SCRIVEN BOLTON, though not often seen at the Society's meetings, was widely known by repute in astronomical circles, and his death on 1929 Christmas Day removes from our midst one whose contributions were of a somewhat unusual kind. That day will have melancholy associations for the Society, for it saw the passing of three other prominent Fellows also. Bolton, who was unmarried, lived with his widowed mother and sisters at Bramley, Leeds, where he was engaged in business as an oil merchant. But his chief interest was astronomy, and in a field adjoining his home he provided himself with a well-equipped observatory, containing, among other instruments, an 18-inch reflector. Here he carried out a programme of observations which, during the last seven years, comprised chiefly the determination of the periods and spectral types of new variable stars, especially those in the regions of the Pleiades and Hyades clusters. Reports of his work were sent to the Society from time to time, and appeared in the annual reports.

Bolton is best known, however, for his astronomical drawings. He was on the staff of *The Illustrated London News* for fifteen years, and to this paper, as well as *The Graphic, The Sphere, Le Journal Astronomique de France,* and several American papers, he frequently contributed sketches illustrative of the objects, apparatus, etc., with which astronomers are concerned. He was a very skilful draughtsman, and received many awards for his work. He obtained a gold medal for his exhibit in the Science section of the Franco-British Exhibition in 1908, and a diploma for drawings of astronomical subjects at the Japan-British Exhibition, 1910. The Astronomical Society of Barcelona also presented him with a certificate. He was, in addition, a painter of some skill in pastel, and produced several musical works for private performance.

At the beginning of his last illness he had just completed the construction of a large reflector for his observatory. It was probably on account of the interruption of his observations by this work that he did not send his customary report to the Society during the last two years. He died in his early forties after an illness of three weeks. He had been a Fellow since 1905 May 12.

JOHN BROWNING, whose death, though occurring in 1925, has only during the past year come to the notice of the Society, was one of the oldest of our Fellows. Among his few seniors in membership was Robert Norton Stevens, elected a few months earlier (on 1865 January 13), who died on 1929 October 29, and of whose career we have unfortunately been unable to obtain particulars. Browning was a well-known figure in the scientific world 50 years ago, his skill in the construction of instruments, not so widely used then as now, bringing him into intimate relations with many of the leading scientific workers of the day. He contributed many papers to the *Monthly Notices*, notably a series on changes in the colour of Jupiter's equatorial belt, about 1870.

Browning appears to have been born early in 1835 in London, where his father, Mr. Spencer Browning, conducted a nautical instrument-

maker's business at 111 The Minories. The business was established as far back as 1760, and it is suggested that Browning's may have been the actual shop which Dickens had in mind in his description of the establishment of Solomon Gills, the ship's instrument-maker, in *Dombey and Son*. It would, at any rate, have been of the same type, and was certainly provided with one of the " little timber midshipmen in obsolete naval uniforms, eternally employed outside the shop doors of nautical instrument-makers in taking observations of the hackney coaches." There was also a " Captains' Room," of which sailors made frequent use for a quiet gossip over their sherry. An old habitué with a wooden arm and a hook in it, whose memory has not yet faded away, might well have been the prototype of Captain Cuttle.

Browning was originally intended for the medical profession, and, with that end in view, entered Guy's Hospital and passed the necessary examinations. A breakdown in health interfered with this plan, however, and resulted in his joining his father's business. Here he encountered an initial difficulty arising from the growth of shipbuilding on the Mersey and Clyde and the establishment of instrument-makers' shops in those districts. Seeing that effective competition was hopeless, Browning changed the character of the business and entered with a will into the agreeable task of designing and constructing instruments of precision for scientific work. Early in the seventies the business (which was then a flourishing concern, employing some 70 men besides " bunting girls," or flag makers, and odd labourers) was transferred to 63 Strand, where it rapidly gained the patronage of workers in various departments of science. The factory in The Minories was shortly afterwards destroyed to make room for railway extension.

Practical optics was the chief interest of Browning's life, and he soon began to develop his business on the ophthalmic side. Here his medical training stood him in good stead and he gained wide repute among ophthalmic surgeons in London. The making of spectacles was an art greatly in need of reform when Browning turned his attention to it. At a time when the advantages of reflecting telescopes were not fully realised he did much pioneer work in bringing those of his own construction to the notice of astronomers, and one of the later editions of his book, *A Plea for Reflectors* (first published in 1867), on the shelves of our library, contains numerous testimonials from those who had used his instruments and gives an interesting insight into his methods of popularising the subjects with which he was concerned. But perhaps his foremost interest was the spectroscope, of which for many years he was the leading English maker. His book, *How to Work with the Spectroscope*, also in our library, was well known to an earlier generation of spectroscopists, and Browning's pioneer constructive work undoubtedly did much to raise the spectroscope from a somewhat neglected chemical accessory to its present position as one of the most important instruments of physical research. Browning's spectroscopes were the best obtainable in England in their day, and much early work of the highest order was done with them. He was fortunate in this branch of his business to acquire the services of Mr. Adam Hilger, who, on coming

from Paris to London with his brother at the outbreak of the Franco-Prussian War in 1870, was employed by Browning as his foreman. Hilger's great skill in this work was doubtless an important factor in the excellence of Browning's spectroscopes, but Browning's own able and conscientious craftsmanship was of very high quality. His zeal for perfection sometimes had untoward results. It was, for instance, partly on account of his reluctance to part with a spectroscope until it had "performed" to his satisfaction that Lockyer was not the first observer to see a prominence on the uneclipsed Sun. His unwitting share in this misfortune was always a source of regret to Browning, and he lost no opportunity for many years afterwards of pointing out to all and sundry that he was largely responsible for the delay. One of his favourite ideas was the importance, from the meteorological point of view, of the "rain-band" in the solar spectrum, and it is interesting to know that this has been realised afresh in recent times.

A former associate of Browning, Mr. W. Woodward, now living at Walthamstow, has kindly supplied some interesting reminiscences from which the following paragraphs are taken. Mr. Woodward joined the firm about 1869, and remained until the middle seventies, when he left with Mr. Adam Hilger, who then set up in business for himself. Writing of this period, during which the transfer from The Minories to the Strand took place, Mr. Woodward says :—

"Astronomy became his hobby, and at his home near Sevenoaks on fine nights he frequently had one of the staff there all night observing. We used to say he thought more of a piece of the Moon's surface being called 'Browning's Land' than of success in business. He put up the first electric light in London when we illuminated the Guildhall for the banquet to the Shah of Persia on his visit to Queen Victoria. We had a light outside each window, as they had to be run with Bunsen cells, the fumes being impossible inside. Each light cost £3 an hour to run.

"The properties of the telephone and the phonograph were well known long before they became a practical proposition, and we made frantic efforts to 'get there' first. We had a man with a stentorian voice who used to go on the roof of 63 Strand and shout, 'Hullo, I am here!'; and Browning below, with the receiver glued to his ear, would say, 'I can hear him!' So could we; his voice resounded through the building! Then, again, with the phonograph; we coated the cylinder with every conceivable foil we could think of—lead, tin, brass, copper, canvas, silk, etc., etc., with no success. But to hear the reproduction of Miss Browning's voice after she had sung 'The Last Rose of Summer' on to our tin-foil effort was something to be remembered. It remained for Edison to hit upon the happy thought of hardening the wax itself after he had asked all the world to try and solve the problem.

"Mr. Browning was kind and considerate for his workpeople and always ready to help in distress. We had long hours in The Minories —from 6 a.m. to 8 p.m. at first—but they were a contented crowd. There were no outside diversions except skittles and beer, which was very cheap, so Mr. Browning started a tonic sol-fa class and encouraged the men to sing at their work, which they did. 'Soh, doh, doh, me, doh,

doh, la ' would start in various quarters, until we had a chorus in full blast. Adam Hilger, who was musical and often played the zither in public, said he ' sufreed martreedum ! ' "

Browning was always more drawn to scientific research than to industrial development, and in later years his business declined considerably. About 25 years ago he retired and went to live at Cheltenham, having been given but a short lease of life by his medical advisers. He recovered, however, and was able to take a leading part in the scientific and educational life of the town. At the end of the year 1925, at the advanced age of 90 years, and after more than 60 years' Fellowship of the Society, he passed away. He is survived by his widow and only daughter, who is the chief librarian at Bradford Library.

RALPH HAMILTON CURTISS was born on 1880 February 8 at Derby, Conn. He graduated from the University of California, receiving the degree of Doctor of Philosophy in 1905. In 1901 he was a member of the Lick Observatory expedition to Sumatra ; he was connected with the Lick Observatory as Fellow until 1905, when he joined the staff of the Allegheny Observatory as Astronomer. In 1907 he went to Michigan University as Assistant Professor. Four years later he was made Assistant Director of the Detroit Observatory, Ann Arbor, under W. J. Hussey, and in 1918 he became a full professor. He succeeded Hussey as Director of the Observatory on the latter's death in 1927. From 1911 onwards Curtiss was responsible for the whole of the spectroscopic work of the Observatory, and the one-prism and two-prism spectrographs used in conjunction with the $37\frac{1}{2}$-inch reflector were designed by him and built under his direction at the Observatory. He also designed the measuring engine. This work is described in vol. i. of the *Pub. Michigan Obs.* (1912). He was greatly interested in the photographic reproduction of stellar spectra ; all of the five series of spectrograms in vol. ii. of the *Publications* were prepared by Curtiss, as there described.

Curtiss was at home in many astronomical fields, but his main work lay in the study of spectroscopic binaries and of early type stars showing bright lines. He combined observational skill, accuracy, and care in reductions with a critical faculty for his own and others' material in a way that was probably unsurpassed. His contributions are to be found mainly in six memoirs on stars of class B showing emission lines published in the Allegheny publications and in the three volumes of the Michigan publications. These include a study of the spectrum of β Lyræ, a study of Cepheid characteristics, and a prolonged study of the spectra of δ and ϵ Orionis and of γ Cassiopeiæ. It is worth remarking at the present day that Curtiss concluded in 1912 that the sharp lines of H and K in δ and ϵ Orionis were definitely non-oscillatory, and that following Hartmann's hypothesis the calcium cloud had a radial velocity of 14 km.sec.$^{-1}$ relative to the Sun. Curtiss realised fully the need for quantitative measures of line-intensities as an aid to the elucidation of physical conditions in stellar atmospheres, and