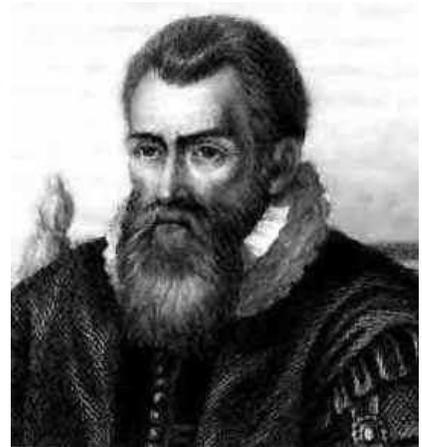


John Napier

The search for better methods of performing tedious calculations was the dream of many who struggled with time-consuming hand computations. **John Napier** (c. 1550 – April 4, 1617), a Scottish genius, theologian and amateur mathematician, had the imagination to invent logarithms for this purpose. His labor saving creations are described in *Mirifici Logarithmorum Canonis Descriptio* (1614, *Description of the Marvelous Canon of Logarithms*), and *Mirifici Logarithmorum Canonis Constructio* (*Construction of the Marvelous Canon of Logarithms*), published two years after his death.



Napier was born in Merchiston Estate Castle, Edinburgh, Scotland, which his family had owned from the 1430s. At various times the family name was spelled Napeir, Nepair, Nepeir, Neper, Napare, Naper, and Naipper. Our subject most commonly signed his name as Jhone Neper. About the only spelling not used during his lifetime is the present one. He was tutored at home until he matriculated at St. Salvator's College, University of St. Andrew's at age 13. He left without receiving a degree, a common practice among the nobility. At St. Andrew's he developed his interest in theology and became a champion of Protestantism. Thereafter he studied in Paris, Italy and Germany, before returning home in 1571 to marry and to cultivate his land. Napier became known as "Marvelous Merchiston" for inventing ingenious machines and new ways to fertilize soil, which produced more bountiful crops and greener grass.

Because of Napier's mathematical ability and his success with making his lands productive, some of his neighbors and servants suspected him of being a magician, although there seems to be no evidence of his involvement in occult practices. The story of how he discovered the identity of a thief among his servants must have contributed to the impression. To catch the culprit who had been pilfering tools from his supply shed, he covered his black rooster with lamp soot and put it in a dark shed. He then assembled his servants and told them that the black cock had the power of divination and would pick out the guilty party. Napier ordered each of his servants into the shed and told them to simply touch the bird. His hunch that the guilty party would not touch the cockerel proved correct. When he examined his servants, all but one had soot on their hands and the thief was unmasked.

Napier was greatly interested in astronomy, to such an extent that his research required lengthy and time-consuming calculations with very large numbers. He labored to simplify these, particularly those involving multiplications, which played such a major role in making astronomical computations. He discovered that there was a relationship between an arithmetical progression and a geometrical progression:

I	II	III	IV	V	VI	VII	VIII	...
1	2	4	8	16	32	64	128	256 ...

The table implied to Napier that, for instance, a number such as 100 which was between 64 and 128 in the geometrical progression corresponded to a number between VI and VII in the arithmetical progression. Over a period of time such observations led to his invention of logarithms – a device that replaces multiplication by addition. What is most amazing about Napier’s work is that it was accomplished before algebra, not much advanced at the time, could be of assistance. Today we know that a logarithm is an exponent, but these were unknown to Napier. They would not be introduced into algebra until much later. Napier introduced a geometric representation of ratio and proportion, imagining the movement of a point along a line such that the successive distances covered in equal intervals of time became less and less. He compared the distances on this line with the distances formed by a point moving along a line of infinite extent with no change in the spans covered in equal intervals of time.

Napier realized that the invention of logarithms was not complete until tables of logarithmic values were constructed showing powers of a fixed number as a base. Towards this end he developed the *Rabdologia*, or “Napier’s rods,” for use in multiplication. The name is derived from two Greek words, meaning “rod” and “word.” Although today Napier is most famous for his invention of logarithms, as far as his contemporaries were concerned his greatest contribution was these rods. They consist of a set of four sided rods on which are inscribed the multiplication tables. Each face of a rod [Figure 4.1] is the multiplication table for a specific digit, each engraved in a square with a top-right to bottom left diagonal separating the units digits of the result (in the right-hand triangle) and the carry digit to the left of the diagonal. The rods or “bones” (many sets were made from ivory, which made the rods look like bones) were placed side-by-side in a board with a rim to perform operations. Explanations and examples of performing operations with these Napier’s rods can be found in many sources, including *The Complete Home Learning Source Book* (1998) by Rebecca Rupp. By today’s standards the rods are a primitive calculator. Yet for a long time after their invention they were considered a major laborsaving device and they were still used in British schools at late as the 1960s to teach multiplication.

0	1	2	3	4	5	6	7	8	9	
0 0	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	1
0 0	0 2	0 4	0 6	0 8	1 0	1 2	1 4	1 6	1 8	2
0 0	0 3	0 6	0 9	1 2	1 5	1 8	2 1	2 4	2 7	3
0 0	0 4	0 8	1 2	1 6	2 0	2 4	2 8	3 2	3 6	4
0 0	0 5	1 0	1 5	2 0	2 5	3 0	3 5	4 0	4 5	5
0 0	0 6	1 2	1 8	2 4	3 0	3 6	4 2	4 8	5 4	6
0 0	0 7	1 4	2 1	2 8	3 5	4 2	4 9	5 6	6 3	7
0 0	0 8	1 6	2 4	3 2	4 0	4 8	5 6	6 4	7 2	8
0 0	0 9	1 8	2 7	3 6	4 5	5 4	6 3	7 2	8 1	9

Napier's Rods
Figure 4.1

During this period, many of Napier's contemporaries made stupendous efforts to display their skills at performing large-scale multiplications and divisions. Georg Joachim Reticus calculated the existing trigonometric tables of the day by excruciating and heroic computations. Some, like François Viète, took delight in making arithmetical calculations that took days to complete and which often served no useful purpose. Were it not for Napier's logarithms Johann Kepler and Sir Isaac Newton might have been unable to make the calculations leading to their considerable contributions to the sciences.

During the period of the Scottish Reformation, Napier became convinced that Spain planned to invade England and restore Catholicism as the state religion. His suspicions were reinforced with the sailing of the Spanish Armada in 1588. Even

England's rout of this force did not put his mind at ease. He railed at the Papacy and condemned the Church of Rome in his book *A Plain Discovery of the whole Revelation of Saint John* (1593). In his treatise, which he considered his greatest achievement, he demonstrated to his satisfaction that the Pope was the Antichrist and that the Almighty Creator planned to destroy the world sometime in the period 1688-1700. The book was extremely well received in the British Isles, running through twenty-one editions.

Napier sought practical means to help his country fight the forces of the Pope, pagans, and the Turks. He considered himself a latter day Archimedes defending Syracuse against the forces of the Roman general Marcellus. The Laird of Merchiston devised terrifying instruments of war, which "by the grace of God and work of expert craftsmen" he proposed to build "for defense of this Island." His plans included an artillery piece that was capable of "destroying everything round the arc of a circle," designed "to kill thirty thousand Turks without the hazard of one Christian." Napier anticipated certain modern weapons with a human-power metal chariot, a forerunner of a tank, and designed "devises for sailing under water, with divers other devises and stratagems for harming the enemies." None of Napier's grandiose ideas for destructive weapons were actually constructed but his plans for them still exist. Napier died suddenly – probably from gout, with which he had been long afflicted. Philosopher David Hume later wrote that Napier was, "a person to whom the title *great man* is more justly due than to any other whom his country ever produced."

Quotation of the Day: "Seeing there is nothing ... so troublesome to mathematical practice, nor that doth more molest and hinder calculators, than the multiplications, divisions, square and cubical extractions of great numbers, which besides the tedious expense of time are for the most part subject to slippery errors, I began therefore to consider in my mind by what certain and ready art I might remove those hindrances." – John Napier