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(*b*. St. Peter, near Klagenfurt, Austria, 24 March 1835; *d*. Vienna, Austria, 7 January 1893)

physics.

Stefan's parents were of Slovene origin. An excellent student at the elementary school and later the Gymnasium in Klagenfurt, he enrolled at the University of Vienna in 1853 and became a *realschule* teacher there four years later. He worked with Carl Ludwig, in the latter's laboratory, on the flow of water through tubes. In 1858 he qualified as lecturer at the University of Vienna. He became full professor of higher mathematics and physics in 1863, and three years later was appointed director of the Institute for Experimental Physics, founded by Doppler in 1850. Stefan was a brilliant experimenter and a well-liked teacher. He was dean of the Philosophical Faculty in 1869–1870 and *rector magnificus* in 1876–1877. In 1860 he became a corresponding member, and in 1865 member, of the Imperial Academy of Sciences. He was named secretary of the mathematics-sciences. He was named secretary of the mathematics-science class of the academy in 1875 and served as vice-president from 1885 until his death. In 1883 he presided over the scientific commission of the International Electricity Exhibition in Vienna. Two years later he held the same position at the International Conference on Musical Pitch in Vienna. He also belonged to several foreign scientific academies, held numerous Austrian and foreign honors, and was both royal and imperial privy councillor.

Stefan's most important work deals with heat radiation (1879). Newton had stated a priori a law of cooling for the temperature loss of incandescent iron in a constant stream of air, and Richmann had restated it in the following form: The speed of cooling is proportional to the difference in temperature between the heated body and the surrounding atmosphere. In equal periods of time, Newton stated, equal quantities of air are heated by quantities of heat proportional of air are heated by quantities of heat proportional to those that they remove from the iron (*Opuscula* [1744], II, 423). G. W. Krafft and Richmann verified this law for temperature differences up to 40° or 50°. Yet as early as 1740 George Martine the younger and others realized its inaccuracy and attempted to replace it with another law according to which the heat losses increased more rapidly.

Nevertheless, physicists still considered Newton's law to be exact. Dalton sought to save it by introducing a new temperature scale. F. Delaroche was aware that the heat losses due to radiation increase much more rapidly than in proportion to the temperature difference, but he did not isolate the radiation from the other heat losses–as Dulong and Petit attempted to do. For radiation in empty space they propounded a rather more complicated law, introducing an absolute temperature scale and extending Newton's law. As was later seen, however, their law also possessed only limited validity and did not agree with measured results even up to 300°C. A. Wüllner remarked in his *Lehrbuch der Experimentalphysik:*... "the quantity of heat emitted increases considerably more quickly than does the temperature, especially at higher temperatures." This followed from Tyndall's experiments on the radiation of a platinum wire heated to incandescence by an electric current. From the weak red glow (about 525°C.) up to the full white glow (about 1200°C.), the intensity of the radiation increases almost twelvefold, from 10.4 to 122 (exactly 11.7-fold).

"This observation," Stefan said, "caused me at first to take the heat radiation as proportional to the fourth power of the absolute temperature." (The ratio of the absolute temperatures 273 + 1200 and 273 + 525 yields, in the fourth power, 11.6.) By means of a thorough discussion of the experiments of Dulong and Petit and of other researchers, Stefan showed that this formula agreed with the results of measurements in all temperature ranges. The theoretical deduction of this relationship was first achieved in 1884 by Boltzmann, who also recognized that it is exact only for completely black bodies (Stefan-Boltzmann law of radiation). Moreover, with the aid of his new formula Stefan could calculate, on the basis of Pouillet's and Violle's actinometric observations, a value for the surface temperature of the sun–approximately 6000°C.

Other important work by Stefan concerns heat conduction in gases, a subject on which reliable measurements were lacking because of extreme experimental difficulties. For this purpose Stefan devised a "diathermometer," which was widely used to measure the heat conductivity of clothing materials. His measurements agreed fairly well with those calculated on the basis of the kinetic theory of gases, especially in the cases of air and hydrogen. Stefan explained the variations as resulting from the movements of the atoms against each other within the molecules. He resumed his investigations on heat conduction in 1876 and 1889. In analogous work on the diffusion of gases (1871, 1872), he calculated the theoretical coefficients of diffusion and of friction and their dependence on the absolute temperature, showing that the calculated values were in agreement with experimental results obtained by Maxwell, Graham, and J. Loschmidt. He also demonstrated that the apparent adhesion of two glass plates is a hydrodynamic phenomenon (1874).

Stefan published further experimental and theoretical works on the kinetic theory of heat: on evaporation (1873, 1881); on heat conduction in fluids, on ice formation, on dissolving (1889); and on diffusion of and in fluids (1878, 1879); and especially on the relationship between surface tension and evaporation, which included "Stefan's number" and "Stefan's law" (1886). He also published many works on acoustics.

In the theory of the mutual magnetic effects of two electric circuits, Stefan succeeded in showing, in opposition to Ampère and Grassmann, that clear results can be achieved only by means of the theory of continuous action. Stefan and Helmholtz were then the the only Continental proponents of the Faraday-Maxwell theory of continuous action. Stefan, in fact, made important calculations in the theory of alternating currents, especially regarding the induction coefficients of wire coils. Many of his experimental and theoretical works dealt with difficult and subtle problems in physics–for example, the discovery of the secondary rings in Newton's experiments and other optical problems.

At the International Conference on Musical Pitch, held at Vienna in 1885 (over which Stefan presided), the proposals of the Austrian commission of experts were generally adopted in central and eastern Europe; the standard pitch was established at 435 cycles per second (as had already been done in France in 1859 and in Austria in 1862). For the production of this tone the conference prescribed, according to Stefan's account, the standard tuning fork constructed to replicate the tuning forks of K. R. König.

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For Wüllner's remarks on heat emission, see his *Lehrbuch der Experimentalphysik*, 3rd ed., III (Leipzig, 1875), 214–215.

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