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(*b*. Wing. Rutland-shire. England. 15 March 1855; *d*. St. Mary Bourne. Andover. Hampshire. England. 30 March 1944)

Physics.

Boys was the son of Charles Boys, rector of Wing, Rutlandshire, and Caroline Goodrich Dobbie. In 1869 he enrolled at Marlborough College. where he was attracted to the teaching of G. F. Rodwell, the first teacher of science to be appointed at the school and a fellow of the Royal Society. Boys later dedicated his book *Soap-Bubbles and the Forces Which Mould Them* (1890) to Rodwell in appreciation of "the interest and enthusiasm which his advent and his lectures awakened in the author, upon whom the light of science then shone for the first time." In 1873 he entered the Royal School of Mines, London. and in 1881 he became a demonstrator in physics under Frederick Guthrie, who was professor at the Normal School of Science (renamed the Royal College of Science in 1890 and later incorporated in Imperial College). For a short period after Guthrie's death in 1886, Boys took charge of the physics department and was promoted to assistant professor in 1889. One of those to whom he lectured was H. G. Wells, who commented in *An Experiment in Autobiography* that while he had found Guthrie uninspiring. Boys was too fast:" Boys shot across my mind and vanished from my ken with a disconcerting suggestion that there was a whole dazzling universe of ideas for which I did not possess the key." Wells described Boys as "one of the worst teachers who had ever turned his back upon a restive audience, messed about with the blackboard, galloped through an hour of talk, and bolted back to the apparatus in his private room." Despite these defects Boys later became an able expositor. both as a lecturer at the Royal Institution (where soap bubbles were the subject of his Christmas lectures in 1889) and as an expert witness in the law courts.

In 1887 Boys published a preliminary note on his "radiomicrometer" which was designed to detect infrared radiation and in which he incorporated a blackened thermojunction into the suspension of a moving-coil galvanometer. This obviated the need for an external circuit and for conducting leads from fixed terminals to the moving-coil suspension. This instrument was probably more sensitive than any preceding infrared detector. Boys calculated that in combination with a condensing lens of one-inch diameter it could detect the heat from a candle at a distance of 1,530 feet, and with it he detected radiant heat from the surface of' the moon. Despite its ingenuity and sensitivity, the radiomicrometer did not come into general use: it required both a steady horizontal platform and the proximity of the observer, and so the conventional thermopile or bolometer in combination with a remote galvanometer proved more convenient.

In the torsion head of the radiomicrometer there was no need for a conducting suspension, and Boys therefore experimented with fibers of various insulating materials. After trying glass. he proceeded to fused quartz, which he found to have a low expansion coefficient and a remarkably low hysteresis. One of his methods of drawing very thin fibers (one micron or less in diameter) was to fuse a portion of a quartz rod of which one end was fixed and the other was attached to the bolt of a crossbow, which was then discharged, drawing the rod into a fiber before it had time to cool. Fused quartz has since become one of the basic materials of experimental physics and has been used in such experiments as those of Beth (1936) and Holbourn (1936) for measuring the angular momentum of a photon. (Holbourn was the first winner of the C. V. Boys Prize, which the Physical Society founded in Boys's memory.)

Noting that the combination of mechanical strength with low hysteresis in the suspension would facilitate a much improved version of Cavendish's experiment (1798) to measure the constant of gravitation, Boys carried out the measurements between 1890 and 1895. Conditions at South Kensington were not good enough. because of vibration due to traffic, and he finally worked in the cellars of the Clarendon Laboratory at Oxford. The experiment was one of the classics of experimental physics and was particularly notable for its discussion to determine the optimum size of the apparatus, especially as regards the effects of temperature gradients and convection currents in the air surrounding the suspension. He gave dimensional arguments to show that the effects of convection currents were likely to depend on a high power, perhaps the fifth or the seventh, of the linear dimensions, and that the apparatus should therefore be as small as possible. Boys gave his final result for the constant of gravitation as 6.6576 X $1O^{-8}$ in cgs units (6.6576 x $1O^{-11}Nm^2kg^{-2}$) estimating that the fourth figure should not be more than 2 in error. The currently accepted best estimate for *G* lies a little (perhaps 0.5 percent) above Boys's upper limit, but the effective precision of his measurement has not yet been substantially improved.

The measurement of the constant of gravitation was the peak of Boys's achievement in pure science. In 1897, just as the experiment was ending. he became a metropolitan gas referee, resigning his post as assistant professor and setting up an office and laboratory in London; thenceforth he was primarily involved in applied physics. He had already begun (in 1893) to develop a lucrative practice as expert witness in patent cases: he himself applied for eighty-seven patents between 1881 and 1939 and took fifty-three of them to the stage of complete specification. These patents covered a wide range of devices in

connection with mechanics, measurement, electricity, and gas metering: in the last area his work on instruments for measuring the calorific value of coal gas was especially important.

Boys prided himself on his invention of the rotating lens camera for photographing lightning flashes. He built the camera in 1900 and carried it about with him for twenty-eight years, until he at last had an opportunity to use it while visiting A. L. Loomis at Tuxedo Park, New York. He concluded that the flash started at the ground, and his work led to that of Schonland in South Africa. He also developed a system for the spark photography of flying bullets, obtaining widely reproduced pictures of shock waves: but, as he was careful to emphasize, he had been anticipated in the initiation of this development by Ernst Mach.

In 1892 Boys married Marion Amelia Pollock; they had two children. In private life he was somewhat unconventional, for example drinking his tea out of a saucer if it was too hot, and covering a dirty shirt when he was about to appear as an expert witness in a lawsuit by inserting a sheet of plain foolscap under his tie and waistcoat. Like some other physicists, most notably R. W. Wood and George Gamow, Boys delighted in practical jokes, in which the victim might equally be a cat invading his garden or a solemn academic colleague. The consequent strain on his domestic life led to a divorce in 1910.

At the same time, he was a much loved figure in scientific circles in London. In 1935 he was knighted, and the Royal Society Club celebrated his eightieth birthday with a dinner. With the deterioration of his eyesight, he retired to St. Mary Bourne, Andover; a year before his death he published a paper on an instrument for drawing ellipses. One of his earliest papers had been on the garden spider (*Nature*, **23** [1880], 149- 150), and he retained his biological interests throughout his life. In his garden he became more interested in weeds than cultivated plants, summarizing his experiences in a small book, *Weeds, Weeds, Weeds* (London. 1937).

Among his honors were a Royal Medal (1896) and the Rumford Medal (1924) of the Royal Society (to which he had been elected in 1888), the Duddell Medal of the Physical Society (1925), and the Elliot Cresson Medal of the Franklin Institute, Philadelphia (1939). He was president of the Physical Society of London (1917- 1918): his presidential address contained some characteristic advice to experimenters, quoting a dictum of Fresnel: “If you cannot saw with a file or file with a saw, you will be no good as an experimentalist.” But for all his pragmatism, Boys had a strong sense of elegance, and spoke, for example, with humorous scorn of “any instrument designer who would lower himself to make use of a *cam*.” His work on gravitation in particular showed his exemplary sense of the many factors in instrument design, his persistence in tracing experimental difficulties to their basic causes, and his patience in advancing the experimental techniques of his time to the limit of the possible.

C. T. R. Wilson (of the cloud chamber), whose investigation of the electrical conduction in the air surrounding a gold-leaf electroscope led to the discovery of cosmic rays, paid this tribute to Boys’s experiments on the insulating power of quartz: “These experiments gave very strong indications that some at least of the leakage of electricity from a charged body suspended in a closed vessel is not through the insulating support but by conduction through the air.” A great experimenter himself, Wilson also said of Boys: “His delight was in designing, constructing and manipulating apparatus for physical measurements of the highest accuracy, and in overcoming experimental difficulties which to most would have seemed insuperable. He was a really great experimenter, and his methods of working were original and often unconventional.”

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