Tartaglia (also Tartalea or Tartaia). Niccolò | Encyclopedia.com

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(*b*. Brescia, Italy, 1499 or 1500; *d*. Venice, Italy, 13 December 1557)

mathematics, mechanics, topography, military science.

The surname Tartaglia, which Niccolò always used, was a nickname given to him in his boyhood because of a speech impediment resulting from a wound in the mouth (*tartagliare* means "to stammer"). According to his will, dated 10 December 1557 and now in the Venice State Archives, he had a brother surnamed Fontana, and some historians have attributed that surname to Niccolò as well.

Tartaglia's father, Michele, a postal courier, died about 1506, leaving his widow and children in poverty. Six years later, during the sack of Brescia, Niccolò, while taking shelter in the cathedral, received five serious head wounds. It was only through the loving care of his mother that he recovered. At the age of about fourteen, he went to a Master Francesco to learn to write the alphabet; but by the time he reached "k," he was no longer able to pay the teacher. "From that day," he later wrote in a moving autobiographical sketch, "I never returned to a tutor, but continued to labor by myself over the works of dead men, accompanied only by the daughter of poverty that is called industry" (*Quesiti*, bk. **VI** , question 8).

Tartaglia began his mathematical studies at an early age and progressed quickly. He moved to Verona, probably sometime between 1516 and 1518, where he was employed as "teacher of the abacus." Certain documents dating from 1529–1533, preserved in the Verona section of the State Archives, testify that he had a family, that he was in reduced financial circumstances, and that he was in charge of a school in the Palazzo Mazzanti. In 1534 he moved to Venice, where he was "professor of mathematics." Tartaglia also gave public lessons in the Church of San Zanipolo (Santi Giovanni e Paolo). Nearly all his works were printed in Venice, where he remained for the rest of his life except for a return to Brescia for about eighteen months in 1548–1549. During this time he taught at Sant'Afra, San Barnaba, San Lorenzo, and at the academy of the nearby village of Rezzato. He died in Venice, poor and alone, in his dwelling in the Calle del Sturion near the Rialto Bridge.

The most important mathematical subject with which Tartaglia's name is linked is the solution of third-degree equations. The rule for solving them had been obtained by Scipione Ferro in the first or second decade of the sixteenth century but was not published at the time. It was rediscovered by Tartaglia in 1535, on the occasion of a mathematical contest with Antonio Maria Fiore, a pupil of Ferro: but Tartaglia did not publish it either. On 25 March 1539, Tartaglia told Girolamo Cardano about it at the latter's house in Milan. Although Cardano had persistently requested the rule and swore not to divulge it, he included it in his *Ars magna* (1545), crediting Ferro and Tartaglia. This breach of promise angered Tartaglia; and in the *Quesiti* (bk. **IX**), he presented his own research on third-degree equations and his relations with Cardano, whom hediscussed in offensive language.

Lodovico Ferrari, who devised the solution of fourth-degree equations, rose to Cardano's defense and sent a notice (*cartello*) of mathematical challenge to Tartaglia. Between 10 February 1547 and 24 July 1548 they exchanged twelve printed brochures (Ferrari's six *Cartelli* and Tartaglia's six *Risposte*, all usually known as *Cartelli*), which are important for their scientific content and are notable for both polemical liveliness and bibliographical rarity. The exchange was followed by a debate between Tartaglia and Ferrari in the Church of Santa Maria del Giardino, in Milan, on 10 August 1548. The scientific portion of the dispute consisted of the solution of sixty-two problems that the two contestants had posed to each other. Although centering mainly on arithmetic, algebra, and geometry, the questions also dealt with geography, astronomy, architecture, gnomonics, and optics. They offer a vivid picture of the state ofthe exact sciences in mid-sixteenth-century Italy.

Tartaglia's other mathematical contributions concern fundamentals of arithmetic, numerical calculations, extraction of roots, rationalization of denominators, combinatorial analysis, and various other problems that are now considered quaint and amusing. "Tartaglia's triangle," the triangular array of binomial coefficients also known as "Pascal's triangle," is found in the *General trattato* (pt. **II** [1556]) but also appears in earlier works by other authors, although in a different configuration.

The *Cartelli* also contain an extreme-value problem proposed by Ferrari that Tartaglia solved without including the relevant demonstration.

In geometry Tartaglia was a pioneer in calculating the volume of a tetrahedron from the lengths of its sides and in inscribing within a triangle three circles tangent to one another (now called Malfatti's problem). In the *Cartelli* Ferrari and Tartaglia

contributed to the theory of division of areas and especially to the geometry of the compass with fixed opening—subjects to which Tartaglia returned in the *General trattato*. Of special importance to geometry, as well as to other fields, was Tartaglia's Italian translation, with commentary, of Euclid's *Elements* (1543), the first printed translation of the work into any modern language.

Tartaglia's contribution to the diffusion of the works of the great classical scientists was not confined to this translation, however. One of the first publishers of Archimedes, he produced an edition (1543) of William of Moerbeke's thirteenth-century Latin version of some of Archimedes' works. Tartaglia returned to Archimedes in 1551, publishing an Italian translation, with commentary, of part of Book I of *De insidentibus aquae* that was included in the *Ragionamento primo* on the *Travagliata inventione*. Material left by Tartaglia provided the basis for Curtius Troianus' publication in 1565 of De *insidentibus aquae* (books **I** and **II**) and of Jordanus de Nemore's *Opusculum de ponderositate*. The latter work, entitled *Liber Jordani de ratione ponderis* in various thirteenth-century manuscripts, is important in the history of mechanics because it contains the first correct solution of the problem of the equilibrium of a heavy body on an inclined plane. (Tartaglia had also published such a solution in the *Quesiti*.)

Yet, despite these contributions to the dissemination of knowledge, Tartaglia drew criticism–sharp at times– by apparently presenting William of Moerbeke's translation as his own, by not crediting Jordanus with the solution of the inclined plane problem, and by proposing in the *Travagliata inventione* a procedure mentioned by others for raising submerged ships. Any unbiased judgment must take into consideration that an extremely easygoing attitude then obtained with regard to literary property.

Tartaglia's contributions to the art of warfare aroused widespread and lasting interest, and the broad range of his competence in nonmathematical areas is also demonstrated in the *Quesiti*. In this work Tartaglia dealt with algebraic and geometric material (including the solution of the cubic equation), and such varied subjects as the firing of artillery, cannonballs, gunpowder, the disposition of infantry, topographical surveying, equilibrium in balances, and statics. His various proposals on fortifications were praised by Carlo Promis. In his attempts at a theoretical study of the motion of a projectile–a study in which he was a pioneer–Tartaglia reached the following notable conclusions: the trajectory is a curved line everywhere; and the maximum range, for any given value of the initial speed of the projectile, is obtained with a firing elevation of 45°. The latter result was obtained through an erroneous argument, but the proposition is correct (in a vacuum) and might well be called Tartaglia's theorem. In ballistics Tartaglia also proposed new ideas, methods, and instruments, important among which are "firing tables."

Problems of gunnery led Tartaglia, in *Nova scientia*, to suggest two instruments for determining inaccessible heights and distances. The historian Pietro Riccardi considered them "the first telemeters" and cited their related theories as "the first attempts at modern tachymetry." In the *Quesiti*, Tartaglia showed how to apply the compass to surveying, and in the *General trattato* he presented the first theory of the surveyor's cross. Hence Riccardi also asserted that he was responsible for "the major advances in practical geometry of the first half of the sixteenth century."

Tartaglia's attitude toward military matters is shown in his letter dedicating *Nova scientia* to Francesco Maria della Rovere, duke of Urbino; the letter eloquently demonstrates his discreet reticence and effectively reflects his ethical qualities.

The short work *Travagliata inventione* deals not only with raising sunken ships but also with diving suits, weather forecasting, and specific weights. Tartaglia's experiments on the latter are described in Jordanus de Nemore's *De ponderositate*.

Tartaglia's pupils included the English gentleman Richard Wentworth, who was probably the author of an Italian manuscript now at Oxford (Bodleian Library, MS 584), in which Tartaglia is mentioned several times; Giovanni Antonio Rusconi, author of a book on architecture (Venice, 1540); Maffeo Poveiano, author of a work on arithmetic (Bergamo, 1582); and the mathematician and philosopher Giovanni Battista Benedetti, who in his noted work on the geometry of the compass with fixed opening (Venice, 1553) stated that he began the study of Euclid with Tartaglia.

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2. The new eds. of Thomas Salusbury's seventeenth-century versions of *Travagliata inventione* with *Ragionamenti* and *Supplimento*, and *Archimedis De insidentibus aquae*, in *Mathematical Collections and Translations. In Two Tomes by Thomas Salusbury. London 1661 and 1665* in facs., with analytical and biobibliographical intro. by Stillman Drake (London–Los Angeles, 1967), II, 331–402, 479–516.

3. The English versions, by Stillman Drake, of long excerpts concerning mechanics, from *Nova scientia* and the *Quesiti*, in *Mechanics in Sixteenth-Century Italy*, selections from Tartaglia *et al*., translated and annotated by S. Drake and I. E. Drabkin (Madison, Wis., 1969), 61–143.

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