DISCUSSION

LARGE NUMBERS USED BEFORE THE CHRISTIAN ERA

FOREIGN missionaries and others have frequently called attention to the very limited number developments among some of the uncivilized tribes of recent times. In many cases it has been reported that such tribes could not count as far as ten, and that members thereof frequently referred to even very small numbers by means of such general terms as many or infinite. As people advance in civilization they naturally use the latter of these terms for larger and larger numbers. Hence it may be of interest to note here a few instances where very large numbers were used before the Christian era, especially since some statements in recent American histories of mathematics convey decidedly incorrect impressions along this line.

Even in our day we meet with expressions which imply that the grains of sand on the seashore can not be numbered. It is therefore of interest to recall that Archimedes, who is commonly regarded as the greatest mathematician of antiquity, wrote a work called "The Sand-reckoner" in which he developed a system of numeration which is not only amply extensive to provide different numbers for every pair of grains of sand on earth, but which provides such a vast number of numbers that those required for the enumeration of these grains of sand is a comparatively insignificant part of the available total. The multitude represented by "the sand of the sea" is therefore insignificant in comparison with the multitude of numbers described in a work of Archimedes written more than two centuries before the beginning of the Christian era.

It may be of interest to observe that each of the two Greek mathematicians who are commonly regarded as most eminent in the remarkable period of early mathematical development has associated with his name an extensive system of numeration. The second of these is Apollonius who was a contemporary of Archimedes and used 10^4 as the base of a system of numeration while Archimedes used 10^8 for this purpose. These arithmetic developments are the more worthy of note here in view of the fact that the Greeks are especially noted for their contributions towards the development of geometry. Their contributions towards the development of arithmetic and algebra have perhaps received too little attention in the past as a result of undue credit to the Hindus and Chinese who have made many claims for discoveries which have proved to be unreliable.

In the favorably known "Vorlesungen über Geschichte der Mathematik" by M. Cantor the statement appears that it is probable that the cuneiform notation for numbers used by the Babylonians did not extend as far as one million—at least no such large numbers had then been found. A similar statement has naturally been introduced into many other works on the history of mathematics. Much larger numbers have, however, been found later in this notation, and it is very interesting to note that these extend to $60^8 + 10.60^7$, and thus suggest a connection between this system and that of Archimedes based upon 10^8. At any rate, we have here an instance of the use of a very large number by the ancient Babylonians even if it is much smaller than those used later by the ancient Greeks. In fact, the ancient Hindus and Chinese are also said to have developed a system of enumeration based on as large a number as 10^{53}, but many of the dates relating to early mathematical developments in these countries seem to be uncertain.

The main object of the present note is to direct attention to the early efforts to exhibit linear order in this world by means of large numbers and thus to extend the field to which the considerations relating to finite multitudes apply. The use of large numbers represents an intellectual emancipation from the narrow channels of experience, for if all the human beings that have ever lived on this earth had assisted each other in counting consecutive numbers, each one confining himself to the numbers not counted by any of the others, they would not yet have reached the enormous totality which the system of Archimedes made available. While the contemplation of systems of numeration relating to large numbers is inspiring it has not been as rich in fruition as regards the later development of number theory as some other very early theoretic considerations relating to numbers, for instance, the contemplation of what are known as Pythagorean triads, which seem to have attracted attention at least as early as 4000 B. C.

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SOYBEAN CHEESE

IT is probable that the Chinese are the best empirical dieticians in the world. In the course of their thousands of years of civilization the Chinese have accumulated an amazing knowledge of the preparation of foods. This knowledge they have handed down from generation to generation with the greatest fidelity, in recorded and printed form in their cyclopedias and in actual practice from master to apprentice.

The interpretation of these dietary practices in terms of modern science is now under way, with the prospect that the Chinese people themselves will learn how to carry out their established dietary