SCIENCE

VOL. LXIII FEBRUARY 19, 1926 No. 1625

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE EARLIEST KNOWN AMERICAN ARITHMETIC[1]

THE American activity of the printing press began in Mexico about the year 1539, Juan Pablos being the first printer. From this press issued in 1556 a work on the value of silver and gold by Juan Diez Freyle, who devoted in his treatise considerable attention to both arithmetic and algebra. This section, with brief notes and translation, has been published in facsimile by Professor David Eugene Smith. A year after the Sumario by Juan Diez Freyle appeared a work on astronomy, and scientific publications of America begin with these works.

A systematic arithmetic was published at Mexico in the year 1623 by Pedro Paz. At the present time no copy is known to historians of mathematics who have written about this field.

The second arithmetical text-book of the new world, "Arte Menor de Arismetica," by Atanasius Reaton, appeared in the year 1649 at the press of the Widow of Bernard Calderon. Some copy of this work has been known to Spanish-American bibliographers, since the bibliographical description was given by Medina in his bibliography of Mexico. The writer prepared in 1924 a list of arithmetics of colonial America, but search at that time failed to locate any copy. However, recently Mrs. Lota Spell, librarian of the Garcia Library at the University of Texas, called my attention to the fact that a copy of this arithmetic is in this library and has very courteously assisted me in obtaining a reproduction by rotograph.

The work is dedicated to Pedro de Soto Lopez, "Contador del Tribunal del S. Oficio de la Inquisicion de esta Nueva Espana, Prior de la Universidad de los Mercaderes deste Reyno, I vez Administrador de las Reales Alcavalas." The approbation of Contador Martinez de Zuvieta, representing the Visitor General of the Holy Inquisition, is given. Herein Atanasius Reaton receives also the title Contador or Accountant. The Licence based upon the approbation was duly issued on December 17, 1648.

In his prefatory letter to the reader Reaton notes that twenty-one years before he had prepared a book, Contador General, de Arismetica, y Geometria, for

[1] Address of the vice-president and chairman of Section L—Historical and Philological Sciences—American Association for the Advancement of Science, Kansas City, Mo., December, 1925.

which license to print had been given. However, the difficulties of printing in the new world induced him to send the book to Spain. But this venture was also a failure and the work was not printed.

The table of contents is as follows:

TABLA DE LOS
CAPITVLOS
DESTE LIBRO

Note that Sumar, Restar, Multiplicar and Partis are the names of the four fundamental operations, termed "Reglas Generales" in chapter six.

Fractions, or "Quebrados," are treated in seven chapters, following upon a brief discussion in chapters seven and eight of denominate numbers, largely confined to money with a passing mention of weights.

Progressions and proportion are followed by the rule of three, without time and with time. Two chapters are devoted to partnerships and one to extraction of square root—the formation of military companies which is mentioned in the title occupies a large chapter, followed by a final chapter on diverse arithmetical problems.

At the John Carter Brown Library is a copy of another arithmetical work, published in Mexico in 1675 by Benito Fernandez de Belo. An examination of a photostat copy obtained through the courtesy of Dr. Lawrence C. Wroth, librarian at the John Carter Brown Library, reveals the interesting fact that the fundamental operations of arithmetic are not touched, but the whole book is devoted to the formation of companies of soldiers in squares, in hollow squares, in hexagonal formation and in other strange geometrical forms.

Noteworthy in Reaton's work is the fact that the author refers to several well-known early authorities on arithmetic, mentioning by name the following: Sacrobosco, Juan Andres, Buteo, Siliceus, Ortega, Yciar, Perez de Moya, Gemma Frisius, Antich Rocha of Gerona, frequently Miguel Geronimo de Santa Cruz and two others, Juan Antonio and Juan Gramatico, whose works are not known to me. He cites frequently also the *Contador General,* probably his own larger work mentioned above.

In numeration the use of Cuento for million is interesting, as the term appears only in Spain. Numbers 1, 2, 3, . . . are placed over the seventh, thirteenth and nineteenth places, respectively, to indicate that the number is to be read millions, millions of millions, and millions of millions of millions, respectively. Several writers of the thirteenth and fourteenth century placed dots over the fourth (thousands), seventh (thousands of thousands), tenth, and further places increasing each time by three, to indicate how many times "thousands" is to be repeated.

In addition and in the other operations the author gives a kind of moving picture of the operation, exhibiting graphically the various stages in the process. The methods of addition, subtraction and multiplication are remarkably similar to the modern ones. Division is different in that the author writes the remainders without writing the partial products. This is now termed the Austrian or additive method of division and is usually associated with the Austrian or additive method of subtraction.

This method of division without writing the partial products appears in only a few text-books of the seventeenth century. D. E. Smith mentions Cataldi's work of 1602 in which the process appears. I have found the process, without explanation, in Zuchetta's "Prima parte della Arimmetica," published at Brescia in 1600. In this treatise only the applications of arithmetic appear, but wherever Zuchetta divides this process is used. For example, 10865 divided by 128 appears simply as:

10865
625
113

The quotient 84 appears entirely separated from the

dividend, in the answer to the problem in question. Here it is to be noted that the partial products 8×128 or 1024 and 4×128 or 512 do not appear at all, but are subtracted immediately, leaving as remainders 62 and 113, which are written down directly.

A problem on fol. 5 verso reads as though from a recent American text-book.

John owes Peter 2386 pesos. He has received from Peter 295 pesos. The question, how much will he owe John. Place the numbers as you have been told above, and it appears here.

	Deue	2386 pesos	2386 ps
	Pago	295 pesos	295 ps
			1
2386 ps	Deue	2386 pesos	
295 ps	Pago	0295 pesos	
91	Resta	2091 pesos	

The explanation is lengthy, borrowing one above and decreasing the upper digit, which is even to-day the most common method in America.

The multiplication table is in column form, with nine entries in the table of ones, and decreasing to two entries, "8, 8. 64" and "8.9. 72" in the table of 8's, closing with 9 times 10 and finally "10. 10. 100."

Historically, the most interesting section in the book is the final chapter which treats in detail the method of distribution of the income (tithes) received by the Mexican churches. Application is made to the income (assumed) of the Cathedral of the Puebla de los Angeles. This minute account of the allocation of the considerable funds received by the churches of New Spain presents material probably not found in any historical work and yet of the greatest historical value in the discussion of the Spanish empire in America where the priests played so large a rôle. Such discussion appears also in the arithmetic of Pedro Paz, indicated by the preface which has been published by Medina.

This arithmetic is indeed a precious document in the history of science in America, revealing a breadth of interest in arithmetic not to have been expected in Mexico at this period.

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THE SCIENTIFIC METHOD AND AUTHORITY. II[1]

DISTRUST OF SCIENCE

Another phase of anti-science emotionalism, not always assuming the attitude of actual hostility, but better described as suspicion or distrust of science, may be noticed briefly. This is evidenced by the charges which are made, violently and even abusively by the uncultured, seriously and earnestly by cultured church leaders, against some of the teaching in our colleges and universities. These charges, so far as I have found them specific, are to the effect that certain young men and young women, following upon their university courses, not always in the physical sciences, however, such subjects as philosophy and sociology also being censured, have become so unsettled in their beliefs that even the ethical standards of some of them have been distinctly altered.

That some students, whose early training had led them to regard the mythical portions of Canonical Scriptures as veritable history and inseparable from the ethical values of those writings as guides to right living, when they become acquainted with the truths which science has brought to light may, in that period of revolt through which all active-minded youth is apt to pass, speak words which seem to be disturbing to well-established ways of thinking, is not a matter of wonder, nor should it be an occasion for alarm. Not all the young people who are exposed to new knowledge suffer mental distress in adjusting themselves to the changed outlook thus necessitated; and not all the young people whose formal intellectual training ends with the high school live lives that are above reproach.

I have had the pleasant experience of associating with many college and university young people through a long series of years, and find nothing in their manner of life to give me uneasiness for the future which is to be moulded by their influence.

Some attempts have been made by the somewhat doubtful method of questionnaires to discover how much basis there is for the charges which have been made that the teaching of biological facts and theories is damaging to religious beliefs. These inquiries thus far seem to give the rather surprising result that such courses tend to strengthen rather than weaken Christian faith. Thus a case reported by Goldsmith[10] resulted in sixty-six reporting that their Christian faith had been strengthened, twenty reported no effect, one way or the other, and two said it had been weakened. Many of the first group told in what ways their faith had been strengthened but, unfortunately, neither of the two whose faith had been weakened told in what way, or to what extent damage had been done.

From a rather extensive acquaintance with teachers of science, more particularly of the biological sciences, I feel warranted in saying that not one of them would intentionally present his subject or arrange his laboratory courses in any other way than

[1] Address of the retiring vice-president of Section F—Zoology—American Association for the Advancement of Science—given at Kansas City, December 29, 1925.

[10] "Evolution versus Christianity," p. 34.