Definitions:

Genotype, the fundamental hereditary constitution or combination of genes of an organism.

Biotype, a group of individuals possessing the same genotype.

Pure line, a group of individuals traceable through solely self-fertilized lines to a single homozygous ancestor.

Clone, a group of individuals of like genotypic constitution, traceable through asexual reproductions to a single ancestral zygote, or else perpetually asexual.

GEO. H. SHULL

HISTORY OF MATHEMATICS IN THE RECENT EDITION OF THE ENCYCLOPÆDIA BRITANNICA

THE new edition of the Encyclopædia Britannica contains numerous articles which purport to deal with the history of various branches of mathematics. None of these have been written by specialists in this field and the articles bear abundant evidence of this fact. The history of mathematics may well ask of the editors of such an encyclopedia the same care in the selection of writers on these topics as that exercised in the selection of writers in other fields, ably represented in general in the Britannica by the leading scholars of the world.

In a recent issue of SCIENCE (December 1, 1911) Professor G. A. Miller has called attention to certain inaccuracies and errors, especially with reference to the theory of numbers and of groups. It seems to me unfortunate, in view of the general worthlessness of the historical passages, that Professor Miller has incidentally chosen for criticism one of the few correct statements. The passage in question occurs on page 867 in volume XIX., in the article on "Numerals" in which the writer states that our present decimal system is of Indian origin. Attention is rightly called by Professor Miller to the fact that the zero appeared in Babylon long before it appeared in India, although the writer on "Numerals" seems to be unaware of this. However, the date is not 1700 B.C., as Professor Miller states, but more than a thousand years later. Photographic reproduction of Babylonian tablets containing the zero appear in F. X. Kugler's "Die babylonische Mond-rechnung," Freiburg i. Br., 1900, and these tablets date from the centuries just before the Christian era. Furthermore, no historian of mathematics has made the claim that modern arithmetic is derived from the Babylonian arithmetic, as Professor Miller implies, but there is general agreement that our arithmetic comes to us from the Hindus through the Arabic writer (c. 825 A.D.) Mohammed ben Musa Al-Khowarizmi. This subject is fully discussed in "The Hindu-Arabic Numerals," Smith and Karpinski, Boston, 1911.

The article on "The History of Mathematics," Vol. XVII., pp. 882–883, is too brief to invite comment. The incorrect statement is made: "The medieval Arabians invented our system of numeration." Reference is given only to the works of Cantor ("1st Bd.," "2d Bd." and "3d Bd."!) and to W. W. R. Ball's "A Short History of Mathematics," London, 1888, and subsequent editions. The latter work is in no sense an authority on the subject.

The articles on "Algebra, History," Vol. I., pp. 616–620, and "Geometry, History," Vol. XI., pp. 675–677, contain so many inaccuracies and so much misinformation that selection becomes difficult. I will devote myself more particularly to the longer article on the history of algebra.

Some ridiculous statements made by Peter Ramus in his algebra of 1560 are quoted. Thus Ramus says: "There was a certain learned mathematician who sent his algebra, written in the Syriac language, to Alexander the Great, and he named it *almucabala,* that is, the book of dark or mysterious things, which others would rather call the doctrine of algebra . . . and by the Indians . . . it is called *aljabra* and *alboret.*" This nonsense, evident on its face, as *almucabala* and *aljabra* are Arabic words, is taken somewhat seriously by this writer in the Britannica. "The uncertain authority," he says, "of these statements, and the plausibility of the preceding explanation, have caused philologists to accept the derivation from *al* and *jabara*." The "preceding explanation," to which reference is made, is the correct one, viz., *algebra* from the first part of the title of Mohammed ben Musa's work on the subject.

Very evidently the writer has only second-hand information about the works of this great Arabic writer to whom the mathematical world is indebted for its knowledge of the Hindu numerals and also for the first systematic treatise on algebra. This is the more to be regretted, coming from Cambridge, since the unique copy of an early (twelfth century) Latin translation of Mohammed ben Musa Al-Khowarizmi's arithmetic is in a Cambridge library and the unique copy of the Arabic algebra is in Oxford and was translated into English in 1831 by F. Rosen. The arithmetic was published by Boncompagni, "Trattati d'Aritmetica," Rome, 1857. The writer in the Britannica regards the two as a single work and his comments on the indebtedness to Greek and Hindu sources are, of course, worthless.

Incorrect is the assertion that the thirteen books of Diophantus's "Arithmetica" are not lost, but this statement, it is only fair to say, may be due to a misprint. Bhaskara, a Hindu mathematician of the twelfth century, made great advances over the algebraic work of Brahmagupta (seventh century), although the Britannica states the contrary. John Pell's algebra of 1668 does not exist nor did he anywhere present the solution of the so-called Pellian, $x^2 - ay^2 = 1$. Pell did in 1668 have in print, simply under his initials, some comments on Brouncker's translation of Johann Heinrich Rahn's "Algebra." To Simon Stevin of Bruges is ascribed the publication of "an arithmetic in 1585 and an algebra shortly afterwards." Both were combined in one volume in 1585, as D. E. Smith shows in the "Rara Arithmetica," Boston, 1909, pp. 386–388. Stevin's fame as the first writer to give an exposition of decimal fractions seems not to be known to this writer, for the statement that Stevin "considerably simplified the notation for decimals" is wide of the mark. Approaches to decimal fractions appeared before Stevin, but no exposition and no notation for Stevin to simplify.

The revival of the study of algebra in Christendom is incorrectly attributed to Leonard of Pisa (1202 A.D.). Robert of Chester, an Englishman living in Segovia, Spain, translated into Latin in 1145 A.D. the Arabic algebra of Mohammed ben Musa. Only a little later Gerard of Cremona treated the same work and about the same time Plato of Tivoli translated into Latin a work dealing with quadratic equations by Savasorda (twelfth century). The revival of mathematics in Christendom begins with these men and others who like them were occupying themselves with translations from the Arabic. The statement that the work of Leonard "contains little that is original, and although the work created a great sensation when it was first published, the effect soon passed away and the book was practically forgotten," is as false as it is ridiculous.

Now this writer turns immediately to discuss Luca Paciuolo and then states: "These works are the earliest printed books on mathematics." How this glaring blunder "got by" the editors is difficult to understand. Leonard of Pisa's work was not in print until 1857, when Prince Baldassare Boncompagni published it and even Paciuolo's "Sūmma de Arithmeticā" did not appear until 1494. The first printed arithmetic is probably that of Treviso, 1478. Between that time and 1494 many important works appeared. No less than three editions of Pietro Borghi's arithmetic (1484, 1488 and 1491) and some six editions of the three different works on arithmetic by J. Widmann (1488, 1489, 1490, 1493), are included among these books. The Algorismus by John Halifax (Sacrobosco) appeared in two editions (1488 and 1490?). Philip Calandri published in 1491 an arithmetic with illustrated problems and Francesco Pellos (Pellizzati) got out an arithmetic in the year that Columbus discovered America. Peurbach's Algorismus (1492) and others could be added to this list.

The transliteration of Arabic names is entirely original, as, for example, Tobit ben Korra for Thabit ben Qorra.

The most amusing statement is, "Fahri des al Karhi, who flourished about the beginning of the eleventh century, is the author of the most important Arabian work on algebra." Now Al-Fakhri, or Fakhri, is, indeed, the title of an Arabic work on algebra by one Abu Bekr Mohammed ibn Al-husain Al-Karkhi, or Al-Karkhi, for short. But the *des* seems, at first, unexplainable. The probability is that the *des* is German and some chance reference in German to the Fakhri des Al-Karkhi, the Fakhri of Al-Karkhi, undoubtedly accounts for this Farhi des Al Karhi.

Equally bad from a mathematical point of view is the surprising statement that "the Arabs accomplished the general solution of numerical equations."

The shorter article by the same writer on "Geometry, History," contains, of course, fewer errors. We must regard it as fortunate, in view of the errors I have shown and others not noted in the article on the history of algebra, that there is no article on the history of arithmetic. In pleasing contrast to these articles mentioned is the summary of the history of trigonometry by E. W. Hobson.

The one man best qualified to write a summary of the history of algebra and also of geometry is undoubtedly Sir Thomas L. Heath, sometime fellow of Trinity College, Cambridge. Even in 1910 the Cambridge University Press published a second edition of Heath's "Diophantus" and in 1908, Heath's "The Thirteen Books of Euclid's Elements," in three volumes. We may well express our surprise that the fame of Sir Thomas Heath should not be known to his Alma Mater, which stands sponsor for the encyclopedia, and that his aid was not sought for the history of mathematics in the Britannica.

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DEVASTATION OF FORESTS IN THE WHITE MOUNTAINS

To those who have supposed that the Weeks bill for the preservation of the Appalachian forests has settled a long-debated question, and that the advocates of the measure may now take a rest, secure in the belief that its execution is in the hands of a scientific man, armed both with authority and with knowledge, the article by Winthrop Packard in the *Boston Transcript* for October 7, 1911, stating the results of his exploration of the White Mountain region during the past summer will be a distinct shock.

"Lumbering," says Mr. Packard, "used to be a winter job, but there is no let-up in the rush now on to get the last spruce off the high levels of the White Mountains." The Weeks bill "is still about to work. But meanwhile the only part of it which is really working is the joker . . . which makes it indefinitely inoperative." An "innocent little paragraph in the Weeks bill says, in effect, that the head of the United States Geological Survey shall decide what areas are to be reserved along the head waters of the navigable rivers."

"Meanwhile, whether it affects the navigation of the Connecticut, the Androscoggin, the Saco and the Merrimac or not, the last of the good black growth of spruce, fir and hemlock is rapidly coming off the higher slopes of the Presidential Range and the lesser ranges that surround it."

"The best of the beautiful primeval forest is still above the high-water mark of this cutting, but it will take only a winter or two to encompass its downfall, and the investigations of the Geological Survey may probably be depended upon to hold the Weeks bill by the throat for that length of time, if not forever.

"The largest body of spruce left within sight of Mount Washington is that which lies at the head of the Rocky Branch Valley, between the Montalban Range on the west, the Rocky Branch Ridge on the east and Boott's Spur. . . . Here are some square miles of splendid black growth. . . . It is a virgin forest which one might suppose would last because of its inaccessibility. It is walled in by mountains on three sides and is sixteen miles up a tremendously rough valley from the south. This valley is drained by a tributary