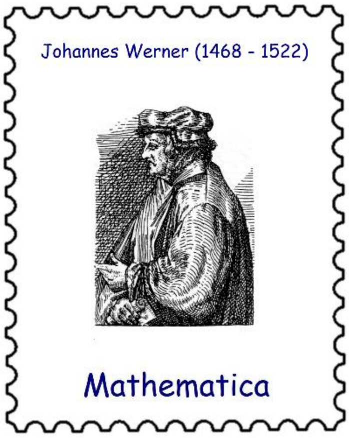
JOHANNES WERNER (February 14, 1468 – May 1522)

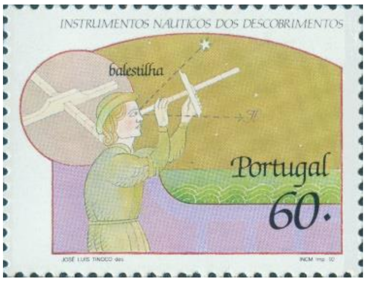
by HEINZ KLAUS STRICK, Germany



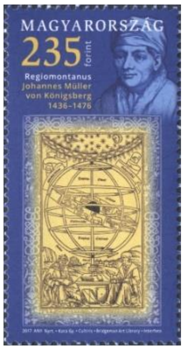
In 1472, Bavaria's first university was founded in Ingolstadt by Duke LUDWIG IX of Bavaria-Landshut. After the schism from 1530 onwards, the university developed into one of the centres of the Counter-Reformation under the influence of the Jesuit Order. Elector MAXIMILIAN, later Bavarian King MAXIMILIAN I, moved the university in 1800, first to Landshut, then to Munich - since 1802 it has borne its present name: LUDWIG MAXIMILIAN University (LMU).

In 1484, 16-year-old JOHANNES WERNER, born in Nuremberg, enrolled in the theological faculty of the Ingolstadt university. Even though he had wanted to become a mathematician from childhood, he now consistently pursued the path to becoming a priest and in 1490 he worked as a chaplain in Herzogenaurach, spent a few years in Rome, moved to a parish in Wöhrd near Nuremberg in 1498, and finally became the pastor of St John's Church in Nuremberg. He conscientiously fulfilled the duties of this office until his death.

WERNER had already used his time in Rome for intensive studies of mathematics and astronomy. When he returned to Nuremberg, he immersed himself in his own research. In 1500, for example, he observed the movement of a comet, made measurements with instruments he had built himself and documented all the data with care. With great skill he builds astrolabes (sidereal altimeters) and sundials, and constructs a special Jacob's staff with angle divisions.



In 1514 WERNER's translation of the *Geographia* of CLAUDIUS PTOLEMY (*In Hoc Opere Haec Continentur Nova Translatio Primi Libri Geographicae Cl. Ptolomaei*) was published.



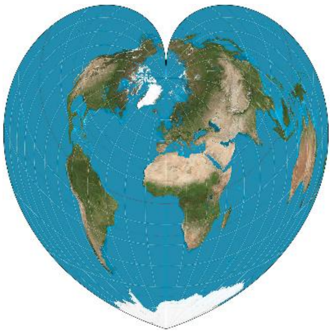
In addition to extensive commentaries, he developed his own ideas that could be applied in astronomy and geography. JOHANNES WERNER explained in his work how to determine the longitude of a place using measurements taken during a lunar eclipse (similar to REGIOMONTANUS in his *Ephemerides* from 1474).

He also developed a method for determining the true local time from the position of the moon in relation to the night sky and then calculating the longitude of the place of observation.

This idea was taken up in 1524 by Peter Apian (1495-1552, whose real name was Peter Bennewitz, from the latin *apis* = bee) in his work *Cosmographicus liber*. Apian did not refer to Werner's authorship, which was not unusual at that time. Apian became professor of mathematics in Ingolstadt in 1527. His work was continued by Gemma Frisius (1508-1555).

Around 1500, Johannes Stabius, professor of mathematics in Ingolstadt, from 1502 in Vienna, had developed a special projection method – it was the first to enable a true-to-surface representation of the globe. Although Martin Waldseemüller had already adopted this method for his famous world map in 1507, it was only through Werner's comments in the work published in 1514 that this heart-shaped projection became generally known.

Today it is called Stab-Werner projection in Germany while in other countries only Werner is named as the inventor of the method.



It is typical for his time that Werner – despite his priesthood – drew up horoscopes for wealthy citizens. In his weather forecasts he also relied on metereological observations, though some were more like horoscopes. For a fee, he translated the elements of Euclid into German and supplemented them with examples of applications. Above all, Werner dealt with conic sections and with problems of spherical trigonometry.

Around 1510 he discovered the relationship $2 \cdot \sin(\alpha) \cdot \sin(\beta) = \cos(\alpha - \beta) - \cos(\alpha + \beta)$;

In the English-speaking world, these and the analogously formed equations

$2 \cdot \cos(\alpha) \cdot \cos(\beta) = \cos(\alpha - \beta) + \cos(\alpha + \beta)$; $2 \cdot \sin(\alpha) \cdot \cos(\beta) = \sin(\alpha - \beta) + \sin(\alpha + \beta)$;
$2 \cdot \cos(\alpha) \cdot \sin(\beta) = \sin(\alpha + \beta) - \sin(\alpha - \beta)$ are referred to as Werner formulas.

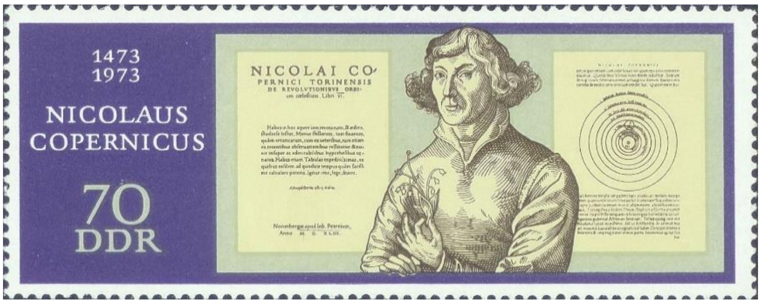
The extent to which Werner actually realised that this equation could also be used to replace the multiplication of two numbers by an addition or subtraction of numbers, see below, can no longer be fully clarified.

He did not find a publisher for the 4-volume work *Ioannis Verneri Norimbergensis de triangulis sphaericis* (Werner of Nuremberg on spherical triangles), but various copies came into circulation.

Werner's writings were given to Georg Joachim Rheticus in 1542, who had them printed in Krakow in 1557. Inspired by this, Rheticus decided to write a comprehensive work on trigonometry himself, including a table of the six trigonometric functions (*sin*, *cos*, *tan* and their reciprocal functions, with a step size of 10'').

However, these tables were not completed until decades after his death by his pupil VALENTIN OTHO and published in 1596 (*Opus palatinum de triangilis*).

RHETICUS was a pupil of NICOLAUS COPERNICUS and during his time in Frauenburg he was able to convince the latter to finally have his main work *De revolutionibus orbium coelestium* printed, which then took place in Nuremberg in 1543.



Around 1580, TYCHO BRAHE, together with PAUL WITTICH, developed the calculation method of *prosthaphaeresis* (Greek *prosthesis* = addition, *aphaeresis* = subtraction). Whether BRAHE found the equation required for this himself or whether he knew WERNER's manuscript can no longer be clarified.

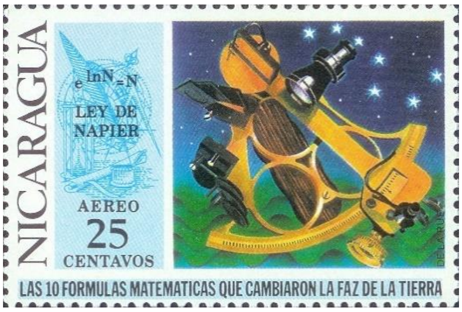
The Prosthaphaeresis Algorithm

To solve a multiplication problem, first divide the two factors by suitable powers of ten, then determine the corresponding angle with the help of a sine table and look up the cosine of the difference or sum angle; finally, multiply half the difference of the cosine values by the powers of ten chosen above. The accuracy of the result obviously depends on the quality and the number of digits of the trigonometric tables.

Prosthaphaeresis: Multiply $58 \cdot 237$	$\vert :100 \quad \vert :1000$			
Substitute task: $0.58 \cdot 0.237$	→	$\sin(\alpha) = 0.58 \Leftrightarrow \alpha \approx 35°27'2''$ $\sin(\beta) = 0.237 \Leftrightarrow \beta \approx 13°42'34''$	→	$\alpha - \beta \approx 21°44'28''$ $\alpha + \beta \approx 49°09'36''$ ↓
half the difference: 0.13746	←	$\cos(21°44'28'') - \cos(49°09'36'')$ $= 0.27492$	←	$\cos(21°44'28'') \approx 0.92887$ $\cos(49°09'36'') \approx 0.65395$
Solution: $0.13746 \cdot 100 \cdot 1000 = 13746$ (the result here is accurate in all places)				

The first book explaining the *Prosthaphaeresis* calculation method was published in 1588 by NICOLAUS REIMERS. He had visited BRAHE in 1584 at his observatory in Denmark and presumably immediately recognised the importance of the method. BRAHE was so incensed by the publication that he sued REIMERS and the legal disputes only ended with REIMERS' death.

The proof of the above equations was finally provided by Jost Bürgi, with whom Reimers worked for a time at the observatory in Kassel and for whom he translated the main work of Copernicus into German (as the latter did not know Latin).



It is hard to imagine today that the method of *prosthaphaeresis* was a labour-saving method for astronomical calculations; the period in which it was actually used spanned just 30 years – until John Napier invented logarithms in 1604, and this made calculations easier for the next 350 years.

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https://www.spektrum.de/wissen/johannes-werner-priester-und-mathematiker/1618070

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