"including the study of the criminal, pauper, and defective classes, and for the
"preparation of special reports on results of work and for all necessary printing,
"sixteen thousand five hundred dollars."

The laboratory is ostensibly not to be put into competition with other psycho-physical laboratories in our country, although this is precisely what should be done and something to which no true scientist would object, seeing that competition is the very life of science. Its purpose will be solely to gather sociological, pathological or abnormal data, as found especially in children, and in criminal, pauper and defective classes, and in hospitals. Besides these data it is desired to gather more special data with laboratory instruments of precision and to make such experiments or measurements as are generally considered of value by psycho-physicists and anthropologists.

The laboratory, thus, will be in the nature of a great statistical reservoir from which individual scientists may draw their facts and working material. The enterprise is a commendable one, and, if established, will, we hope, be committed to competent hands and not draw upon itself the criticisms which have been aimed at other government ventures in the patronage of science.

A HISTORY OF ELEMENTARY MATHEMATICS.

The charm which the elucidations of history impart to scientific instruction has long been appreciated, but our consciousness of it has been immeasurably enhanced by the *renaissance* which has taken place in recent years in the study of the history of science. While mathematics was perhaps the first of the sciences to receive attention in this regard, it was one of the latest to incorporate the enlightenment which emanated from this source into its formal instruction. "Dry-as-dust" is an epithet which almost connotes fascination as compared with the descriptive adjective one is tempted to apply to the majority of the standard text-books of mathematics formerly in vogue. It was the great original treatises only, like Lagrange's *Theory of Functions*, that were interesting reading in a historic and philosophic regard. The text-books proper seemed to possess a monopoly of making themselves forbidding in aspect and content; and while much has been done to remedy this state of affairs by the addition of historical notes and appendices, it is after all to be admitted that the historical and developmental treatment of mathematics must from the nature of the case be largely relegated to the personal initiative of the teacher. The knowledge in question must in most cases be sought outside the text-books; and it is here that the brief histories of mathematics perform their function.

From the purely human side the most interesting of these in English is Ball's *Short Account of the History of Mathematics*. But neither this work nor the more recent book by Cajori (both are relatively expensive volumes) treats of the great body of mathematical truth as a thing of purely logical and evolutionary growth; their exposition is given rather in connexion with the individual *persons* who have contributed to the development of mathematics, and regarding whom many interesting anecdotes and stories are told. In *Fink's Brief History of Mathematics*, on the other hand, a volume which has been translated from the German by Prof. Wooster Woodruff Beman and Dr. David Eugene Smith, and published during the year just past by The Open Court Publishing Company, a systematic attempt has been made to write a compendium of mathematical history from a purely scientific and evolutionary point of view, eschewing utterly the

romance of the subject and relegating biography and such subsidiary matter to the appendices.[1] In this way the author successively considers the "growth of arithmetic, algebra, geometry, and trigonometry, carrying the historic development, as should be done, somewhat beyond the limits of the ordinary course." He has thus made the attempt to differentiate the histories of the separate branches of mathematical science, replying to the objection that in this way our general survey of the culture history of a certain epoch will suffer, with the remark that "in a his-
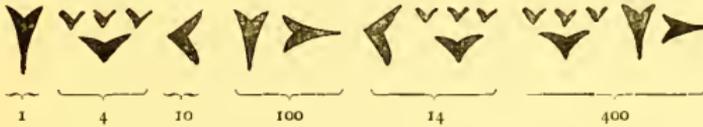

BABYLONIAN WEDGE-SHAPED NUMERALS.

tory of elementary mathematics, especially one confined within such modest bounds, an exhaustive description of whole periods with all their correlations of past and future cannot well be presented."

CUT ILLUSTRATING DEVELOPMENT OF MODERN NUMERALS.

The discussion of each subject is preceded by a general survey which gives the prevailing trend of development and strikes the dominant key-notes. The opening section of the book is devoted to number-systems and number-symbols, in
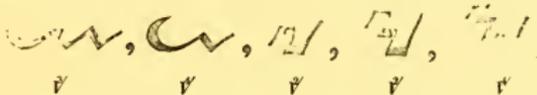
SYMBOLS FOR THE EXTRATION OF ROOTS.   (Sixteenth century.)

They represent respectively the third, fourth, second, third, and fourth roots of the numbers they precede. The first two were used by Rudolff (early sixteenth century), the other three by Stifel (1544).

which the development of the Hindu notation is especially emphasised, and the interesting character of which may be inferred from the first two cuts accompanying the present notice. In the second section, the development of arithmetic among

[1] *A Brief History of Mathematics.* An Authorised Translation of Dr. Karl Fink's *Geschichte der Elementar-Mathematik.* By Wooster Woodruff Beman, Professor of Mathematics in the University of Michigan, and David Eugene Smith, Principal of the State Normal School at Brockport, N. Y. Chicago: The Open Court Publishing Co. 1900. Pages, xii, 333. Price, cloth, $1.50 net (5s. 6d. net).

the Egyptians, Babylonians, Greeks, Romans, Chinese, Arabs, and Hindus, and in the fifteenth, sixteenth, seventeenth, eighteenth, and nineteenth centuries, is considered. The history of algebra is traced from the Egyptians and the Greeks to the Arabs. The first period culminates in the complete solution of the quadratic equation of one unknown quantity and in the trial method, chiefly by means of geometry, of solving equations of the third and fourth degrees. The second period of the development of algebra begins with Gerbert and ends with Kepler. The achievements of this period are the purely algebraical solution of equations of the third and fourth degrees by means of radicals, and the introduction of symbols and abbreviated expressions for the development of formulæ. From the section treating of this period the last cut accompanying our notice is taken. The third period begins with Leibnitz and Newton and extends through Euler, Lagrange and Gauss to the present time. It includes the discovery and development of the methods of the higher analysis, as well as that of a variety of new purely formal sciences. Fink's treatment of these two periods is valuable for the large amount of special information which it gives regarding the development of arithmetical and algebraical thought in Germany.

The history of geometry is divided into four periods, the first including the Egyptians and Babylonians; the second, the golden age of Greek geometry; the third, the relatively meager achievements of the Romans, Hindus, Chinese, and Arabs; the fourth, the period from Gerbert to Descartes; and the fifth, the time from Descartes to the present. The section devoted to trigonometry is comparatively brief.

The translators, who have performed their difficult task in a very commendable manner, have not made any considerable alterations in the original work, but they have corrected a considerable number of errors, provided additional references, and greatly improved the biographical notes. The work altogether is a compact, practical, and business-like handbook,—qualities which, conjoined with its inexpensiveness, will doubtless assure it a wide reception.   *μ.*

BOOK REVIEWS.

SOCIAL JUSTICE, A CRITICAL ESSAY. By *Westel Woodbury Willoughby, Ph. D.* New York: The Macmillan Company. 1900. Pages, ix, 385. Price, $3.00.

So many books are written nowadays about what others have thought about this, that, or the other, that we take up "a critical essay" with a certain amount of suspicion that it contains a more or less interesting display of intellectual juggling whereby we are shown how far astray preceding thinkers have been, but are left without any definite idea as to where the writer himself stands. The object of a critical work is too often the mere display of critical power. The work before us, however, affords a pleasant surprise. Critical analysis here is subordinate and subservient to constructive thought. The author has ideas of his own systematically arranged. His style is luminous. There is not a dry chapter in the book.

The first part of the book is devoted to an analysis of the idea of justice as an abstract conception, and to a consideration of the various canons of distributive justice, to discover which of them contain elements of truth and rationality. The theory of equality, the labor theory, the effort theory, and the needs theory are all criticised at length. The conclusions reached are that "justice consists in granting, so far as possible, to each individual the opportunity for a realisation of his