LES ATLAS

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A NOTE ON DISTRIBUTION OF ARABIC VERBAL ROOTS

As is well known most Arabic roots are composed of three consonants C_1-C_2-C_3 which appear in certain combinations with vowels, semi-vowels and some consonants, constituting verbal stem-patterns. The same root may often form more than one stem, e. g. the root *ḳ-t-l* with general meaning „to kill" forms several stems as e. g.: I. *ḳatala* „to kill, to assassinate" (literally „he has killed", as the stem alone functionates as the 3 pers. sg. perf.); III. *ḳātala* „to fight somebody"; VIII. *iḳtatala* „to fight one another".

As the above example shows stem-patterns modify the general meaning of the root. In fact, each of more than ten patterns actually used in Arabic has certain modifying quality or „a meaning in itself", which when combined with the meaning of the root renders a verb belonging to a certain group of words, characterized by some general specific features: reflexivity, causativity, intensification, and so on. It seems superfluous to give here the full list of stem-patterns and to describe their respective modifying qualities, as they are listed in every Arabic grammar. The interesting point is that these patterns allow us to divide the Arabic verbal roots into classes, according to their ability to form 1, 2,..., *n* stems. In this classification the number of stems only is considered, thus e. g. the roots forming stems according to the I and IV pattern belong to the same class as those having stem-patterns II and V.

The number of stem-patterns characterizing a given class can be viewed — though in a somewhat vague manner — as a measure of „size" of concepts underlying the meaning of the roots, constituting the elements of this class. One can feel intuiti-

vely that a concept expressed by a one-stem verb only is in a sense „narrower", „smaller" than the one, that can be modified in several ways by various stem-patterns. One could try to construct a more rigorous model, e. g. regarding the roots as points in a multi-dimensional space and identifying the stem-patterns with the coordinates of this space, but this would go beyond the scope of the present note, dealing with some empirical data only. It was sufficient for our investigation to borrow two notions proposed by G. Herdan in his *Type-Token Mathematics*, p. 210 ff, viz. „size" and „content" of concepts and his assumption of their inverse relation. According to his theory of „pigeon-holing" of semantic information the concepts of greater „size" and smaller „content" should be smaller in number than those with smaller „size"; that means in our case that the number of Arabic tri-literal verbal roots in s-stem-classes ($s = 1, 2, \ldots, n$) should be inversely proportional to s.

In order to verify this hypothesis all tri-literal verbal roots in H. K. Baranov's *Arabsko-russkij slovar*, 2-nd ed., Moskva 1958, have been counted and divided into classes. It was found that the relation between s i. e. the number of stem-patterns characterizing the given class, and r_s i. e. the number of roots in this class is not only inversely proportional, but also functional and that it can be described with good approximation by an equation of second degree:

$$r_s = N(As^2 + Bs + C); \quad (s = 1, 2, \ldots n); \qquad (1)$$

wherein N is the sum of all roots and A, B and C are specific constants.

The empiric data for the Baranov's Dictionary are as follows:

$$N = 3209;\ A = 0{,}004419;\ B = -0{,}08200;\ C = 0{,}3812\ ^{1}.$$

Table I lists the observed and the hypothetical values of r_s, obtained from (1). Except for the last value the fit is rather good, as it renders a chi-square value not exceeding 0,3 significance level.

[1] Numerical values of the constants have been computed by Dr. J. Kordylewski of the Computer Laboratory of the Mining Academy in Kraków, for whose assistance I am much indebted.

TABLE I

s	1	2	3	4	5	6	7	8	9
r_s — observed	988	714	586	411	254	154	74	18	10
r'_s — hypothetical	974	754	561	398	262	155	76	26	4
r_s in %	30,78	22,25	18,27	12,81	7,92	4,80	2,30	0,56	0,31

It could be argued that the distribution of roots in some particular dictionary depends so much on the materials at its author's disposal and the extent of his knowledge of language that this particular given distribution is due to chance only; moreover it can be actually shown that there exist differences between various Arabic dictionaries. In order to estimate those possible differences and to verify the general validity of the discussed distribution two samples covering the same entry-letters (from ă to ḫ) have been taken from two different dictionaries (Baranov's Dictionary and H. Wehr *Arabisches Wörterbuch für die Schriftsprache der Gegenwart*, Leipzig 1952) and compared with each other in respect to the percentages for r_s in Baranov's Dictionary (the third row of Table I). The results are listed in Table II.

TABLE II

s	1	2	3	4	5	6	7	8	9	N
Baranov	213	163	131	99	55	25	18	3	1	708
Wehr	229	163	117	95	50	26	13	3	1	697

These two sample distributions show a striking similarity with each other and their chi-square values in respect to the over-all distribution are nearly identical (6,72 and 7,39 respectively).

This is a strong argument in favour of the assumption of general validity of the discussed distribution of the Arabic verbal roots. The regularity of their distribution in the vocabulary is probably a manifestation of a more general law governing the domain of semantic information. It seems that the above regularity could be connected with the so-called Willis' Law (see Herdan, *l. c.* and B. Mandelbrot „On the Language of Taxonomy" in *Information Theory*, ed. C. Cherry, London 1956), but this problem would require a separate study.

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INTERPRETATION OF NATURE IN THE ART OF ANCIENT MESOPOTAMIA

Definition of Terms

a) The interpretation of nature in art is conceived here to consist in the following: which natural phenomena are seen by the artists and in which way the observed phenomena are rendered, which forms are given to them, in which way they are grouped in scenes, etc., i. e. in which way are modified the things seen. The understanding of this process permits to establish the role of imagination. Other questions should also be considered: the respective roles of visual data and of their memory, and the treatment of space (perspective).

b) It is therefore attempted in this paper to confront two series of phenomena, artistical and natural. The following groups of natural phenomena will be distinguished: man; animals; plants; atmosphere; waters of land and sea; land itself; sky and celestial bodies; distance and surface; and the following groups of artistical phenomena: statues, reliefs, seals, and paintings mainly ceramical.

c) The Ancient Mesopotamia (Fig. 1) is conceived to be formed of three regions, Lower Mesopotamia, Upper Mesopotamia (Assyria), and to the West, Syro-Mesopotamia; to these should be joined during some periods the Elam or Susiana; and to exist from the prehistoric times till the end of the Assyrian state.

Mode of Establishing the Relation of Art to Nature

It follows from the above that it is necessary to understand very exactly the criteria on which the relation of art to nature may be established. Two questions should be answered. The first