park travel year ends on September 30 of each year. This year the number of visitors to the national parks totaled 2,818,618 as against 2,680,597 in 1929, an increase of 138,021. Yosemite National Park led in numbers, with 458,566 visitors. Mount Rainier was second, with 265,620. The national monuments as a whole suffered a loss, with 466,075 visitors as against 567,667 in 1929. A large part of this decrease, however, was the result of the abolishment last April of the Papago Saguaro National Monument, which last year reported 87,600 visitors. During the first six months of this year, the period of heaviest travel in the southwest, approximately 50,000 people visited this monument. The Petrified Forest National Monument in Arizona, with 105,433 visitors, led both in numbers and in point of increase. The 1929 visitors to this monument numbered 69,350. Director Albright was enthusiastic over the development possibilities of the area. Despite the reduction in the number of visitors to the monuments, the combined park and monument travel for 1930 is greater than that for any previous year with the exception of 1929.

THE council of the British Association have asked the government to give effect to the recommendations of the Royal Commission on National Museums and Galleries for the establishment of a National Open-Air Folk Museum. It is suggested that the Royal Botanic Gardens in Regent's Park could be utilized.

THE London *Times* reports that an expedition from the University of Cambridge is sailing for Mombasa early in December to carry out biological investigations of certain little-known lakes in East Africa. The particular objectives will be Lake Rudolf, Lake Baringo and Lake Edward. Several expeditions have been made to the better-known lakes, and in 1927 government surveys of the Victoria and Albert Nyanzas were made to investigate the economic value of native fishes. Lakes Rudolf, Baringo and Edward have never been scientifically examined, and it is expected that the expedition will bring home a large number of new forms of life, as well as information about the inter-relationships of the fauna and flora, about the chemistry and physiography of the lakes, and perhaps a solution of the interesting problem of the absence of crocodiles from Lake Edward. Another side of the work will be the extension of Mr. L. S. B. Leakey's recent Kenya archeological explorations northwards in the Great Rift Valley; it is hoped to find further archeological remains round Lakes Baringo and Rudolf. The expedition is being financed by the Royal Society, the Natural History Museum, the Royal Geographical Society, the British Association and other scientific bodies. It will be under the leadership of Dr. E. B. Worthington and other members from Cambridge will be Mr. L. C. Beadle as zoologist and Mr. V. E. Fuchs as geologist and surveyor.

DISCUSSION

BABYLONIAN MATHEMATICS

ALL the earlier accounts relating to the historical development of the quadratic equation have become antiquated during the last two years as a result of recent discoveries relating to the mathematical attainments of the Babylonians during a period of at least 1,500 years beginning about 2000 B. C. It is especially interesting to observe that this period overlaps that of the early Greek mathematical activity and hence it establishes a continuity in algebraic developments which had not been known to exist hitherto. According to a recent number of the *Quellen und Studien zur Geschichte der Mathematik,* a new publication to which Professor R. C. Archibald called attention in this journal,[1] we now know at least 19 Babylonian problems which give rise to quadratic equations, and with respect to 10 of these the details of the solutions are given. In some cases the method used corresponds to the modern method of completing the square and differs only from our modern procedure by omitting the double sign when the square root is extracted.

The Babylonian mathematics is of special interest in view of the fact that our division of the circle into 360 parts called degrees, and our division of the degree and the hour into 60 parts called minutes and of the minute into 60 parts called seconds can be traced back thereto. It has often been stated that the Babylonians employed a sexagesimal system of numerical notation. As a matter of fact this is not strictly true since they did not employ 59 different symbols for the first 59 natural numbers; neither did they employ a sexagesimal symbol corresponding to our decimal point to mark the starting-point of their integral numbers and their systematic fractions represented by multiples of negative powers of 60. A fully developed sexagesimal system of numerical notation has never been commonly used as far as we know. The early Babylonians do not seem to have possessed even an emptiness zero, but a symbol which was also used as a symbol of separation was employed later by them for this purpose.

[1] SCIENCE, 70: 67, 1929.

Since the Babylonians commonly employed only two distinct symbols to represent the first 59 natural numbers, *viz.*, a symbol for unity and a symbol for ten, their system of numerical notation can be more properly called a decimal system than a sexagesimal system. There is, however, a very striking difference between their system of notation and the systems employed by the other early nations, since their symbol for unity was used also to represent various positive and negative powers of 60, depending upon the relative positions, which are, however, frequently not clearly exhibited in their notations. Hence we meet here for the first time in the history of mathematics an approach to our modern positional notation where the same symbol is used to represent an infinite number of different numbers depending upon its position relative to the decimal point, either implied or expressed. When multiples of negative powers of the base are used to represent fractions, a symbol of separation, corresponding to our decimal point, is almost as important as an emptiness zero symbol, but the former has received much less attention on the part of mathematical historians than the latter.

In the periodical noted above Professor O. Neugebauer, of Göttingen, Germany, stresses the fact that the ancient Babylonians did not have a fully developed positional system of numerical notation but that it is likely that our modern system to the base 10 was influenced by their steps in this direction. In view of the fact that they made such important progress towards the solution of the general quadratic equation one might have expected that they would have easily mastered the simpler problem of completing their positional arithmetic by means of a symbol corresponding to our decimal point and by a much earlier and more common use of a symbol for an emptiness zero. The great importance of these apparently easy forward steps may be seen if it is noted that the translation of the numerical notations now frequently presents the greatest difficulties to the students of the ancient Babylonian literature. Just where one might have expected the greatest clearness one finds the greatest vagueness.

We are thus brought face to face with the fundamental fact of the history of mathematics—that unexpectedly advanced results are frequently found side by side with very crude ancient developments. It is therefore often very difficult for the mathematical historian to convey a correct picture of the actual attainments at a certain period of time. Naturally the most advanced developments are usually first considered and hence the beginner is apt to think too highly of the attainments of the ancient civilizations. The solutions of the quadratic equations to which we referred above are, however, also of great interest since they tend to exhibit the naturalness of this equation in our efforts to secure an intellectual penetration into our surroundings and hence they tend to dignify this equation as an intellectual tool. They also tend to emphasize the fact that mathematical history is a subject that must be frequently revised in order to be up to date even as regards very elementary results.

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A FOSSIL FROG, INDOBATRACHUS NOBLE, FROM THE EOCENE OF SOUTH-WESTERN INDIA

A FEW months ago G. K. Noble[1] reported upon his study of a number of specimens of a fossil anuran which, from the geographical locality and geological horizon as well as general resemblance to the descriptions, seems to be what was first named *Rana pusilla,*[2] later called *Oxyglossus* by Stoliczka,[3] now *Oxydozyga.*[4] Noble regards the form as an "archaic bufonid" closely related to the "archaic bufonids" found to-day in Australia. Noble writes, "The discovery of a toothed bufonid in the Eocene of India lends support to the theory of a northern origin for the Australian frog fauna."

Noble's "toothed bufonids" now living in Australia are regarded as Leptodactylids by other herpetologists. These apparently arose in South America from true bufonids. The family Bufonidae may, for convenience, be divided into two divisions, the first including archaic forms of pre-Cretaceous or early Cretaceous origin in southern lands and belonging to genera other than *Bufo;* the second division including only the comparatively modern genus *Bufo,* which probably evolved in southeastern Asia in the Cretaceous period. The genera of the first division occur to-day in Australia, in northern South America, in Java and Borneo, Ceylon, southern India and in tropical Africa. From ancient bufonids evolved apparently: (1) *Bufo,* in southeastern Asia—*Aelurophryne* seems an intermediate form from this general locality. *Bufo* has spread to all parts of the world accessible since, say, the middle Cretaceous; (2) the Hylidae arising apparently in the Guiana-Brazil highlands after they united with the Ecuadorean island; (3) the Lepto-

[1] G. K. Noble, "The Fossil Frogs of the Intertrappean Bed of Bombay, India," *Am. Mus. Novitates,* No. 401, February 8, 1930.

[2] Owen, "On the Batracholites Indicative of a Small Species of Frog (*Rana pusilla,* Owen)," *Quart. Journ. Geol. Soc., London,* III, 1847.

[3] Stoliczka, "Osteological Notes on *Oxyglossus pusillus* (*Rana pusilla,* Owen) from the Tertiary Frog-beds in the Island of Bombay," *Mem. Geol. Survey India,* VI, 1869.

[4] "Kuhl," quoted by Tschudi in synonomy of *Oxyglossus, Mem. Soc. Sci. Nat. Neuchatel,* II: 85, 1838.