# Christian Johann Doppler | Encyclopedia.com

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(*b*. Salzburg, Austria, 29 November 1803; *d*. Venice, Italy, 17 March 1853)

*mathematics, physics, astronomy*.

Christian Doppler was the son of a noted master stonemason. Although he showed talent in this craft, his poor health led his father to plan a career in business for him. Doppler’s mathematical abilities were recognized by the astronomer and geodesist Simon Stampfer, at whose advice Doppler attended the Polytechnic Institute in Vienna from 1822 to 1825. Finding the curriculum too one-sided, Doppler returned to Salzburg and pursued his studies privately. He completed the Gymnasium and subsequent philosophical courses in an unusually short time, while tutoring in mathematics and physics. From 1829 to 1833 he was employed as a mathematical assistant in Vienna, and wrote his first papers on mathematics and electricity. In 1835 Doppler was on the point of emigrating to America; he had sold his possessions and had reached Munich when he obtained a position as professor of mathematics and accounting at the State Secondary School in Prague. In 1841 he became professor of elementary mathematics and practical geometry at the State Technical Academy there, during the tenure of which he enunciated his famous principle. He had become an associate member of the Königliche Böhmische Gesellschaft der Wissenschaften in Prague in 1840 and was made a full member in 1843. Doppler moved to the Mining Academy at Schemnitz (Banská Štiavnica) in 1847 as *Bergrat* and professor of mathematics, physics, and mechanics. As a result of the turbulence of 1848–1849 he returned to Vienna; there, in 1850, he became director of the new Physical Institute, which was founded for the training of teachers, and full professor of experimental physics at the Royal Imperial University of Vienna, the first such position to exist in Austria. Doppler had suffered from lung disease since his years at Prague. A trip to Venice in 1852 was of no avail, and he died there the following year, survived by his wife and five children.

Doppler’s scientific fame rests on his enunciation of the Doppler principle, which relates the observed frequency of a wave to the motion of the source or the observer relative to the medium in which the wave is propagated. This appears in his article “Ueber das farbige Licht der Doppelsterne und einiger anderer Gestirne des Himmels” (read 25 May 1842). The correct elementary formula is derived for motion of source or of observer along the line between them; the extension to the motion of both at the same time appears in an article of 1846. Doppler mentions the application of this result both to acoustics and to optics, particularly to the colored appearance of double stars and to the fluctuations of variable stars and novae. The reasoning in the latter arguments was not always very cogent; for example, he believed that all stars were intrinsically white and emitted only or mainly in the visible spectrum. The colors which he believed to be characteristic of double stars, then, were to have their origin in the Doppler effect. It should be noted that Doppler worked under rather isolated circumstances, being the earliest important physicist in Austria in the nineteenth century. He was unable to justify in his own mind the application of his principle to transverse vibrations of light, an extension performed by B. Bolzano shortly afterwards.

The first experimental verification of the acoustical Doppler effect was performed by Buys Ballot at Utrecht in 1845, using a locomotive drawing an open car with several trumpeters. Buys Ballot also criticized the unsound assumptions upon which Doppler had based his astronomical applications. Doppler replied to these and similar criticisms in a rather stubborn and unconvincing fashion. The acoustical effect was also noted and commented on at the British Association meeting in 1848 by John Scott Russell and by H. Fizeau in the same year, perhaps without knowledge of Doppler’s work. Fizeau pointed to the usefulness of observing spectral line shifts in the application to astronomy, a point of such importance that the principle is sometimes called the Doppler-Fizeau principle. Although in 1850 the Italian astronomer Benedict Sestini had published data on star colors apparently supporting Doppler’s application of his principle to double stars, its valid astronomical use had to wait until proper spectroscopic instrumentation was available, beginning with the work of the English astronomer William Huggins in 1868. The optical effect was first confirmed terrestrially by Belopolsky in 1901. Modified by relativity theory, the Doppler principle has become a major astronomical tool.

Doppler’s principle itself was criticized by the Austrian mathematician Joseph Petzval in 1852, on the basis of an incorrect mathematical argument. Doppler defended himself to good effect in this situation. Doppler also published works of less importance on related optical effects (Bradley’s aberration of light; dependence of intensity on the motion of the source; the deviation of waves by a rotating medium, as, for example, an ethereal atmosphere rotating with a star), optical instruments, and topics in mathematics and physics, especially in geometry, optics, and electricity.

# BIBLIOGRAPHY

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II. Secondary Literature. See the obituary by Anton Schrötter in *Almanach der Kaiserlichen Akademie der Wissenschaften*, **4** (1854), 112–120; further information appears in Julius Scheiner, “Johann Christian Doppler und das nach ihm benannte Prinzip,” in *Himmel und Erde*, **8** (1896), 260–271. Some of his ideas and accomplishments are described in B. Bolzano, “Christ. Doppler’s neueste Leistungen auf dem Gebiete der physikalischen Apparatenlehre, Akustik, Optik und optischen Astronomie,” in *Annalen der Physik und Chemie*, **72** (1847), 530–555.

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