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(*b*. Lübeck, Germany, 22 October 1587; *d*. Hamburg, Germany, 23 September 1657)

natural science, mathematics, logic.

Jungius was the son of Nicolaus Junge, a professor at the Gymnasium St. Katharinen in Lübeck who died in 1589, and Brigitte Holdmann, who later married Martin Nortmann, another professor at St. Katharinen. Jungius attended that Gymnasium, where he commented on the *Dialectic* of Petrus Ramus, as well as writing on logic and composing poetry, then entered the Faculty of Arts of the University of Rostock in May 1606.

At Rostock Jungius studied with Johann Sleker, from whom he learned metaphysics in the tradition of Francisco Suarez and his school. In general, however, he preferred to concentrate on mathematics and logic. In May 1608 Jungius went to the new University of Giessen to continue his studies. He took the M.A. at Giessen on 22 December 1608, and remained there until 1614 as professor of those disciplines then generally designated as mathematics. His inaugural dissertation was the famous oration on the didactic significance, advantage, and usefulness of mathematics for all disciplines, which he later repeated at Rostock and Hamburg and which revealed the idea that guided his lifework. He arde3ntly pursued mathematical studies. He copied a book by F. Viète, although which one is not known, and in 1612 and 1613, while on a journey to Frankfurt, observed sunspots, the existence of which had been confirmed by Johann Fabricius and Christoph Scheiner.

At this time Jungius was attracted to pedagogy. In 1612 he traveled to Frankfurt with Christoph Helvich of the University of Giessen to attend the coronation of the emperor Matthias; there he met Wolfgang Ratke, who was trying to revive the "Lehrkunst". Jungius resigned his post at Giessen in 1614 and devoted himself to educational reform in Augsburg and Erfurt, but by the time of his return to Lübeck, on 27 July 1615, he had changed his mind in favor of the natural Sciences. He began to study medicine at the University of Rostock in August 1616 and received the M.D. at Padua on 1 January 1619.

The years between 1619 and 1629 were a peak in Jungius'scientific life. He deepened his knowledge in the natural sciences while practicing medicine at Lübeck (1619-1623) and at Brunswick and Wolfenbüttel (1625) and during his tenure as a professor of medicine at the University of Helmstedt. He improved his abilities in mathematics as a professor of mathematics at Rostock in 1624—1625 and again from 1626 until 1628. He utilized this practical experience in the intensive private research that he conducted at the same time. This is particularly apparent in his "Protonoeticae philosophiae sciagraphia" and in his "Heuretica". In addition, he founded in about 1623 the Socientas Ereunetica, a short-lived group dedicated to scientific research and perhaps modeled on the Accademia dei Lincei, with which Jungius had become acquainted in Italy. Finally, he was appointed professor of natural science and rector of the Akademisches Gymnasium at Humburg, a post he held until his death.

Two tragic features characterized this last period of Jungius' life. His wife, Catharina, the daughter of Valentin Havemann of Rostock, whom he had married on 10 February 1624, died on 16 June 1638. During the 1630's, too, he became subject to the envy of his colleagues and even to attacks by the clergy, despite his devout Protestantism. He was thereafter reluctant to publish his writings and left some 75,000 pages in manuscript at the time of his death, of which two-thirds were destroyed in a fire in 1691, while the remainder have been little studied. Indeed, the primary source of Jungius' influence on his disciples and contemporaries must be sought in his correspondence and in his composition of some forty disputations.

Jungius tried to apply his mathematical training in two ways. First, he used it to solve problems, as, for example, in proving that the catenary is not, as Galileo had assumed, a parabola. Many of his problems in arithmetic and geometry, including those set out in his *Geometria numerosa* and *Mathesis specialis*, have not been found. He was one of the first to use exponents to represent powers. His experiments and views on the laws of motion are also mathematical in nature, as was explicit in the *Phoranomica*, which in part set out the instruction given by Jungius to Charles Cavendysshe, Jr., of Newcastle-upon-Tyne, when the latter mathematician was staying at Hamburg, from 8 July 1644 to February 1645, as a refugee from Cromwell's regime. In this complete, but lost, *Phoranomica* Jungius also wrote on such topics as "De impetu," "De intensione motus" (on velocity), "De tempore," and "De tendentia motuum." A specimen of this work, containing the titles of single chapters, was sent to the Royal Society of London in December 1669. Astronomy was at that time comprised in mathematics, and an account of Jungius' observations of the variable star Mira (Omicron) Ceti, made in 1647, was also sent to the Royal Society by Heinrich Sivers in a letter of 23 June 1673. While Jungius made other astronomical observations and calculations, they remained unpublished, as did his optical researches.

Second, Jungius used mathematics as a model on which to base a theory of science in general. He outlined this principle in the "Protonoeticae Philosophiae sciagraphia," of which a copy was sent by Samuel Hartlib to Robert Boyle in 1654. In this paper and in his orations in praise of mathematics and his ";Analysis heuretica," Jungius worked out a scientific method analogous to the mathematical mode of proof that he called "ecthesis." These works were composed more than eight years before Descartes's *Discours* appeared. In other writings Jungius rejected such Scholastic devices as single syllogisms and consequences and advocated the "clear and distinct" methodological principle of Galen. He further elaborated a theory of mathematical operations ("Zeteica") that continued in more detail the "general mathematics" of the school of Proclus, Conrad Dasypodius, and Johann Heinrich Alsted. Jungius thought that this methodology was closely connected with the logical doctrine of proof that he presented in 1638 in the fourth book of his *Logica Hamburgensis*, in which he for the first time also treated such mathematical principles as "problems, "regulas," and "theorems" abandoned distinctions in favor of exact nominal definitions; recommended a "geometric style" ("stylus protonoeticus"); and defined a systematic science ("scientia totalis"). His method of scientific inference as here set forth was based upon "demonstrations" from principles (including definitions) and upon both complete and incomplete induction.

Jungius' taste for systematizing led him to morphological studies in botany and to a corpuscular theory of chemistry, among other things. All his arguments were based on observations that he put in writing as "protonoetical papers." In botany he built his system on what Andrea Cesalpino had defined as plant morphology; some of his work was incorporated by John Ray in *Catalogus plantarum circa Cantabrigiam nascentium* (1660) and was communicated to the Royal Society of London by John Beale on 6 May 1663.

Jungius' chemical system was elaborated before 1630 and was published in two *Disputationes* (1642) and in the *Doxoscopiae physicae minores* (1662). It was based upon planned experiment and closely related to the medical tradition of the corpuscular hypothesis, as opposed to atomism. Jungius explained the apparent homogeneity of a natural body, the mechanism of chemical reaction, and the conservation of matter and weight through the assumption of invisible particelucidate the precipitation of copper elucidate the prescipitation of copper by iron in solution as an exchange of individual particles at the metal and in the solution, as opposed to the "transubstantiation" suggested by Andreas Libavius, the mere extraction from solution proposed by Nicolas Guibert and Angelo Sala, and "the simple disappearance of iron particles in the solution postulated" by J. B. van Helmont.

Jungius stressed that the parts of a body should be reducible to their original states with the same weights that they had originally had. In keeping with his analytical point of view he defined an element a posteriori, that is as experimentally separable. He found that gold, silver, sulfur, mercury, saltpeter, common salt, soda, and some other substances had existed as discrete elements before separation. He distinguished the bodies arrived at after separation, that is, those "exactly simple bodies," from the substantial parts, that is, "elements," in the natural body. He chose to emphasize the former, and stated that each consisted of like particles—although he did not specify how the particles of one such exactly simple body might be told from those of another. He further recognized spontaneous reactions, but referred them to attraction, and so he did not believe that any motion is inherent to the corpuscles. Like Galileo, he tried to objectify the properties of bodies and studied the transitions between their solid, liquid, and vapor phases. He was opposed to the Peripatetic notions of substantial forms and inseparable matter and fought strongly against the ideas of inherent qualities and a single principle of combustion.

Jungius'systems for botany and chemistry—cited here as an example—were products of his methodological program for all sciences, with its emphasis on observation and mathematical demonstration.

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