in contraries. Thus to see oneself dead is to have a long life in prospect. Very often, no doubt, the interpretation depended upon some superstitious association of ideas to which the clue is lost. And last of all there is much likelihood that in a number of cases the interpretation rested, not on any traditional ground or application of pseudo-logic, but solely on the caprice of the interpreter."

Any one who is at all familiar with dream books, whether Arabic or Latin, or those which are being peddled to this very day along the country roads all over the world, will recognize at once their main features in this Egyptian exemplar of four thousand years ago. Verily superstitions are as tenacious and irrepressible as the weeds of our gardens.

A part of Pap. IV is devoted to what the editor calls a " student's miscellany " (p. 37), a collection of edifying writings which formed the staple of a Ramesside scribe's education. The scribe's profession is glorified. Famous scribes of the past such as ḤARDEDEF and IMḤÔTEP (1) are praised. Similar texts are also found in Pap. V, as well as sequences of model letters.

The majority of these papyri contain magical texts (Pap. V, VI, VII, XI, XII, XIII, XVI) or magico-religious ones (Pap. VIII) or magico-medical ones (Pap. XV). Pap. VI and XVIII contain medical prescriptions; pap. X, fragments from a book of aphrodisiacs—a subject frequently represented in almost every oriental literature. Pap. IX which is (after pap. I) the longest in the collection, and dates from the time of RAMESSES II (XIIIth cent.), is devoted to a ritual of AMENOPHIS I (XVIth cent.), a book of invocations, and a book of protection.

These difficult and dismembered texts have been admirably edited by one of the great masters of Egyptian grammar, palaeography and literature, and the presentation of the results—facsimiles, transcriptions, translation and commentary—is splendid.

GEORGE SARTON.

B. Datta and **A. N. Singh.**—*History of Hindu Mathematics.* A source book. Part I, Numeral Notation and Arithmetic, xx+261 p. Motilal Banarsi Das, Lahore, 1935.

1. — *Arrangement and Contents*

The whole book is scheduled to appear in three parts; the second part will be devoted to algebra, and the third part to geometry and various topics of advanced mathematics. The volume before us is the first part which deals with numerical notation and elementary arithmetic

(1) JAMIESON B. HURRY (1857-1930) : IMHOTEP (2nd ed., Oxford, 1928; *Isis* 13, 373-5). G. SARTON : IMHOTEP, two statuettes in the Boston Museum (*Isis* 14, 226, 1 pl., 1930).

in two big chapters. The first chapter gives in eighteen sections a rather extensive discussion of the history of the Hindu numerals. After a general introduction, the authors deal with such interesting subjects as writing in ancient India, the *Brāhmī* and the *Kharoshṭhi* numerals, the place value system, the symbolic word numerals, the alphabetic notation, the zero, and the Hindu numerals in Arabia and in Europe. The chapter is concluded with numerous tables which demonstrate the development of the numerals. The second chapter contains fifteen paragraphs dealing with the four fundamental operations, the squares and cubes, checks on operations, the rule of three and some other commercial and miscellaneous problems, and the mathematics of the zero.

2. — *Antiquity of Hindu Civilization*

One of the most knotty problems in the history of science is the question as to the origin and antiquity of Hindu mathematics. Do the achievements of the Hindu mathematicians precede the time of the Greek influence, beginning with the invasion of ALEXANDER THE GREAT (327 B.C.), and rest upon the natural growth of native elements, or do they succeed the penetration of Hellenic culture and thus represent the reception and assimilation of a foreign civilization? In addition to that there is still the vexing question as to the possible contacts with the ancient oriental races of Egypt and Mesopotamia, or of Persia and China. The higher the rank of a civilization is, the less inclined are we to regard it as an isolated phenomenon independent of the achievements of the other nations. For the authors of our book these problems seem not to exist at all. They confine themselves to an array and a restatement of all the facts, or pseudo facts, and of all the evidence, or pseudo evidence, tending to support the orthodox theory of the high antiquity, of the originality and perfection of the Hindu civilization.

According to DATTA-SINGH (p. 1) the Vedas were composed about 3000 B.C., " or probably much earlier," the Brahmaṇa literature flourished c. 2000 B.C., and the beginnings of Hindu mathematics go back to that time. We are told that the cradle of our methods of performing the fundamental arithmetical operations is India, and that the " present method of expressing fractions is derived from Hindu sources and can be traced back to 3000 B.C." (pp. X and 186). To the European student these dates and beliefs have no other basis than the legends of the *Mahābhārata*. All that the critical historian will admit is " that the Vedic religion had been at work long before the rise of Buddhism in the 6th century B.C." From astronomical dates it has been inferred that the composition of the Vedas was going on about 1400 B.C. " But these dates are themselves given in writings of later origin." (1) For a proper understanding of these things it must be borne in mind that Hindu literature was preserved by oral transmission. A literature transmitted by word of mouth only has no definite chronology and no clear distinction between the author and reciter, between the originator and transmitter. All the additions and improvements of the later generations are so edited as to blend to a seemingly organic unit. Another characteristic feature of Hindu literature is that it is based upon divine revelation and inspired tradition. Consequently there can be no references to foreign origins or foreign influences. "No early Indian writer mentions the invasion of ALEXANDER THE GREAT," says G. R. KAYE (2) and that is exactly the attitude of our authors. They simply conform to the orthodox tradition, everything is traced back to the hoary antiquity of 3000 or 2000 B.C., and the possibility of a foreign influence is entirely ignored.

And still there is abundant evidence to show the reality and the diffusion of foreign influences. In the time of DARIUS THE GREAT, c. 500 B.C., the valley of the Indus was a Persian satrapy. When ALEXANDER THE GREAT invaded India in 327 B.C., he was accompanied by a host of historians and men of science, of adventurers and merchants. Since that invasion the contacts between India and the Hellenic world continued for a long time. ALEXANDER founded cities and planted garrisons, and these Greek colonies exerted a powerful influence upon the spiritual life of the Hindus. References to the Yavanas occur in the literature, Greek and Roman coins are found at many places, and the names of Greek kings appear in the rock inscriptions under Indian forms. Similarly Greek methods and Greek technical terms may be recognized in the records of Hindu astronomy (3). Much older and much more fundamental must have been the Semitic influence. It has been generally conceded that the two kinds of script known in ancient India, the *Brāhmī* and *Kharoshṭhi*, are both derived from the Semitic alphabet. The *Kharoshṭhi* script resembles the Aramaic letters of the 5th century B.C. and it is written in the Semitic fashion from right to left. It was emlpoyed in certain parts of India from c. 400 B.C. to c. 200 A.D., and it was most probably introduced as a consequence of the Persian invasion of c. 500 B.C. The *Brāhmī* script resembles the Phoenician type of the Semitic alphabet and was believed to have been imported into India about 800 B.C. by

(1) *Encyclopaedia Britannica*, 11th ed., XIV, p. 395 f.

(2) *Indian Mathematics*, Calcutta, 1915, p. 2.

(3) See KAYE, *loc. cit.*. SARTON, *Introduction to the History of Science*, I, pp. 386 f. and 428; *Encyclopaedia Britannica*, 11th ed., XIV, p. 397 ff.

traders coming from Mesopotamia (4). Recently, the theory has been advanced that the *Brāhmī* alphabet is derived from the script of Mohenjodaro, and that through this the connection of *Brāhmī* with the South Semitic and Phoenician scripts is proved (5). It is, however, a great mistake on the part of our authors to identify the people of the Mohenjodaro civilization (c. 3250-c. 2750 B.C.) with the Hindus and to say that " the Hindus knew the art of writing in the fourth millennium B.C." (6) The fact is, quite to the contrary, that the archaeological excavations at Mohenjodaro, carried out by the government of India in the years 1922-27 and edited by Sir JOHN MARSHALL in the volume called *The Mohenjo-Daro and the Indus Civilization*, 1931, tend to confirm the hypothesis of an early Mesopotamian influence upon the Indo-Aryan culture. The archaeological finds prove, in the words of the editor Sir JOHN (*ibid.*, p. V), that " 5000 years ago, before even the Aryans were heard of, the Punjab and Sind... were enjoying an advanced and singularly uniform civilization of their own, closely akin but in some respects even superior to that of contemporary Mesopotamia and Egypt." This old and highly developed civilization was in all likelihood destroyed by the invading tribes of the Indo-Aryans who brought into India an inferior civilization of their own. Their relation to the old Mohenjodaro civilization may be likened to the relation of the Hellenic tribes to the Aegean civilization. It is historically impossible to think of Sanskrit as the Indus valley language, and of the Indo-Aryans as of the literary inhabitants of the cities of the Punjab, at such a date as 3000 B.C. (7).

3. — *The Hindu Numerals*

Half of the book is devoted to the discussion of the Hindu numerals, the greatest mathematical contribution of the Hindus. No wonder, therefore, that DATTA-SINGH are making great efforts to prove the real Hindu origin of these symbols and the high antiquity of this Indian invention. According to our authors the earliest epigraphic evidence found in India of the use of the new numerals with place value and zero is 595 A.D. " No other country in the world offers such an early instance of its use. Epigraphic evidence alone is, therefore, sufficient to assign a Hindu origin to the modern system of notation." (8) The earliest

(4) See L. D. BARNETT, *Antiquities of India*, p. 225-7; A. MACDONELL, *A History of Sanskrit Literature*, p. 14-16.

(5) See G. R. HUNTER, *The Script of Harappa and Mohenjodaro*, London, 1934. I am quoting from the short summary given in *Isis* 24, 1935, p. 257 f. Cf. also the book of DATTA-SINGH, pp. 10, 29.

(6) See p. 36 and cf. also pp. 1, 19, 29.

(7) See F. W. T. in *The Journal of the Royal Asiatic Society*, 1932, p. 464 f.

(8) P. 49, and 40.

use of the place value principle in the system of symbolic word numerals is supposed to go back to the second or third century A.D. Literary references to the place value system are said to be found from about 200 B.C. (9). The conclusions reached by the authors are therefore " that the place value system was known in India about 200 B.C.," and the possibility is even admitted " that further evidence may force us to fix an earlier date." The reviewer is unable to form an independent opinion with regard to Hindu inscriptions or references in Sanskrit literature. But he would like to mention that KAYE and other competent investigators of Hindu epigraphy question the reliability of the epigraphic evidence. The inscriptions were found on the so-called copper plate grants, many of which were proven to be forgeries. KAYE asserts that of the 17 inscriptions, antedating the tenth century A.D. and containing the decimal place value numerals, 16 have been eliminated as spurious by students of Hindu palaeography. The one left bears the date of 867 A.D. (10). On the other hand, it should also be noted that palaeographic instances, going back to the early part of the 7th century A.D. and testifying to the use of the place value notation, have been found in the Hindu colonies of the Far East, in Indo-China and Indonesia. In Indo-China, Sanskrit inscriptions have been deciphered which are using the symbolic word numerals with place value and zero and are dated of the years of the Šaka Era 526, 609 and 654, corresponding to the years 604, 687 and 732 A.D. On the Indian islands, inscriptions in the vernacular were found which contain numerals with place value of the dates of the Šaka Era 605, 606 and 608, corresponding to the years 683, 684 and 686 A.D. (11).

With regard to the literary references M. W. E. CLARK summarizes his opinion (12) " that the Indian literary evidence proves conclusively the presence of a symbol for zero by A.D. 600... It also proves the knowledge of nine symbols with place value (with either a blank column on the reckoning board for zero, or a symbol for zero) by the end of the fifth century A.D. at least. Beyond that the present evidence does not go." These dates are about 400 years earlier than the dates of KAYE, but about 700 years later than those of DATTA-SINGH. To the sixth

(9) See pp. 86-88.

(10) See *Indian Mathematics*, p. 31 f., and his articles in the *Journal of the Asiatic Society of Bengal*, vols. III, IV and VII, 1907, 1908, and 1911, and in *Isis*, II, 1914-19, pp. 326-56.

(11) Cf. G. COEDÈS, " A propos de l'origine des chiffres arabes," in the *Bulletin of the School of Oriental Studies*, University of London, VI, 1931, pp. 323-8, (*Isis* 20, 581), and see also DATTA-SINGH, p. 43-4.

(12) In his article " Hindu-Arabic Numerals " in *Indian Studies in honor of Charles Rockwell Lanman*, 1929, pp. 217-36, quoted by COEDÈS, *loc. cit.*

century as the lower limit of the date of their invention, or introduction into India, points also the testimony of the Syrian bishop SEVERUS SĒBŌKHT of 662 A.D. concerning the ingenious system of the nine numerals of the Hindus (13). On the ground of all this evidence it may well be safe to say that in the sixth century A.D. a decimal system of notation with nine numerals, place value and zero was known in India. By no means, however, are we entitled to proclaim the place value and the zero, the two fundamental elements of the system, as Hindu inventions. These devices are proved beyond doubt to have been well known to the ancient Babylonians and to the Maya of Central America. The Babylonians may have used the system of local value as early as 2000 B.C. The zero symbol was employed only in the middle of a number, and the earliest text in which it occurs belongs to the time of the Persians, c. 500-400 B.C. (14). How old the Maya system is we cannot tell, but authorities on the Maya civilization have asserted that their calendar began as early as 3373 B.C. At any rate their system of notation is certainly independent of the Hindu notation. While the Babylonians applied the place value to the sexagesimal scale, the Maya notation was based on the scale of twenty. All that the Hindus may claim for themselves is the first application of these principles to a notation based upon the decimal scale. It follows, therefore, as has already been well remarked by F. CAJORI (15), that the present controversy on the origin of our numerals does not involve the question of the first use of the local value and of the zero at all; it concerns itself only with their first application to the decimal scale and with the origin of the present forms of our ten numerals. It is now characteristic for the methods of our authors that these well established facts of the priority of the Babylonians and of the independent occurrence of the invention among the Maya are consistently ignored. Again and again the Hindu origin of the place value system and of the zero is stressed (16), but in the whole discussion of the subject, which occupies more than one hundred pages, not a word is said with regard to the Babylonian and Maya origins. But quite apart from all that, the historian of mathematics will not fail to realize that these two fundamental elements of our system of notation,

(13) See SMITH, *History of Mathematics*, II, p. 64; SARTON, *Introduction to the History of Science*, p. 493.

(14) See NEUGEBAUER, *Vorgriechische Mathematik*, p. 4-5, and *passim*. SMITH, *loc. cit.*, p. 37 ff. On the Maya notation see SMITH, *ibid.*, p. 43-5.

(15) See the lucid presentation of the whole problem in his paper "The Controversy on the Origin of our Numerals," *The Scientific Monthly*, IX, 1919, pp. 458-64.

(16) See especially pp. 27, 87 ff., 38 and 51.

the place value and the zero, are derived from the abacus, on which the columns or wires had their place value and the blank column, or blank counter, represented the zero. The abacus, however, appears to be one of those universal devices to the invention of which no single nation can lay claim. There was among the Peruvians a knotted cord abacus on which the pending ropes attached to the main cord marked the place value of the knot numbers and represented the columns of the abacus. As early as the sixth century B.C. the Chinese spoke already of the knotted cord as of an ancient and antiquated contrivance. Thus LAO-TZE, the philosopher of the 6th century B.C., said : " Let the people return to knotted cords and use them " (17). In some form or other the abacus was well known to all the civilized races, as the Babylonians and Egyptians, the Chinese and Japanese, the Greeks and Romans. In the tenth century the abacus reappears in western Europe as a legacy of classical antiquity, but without any connecting links to the Hindu or Arabian world. The columns have their place value, and the blank counters with the hole in the center represent the zero. This instrumental arithmetic of the abacus transferred into written form gives the modern system of notation with place value and zero. Hence the theory was advanced by BUBNOV (18) that our numerals were derived from the marked counters, and, therefore, commonly referred to as abacus numerals.

To say with KAYE, BUBNOV, DATTA-SINGH (19) and others, that the Hindus and Arabs had no knowledge of the abacus is entirely wrong. The abacus was well known to the Arabs and referred to by the two terms *takht*, the board, and *ghubār*, dust. The advanced stage of written arithmetic was called the abacus arithmetic, and the numerals were known as the ghubār numerals, which means " abacus numerals " (20). In like wise the Hindus called their abacus either *pāṭī*, board, or *dhūlī*, dust. And in contrast with the primitive forms of *mudrā*, finger arithmetic, and *ganana*, mental arithmetic, they coined for the advanced stage of the calculation on the abacus, the terms *pāṭī-ganita*, calculation on the board, and *dhūlī-karma*, dust work (21), both meaning : abacus arithmetic. The abacus simply became the symbol of the sciences of mathematics, among the Arabs and Hindus as well as among the Romans and the mediaeval mathematicians of the Latin world.

(17) See SMITH, *loc. cit.*, II, p. 195, and the whole very instructive chapter on the abacus, *ibid.*, pp. 156-96. Cf. also the writer's paper on the knots in *Isis*, XIV, 1930, p. 205 f.

(18) Cf. MRS. LATTIN's article in *Isis*, XIX, 1933, pp. 181-94.

(19) On p. 124.

(20) See the writer's article on " The Origin of the Ghubar Numerals " in *Isis*, XVI, 1931, pp. 393-424.

(21) DATTA-SINGH, pp. 8, 124.

With regard to the abacus, however, the priority of the classical civilization cannot be doubted. Hence the probability must be admitted that the abacus together with the " art of the abacus " and the " symbols of the abacus " wandered from the West to the East. The theory of the Hindu origin of our numerals rests mainly upon the testimony of the Arabs that they learned their numerals from the Hindus, and upon the assumption that the Europeans adopted the very same numerals from the Arabs. The foundations of this theory were considerably shaken by the writer's above mentioned paper on the origin of the ghubar numerals. In this paper the writer demonstrated first the familiarity of the Arabs with the abacus, the existence of the two Arabic terms " board " and " dust " for the instrument (22), and that these terms exactly correspond to the classic Latin terms *abacus* and *pulvis* or *pulvisculus*. It was further shown that the Arabs distinguished two types of numerals, the Hindu- and the ghubar numerals (23); that this latter term means abacus numerals, and that, by an abundance of indications, these ghubar numerals point to a western, Roman origin, and not to India. Not only were they generally called *'uqūd*, " joints, knots," which is the Arabic rendering of the Latin *articuli*, but, according to the testimony of MAIMONIDES (1135-1204), they were also traditionally known as *al-'uqūd al-rūmī*, " the Roman, or Greek knots."

Two years later the theory was further corroborated by an interesting paper of GEORGES S. COLIN, entitled " De l'Origine Grecque des Chiffres de Fès et de nos Chiffres Arabes " (24). In this paper COLIN reports about the existence of a notation of 27 numerals employed by the notaries of Fes, which is called *al-qalam al-Fāsī*, the Fes notation, and about which tradition says that it was derived from the Roman or Greek notation. Unaware of my paper in *Isis* and entirely independent of it, COLIN suggests the Greek origin of the Fes numerals and of our Arabic numerals. The summary of this theory, on pp. 214-5, reads :

I. — The 27 numerals of the Fes notation follow the Greek system of the 27 alphabetic numerals, and represent a mixture of symbols adopted from the Greek and Arabic alphabet and from the ghubar numerals.

II. — Due to the ancient use of the column abacus, the first nine numerals assumed a place value. The rest of the numerals was discarded.

III. — These nine symbols were carried into the wide world by the

(22) This was already established in the writer's article " Did the Arabs know the Abacus ? " *American Mathematical Monthly* 34, 1927, pp. 308-16.

(23) Both types were known to AL-KHUWĀRIZMĪ (c. 820), who refers to the differences in the symbols for 5, 6, 7 and 8 in his *De numero Indorum*, p. 1.

(24) In *Journal Asiatique*, 1933, pp. 193-215. The article was called to my attention by Dr. SARTON.

Neo-Pythagoreans of Alexandria. Through the medium of the Roman *apices* they became the prototypes of the ghubar numerals. They penetrated into India and from there to the eastern Arabs. The European Arabs, however, adopted the ghubar type.

IV. — A modern Moroccan jurist writing about the Fes numerals says that they were originally drawn from the ancient *Rūmī* notation (25).

V. — A comparative table of the Greek, Coptic and Fes forms of the 27 numerals is given on pp. 199-201 in order to illustrate the Greek origin through the Coptic medium. The Greek letters and numerals were adopted by the Copts in the third century A.D. In 640 Egypt was conquered by the Arabs, but the Coptic scribes remained the officials of the administration. Hence the 27 numerals were first adopted by the Arabs in Egypt, from there they came to Spain and thence to Morocco.

DATTA-SINGH (on pp. 89-91) admit the likelihood that the Arabs knew the ghubar numerals, without place value and zero, long before they had direct contact with India. They also concede that they must have obtained them from the Alexandrians or the Syrians. But there is no reference to the papers of GANDZ or COLIN. Apparently, they had no knowledge of these recent studies, or, possibly also, that they chose not to take cognizance of them.

4. — *A few Critical Remarks concerning Details*

Owing to the great uncertainty of the dates in early Hindu mathematics, SARTON preferred it to postpone the discussion to a future chapter (26). It is perfectly clear that in a book arranged according to centuries and half centuries, the *Sulvasūtras* which are dated as between 500 B.C. and 200 A.D. could hardly find the proper place. KAYE (27) distinguishes three periods in Hindu mathematics : I. The *Sulvasūtra* period. II. The astronomical period, 400-600 A.D. III. The Hindu mathematical period proper, 600-1200 A.D. He notices the remarkable fact that the second and third periods have no connection whatever with the first or *Sulvasūtra* period. " The later Indian mathematicians completely ignored the mathematical contents of the *Sulvasūtras*. They never refer to them nor do they utilise the results given in them." In the writer's opinion, this strange behaviour may be due to the fact that the later mathematicians were conscious of the foreign origin and of the superior character of their knowledge and were loath to place it side by side with the primitive rules of the old *Sulvasūtras* and thus invite an unfavorable comparison.

(25) The above quoted testimony of MAIMONIDES shows that this is an old tradition. As COLIN remarks, *Rūmī* may denote : European, Roman or Greek.

(26) See *Introduction*, I, pp. 36, 74.

(27) *Indian Mathematics*, p. 3; cf. also p. 9, note.

A somewhat similar phenomenon may be observed in Hebrew mathematics. The later mathematicians of the Arabic period (from c. 1100 on), like SAVASORDA, IBN EZRA and the others, never refer to the *Mishnat ha Middot*, the genuine Hebrew geometry of c. 150 A.D., corresponding in its primitive character to the *Sulvasūtras* (28). With regard to the names for the decimal powers DATTA-SINGH (on p. 9) stress the fact that the ancient Hindus had special terms for no less than eighteen denominations, whereas the Greeks did not go beyond the myriad and the Romans even stopped at the mille. Even in modern times, they say, " the numeral language of no other nation is as scientific and perfect as that of the Hindus." A multitude of words for single numbers and conceptions, however, is by no means a sign of perfection. Primitive languages have this peculiarity, while the modern languages of an advanced civilization have more words for general classes and abstractions. The very characteristic of the high standard of our numerical system consists in the fact that through it we are able to dispense with this bewildering multitude of special verbal or notational symbols for each denomination. Truly scientific was the Greek arrangement into octads and tetrads. The use of the centesimal arrangement in the *Lalitavistara* (29), a Buddhist work of the first century B.C., may be due already to Greek influence.

On p. 210 our authors say, " the rule of three occurs in the treatises of the Arabs and mediaeval Latin writers, where the Hindu name ' Rule of Three ' has been adopted." The Arabs certainly did not call it by that name. They deal with the subject in a chapter on " Business transactions," or " Commercial transactions," *Bāb al-mu'āmalāt* (30). The origin of the rule of three goes back to the Egyptians and Babylonians.

Contrary to the assertion of our authors (on p. 101 f.), I wish to emphasize that no " competent authority " ever stated that the words *handasa*, *handasi* etc. are adjectives formed from *Hind* and mean " Indian.' There is no connection whatever between the two words. *Hindi* means " Indian " and *handasa* means " measure, surveying, geometry." It is a Persian loanword and occurs already in the Aramaic papyri of 447 and 410 B.C. (31). The Hindus have a method of expressing numbers by names of things which are associated with that number. For instance,

(28) Though IBN EZRA, at least, knew of its existence and mentioned it at the beginning of his *Yesod Mora*.

(29) DATTA-SINGH, p. 11.

(30) Cf. my note on " The Rule of Three in Arabic and Hebrew Sources " in *Isis* 22, 1934, pp. 220-22, and see also paragraph 5 of my paper " Mene mene tekel upharsin," to appear in *Isis*.

(31) See the writer's edition of the *Mishnat ha Middot*, p. 69, note 15.

the number two is referred to by such words as " eyes," " hands," or of other things occurring in pairs. It is a poor terminology to call these numerals " word numerals," as DATTA-SINGH do (on p. 53 and passim). The proper term would be symbolic, or associative, word numerals. Thus KAYE (32) speaks of a " word-symbol notation." Word numerals are the regular, spoken number words, one, two, three, etc., in contradistinction to the written number symbols, which are the written numerals.

The term *hanana* and its synonyms, meaning " killing, destroying," which are used for multiplication (33), seem to have a common origin with the still unsatisfactorily explained Arabic term *ḍaraba*, " to strike, kill " (34).

In conclusion I would like to say that the book before us certainly contains an abundance of material for the history of Hindu mathematics, but the material presented has to be used with caution. The authors, as native Hindu scholars, certainly are possessed of a deep erudition in Hindu literature, but they display a lack of training in the modern methods of philological and historical criticism, which deficiency is still enhanced by a too perspicuous bias and tendency towards exaggerating the achievements of the Hindu race. As an industrious collection of material and as a starting point for further critical investigation the present volume is very welcome indeed. But on the whole it impresses us as a mathematical panegyric on Hindu history. A History of Hindu Mathematics still remains to be written.

New York City. SOLOMON GANDZ.
January 23, 1936.

Annals of science.—*A quarterly review of the history of science since the Renaissance.* Editors: D. McKIE, HARCOURT BROWN, and H. W. ROBINSON. Vol. 1, January 15, 1936, No. 1, 113 p., 11 pl. London, E.C.4, TAYLOR and FRANCIS, Red Lion Court, Fleet St. (Annual subscription £1).

As its title indicates this new journal will be restricted to the study of modern science. We greet its publication with special pleasure and send our best wishes to its editors. Our forty-sixth Bibliography contains an analysis of the first number—which is splendid—and ulterior numbers will be analyzed in the same manner. Thus our Critical Bibliography will include, among other things, a classified list of the papers published in the *Annals of science*, and readers of *Isis* may feel confident that no

(32) *Indian Mathematics*, pp. 27, 31.
(33) See pp. 134, 137 and 139.
(34) See the writer's paper " The Terminology of Multiplication," *The Hebrew Union College Annual*, VI, 1929, pp. 247 ff.