Robert Record
(c. 1510 – 1558)

This essay gives a brief account of a passage from Robert Record's *The Ground of Artes*. Following a few biographical details, we locate Record's work relative to various mathematical traditions, comment on his work more generally and then move to consider the passage itself.

Born in Tenby, South Wales, Record earned his B.A. at Oxford in 1531 and, perhaps after teaching and further study there, his M.D. at Cambridge in 1545. Record went on to be an eminent medical doctor in London, and may even have been doctor to Edward VI and/or Mary I. From 1549, Record occupied important positions as controller of the Bristol mint and then as general surveyor of mines and monies in Ireland. In 1558, convicted of libel against Sir William Herbert, Record died in prison after failing to pay a fine of £1000.[1]

Convinced of the usefulness of mathematical knowledge and with a desire to spread that knowledge as widely as possible, Record became a key figure in the *vernacular tradition*, being one of the first to write mathematical works in English. Record also belongs to the *humanist* and *practical traditions*. While his works "emphasized reason over authority,"[2] they are not concerned with rigorously proving new theorems, but primarily with teaching useful mathematical techniques to his readers.

Record wrote four mathematical textbooks, *The Ground of Artes* (1543) on arithmetic, *The Pathway to Knowledge* (1551) on geometry, *The Castle of Knowledge* (1556) on astronomy and *The Whetstone of Witte* (1557) on algebra.[3] The use of the vernacular, along with his engaging style made Record's works unprecedentedly popular; *The Ground of Artes* went

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[1] For a more detailed account, see J.J. O'Connor and E.F. Robertson, "Robert Recorde" *The MacTutor History of Mathematics Archive* <http://www-history.mcs.st-andrews.ac.uk/history/Mathematicians/ Recorde.html> Accessed 17th May 2003.

[2] **SB** from the editors' introduction to 9.A, p. 276.

[3] He also wrote a medical treatise *The Urinal of Physick* (1547).

through some fifty printings, the last being in 1699, over 150 years after the book's first appearance.

Excepting *The Pathway to Knowledge*, these textbooks took the form of dialogues between scholar and master. Rather than using technical terms borrowed from other languages, Record invented his own, adapting words from ordinary English. While few of Record's terms are now in use, the modern equals sign "=" is derived from that appearing in *The Whetstone of Witte*.

The passage for discussion brings out further themes from Record's work. That passage comes from the 1552 edition of *The Ground of Artes*, and is reproduced under the heading "A Discussion of Sheep" at **SB** 9.A1(c), pp. 278-9. Interestingly, the passage is absent from some editions of the book, such as the 1660 version.

The passage opens as the scholar asks how many sheep may be kept on a 7000-acre farm if law requires that there be one acre of arable land for every 10 sheep, and one acre of pasture for every 4 sheep. The master returns the question to the scholar, who proceeds to his answer by the *method of double false position*, a method used by Leonardo of Pisa (Fibonacci) in *Liber Abbaci* (1202), and which probably came to Europe together with the Hindu-Arabic number system.[4]

This method, whose general validity is easily demonstrated, simplifies calculation by (initially) avoiding the use of fractions and may be used to solve any linear problem in one unknown. Furthermore, since any differentiable function approximately linear over sufficiently small intervals, the method can also be used to find approximate solutions to non-linear problems.

The method of double false position requires that two 'guesses' be made, from which the correct answer is then deduced. The student makes guesses of 500 and 1000 sheep, and

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[4] The method can also be found in the ancient (1st century?) Chinese text *Nine Chapters on the Mathematical Art* <http://www.math.sfu.ca/histmath/China/1stCenturyAD/NineChapIntro.html> Accessed 19th May 2003.

writing these numbers down, calculates that to keep this many sheep a farmer would need only 175 and 350 acres respectively. Noting that these figures are 'out' by some 6825 and 6650 acres, the scholar produces the following diagram.

500   1000

6825   6650
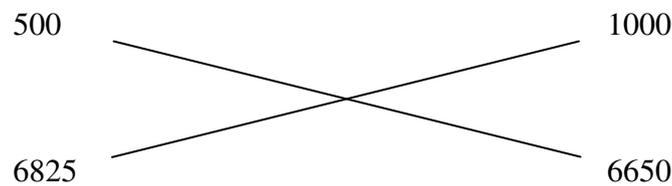
Multiplying the numbers joined by lines, the scholar then takes the lesser product from the greater. The result, 3500000, is divided by 175, the difference between the two errors. This gives 20000, the number of sheep that may be kept on a 7000-acre farm.

The scholar goes on to claim that under such laws many men might keep this many sheep, since many possess so much land. In reply, the master states that an area of 7000 acres is "in compas above 48 ¾ miles". While it is unclear how this last figure is derived (and therefore what is meant by 'in compas') the master clearly intends the figure to make apparent just how much land is 7000 acres, and on those grounds how unlikely it is that *many* men possess so much land.

Delaying the return to mathematics, the scholar comments that modern farmers possess far more sheep than did the shepherds that "the Egyptians did grudg so much against," and that breeding has made them so fierce that "none can withstande them but the lyon". Typically for Record, the point is not only humorously made, it is also politically loaded. Here he is objecting to the enclosure of the common land for the use of the landowner, a practice that prevented the poor from living off the land and led to 'Kett's rebellion' in 1549.

The passage closes with an editorial note stating that the master went on to explain an easier way to solve the problem. This was probably the *method of (single) false position*, used

by Egyptian mathematicians as early as 1800 BC.[5] Here we need to make only one initial guess, and we make it carefully to avoid the use of fractions. Since the imagined laws require that farmers keep no more than 10 sheep per acre of arable land, and 4 sheep per acre of pasture, we take the lowest common multiple of 10 and 4, namely 20. By an appropriate scaling, we quickly see that since 20 sheep require 7 acres of land, on 7000 acres we may keep 20000 sheep, which agrees with our previous answer.

Written in the vernacular, in dialogue form, and using examples carefully chosen for maximum impact, Record's textbooks were (and are) a pleasure to read. The unprecedented popularity of those textbooks was well deserved.

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[5] For example see problem 25 of the Rhind papyrus, **SB** 1.D2(a), p. 16.