returned to the neighbourhood of Wellington College, and took up his residence at Crowthorne, where he died on 1920 May 5.

His most active astronomical work was done as a member of several of the observing sections of the British Astronomical Association, including those for the study of the star colours, Saturn, Mars, and Jupiter; his observations being obtained by means of a 12½-inch reflector by Calver, and a 3¾-inch refractor by Wray.

He was elected a Fellow of the Society on 1883 May 12.

Major-General Henry Herbert Lee, C.B., O.B.E., J.P., was born at The Mount, Duras Powys, Glamorganshire, in 1838, his father being the Rev. Henry Thomas Lee, at one time rector of Wenvoe. He was educated at Marlborough and at Addiscombe College (the College of the old East India Company), and after obtaining a commission in the army served for a considerable time with the Bombay Engineers. He saw active service in the Abyssinian War, and was stationed at the base of operations at the time of General Roberts' famous march to Kandahar. He was on duty at home from 1878 to 1883, but in the latter year went out to Egypt and served under General Wolseley. He retired from the army in 1886, and spent the remainder of his life in his native country, throwing himself with unwearying energy into a variety of movements—religious, social, educational, and recreative—which tended to the betterment of his fellow-men. He also maintained his interest in military matters, was one of the original members of the Glamorgan Territorial Association, and gave his most hearty support to such organisations as the Church Lads' Brigade and the Boy Scouts movement. About two years before his death he was appointed Deputy Lord-Lieutenant for Glamorgan. He also took a very active part in ecclesiastical affairs, and was a member of the House of Laymen of the Province of Canterbury.

Amongst his many and varied activities he found time for astronomy, and set up a fine 6-inch Cooke equatorial furnished with spectroscope for solar and stellar work. These instrumemts he was always glad to place at the disposal of any student of astronomy. He was at one time President of the Astronomical Society of Wales, and served on its Council from its formation.

In 1873 he married Constance Mary, daughter of Mr. George Lyall of Headley Park, near Epsom. There were no children of the marriage, and his wife died about twenty years before him.

He died on 1920 March 12.

He was elected a Fellow of the Society on 1907 June 14.

Sir Joseph Norman Lockyer was born at Rugby, 1836 May 17. He was educated at private schools and on the Continent. He entered Government service as a clerk in the War Office in 1857; and all his earlier astronomical work was done in spare hours at his private observatory. Later he was employed on scientific commissions and organisation for the Government; and it was not until 1881 that he became Professor in the Royal College of Science. He became Director of the Solar Physics Observatory at South Kensington in 1885, and held the post until the removal of the observatory to Cambridge in 1913.

In the year 1859 Kirchhoff's discovery of the interpretation of the Fraunhofer lines in the sun's spectrum opened up a new sphere of research in astronomical spectroscopy. In England two amateur astronomers became pre-eminent in the new field: Huggins first turned his attention to the stars and nebulæ, Lockyer occupied himself with the sun. It is an interesting example of co-operation that each of them worked in conjunction with a chemist; and the two combinations, Huggins and Miller, Lockyer and Frankland, rivalled one another in the importance of their discoveries during those great years of progress. Lockyer began in 1866 with a small spectroscope attached to his 6-inch equatorial. The same year, in communicating his observations of the spectra of sunspots, he suggested the possibility of detecting the red prominences by means of the spectroscope without the need of a total eclipse. His instrument was then not sufficiently powerful to test this; but by the aid of a Royal Society grant be obtained in 1868 a spectroscope of higher dispersion, and immediately it was received he was able to detect a prominence by the bright lines, which were clearly visible. His discovery was simultaneous with that of Janssen, who was independently led to try the same method through his observations during the total eclipse of that year.

Continuing these researches, Lockyer found that the prominences were projected from an envelope completely surrounding the sun, which he named the chromosphere. Throughout his subsequent work he was impressed with the importance of recognising that a solar or stellar spectrum is a complex effect, the different layers, which vary widely in temperature and constitution, contributing each its quota of absorption or emission. Looking down on the disc of the sun, we see light which has passed through the whole succession of layers from the hot and dense vapours near the photosphere to the outermost rarefied gases. How to disentangle the layers, to trace each absorption to its level, and to discover the changes in constitution and dissociation along the column, is a task which still taxes all our ingenuity. A partial separation was possible at the limb of the sun, where the spectral lines of different characters rise to different heights. This was followed up by studies of the conditions of excitation of these lines in the laboratory. The early recognition of the importance of this clue to the physical conditions prevailing at different levels in the solar and stellar atmospheres is a special feature of the work of Lockyer and his staff at South Kensington. It was in 1881 that Lockyer first made and published his celebrated observation that the iron lines 4924·1 and 5018·6 are greatly enhanced in brightness in the spark spectrum as compared with the arc. The study of enhanced lines which arose from this observation has now become one of the most important guiding principles in astronomical spectroscopy. The systematic search for this kind of effect in terrestrial spectra seems to have been left in abeyance for many years, and it was not until 1906 that an extensive table of enhanced lines was published from South Kensington. But parallel with, and even earlier than, this discovery Lockyer had been using the same kind of criterion in his theory of dissociation of the elements at high temperatures, relying largely on his interpretation of the chromospheric spectrum. In the *Chemistry of the Sun* (1887) he maintained that the H and K lines were due to a dissociation product of calcium, pointing out that they tended to replace more and more completely the ordinary spectrum as the strength of the electric discharge was increased. Neither his criterion nor his theoretical view of dissociation is sensibly altered when translated in terms of the modern theory of ionisation. This view that the atom is broken up when the element passes into the state necessary for the emission of enhanced lines is now regarded as literally true; an electron has been detached, and the remaining "proto-element," as Lockyer called it, is from the spectroscopic point of view an essentially different atom. Where Lockyer wrote *p*Ca we now write Ca + +, indicating the nature of the change more particularly, but recognising the far-reaching importance of the distinction which he was the first to point out and insist on. If any criticism is to be made on this pioneer work, it is that he attached too exclusive an importance to temperature in breaking up the atom; recent theory has shown that low density is also a very potent factor favourable to ionisation.

To return to his earliest work on prominences, in 1869 he was occupied in studying their spectra, which could now be observed daily, thanks to his and Janssen's discovery. He soon observed the bright yellow line D_3, and deducing from its behaviour that it could not be due to any known terrestrial element, he named the new substance *helium*. For nearly thirty years this gas remained unknown except as a constituent of solar and stellar atmospheres, until in 1895 Ramsay found it given off from radioactive minerals. Since then helium has become one of the indispensables of physics, and it is difficult now to recover the outlook of a time when the helium atom was unknown. Besides giving the line D_3, helium is the source of important series in the spectra of the nebulæ and hottest stars; in particular, it gives the line 4686, at one time attributed to hydrogen. A unique spectrogram of a helium tube taken at South Kensington showed this line, and in 1905 Lockyer and Baxandall published accurate measurements of its position. But this terrestrial production of the line remained an isolated accident, and the necessary conditions were not again reproduced experimentally until Fowler in 1912 showed how to obtain this and other series lines of helium at will.

In 1887 Lockyer put forward his classification of stellar spectra, according to which the stars formed two series, one of ascending and one of descending temperature. After further laboratory researches on the behaviour of different substances under different conditions of excitation, he published in 1902 a *Catalogue of 470 Brighter Stars classified according to their Chemistry.* Although the existence of two series was in accordance with the theories of Lane and Ritter, which were widely accepted, Lockyer stood alone for twenty years in urging the practical consequence—that it involved a division of the usual Draper sequence of stellar spectra. It was a source of great pleasure to him in later years that the discovery of giant and dwarf stars by Russell and Hertzsprung led to the general acceptance of a scheme corresponding in its chief features with that which he had so long foreseen.

Owing to the researches of Adams, it is now possible to see almost at a glance the distinction between the spectra of the ascending and descending stars; and the criterion depends on the intensities of enhanced lines, which Lockyer had been the pioneer in recognising. It is perhaps disappointing that the details of his classification did not agree more closely with that now accepted, seeing that in regard to the two main points—the existence of widely diffused stars and condensed stars at the same temperature level, and the importance of the study of enhanced lines as a key to physical conditions—he was far in advance of his time. The spectroscopic clue was almost in his hands; but it was through investigations by the older astronomical methods that the solution was actually reached. The reason is not far to seek. The spectroscopic distinction is clear enough as an empirical fact; but it could not have been interpreted with certainty as a criterion of diffuseness without reference to the data of proper motions and parallaxes which have only recently been accumulated. Another difficulty was the extreme faintness of dwarf stars of types K and M, which would be practically unrepresented among the bright spectra that he was studying. He had therefore no opportunity of comparing the ascending and descending stars at those temperature levels where they are most widely separated. The classification formerly accepted placed all these stars on the descending side, whereas actually those available for study were all on the ascending side. Lockyer was not quite radical enough. But although he seems to have erred in leaving Arcturus, for example, as a dwarf star, it does not appear that in any case he wrongly transferred a genuine dwarf star. In examining his classification, one notices particularly the elaborate subdivision of stars generally grouped together as types O and B; he recognised six temperature levels above Sirius compared with three below. Modern opinion is tending to appreciate the soundness of this view; for although stars in these higher groups are rare, it is recognised that they cover a vast range of temperature with wide changes of physical conditions. The actual order of these groups adopted by Lockyer has received substantial confirmation from the statistical researches of Ludendorff and Herassimovitch.

Perhaps the most significant thing in estimating Lockyer's hypothesis as the forerunner of the modern giant and dwarf theory, is Russell's own statement that he had been deeply impressed with Lockyer's work, and was imbued with these ideas at the time when he found the two series of ascending and descending stars manifested in his statistical studies of absolute magnitude.

With regard to some of Lockyer's more speculative theories, judgment must still be reserved. The chief merit of his meteoritic hypothesis was that it explained the luminosity of the great diffuse nebulæ. It is difficult to believe that these are intensely hot throughout, and Lockyer explained the luminescence as due to continual collisions of meteoric stones. Stars were supposed to be formed by condensations in the nebula; and at these points the increasing frequency of collisions would rapidly convert the whole mass into gas. Some of the spectroscopic evidence which he first adduced in support of this theory has been found to be untenable. But the theory itself is perhaps as plausible as any of the other tentative explanations of this very obscure problem. Lockyer also held that there was an evolution of the elements occurring in the stars, the complex atoms being gradually formed from simpler ones. This was part of his dissociation hypothesis. In the light of the most recent discoveries as to the nuclear structure of the atom, few will disagree with his final statement in *Inorganic Evolution* (1900) that there may be "a gradual building up of physical complexes from similar particles associated with the presence of electricity."

We can do no more than mention Lockyer's archæological researches on the age of Stonehenge and other monuments, leading to results of great interest, though from the nature of the problem somewhat controversial. He was prominent in public life, fighting keenly for a fuller recognition by the Government of the claims of science. With this object he brought about the establishment of the British Science Guild in 1905. But the most conspicuous of these general services to science was his foundation and editorship of *Nature*. It would scarcely be possible to overestimate the importance to scientific progress of this journal, which he edited for fifty years.

On compulsory retirement from South Kensington, Lockyer retired to Sidmouth, where he erected the Hill Observatory. A corporation was formed to carry on the work permanently, and Sir Norman and Lady Lockyer presented the site of 7½ acres. Though the development was interrupted by the war, he lived to see the observatory in full working order, and an organised programme of research actively begun. He died on 1920 August 16.

By his death we lose an astronomer of outstanding fame, whose fifty years of active work links the present stage of astrophysics to its earliest beginnings. He had a rich harvest of immediate and unequivocal discoveries; but we linger now with yet keener interest over his fluctuating contest with the more baffling problems of stellar physics. Time and progress have cleared away many of the false starts, and have partly reshaped the theories which he held; but we can recognise, better than his contemporaries could, that he was led forward by a vision of principles of evolution which was not an illusion; and now that other fields of research are converging towards his own lonely path, the fulfilment of his vision seems to be drawing near.

He was elected a Fellow of the Society on 1862 March 14, and served on the Council from 1866 to 1872. He resigned his Fellowship in 1897. A. S. E.

Sir Edmund Giles Loder, Bart., was born on 1849 August 7. He was a man of very wide culture and interests. He travelled much and was a keen sportsman, but also a diligent and successful student of various branches of natural science. At Leonardslee, Horsham, he accumulated a fine museum well stocked with specimens of big game and other animals which he had himself shot in various parts of India, America, and Africa, and on the occasion of a short trip to the Sahara secured the fine specimen of a small gazelle now known as *Loder's Gazelle*. In addition he kept a number of interesting and rare animals in a live state. He was also exceedingly interested in trees and horticulture, and possessed unusually fine collections of conifers and rhododendrons, and his rock garden was the model on which that at Kew was based.

It does not appear that he did any systematic observational work in astronomy, at any rate in later years, but he erected an observatory with a refractor of 8 inches aperture, the object glass being by Alvan Clark. He went to the Andaman Islands in 1874 to observe the Transit of Venus, and on an eclipse expedition to Colorado in 1878.

His death occurred on 1920 April 14.

He was elected a Fellow of the Society on 1874 November 14.

Mrs. Fiammetta Wilson was the eldest child of Mr. F. S. Worthington of Lowestoft. The family had been settled in Lowestoft since 1820, and Mr. Worthington took up the practice of medicine and surgery, and succeeded to his father's practice in that town. Mr. Worthington was very devoted to natural science, and after his retirement from practice spent his time in microscopical studies and became an authority on Rotiferæ. He married in 1862 Miss Helen Felicite Till, daughter of Mr. Richard Till, of Clapham.

Mrs. Wilson was born 1864 July 19. Her early education was at home under governesses. She then spent four years in Lausanne, and finally a year at school in Germany. She early showed great facility in acquiring foreign languages, and spoke Italian, French, and German. Always exhibiting a courageous temperament, she was a fearless horsewoman. She played lawn tennis, and danced exceedingly well. All her life she was devoted to animals, and a dog was her constant companion.