# ARITHMETICAL MORPHOLOGY

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Several recent **Word Ways** articles have used the word **mathematics** in studies of the morphology of words. Mathematics is a word, but the study of the numbers and disposition of letters in words doesn't merit the label mathematics. Counting and segregating words, and letters in them, seems only to require the use of arithmetic. Such operations merely provide numerical information on their frequencies of occurrence in the examined corpus. Certain counts of this nature - the word **statistics** is not used here for such figures, to avoid confusion with the mathematical study of quantitative data - are of practical use, for example, in determining quantities of typeface required by a printer. And a useful gematrical coding of words according to their alphabetic nature enables words of similar pattern to be found very easily. But this does not demand mathematical attention, even though it might yield information to suggest that, from many millions of possible permutations of 10 from 26 letters, only a minute percentage of them produced ten-letter words. Arithmetic is quite adequate for such calculations.

Word structure and mathematical analysis are not compatible subjects. Words and their components can be counted and the resulting numbers may be processed arithmetically. Numbers are part of a formal axiomatic arithmetic but there is no formal ordering of word structure. Words are formed in a highly capricious manner, being based mainly on longstanding traditions. Even a dictionary has to rely on gematria to place its words in an arbitrarily-chosen order, which is generally committed to memory. As an example of the difference between the axiomatic numbering system and letter-order, most people can easily count backwards from any number but find difficulty in reciting the alphabet backwards. Consider the impossibility of remembering the reverse order of even the set of three-letter words. Those who may say that this would be an easy task for a computer should consider the fact that the set of numbers is complete; there are no gaps in its order pattern. A list of 3 (or any other digit) numbers would, if required, be a doddle to make or memorise in both directions. Another feature of numbers, which is not generally acceptable with words, is the ability to insert a digit between any two existing ones and still retain validity as a number. Few words result from the random insertion of an extra letter.

**Word Ways** readers are naturally conversant with the English language and may be considering how its words shape up to some of the above statements. Many languages also employ the same

Latin (Roman) alphabet but the morphology of words in the different languages has many dissimilarities, particularly concerning the disposition of vowels and consonants in words, syllables and letters. English has possibly a larger number of variations in this respect than any other single language, owing to its great number of words adopted from other tongues. For this reason, there are more patterns of word structure in the English language than in others.

Successful mathematical analysis, leading to an expression of a general useful relationship between variables, can only be based on data which satisfies some such relationship. If the variables are not amenable to obeying some, currently unknown, formula, because the data is so unpredictable, then no amount of wrangling will achieve such a relationship. Again comparing letters with digits, a position in a number can only be taken by a digit from 0 to 9. A position in a word is a potential placement for any one of 26 letters. Admittedly, this is an extreme situation but, as an example, a study of 54,000 ten-letter words showed that, of the 676 theoretical leading bigrams, there occurred 281. This represents an average of virtually 17 letters for each of the first and second positions.

Whereas a system of numeration is readily understood, or can be easily determined by others, a language is species-specific. Vocal communication by speech is acquired as a natural childhood ability within a community but a different language generally has to be learned. A particular language may be sounded differently by some members of the native community but all its members will be able to understand one another relatively easily. Mathematics is, however, a universally understood branch of knowledge; values such as pi, i and e are immutable and, together with mathematical processes, will be understood, not only here on earth, but by extraterrestrial beings. In essence, a language is developed by its speakers, while mathematics is there to be discovered and will be the same for all. Mathematics has been found to explain the workings of the universe, in both Pure and Applied analysis. It is suited to scientific subjects such as heat, light, sound, electricity and magnetism as well as engineering calculations. The stresses to which a tree is subject by the pressure of wind may be calculated according to formulae applied by engineers to structures created by man, the point being that the identical patterns of stress occurred in trees long before man discovered the mathematical relationships between the internal stresses and externally applied forces. This is in direct contradiction to the title "Mathematics, The Man-made Universe", of a book by Sherman K. Stein.

Words, however, are man-made. The capricious nature of the English language, with its notorious diversities in spelling and pronunciation, is a human achievement which defies all logical comprehension. This is one of its main attractions to puzzlists, though it does make one wonder why English is chosen to be **the** universal language. It certainly is illogical - and incapable of yielding to mathematical analysis!