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(*b*. Lausen, BaselLand, Switzerland, 1 May 1825; *d*. Basel, Switzerland, 12 March 1898)

mathematics, *physics*.

Balmer was the oldest son of Chief Justice Johann Jacab Balmer and Elisabeth Rolle Balmer. He attended the district school in Liestal and the secondary school in Basel, studied mathematics at Karlsruhe and Berlin, and was granted a doctorate at Basel in 1849 with a dissertation on the cycloid. In 1868 he married Christine Pauline Rinck, who bore him six children. He taught at the girls' secondary school in Basel from 1859 until his death, and from 1865 to 1890 he also held a part-time lectureship at the University of Basel. His major field of professional interest was geometry; spectral series, the topic of his most noted contribution, was an area in which he became involved only late in life.

The earliest attempts to establish relationships between the observed lines of an elementary spectrum were organized primarily within the theoretical context of a mechanical acoustical analogy. May investigators attempted to establish simple harmonic ratios, but in 1881 Arthur Schuster demonstrated the inadequacy of this approach. The essentially successful mathematical organization of the data began in 1885 with Balmer's presentation of the formula $\lambda = hm^2/(m^2-n^2)$ for the hydrogen series, This formula could be used to generate, with considerable accuracy, the wavelengths of the known characteristic spectual lines for hydrogen when $n = 2, h = 3645.6 \times 10^{-8}$cm., and $m = 3,4,5,6,...$successively.

Initially, Balmer knew only Angström's measurements for the first four visible hydrogen lines, but he calculated the next, or fifth, result of the formula using $m = 7$, obtaining the wavelength of a line that, if it existed, would be barely on the edge of the visible spectrum. Jakob Edward Hagenbach-Bischoff, a friend and colleague at the University of Basel who had stimulated his interest in this topic, informed him that this fifth line had been observed, and that a number of other hydrogen lines had been measured. Comparisons between the calculated results obtained using Balmer's formula for these lines and the observed values showed close agreement, differences being at most approximately one part in one thousand. Later investigators demonstrated that the formula, with a slightly altered constant, represented the whole series, including additional lines, with unusual accuracy. Balmer speculated that values for other hydrogen series in the ultraviolet and infrared regions would be generated if n were assigned integer values other than two. Such predicted series were experimentally found later and are known as the Lyman, Paschen, Brackett, and Pfund series.

Balmer's relationship was so different from the simple harmonic ratios expected on the acoustical analogy, that investigators were bewildered as to what sort of mechanism could produce such lines. In spite of this disturbing feature, Balmer's work served as a model for other series formulas, especially the more generalized formulas of Johannes Robert Rydberg (1854-1919), Heinrich Kayser (1853-1940), and Carl Runge (1856-1927). Balmer published only one further paper on spectra, in which he extended his considerations to the spectra of several other elements (1897).

BIBLIOGRAPHY

1. Original Works. Balmer's major article on the hydrogen spectrum is "Notiz ūber die Spektrallinien des Wasserstoffs," in *Verhandlungen der Naturforschenden Gesellschaft in Basel,***7** (1885), 548-560, 750-752; also in *Annalen der Physik*, 3rd ser., **25** (1885), 80-87. His second and only other spectral article is "Eine neue Formal fÜr Spectralwellen." in *Verhandlungen der Naturforschenden Gasellchaft in Basel*, **11** (1897),448-463: and in *Annalen der Phisk*, 3rd ser., **60** (1897), 380-391. It is also available in *Astrophysical Journal,***5** (1897), 199-209. A short note of historical interest is Jakob Edward Hagenbach-Bischoff's "Balmer'sche Formal FÜr Wassertofflinien," in *Verhandiungen der Naturforshenden Gesellshcft in Basel*, 8 (1980), 242.

II Secondary Litterature. For discussions on aspects of Balmer's life and works, see August Hagenbach, "J. J. Balmer's und W. Ritz." in *Die Naturwissenschaften*, **9** (1921), 451-455, and "Johnson Jakob Balmer," in Edward Futere ed., *Grosse Schwelzer Forescher* (Zurich, 1939), pp. 248-249; L. Hartmann, "Johnson Jakob Balmer," in Physikalische Blätter, **5** (1949), 11-14; and Eduard His, "Johann Jockob Balmer," in *Baster Gelehere des 19. Jahrhunderts* (Basel. 1941), pp. 213-217,

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