On Abaci of Every Kind

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We all remember the abacus from our kindergarten days—a simple, colorful toy that helped us learn how to count and do simple arithmetic. Yet until recently, the abacus has actually been used by merchants and accountants as an efficient calculator. Indeed, in some countries, proficiency in their use had been a national tradition, to be learned at an early age and kept for life. In the Orient, school children were taught to do all four arithmetic operations on their personal abacus, and do them extremely fast. Several professions required an applicant to pass an abacus proficiency exam that included quite complex calculations which had to be done within a given time limit. Sadly, this centuries-old tradition has all but come to an end. The low-cost electronic calculator has done to the abacus what it did to the slide rule—it effectively killed it.

Predictably, the demise of both instruments has spurred an interest in collecting them. In this regard, the abacus has several advantages over its more famous brother: abaci are easier to come by and much cheaper to get, they often have a rich geographic or cultural history, and they are much easier to master: you don't need to be an expert on exponents or logarithms to become proficient in their use. And abaci have one more advantage: they can be used as attractive wall decorations, a feature that the slide rule is definitely lacking!

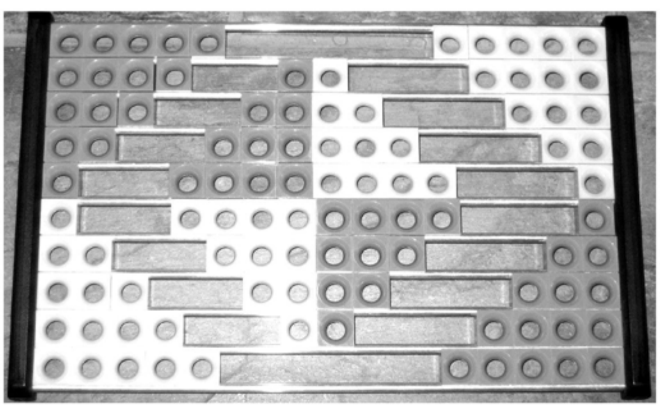

Figure 1. European abacus.

I got interested in abaci after I found an unusual one at the gift shop of the Minneapolis Museum of Art (Figure 1). Its yellow and blue square "beads" can slide on a kind of railing, allowing the creation of beautiful geometric patterns. Once the collecting bug had kicked in, it became hard to suppress, and I soon found myself in possession of quite a few of these "primitive" calculating devices.

Despite their superficial similarity, not all abaci are alike. There are four basic types, according to their country of origin. The Western abacus, the one many of us remember from our childhood, usually has ten rows of ten beads each, although as a toy it can also come with fewer rows or beads. Next are two types of Oriental abaci: the Chinese *suan pan* and the Japanese *soroban.* Both have a partitioning board that divides the abacus into an upper and a lower part (the terms "upper" and "lower" indicate that these abaci are held with the rods pointing away from the user when the instrument is placed on a desk). The suan pan has two beads per rod in the upper part while the soroban has only one (originally the soroban was identical to the suan pan, with two beads above the partitioning board, but in 1850 Japan switched to one upper bead). Both types can have any odd number of rods, typically 9, 11, 13, 17, or 27 (abaci with an even number or rods are rare). The suan pan has five beads per row below the partitioning board, as did the soroban prior to 1930; in that year Japan officially switched to four lower beads (Figure 2 shows a modern soroban next to a suan pan).

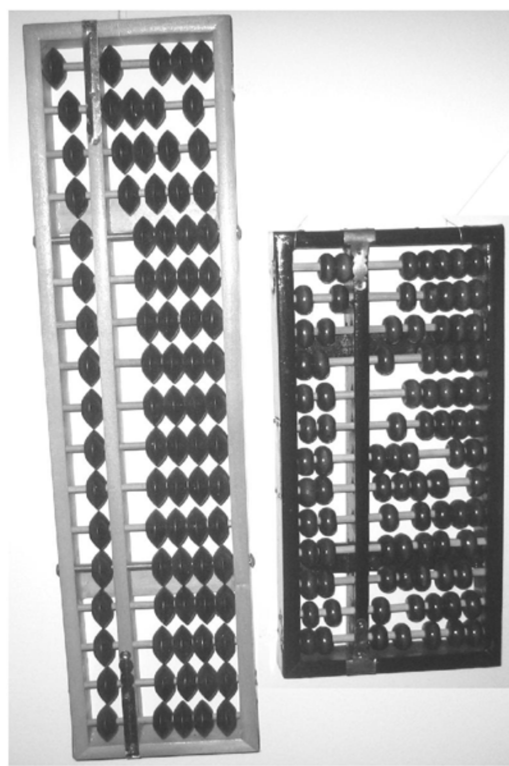

Figure 2. Japanese and Chinese abaci.

Finally there is the Russian schotyi (pronounced 'shotee'), which is specifically designed for accounting and commercial calculations. Each row has ten beads, of which the middle two are black and the remaining ones are brown or white; in addition, there is one row with just four beads. The four-bead row divides the abacus into rows representing rubles in denominations of 1, 10, 100, and so on, and rows representing kopecks (1 ruble = 100 kopecks).

In the days before the fall of the Soviet Union it was difficult to find Russian abaci outside the communist world. A friend of mine, on a visit to Moscow to attend a scientific conference, brought me a small one, which he found in a special store where only tourists and Party functionaries were allowed to shop; it was opposite the headquarters of the dreaded KGB, and my friend had some jitters as he emerged from the store with a suspicious device like an abacus! I later found a much larger one at a flea market in Jaffa, Israel. The two abaci are shown in Figure 3.

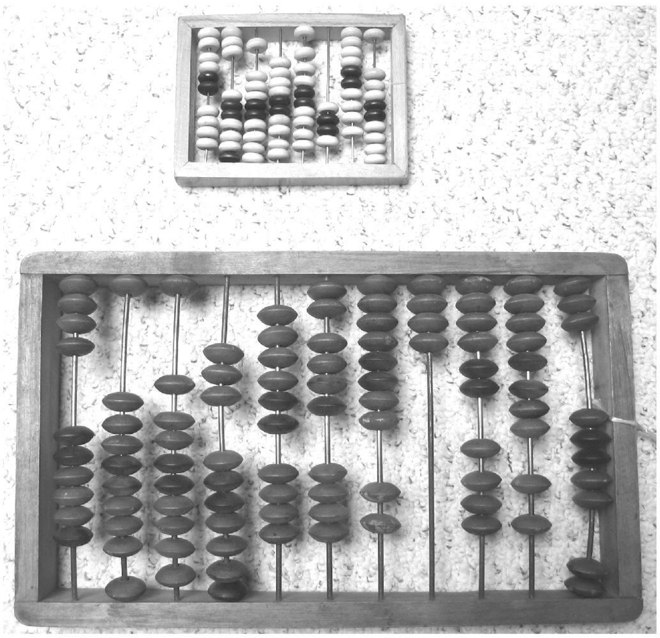

Figure 3. Russian abaci.

Figure 4. Indian clerk with abacus.

Not so many years ago one could still see merchants in Central Asia doing their calculations on the schotyi, often squatting on the floor or sitting on a low stool; when electronic calculators became common, a merchant would often do his sums on the abacus and then check them on his calculator! Figure 4 shows an accountant from India with his standard tools of trade—an inkwell and an abacus.

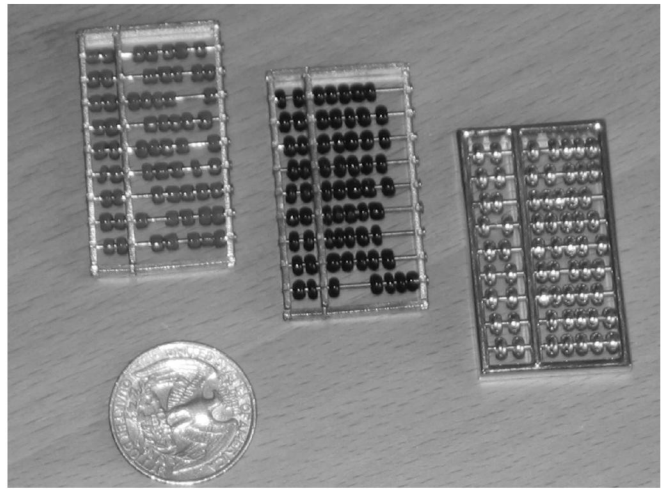

Figure 5. "Charm" abacus.

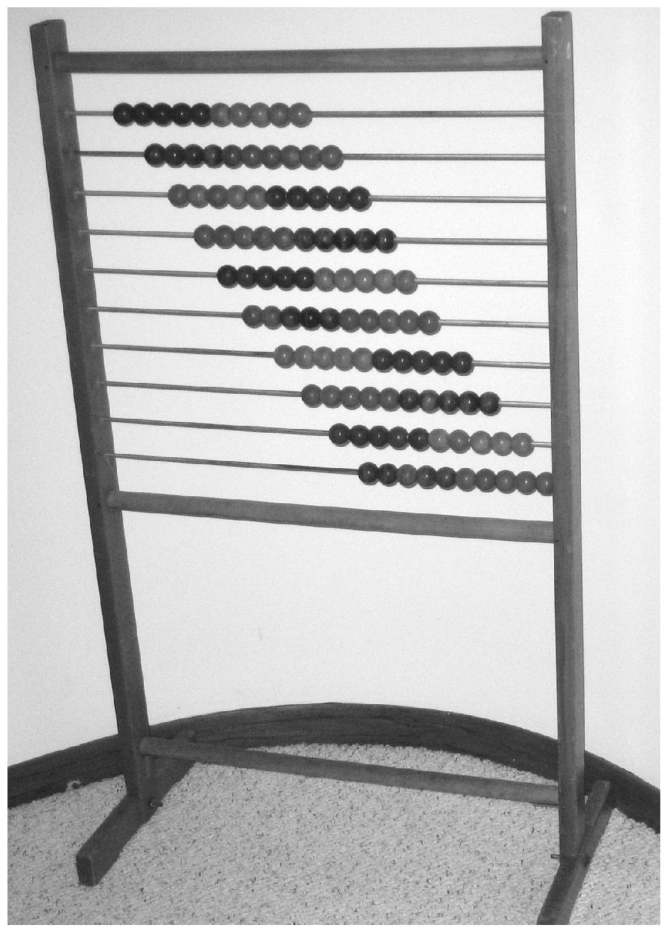

Figure 6. School abacus.

Abaci come in all sizes and shapes, from tiny "charm" abaci used as pendants (Figure 5) to giant school abaci from the early years of the twentieth century (Figure 6). One can also find them on public display. Figure 7 shows a gigantic abacus, actually a piece of art, at the lobby of a large bank in Ramat Gan, Israel. Figure 8 shows an abacus in a public park in the town of Ra'anana, Israel, obviously meant so that children could learn arithmetic while having fun outdoors.

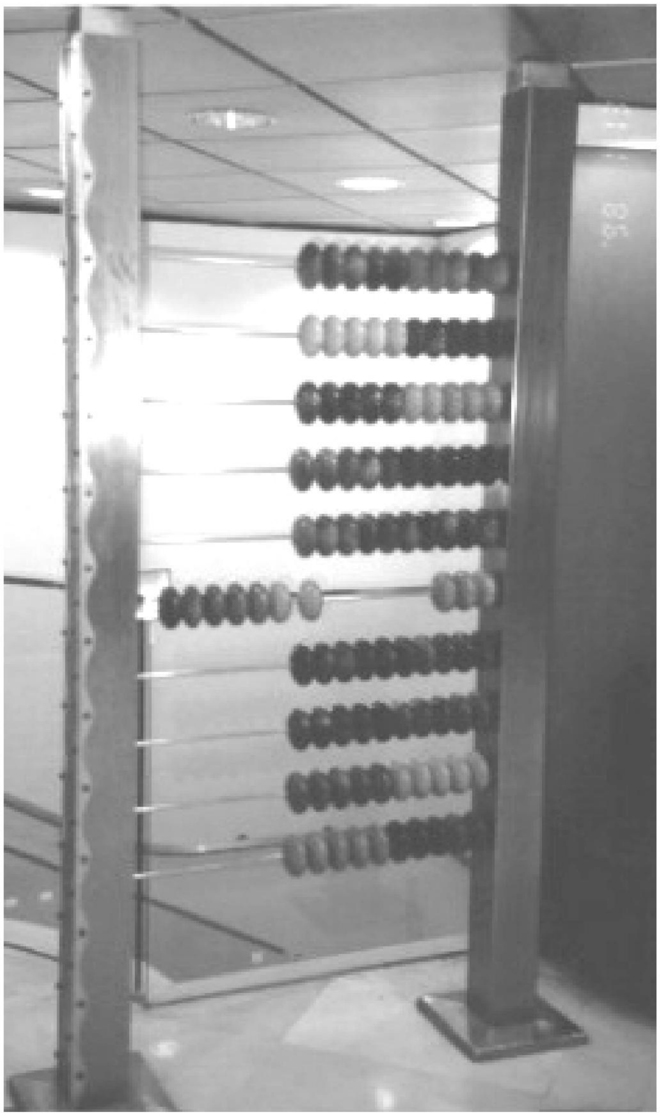

Figure 7. Giant abacus in Ramat Gan, Israel[1].

While the construction of abaci is fairly standard, occasionally one encounters abaci built to serve special purposes. Figure 9 shows a "direct-read" abacus that displays the number represented by each bead as one moves it up or down. Figure 10 shows an abacus with just two rows, the lower row having ten half beads; any two adjacent half-beads can be pushed together to make one full bead. Made in Poland of white beechwood, it probably was intended as a toy, but it can be used to demonstrate the way fractions are added; for example, adding three half-beads to five half-beads results in eight half-beads, which make four full beads. Figure 11 shows an abacus for the vision-impaired; the place-values of the various rows are engraved in Braille on the outer frame. Abaci have even been given free as souvenirs: Figure 12 shows a gift abacus for patrons of a Chinese restaurant, perhaps meant so you can quickly figure out the correct tip to be left on your table.

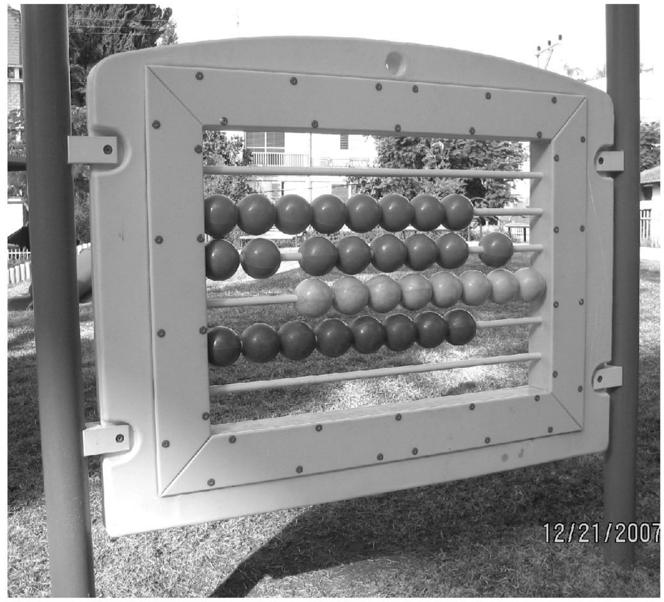

Figure 8. Abacus in an outdoor park, Ra'anana, Israel.

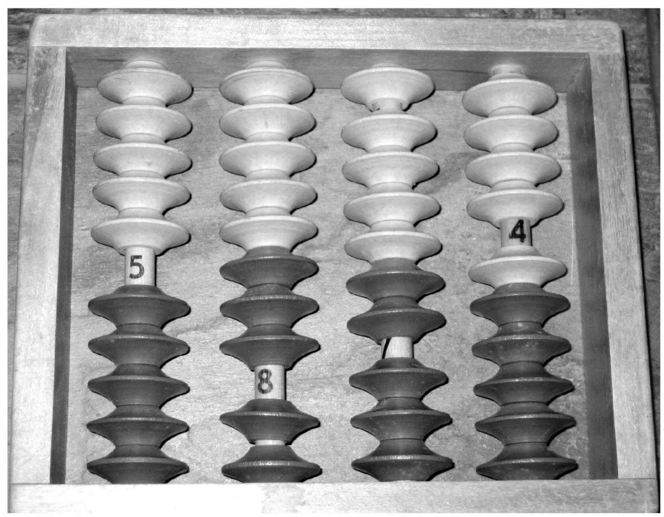

Figure 9. "Direct Read" abacus.

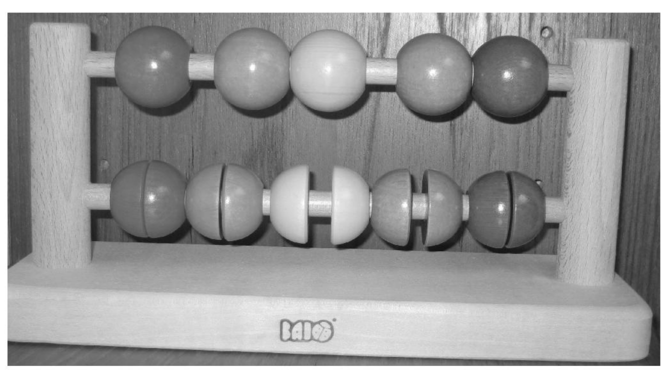

Figure 10. "Half-bead" abacus.

[1] *Ed note:* Ten rows, ten beads!

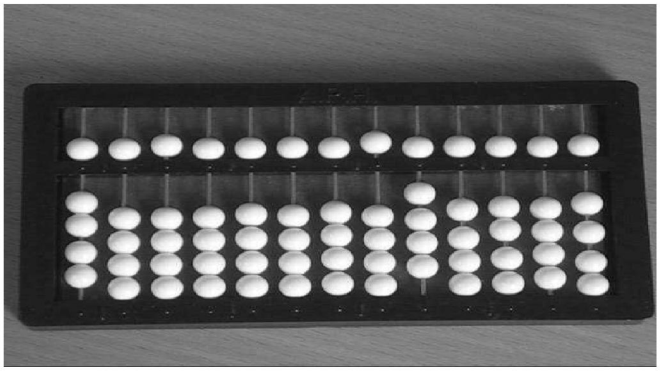

Figure 11. Abacus for the vision-impaired.

Figure 12. Chinese "restaurant" abacus.

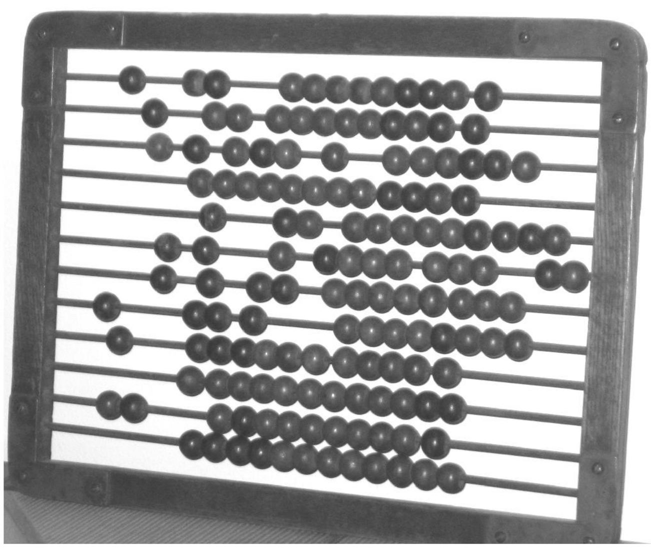

Figure 13. Duodecimal abacus.

The abacus shown in Figure 13 seems at first rather common, but it is nevertheless unique in having twelve rows and twelve beads to a row. This abacus may have been designed to work in the duodecimal system, in which 12 takes the place of 10 as the base of the numeration system. It is possible that this particular abacus was issued by the Duodecimal Society of America, an organization founded in 1944 to promote a universal transition to the duodecimal system. The rationale for such a move is obvious: 12 has four proper divisors (2, 3, 4, and 6), whereas 10 has only two (2 and 5), making division in base 12 much easier than in base 10. However, considering that the decimal system is so firmly ingrained in our consciousness, a universal switch to base 12 seems highly unlikely.

Figure 14 shows a rather large abacus with an unusual layout: nine rows with 15 beads per row, of which ten are red and five yellow. The small chalk tray at the bottom of the frame indicates that this was a teaching device, perhaps used in a one-room school. And Figure 15 shows an even stranger abacus: it has three horizontal rows of 20 beads per row, and twelve vertical rows of ten beads per row. I am not sure if this abacus was a teaching aid or just a pretty toy; whatever its purpose, it became an unusual addition to my collection.

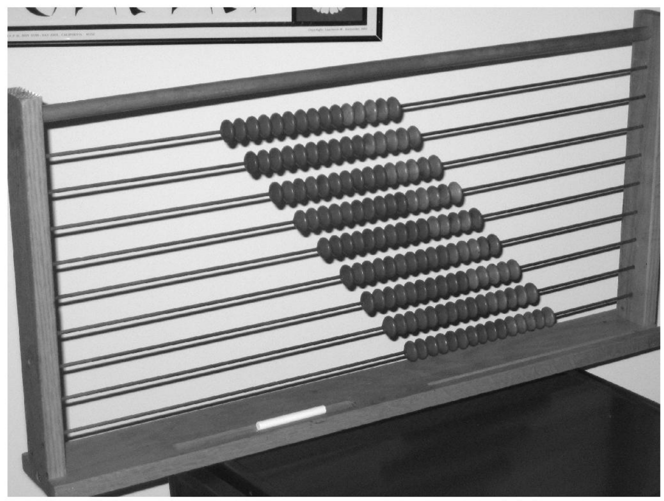

Figure 14. Large abacus with 9 rows of 15 beads per row.

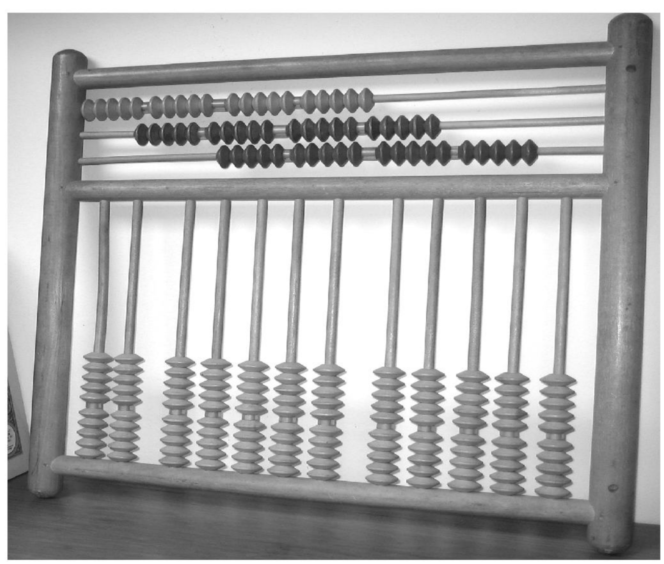

Figure 15. Abacus with 3 horizontal and 12 vertical rows.

Figures 16 and 17 show two examples of abaci as art objects. The first example is a Japanese "writing box" with a number of small drawers, obviously meant to store pencils, pens, or postage stamps; one drawer contains a surprise: a small, built-in 13-row abacus. The second example is a very large Chinese "double" abacus with 38 rows and a central board that divides the frame into two separate abaci facing each other. This abacus may have been designed as a decorative piece, as indicated by the cryptic message engraved on the central board; or perhaps it was meant as a kind of board game in which two contestants face each other and compete to do a series of calculations in the least time.

Figure 16. Japanese "writing box" with small abacus in drawer.

Figure 18. Greeting postcard for first day of school.

Abaci can have their whimsical side too, as shown on two postcards from the early years of the twentieth century (Figures 18 and 19). One is a greeting card for the first day of school; the other needs no explanation. They evidently were meant to ease a child's fear of the beginning of school, and the inevitable math class that would follow.

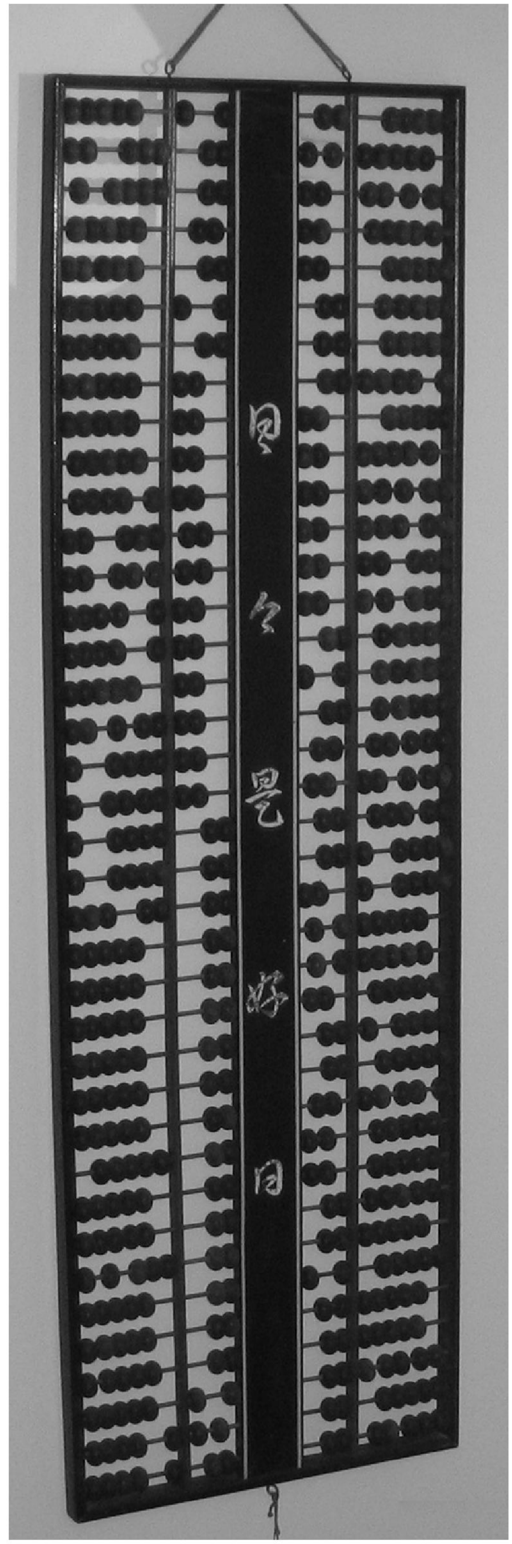

Figure 17. Chinese "double" abacus.

Figure 19. Who said math is boring?

Figure 20. Engraving showing a contest between an “abacist” and an “algorist”.

In Medieval Europe the abacus, or counting board, as it was often called, served as an “analog computer” with which the recently introduced base-ten numeration system was practiced. This system, with its new numeral zero, was invented by the Hindus around the ninth century CE and transported to Europe by Arabic merchants; hence it is known as the “Hindu-Arabic numeration system”. It enormously facilitated the art of computation, which previously relied on cumbersome Roman numerals. But it took several hundred years until the new system was universally adopted. The strange new numeral, zero, scared off many people, who could not understand how the addition of a zero—that is, “nothing”—at the end of a number would instantly multiply it tenfold. So merchants and accountants preferred to do their calculations on an abacus. Slowly, however, they began to accept the advantages of paper-and-pencil, “algorithmic” calculations. A famous engraving in an early encyclopedic work, *Margarita Philosophica* (“The Philosophic Pearl”) by Gregorius Reisch (Freiburg, 1503; see Figure 20) shows a contest between an “abacist” and an “algorist”. The judge is Miss Arithmetica, and the expressions on the faces of the two contestants leaves no doubt as to who is the winner.

Figure 21. Chinese school children practicing on a suan pan.

Figure 22. Japanese prize abacus with case and inscription.

A similar contest was held in Japan in 1950 between a local clerk using his abacus and an American GI who used an early model of an electric desktop calculator. Reportedly the Japanese won. And no wonder: the art of computing with the abacus had been a time-honored Oriental tradition, learned by every child at an early age and constantly being drilled at school (Figure 21). Moreover, applicants to certain professions had to pass an abacus proficiency test. Figure 22 shows an abacus in a case with hinged clamps and a prize certification that says, “In Commemoration of Soroban Contest Nov. 26 1949.

Minister of Postal Services, Ozawa." Ironically, it was Japan which in the 1970s introduced the first low-priced electronic calculators to the market, causing the quick demise of the abacus. Then as now, it was a struggle between the "New Math" and the old way of doing things.

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A bibliographical note: The literature on the history of the abacus is rather limited (in contrast to instruction books on how to use the abacus, of which there are many). I am aware of only two books on the subject: *The History of the Abacus* by J.M. Pullan (New York and Washington: Frederick A. Praeger, 1969) and *The Abacus: Its History; its design; its possibilities in the modern world* by Parry Moon (New York, London, and Paris: Gordon and Breach Science Publisher, 1971). Both are, unfortunately, out of print.

Eli Maor's Latest Book

The Pythagorean Theorem, Eli Maor, Princeton University Press, 2007, 259pp.

Oughtred Society Member Dr. Eli Maor has written a series of books extolling the virtues of mathematics. Check with Amazon for the current listing of his publications.

Before starting with a short review this book, let me acknowledge my biases on this subject: I love geometry and trigonometry: they are among the major mathematical building blocks in mathematics, engineering, physics, medicine, etc.

As math goes, the book is very accessible. And Professor Maor has made the subject and its long history a pleasure to read for anyone with, say, a high school education in mathematics.

He dates the origin of the Pythagorean theorem back to 1800 BCE. He does not discuss all of the many proofs of it since then (as I understand it, there are hundreds, including a recent one by a high school girl in the US).

reviewed by Bob Otnes

OS Member and author, Dr. Eli Maor.