

***Indo-European Numerals.* (Trends in Linguistics. Studies and Monographs, 57). Edited by Jadranka Gvozdanović. Berlin & New York: Mouton de Gruyter, 1992. x+943 pages. Published in *Historia Mathematica* 20 (1993), 99–103.**

This book does not deal with mathematical thinking or its history, nor, if one wants to make such distinctions, with ethnomathematics. Its topic is, strictly, the number words of the Indo-European languages, their etymologies and affiliation, and grammatical features like inflection in case and gender.

Yet, what is told in the book concerning the form and development of numerals in mathematically "innocent" cultures—i.e., cultures where most speakers use number words in speech and for counting but not for discussing accounts nor for giving phone numbers, nor in institutional arithmetic instruction—may still contribute significantly though mostly indirectly to our understanding of the pre-mathematical practice and "psychology" of numbers.

15 chapters of the book present the numerals of single language groups: Anatolian (Hittite, Luwo-Lycian, etc.); Tocharian; Old Indian (Vedic, Classical Sanskrit); Middle Indo-Aryan (Pali, Prakrit, and many other dialects); Modern Indo-Aryan; Iranian; Armenian; Thraco-Phrygian (no claim being made that these belong to one group; from each, by the way, only one numeral is known); Greek (centered on Attic and Mycenaean); Italic (mostly Latin); Romance; Celtic; Germanic; Balto-Slavonic (again, no claim is implied that Baltic and Slavonic languages belong to a common group); and Albanian. In the case of still living groups, historical languages as well as the many actual (thus not only the official national) languages constitute the subject. In as far as the sources permit, cardinal, ordinals, collectives, distributives, and multiplicatives are discussed, often even fractions and composite words containing or derived from fractions.

Each of these chapters is written by a specialist, and the presentation is highly technical—mostly so technical that the details can only be appreciated and evaluated by other specialists in the same area possessing, furthermore, a thorough training in comparative Indo-European studies.

Most of these chapters were originally written around 1970, when the volume was first planned. They have been revised recently (mostly by the authors, but Jan Berns has updated the chapter on Germanic languages initially written by the late Alan S. C. Ross); the original chapters on Greek and Albanian, however, have been replaced.

These 15 particular studies are preceded by two of more general scope. The editor, in her "Remarks on numeral systems", discusses the construction of these (within a framework inspired by generative grammar and by certain recent works of Noam Chomsky) as situated "in the intersection of the human language faculty and the number faculty". The outcome is interesting, since the hierarchical recursive structure made

from "building blocks" (e.g., "ten", "hundred") and "numeral elements" ("one", etc.), in as far as it is indeed universal (actual languages are not always as clear-cut as the diagrams but can mostly be explained by reference to them), suggests that principles of many written numerals and metrologies like "bundling" and multiplicative writing (ultimately stenographed into place value systems) are also rooted in a general human "number faculty". Werner Winter, in "Some thoughts about Indo-European numerals, demonstrates from living and well-documented historical languages that "there is considerable leeway for the construction of complex numerical terms provided the building blocks used remain recognizable [...] and the operations used in combining the elements of a complex entity are apt to be discovered by the language user" (p.26). Trying to reconstruct a single Proto-Indo-European system of higher numerals is thus likely to be an endeavour doomed to failure; on the other hand, as pointed out, the contradictory outcome of such attempts which have been made do not demonstrate that the speakers of the dialects from which the Indo-European languages radiated were not able to tell numbers above (say) 80.

One phenomenon with general implications is change caused by "analogy", which has affected the development of numerals in most or all languages. Such change is not restricted to numerals, but in other cases features of one word are transferred to another because of semantic affinity or analogous function; numbers, on their part, often anticipate features from *the following* by rhyme or alliteration (cf. p. 294)—e.g., Slavonic (represented by Russian) *dévjat'* (9) imitating *désjat'* (10). The obvious conclusion is that numbers (mostly of course cardinals) are mainly used in "mathematically innocent" cultures *for counting*, and less often for telling a single number (of items, of years, etc.).

Even though the question of common descent versus parallel development is not easily solved it may also be of broader interest that constructions of the type "*n* parts" meaning $n/n+1$ are widespread; the book mentions the usage in Old Indian, Middle Indo-Aryan, Modern Persian ($n=2$), Greek ($n=2$), Lower Sorbian.

Paradoxically, even the unique structure of the Modern Indo-Aryan numeral system deserves the attention of readers of this journal, being not only atypical but defying indeed common-sense notions as to what is at all possible in the practice of numbers. Apart from a few languages (Gypsy, Sinhalese) which have been isolated from the quasi-continuum of related dialects, all numerals below 100 have developed forms which (like English "eleven" and "twelve"), can no longer be analyzed by speakers into constituent elements. Even a number of proper and improper fractions ($1/2$, $1^1/2$, $2^1/2$, $1/3$, $1/4$, $3/4$, $1^1/4$) have developed names which, "according to present-day etymological consciousness, shows no connection either with the cardinals or with the ordinals" (p. 279).

There may be observations of general interest to be made from the changing syntactical function of numerals: some are adjectives inflected in gender and case (1 to 4 in Proto-Indo-European), others have no gender inflection or no inflection at all;

some languages treat certain numbers (in particular the "building blocks") or even most of them as nouns, taking the items counted in the genitive plural. These syntactical choices may carry implications about the semantics of numbers, and there may be a tendency toward the use of non-inflected adjectives when literacy and written numeracy develop; but the pattern is not unambiguous to the reviewer.

Since some knowledge about numerals (not least Indo-European numerals) belongs to the folklore of the history of mathematics, it may be useful to update some of our received notions in this domain by means of the information provided by the single chapters.

According to our traditional lore, two sub-families developed each its own term for 100 ("satem" and "centum" with their cognates, respectively) after a first split in the Indo-European language family, the implication being that unified Proto-Indo-European did not count thus far[1]. According to the present analyses (which do not innovate on this account), both forms go back to a term designating "ten decades". Only an Armenian novelty is thus an exception to the rule that the term for *hundred* is common-Indo-European, together precisely with Germanic "hundred"/"Hundert", etc. These words containing an *r* rather appear to derive from an expression designating a "count of decades" (p. 620; forms without the *r*, like Gothic, Old Saxon and Old English "hund" and Old High German "hunt", however, derive from the common root).

This differentiation may provide at least part of the solution to a problem which is not even mentioned in the chapter on Germanic languages: that early "hundred" (but not the *r*-less term) meant, or at least mostly meant, 120 (only B. Comrie, in the chapter on Balto-Slavonic languages, at all mentions the Germanic "Großhundert").

This phenomenon has been interpreted in various ways—even an underlying sexagesimal system has been posited (e.g., [Anderson 1982, 140 n. 14]. Mostly a counting by twelves is inferred, with the consequence that, e.g., "eighty" has been interpreted as 96.

The material presented by Ross and Berns (pp. 619f) instead suggests that a standard "count" goes until 12 [in case, 12 decades], leaving "eighty", "ninety", "tenty", "eleventy" and "twelvety" (all existing) with respective values 80, 90, 100, 110 and 120. This interpretation matches the development which took place in Icelandic after Christianization, where (according to *Icelandic-English Dictionary*, articles "Hundrað" and "Tólf") a "traditional" hundred (12·10) could be specified as "tolfrætt hundrað" (alternatively as "tólf-tigr" or "twelvety" hundred), while the "modern" value (10·10) was specified as "tírætt hundrað". The former epithet, indeed, would mean a "twelve-count" hundred, the latter a count of decades going only to ten.[2]

Certain Indo-European languages make use of (hybrid) vigesimal systems. Most frequently, French ($71=3\cdot 20+11$) and Danish ($71=(4^{-1}/_2)\cdot 20+1$) are cited, the French example often being explained by a Celtic substrate.

Actually, hybrid vigesimal counting is much more widespread; yet, even though

most of the Romance instances (French as well as Sicilian and Southern mainland Italian) can at a pinch be imagined to be due to Norman adstrate influence (a Celtic substrate is ruled out, since Celtic vigesimal counting is a late phenomenon), most vigesimal systems appear to have developed independently, perhaps on the basis of trade counting items in scores, perhaps because numerals until 20 are often less analyzable into constituents than the following (p. 467, G. Price mentions a Catalan example of spontaneous development among young people, who are only forced by the mockery of elders to conform to the standard decadic system).

Curiously, Ross and Berns in their chapter on Germanic languages know of no other instance of Germanic vigesimal counting than old (and subsequent) Danish. Comrie, when treating of the occurrence in certain West Slavonic languages (Slovenian, Slovincian and, less outspokenly, other Pomeranian languages; p. 780f), refers to a borrowing from a Low Germanic vigesimal system suggested by F. Hinze (probably because a cognate of the Pomeranian 20 occurs in Low German and Frisian as "Stiege" in the sense of "score" though not as a component of genuine numerals; the etymology is unknown and might as well be Slavonic as Germanic). Combination of the two discussions suggests the alternative possibility that Old Danish, in intimate contact with Wendish populations at least since the early ninth century (the first Danish commercial town Haithabú being created at that moment by forced settlement of Wendish merchants), may indeed have been the recipient.

Other readers might find other material for further thought. For this purpose, the organization of the book is laudable: even though the single authors have been given the freedom to arrange their text in agreement with the requirements of their particular subject-matter, all chapters are systematized in a way that makes it easy to retrieve a particular piece of information when, after the reading of another five chapters, it turns out to be important.

Misprints of the kind that can be discovered by the non-linguist are rare to acceptably rare, except in the chapter on Germanic languages.

BIBLIOGRAPHY

Anderson, George K. (ed.), 1982. *The Saga of the Völsungs*. Newark: University of Delaware Press.

Icelandic-English Dictionary. Initiated by Richard Cleasby, revised, enlarged and completed by Gudbrand Vigfusson (1874). Second Edition by William A. Craigie. Oxford: The Clarendon Press, 1957.

Menninger, Karl, 1957. *Zahlwort und Ziffer. Eine Kulturgeschichte der Zahl*. I. *Zählreihe und Zahlsprache*. II. *Zahlschrift und Rechnen*. 2. neubearbeitete und erweiterte Auflage. Göttingen: Vandenhoeck & Ruprecht.

Vogel, Kurt, 1958. *Vorgriechische Mathematik*. I. *Vorgeschichte und Ägypten*. (Mathematische Studienhefte, 1). Hannover: Hermann Schroedel / Paderborn: Ferdinand Schöningh.

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NOTES

1. Thus, e.g., [Vogel 1958, 8]. Menninger [1957, I, 111], however, points out the common etymology of the two words.

2. Even "átræðr", "an "eight-count", would thus mean 8·10 precisely like "átta-tigir", "eight-ty". Similarly concerning "níræðr" and "tíræðr", "counts" of nine and ten, respectively.

Comrie mentions the Germanic *Großhundert* in connection with a term "devjanósto" ("a nonal hundred") for 90 found in Russian and other East Slavonic languages and possibly, in view of the etymology of "sto" ("hundred") also to be understood as a nonal "count" of decades.