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PLATEAU, JOSEPH ANTOINE FERDINAND (*b*. Brussels, Belgium, 14 October 1801; *d*. Ghent, Belgium, 15 September 1883), *physics, visual perception*.

Plateau was one of the best-known Belgian scientists of the nineteenth century. The son of an artist, he received his early education at schools in Brussels. In 1822 he entered the University of Lix00E8;ge as a student in the law faculty. He became interested in science; and in 1824, after he received a diploma in law, he enrolled as a candidate for an advanced degree in the physical sciences and mathematics.

Since Plateau had been orphaned at the age of fourteen, he had to support himself during his studies by serving as professor of elementary mathematics at the *athénée* in Liège. He received his *docteur ès sciences* in 1829 and the following year returned to Brussels, where he became professor of physics at the Institut Gaggia, then one of the most important teaching institutions in Belgium. In 1835 he was called to the State University of Ghent, as professor of experimental physics. He accepted the offer, and in 1844 became *professeur ordinaire*—a post that he held until his retirement in 1872. He was a successful teacher and was also active in organizing the physics laboratory at the university.

In 1834 Plateau was elected a corresponding member of the Royal Academy of Belgium and in 1836 a full member. He was also a member of a large number of foreign scientific organizations, including the Institut de France, the royal academies of Berlin and Amsterdam, and the Royal Society. In Belgium his honors included the office of *chevalier de l'ordre de Léopold* (1841), and in 1872 he rose to the rank of commander. In 1854 and in 1869 he also won the Prix Quinquennal des Sciences Physiques et Mathématiques of the Royal Academy of Belgium.

Plateau's long (he continued to do research even after his retirement) and productive career is especially remarkable because he was totally blinded in 1843. This was apparently the result of an 1829 experiment in physiological optics, during which he stared into the sun for twenty-five seconds. At that time he was blinded for several days, but his sight returned partially. In 1841 he showed signs of serious inflammation of the cornea, which became steadily worse and ended in blindness. During his blindness he was aided in his work by colleagues—particularly, E. Lamarle, F. Duprez, his son Felix Plateau (a noted naturalist), and his son-in-law G. Van der Mensbrugghe.

Plateau's early work was in the field of physiological optics. The basis of much of this work was his observation that an image takes an appreciable time to form on, and to disappear from, the retina. In his dissertation (1829) Plateau showed, among other things, that the total length of an impression, from the time it acquires all its force until it is scarcely sensible, is approximately a third of a second. He applied his results to the study of the principles of the color mixture produced by the rapid succession of colors. This led to the formulation of the law (now known as the Talbot-Plateau law) that the effect of a color briefly presented to the eye is proportional both to the intensity of the light and the time of presentation. Plateau also studied various optical illusions that result from the persistence of the image on the retina. In 1832 he invented one of the earliest stroboscopes, which he called a "phénakistiscope." Plateau's device consisted of pictures of a dancer that were placed around a wheel. When the wheel was turned, the dancer was seen to execute a turn. Plateau sent his stroboscope to Michael Faraday.

Plateau studied in great detail the phenomena of accidental colors and irradiation, both of which he considered as arising from a similar cause related to the persistence of the image on the retina. Accidental colors are those that appear after staring for some time at a colored object and then at a black surface, or closing one's eyes and pressing one's hands over them. An image of the object appears, usually in complementary color and slightly diminished in size. Plateau's results include his discovery that accidental colors combine both with each other and with real colors according to the usual laws of color mixture. In irradiation luminous objects on a dark background appear enlarged, a factor clearly of interest to astronomers, among whom the question of the extent of the enlargement was causing controversy. Plateau showed that enlargement occurs regardless of the distance from the object and—explaining the varied experiences of the controversialists—that the mean amount of enlargement from the same source varied considerably from one individual to another.

Plateau was one of the first to attempt to measure sense distance. He used the method of bisection, presenting artists with white and black papers and asking them to produce a color midway between the two. Throughout his career, Plateau was interested in visual perception, and between 1877 and 1882 he published a critical bibliography of what he called "subjective phenomena of vision." He analyzed works from antiquity to the end of the eighteenth century, and listed, with short summaries, nineteenth-century works. Plateau's optical work has been neglected, perhaps because it contained theoretical errors, but his experiments were imaginative and interesting and earn him a name as a pioneer in physiological psychology.

In the 1840's Plateau turned his major energies to the study of molecular forces, through the consideration of a weightless mass of liquid. By immersing a quantity of oil in a mixture of water and alcohol, the density of which was equal to that of the oil, Plateau effectively annulled the action of gravity and showed that under these conditions the oily mass formed a perfect sphere. He then introduced centrifugal force and found that the sphere flattened at the poles and bulged at the equator. By controlling the velocity, he transformed the sphere into a ring, then a ring with a sphere at the center. He also formed a system of small spheres, which rotated about a central axis, each rotating around its own axis; this corresponded strikingly with the image of the formation of the rings of Saturn, and with that of the formation of the planets in Laplace's nebular hypothesis. (There are, of course, essential differences between conditions of the experiment and the astronomical situation, as Plateau himself indicated.)

Plateau also varied the conditions of his experiment by introducing metal wires to which the oil could adhere. He studied the forms of equilibrium that occurred, particularly the cylinder. Based on the assumption that the action was due to a very thin layer at the surface, he concluded that these forms should have surfaces of constant mean curvature. He obtained five different forms and showed geometrically that these were the only possible ones. He was, despite his blindness, a superb geometer, with a gift both for visualizing physical results and for physically interpreting geometric results.

Another way in which Plateau studied the effects of molecular forces—not influenced by the force of gravity—was by using thin films. In these studies he employed a treated mixture of soapy water and glycerin that he himself had developed. This liquid had the property that, with proper precautions, a bubble or film would last up to eighteen hours. Among other things Plateau studied the films that formed within wire contours dipped into the solution. His theoretical work led him to conclude that the surfaces formed were always minimal surfaces, and his experimental results confirmed this. But because his mathematical analysis was not rigorous, other mathematicians were led to formulate what is known as the problem of Plateau—to show that across any Jordan space curve there may be stretched a minimal surface. The question led to the study of functions of a complex variable and attracted the attention of Riemann, Weierstrass, and Schwarz. In 1931 Jesse Douglas gave the first mathematical solution.

Plateau's work on molecular forces was published in a series of memoirs between 1843 and 1868, and again, with some revision, as a book in 1873. In the work on thin films Plateau was drawn to the question of surface tension. He concluded that molecular forces alone were not sufficient to account for it. This probably indicates why Plateau is not as well-known as he was in his own time. He was nonetheless an able and ingenious experimenter and his work on thin films is remarkable for the results he obtained with the simplest of apparatus. His theoretical explanations, both in his optical investigations and in the study of molecular forces, are not, however, generally accepted.

Plateau also did interesting work in magnetism, proving that it is impossible to suspend something in the air using magnetic forces alone. His mathematical writings include papers on the theory of numbers. In addition he was the coauthor, with Adolphe Quetelet, of a long article on physics in the *Encyclopédie populaire*.

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