discussed, we have convincing evidence that this path is very precisely the same for all the stars on the photographic plate". Now for the paths to be the same over a substantial part of the sky, the striæ would have to have correspondingly large dimensions, subtending at the eye angles in excess of twenty minutes of arc, being, say, ten metres at least in width if the striæ are situated 2,000 metres above the observatory. Now these large dimensions do not agree with the much smaller ones referred to above. Nor do they agree with the small dimensions which are required in order to explain the presence of marked scintillation of the stars, but its almost complete absence in the case of the planets. It may be contended that there may be both small and large striæ present at one and the same time, but this cannot be accepted because if there were small striæ they would disturb the star images on a photographic plate. Here then is another inconsistency in the turbulence theory.

I would now like to report a recent experiment in which atmospheric effects have been largely, if not completely, eliminated. Into a brass tube were placed: a miniature tungsten-filament electric-light bulb and a number of microscope objectives in series so arranged that a greatly diminished aberration-free image of the source was presented to the observer's eye. Both ends of the tube were closed and were made vacuum-tight, at one end being a glass window through which the observer could look. The brass tube was connected to a vacuum pump and the pressure of air inside was reduced to a few millimetres of mercury. As a further precaution, an electric fan was placed close to the observer so as to blow away any warm air which might be rising between the end of the tube and his eye. The removal of atmospheric effects did not alter in any way the appearance of scintillation as seen on looking down the tube, nor was the sudden rush of air into the tube on disconnecting the vacuum pump accompanied by any visible effect. We conclude that the turbulence of the atmosphere plays no observable part in the changes of brightness and colour which are seen to affect a local light source.

While, on one hand, these experiments appear to provide proof of a physiological type of scintillation, on the other hand, our recent observations of the twinkling of true stars and their comparison with the twinkling of local sources has convinced us that the true stars twinkle more effectively than the artificial ones. In other words, as we have thought all along, there appears to be a physical cause of twinkling as well as a physiological one.

To sum up, I am quite convinced that the theory of irregular atmospheric refraction does not explain all the observed phenomena. It does not account for the colours of scintillation being limited to red and blue-green. It does not explain why small stars twinkle less than large ones. It does not cover the scintillation of a local source viewed through a vacuum tube. In all these respects and many others besides, it is incompatible with known facts. It seems reasonable to suppose that the atmosphere is one factor in company probably with several others, some physical and some physiological, which together produce the stellar changes which are observed in position, in shape, in size, in brightness and in hue. That physical factors play a part, as we have believed all along, is clearly shown by the facts mentioned by Prof. Minnaert that changes of star brightness can be photographed and can be recorded by means of

a photocell. That physiological factors also may come in is shown with equal clearness by the vacuum-tube experiment described above.

Now what could the other physical factors be? Could it be that the stars themselves emit light in an irregular manner? Some hold the view that the sun contains light under high pressure and that this escapes in jets; could the same process be occurring in the stars? Are there starspots as well as sunspots? We know that light, since it possesses energy, must also possess mass, and we know that gravitation affects light by virtue of that mass. Is it not possible, then, that the mass of one lot of light attracts the mass of another lot of light, and thus in course of time produces what may be called 'light aggregates'? The seismograph shows that the earth's crust is in a constant state of tremor, and therefore an observatory, since it is attached to one part of the crust, must be in a constant state of tremor too. Would this not cause the star images to undergo synchronous tremulous movements of the kind recorded by Schlesinger? Here, then, are some tentative hypotheses, probably of little weight in themselves, but suggesting the kind of survey which I think is wanted. Every part of the system should be scrutinized: source, light path, telescope, camera and eye, because any one of these may be contributing to the phenomena of scintillation.

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OBITUARIES

Prof. C. S. Gibson, O.B.E., F.R.S.

CHEMISTS, not only in Great Britain, but also abroad, will have learnt with deep regret of the death on March 24 after a long illness of Prof. C. S. Gibson. He was born on February 8, 1884, and was educated at the Manchester Grammar School, where he was fortunate in coming under the influence of that great chemistry master, Francis Jones. With a natural science scholarship he went in 1901 to Corpus Christi College, Oxford, graduating with honours in 1905. Shortly afterwards he became research assistant to the late Sir William Pope, then professor of chemistry in the College of Technology in Manchester. This was the beginning of a life-long friendship. Holder of a Senior Goldsmiths research studentship, Gibson followed Pope to Cambridge, where he became a member of Sidney Sussex College and later an assistant lecturer and demonstrator in the University Chemical Laboratory. He remained in Cambridge until 1912, when he was appointed professor of chemistry in the Maharaja's College, Trivandrum. Here he found the conditions to be very primitive, and it was only by frequent visits to my laboratory in the Presidency College, Madras, that he was able to continue his original work.

At the outbreak of the First World War, Gibson returned to Cambridge and, in collaboration with Pope, he was responsible for work of first-class importance in the manufacture of mustard gas. Unfortunately, he was badly gassed on more than one occasion and he suffered from the effects for the remainder of his life. In 1919 he was appointed

to the chair of chemistry in the Egyptian School of Medicine, Cairo; but his stay there was brief, and he returned to London in 1920 as professor of chemistry at Guy's Hospital Medical School. Here he was to remain until his retirement last September on reaching the age of sixty-five. During the Second World War he was senior gas adviser in south-eastern England.

Gibson's original work was largely influenced by his long collaboration with Pope. His main interest undoubtedly lay in the field of stereochemistry; but for a number of years after his return to England he devoted much attention to organic arsenic compounds, his interest in which had been aroused as a member of the Chemical Warfare Committee. In 1929, however, he returned to a problem which he had investigated earlier with Pope, namely, the organic compounds of gold. Here his great experimental skill enabled him to make contributions of outstanding importance, and few who visited his laboratory will forget the beauty of his gold mirrors, for which he devised a simple method of preparation. It was a profound disappointment to him that the anti-glare glasses which he made could not be used during the Second World War.

To the Chemical Society Gibson gave devoted service. He was honorary secretary during 1924-33 and a vice-president during 1933-36. In 1945, on the sudden death of the Society's editor, Dr. Clarence Smith, he, at considerable personal sacrifice, acted as editor for a number of months. He also took a great interest in the International Union for Pure and Applied Chemistry and was a member of the Organic Nomenclature Commission. In spite of failing health, he was able to attend the meeting in Amsterdam last September. On the formation in 1935 of the Society for the Protection of Science and Learning, Gibson and Sir William (now Lord) Beveridge were appointed secretaries. He also served on the councils of the Institute of Chemistry and the Royal Society of Arts. In his young days Gibson was an accomplished pianist; but he was never satisfied with his own performance, and latterly he gratified his love of music by listening to broadcasts.

Gibson's services to science did not pass unrecognized. He received the O.B.E. in 1919, and in 1931 he was elected a fellow of the Royal Society. He was the president of Section B (Chemistry) at the Cambridge meeting of the British Association in 1938, and was an honorary member of the Société de Chimie Industrielle. Many of his former students at Cambridge and Guy's Hospital will recall his many acts of kindness, not infrequently accompanied by financial assistance. He was unmarried.

J. L. SIMONSEN

Prof. George W. Todd

GEORGE W. TODD, professor of experimental physics in King's College, Newcastle upon Tyne, died at his home in Ponteland, Northumberland, on February 24, after an operation. He had been in ill-health for some time.

Born in Birmingham in 1886, he was educated in that city and proceeded to the University in 1904. He graduated with honours in physics in 1907 and for the next two years worked under Prof. Poynting, with whom, jointly, he published his first paper, "On a Method of Determining the Sensibility of a Balance". In 1909 he went to Emmanuel College, Cambridge, as an 1851 Exhibition research scholar,

and worked at the Cavendish Laboratory under Sir J. J. Thomson until 1912. The results of his work here on the mobility of gaseous ions are published in a series of papers in the *Proceedings of the Cambridge Philosophical Society* and *Philosophical Magazine*. During 1913-16 he held the appointment of science master at the Royal Grammar School, Newcastle upon Tyne. He became adviser in physics to the Nitrogen Products Committee of the Ministry of Munitions in 1916, and in 1917 was appointed head of the Physics Section, Munitions Inventions Department Laboratories, London. Here he carried out researches on nitrogen fixation processes. In 1919 he was appointed professor of experimental physics in Armstrong College (now King's College), Newcastle upon Tyne, an appointment which he held until his death. He had received the degrees of D.Sc. (Birmingham) in 1913 and M.Sc. (Dunelm) in 1920.

The bulk of Prof. Todd's published work was done between 1909 and 1922, and consists of papers on thermal conductivity, ionic mobilities, gas reactions and properties of gases. Shortly before his death, he edited Poynting and Thomson's "Properties of Matter". His teaching was noteworthy for clear and simple exposition. He made use of only the simplest mathematical technique, and his methods were those of the 'Poynting and Thomson' school. He was interested in devising new laboratory experiments, and nothing gave him greater pleasure than a novel idea or an original experimental device or method.

Prof. Todd found in gardening a congenial relaxation from academic work until ill-health intervened, and he was an enthusiastic member of the Newcastle Society of Artists, of which he was chairman. He got the same kind of æsthetic pleasure from drawing and painting and looking at pictures as he derived from a study of physics. A few weeks before his last illness he was elected chairman of the recently formed North-Eastern Branch of the Institute of Physics, of which he was a founder fellow. His old students, who remember his modesty and kindness, will deeply deplore his death.

He leaves a widow and married daughter.

J. F. WOOD

Mr. R. Kirkpatrick

RANDOLPH KIRKPATRICK, who died on March 16, was assistant keeper in the British Museum (Natural History) from September 1886 until his retirement on January 20, 1927. Originally intending to take up a medical career, he passed through Christ's Hospital and King's College Schools to become a medical student at St. George's Hospital, London, but ill-health determined him to "take up a less strenuous career". Ironically, he not only lived to be eighty-seven and enjoyed excellent health for the greater part of this time, but also managed to crowd into his forty years service at the Museum a very great deal of scientific work. In addition, his wanderings took him to many parts of Europe, Asia and Africa, often to the more inaccessible regions, in search of scientific materials. Finally, he continued to ride his bicycle through the busy London streets until within a few months of his death.

Kirkpatrick's published works do not form an impressive total, though what he did publish was of high quality. On the other hand, the collections that were in his charge—and for the greater part of his time these included the Protozoa, Sponges, Coelenterates, Polyzoa and Protochordates—were left in