUS ECHIS

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Carpet vipers occupy a wide area from the northwestern coast of Africa to the delta of the Ganges and from the Aral Sea to the equator in Kenya. A large number of taxa has been described, but due to the absence of a general treatment it has until now been impossible to correctly evaluate their status (Hughes 1976, Boehme 1978)

In addition to its theoretical interest, the problems of carpet viper taxonomy are also of considerable practical interest. Carpet vipers possess virulent venoms dangerous to human beings (Deoras & Vad 1965-1966, Hughes 1976, and others). From the experience of medical establishments, anti-venom sera appear effective only when treating snake bites of those taxonomic groups from whose venoms a serum has been prepared, otherwise the consequences of the bites are likely fatal. For instance, sera prepared in Africa have no therapeutic effect when applied in Iran and, in Nigeria, mortality of people during treatment with sera manufactured in Teheran or Paris is nearly 20%.

All this compelled me to undertake a comprehensive study of snakes of the genus Echis in order to develop a more natural classification.

In 1801, Schneider described the snake Pseudoboa carinata from Arni near Madras, India (Schneider 1807), now known as Echis carinatus. In 1827, Geoffrey Saint Hilaire distinguished Scytale pyramidium, now called E. c. pyramidium, from the territory of Egypt (Geoffrey Saint Hilaire 1827). In 1878, Gunther described E. arenicola (now E. coloratus) from Arabia (Gunther 1878). In 1949, Constable referred snakes from northern India to E. c. pyramidium (Constable 1949). In 1951, Deraniyagala described E. c. sinhalensis from Ceylon (Deraniyagala 1951). S. A. Chernov noted that vipers from central Asia and Iran are different from the vipers of Egypt but he did not have adequate samples of these snakes from Africa in order to reach definitive conclusions (Chernov 1930). From 1969 onwards, a number of articles devoted to the taxonomy of vipers appeared, Stemmler and Sochurek distinguished E. c. leakeyi from Lake Daringo in Africa \*(Stemmler and Sochurek 1969), while Stemmler described E. c. sochureki from northern India, Pakistan, Iran, Afghanistan and central Asia (Stemmler 1969). In 1970, Mertens described E. c. astoles from the Astole Island in Pakistan (Mertens 1970). In the same year, Stemmler also described E. c. ocellatus from the "northern coast of the Gulf of Guinea" \*(Stemmler 1970). Then in 1972, Roman

\* Cherlin says wrongly Lake Rudolph (now Lake Turkana) - B.H.

\*\* The type is actually from Garange, Upper Volta - B.H.

identified E. c. leucogaster from south of the Sahara (Roman 1972) and, in 1975, he elevated this form to the taxonomic status of E. leucogaster (Roman 1975). Drews and Sacharer described E. c. allaborri from northeastern Kenya (Drews and Sacharer 1974). In 1976, Hughes identified E. ocellatus as a separate species (Hughes 1976). In 1981 the author of this work described E. multisquamatus from central Asia and the adjacent regions of Asia (Cherlin 1981).

#### MATERIAL

The following abbreviations are used [letters A to Q substituted; I and O omitted. B.H.]:

- A Zoological Institute, USSR, Leningrad.
- B Zoological Museum, Moscow State University, Moscow.
- C American Museum of Natural History, New York.
- D British Museum (Nat. Hist.), London.
- E Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn.
- F Naturhistorisches Museum, Vienna.
- G Field Museum of Natural History, Chicago.
- H Museum of Comparative Zoology, Harvard University, Cambridge.
- J Museum National d'Histoire Naturelle, Paris.
- K Zoologisches Museum, Humboldt Universitaet Berlin.
- L Rijksmuseum van Natuurlijke Historie, Leiden
- M National Museum of Natural History, Smithsonian Institution, Washington.
- N Museum d'Histoire Naturelle, Geneva.
- P Museo Civico di Storia Naturall Genova.
- Q Naturhistorisches Museum, Basel.

Disposition of specimens [and number of specimens] from countries as follows:

USSR A56, B25	81
Afghanistan C1, E1, G2	4
Pakistan G47, D2, E1, G3, H3, E7, L1, Q1	75
India A1, C3, D4, E13, G2, H5, J1, K3, L3, M1	36
Sri Lanka A1, N5, Q3	9
Iran A11, E6, G11, M4, N2	34
Arabia G11, H3, K4, Q24, C6, K2, J1	51
Libya A5, G14, J4, L4, M18	45
Algeria D1, N1, P1, Q1	4
Morocco D2, E2, J1, L2	7
Mauretania M1	1
Mali J1	1
Senegal M22	22
Cameroons K3	3
Upper Volta K1	1
Benin M6	6
Togo M2	2
Nigeria D1	1
Sudan C1, D9, G1	11
Ethiopia A4, D13, E4, J3, P2, Q2	28
Kenya C1, H22, J1, K1	25
Somalia A1, D15, G1, H1, K2, P1	21
Djibouti J1	1
Total:	466

We also acquainted ourselves with the E. c. carinatus x E. c. sochureki hybrid (Berlin #18565).

#### RESULT

We studied the variability of the scale arrangements of the head, body, and tail (a total of 15 characters), a number of meristic parameters and indices as well as color patterns of the head and body of vipers throughout the entire range of the genus. This enabled us to identify characters which show almost the same variation in nearly all the groups as well as other characters whose variations appear specific to a complex of taxonomic groups. The latter characters are discussed below. However, before each of them is examined separately, it is important to note that distribution of the genus Echis encompasses three zoogeographical regions, Palearctic, Indo-Malaysian and Ethiopian. Since the distribution of the characters recorded by us appeared related to zoogeographic provenance, we shall henceforth call the vipers found in each of these regions Paleasiatic, Indian and African. Also, it must be noted that none or the currently described taxonomic groupings of vipers occurs in more than one zoogeographical area.

Scale Arrangement on the Throat\* (size and shape of the scales).

Four variants of scale arrangement are recognized by us: the [median] scales of the throat differ neither in size nor shape from other scales on the throat (Fig. 1a); the median scales of the throat are sharply enlarged in size on each side of the midline forming longitudinal rows, [thus] differ from the other scales (Fig. 1b); the scales of the throat are enlarged, but they are not all the same size (Fig. 1c); intermediate variant between "a" and "b" when the posterior scales of the throat are arranged in two equal rows but very weakly enlarged (Fig. 1d).

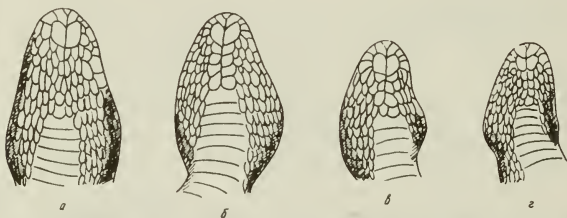


Fig. 1. Various arrangements of the throat scales of carpet vipers (explanation in the text).

Paleoasiatic vipers possess the type "a" scale arrangement on the throat. Of the 235 snakes of this group examined, only three had the type "d" scale arrangements. The throat scales of the African vipers correspond to type "b", rarely "c" and more rarely "d".

Number of the Dorsal Scales Rows at Midbody.

According to the values of this character, vipers are divisible into two large groups: (a) vipers with 30 to 40 midbody scale rows (and not more than 1.5% of the snakes in this group have 28-29 midbody scale rows), the average number of small scales in the taxonomic groups is not less than 31; and (b) vipers with from 24 to 32 body scale rows - the average number in this group is not more than 31.

All the Paleoasiatic vipers belong to group "a" whereas all Indian and African snakes belong to group "b".

\* lower jaw" was used in the original - B.H.

### Markings on the Top of the Head.

Even though the variability of the pattern on the top of the head is very great, depending on the [pattern's] shape and the amount of simplification, it is possible to recognise two large groups: 1) a pattern with one transverse element (like the tip of a spear - Fig. 2a) and its modifications which relate to the reduction of the sides of the pattern and convert the pattern into either a broad cross (Fig. 2b) or a narrow cross (Fig. 2c); 2) a pattern with two transverse elements forms as a result of the reduction of the sides and the middle part of the tip of the spear; sometimes it divides vertically into two (Fig. 2d) sometimes it becomes indiscernible.

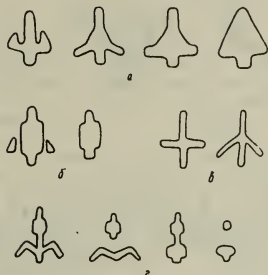


Fig. 2. The pattern on the top of the head. Modifications of the pattern with one transverse element. a - tip of a spear, b - broad cross, c - narrow cross; d - modifications of the pattern with two transverse elements.

Paleoasiatic vipers have the pattern of the first group with modifications mainly towards a narrow cross. Indian vipers also have the pattern of the first group but with modifications mainly towards a broad cross; all African vipers have the pattern of the second group.



Fig. 3. Geographical distribution of species of snakes of the genus *Echis*: 1 - *E. multisquamatus*, 2 - *E. sochureki*, 3. - *E. coloratus*, 4 - *E. carinatus*, 5 - *E. pyramidum*, 6 - *E. ocellatus*, 7 - *E. leucogaster*.

It must be strongly emphasized that the characters recognized above are less variable in comparison to others - for instance, the ventral scale count, pattern on the body, etc. - and that the character complex of each taxonomic group in each zoogeographic region is stable. For example, the Palearctic vipers have the same number of midbody scale rows (more than 31), the same throat scale pattern, and the head pattern is of the tip of a spear or its modifications in the direction of a narrow cross. Sometimes the pattern on the head may be completely reduced (*E. coloratus*).

The Indian and African vipers possess to a different degree enlarged scales on the back of throat and the number of the small midbody scale rows is less than 31; these groups differ in the pattern on the head - the Indian vipers have the pattern of the tip of the spear or its modification in the direction of a broad cross, whereas the African vipers have the pattern with two transverse elements or it may be reduced completely.

The facts stated above make it possible to suggest that the vipers found in different zoogeographical regions differ much more from one another than the vipers within each zoogeographic region differ amongst themselves. This statement in turn has an important implication: since it has been shown beyond doubt that there are independent species among vipers within the same zoogeographic regions, vipers in different regions cannot belong to one species. In this case, the presence of hybrids between vipers from different



zoogeographic groupings (e.g., sochureki x carinatus - Zoologisches Museum der Humboldt Universität, Berlin no. 18565; coloratus x leakeyi, Lehmann 1980) obtained in captivity, cannot contradict this statement since, in the first place, in view of the great polymorphism of vipers, hybrid analysis is relevant only with regard to vipers from an area of sympatry; secondly, a certain number of hybrids of reptiles of different species is generally known; and thirdly only single hybrids of the first generation have been obtained to the present time. Therefore, the species E. carinatus which has until now been considered to consist of a number of subspecies is, in fact, a complex of species. Neither Paleoasiatic nor African groups can be considered as subspecies and must, therefore, be identified as independent species.

Therefore, we recommend the following taxonomy of snakes of the genus Echis: Paleoasiatic species - E. multisquamatus, E. s. sochureki, E. s. astolae, E. c. coloratus; Indian species - E. c. carinatus, E. c. sinhaleus; African species - E. p. pyramidum, E. p. leakeyi, E. p. aliaborri, E. ocellatus, E. leucogaster.

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