efficiency or deficiency for each colour in terms of a per cent of the normal or average attainment". Troland states that the original restriction of colour-blinds to protanopes, deuteranopes and tritanopes is no longer adequate, and allowances must now be made for more types of variation. Edridge-Green recognizes seven different types of colour vision, and Schjelderup states that there are at least eighteen significant species of colour-blindness. Collins reaches the conclusion that it is quite unprofitable to try to classify the colour systems of the colour-blind because there exist so many individual variations.

One group in which the colour defect is not extreme has been definitely recognized. Seebeck, in 1837, found certain cases which he was reluctant to classify as colour-blinds, who yet showed signs of colour abnormality. It was not until 1881, however, that these cases were understood. In that year, Rayleigh found that a number of individuals with otherwise normal colour vision were unequally sensitive to red and green. In equating red (lithium line $670.8 \mu\mu$) and green (thallium line $535 \mu\mu$) to match a yellow (sodium line $589 \mu\mu$), since known as the Rayleigh equation, some were found to require far more red than the normal, others required an excess of green. Von Kries, in describing an extensive series of experiments, applied the name 'anomalous trichromates' to these cases, and this designation has gained universal currency. Guttman advocated the terms red-weak and green-weak, and distinguished seven characteristics which they manifest, the chief of which are high thresholds, heightened colour contrast and a quick fatigue to colour stimuli.

It is customary to divide these anomalous trichromates into two groups corresponding to the two groups of dichromates, deuteranomalous trichromates or partial deuteranopes in which the sensitivity to green is below normal, and protanomalous trichromates or partial protanopes in which the sensitivity to red is below normal. The

green anomalous seem to be more numerous than the red anomalous, the ratio being quoted as 5 to 1.

These cases, it may be, form the connecting link between normal colour vision on one hand and colour defect on the other, and if a sufficient number of cases could be tested ranging from normality to complete red-green deficiency, a continuous series might be obtained.

It is a moot point as to whether these anomalous trichromates form 'dangerous colour-blinds'. The general finding seems to be in favour of the affirmative. Some writers, for example, Troland, actually include them in classifications of types of colour-blindness. Oblath points out that they can only recognize colours when they are saturated and of intense luminosity; "It is evident that these peculiarities render these subjects less fitted for certain services". In a report on "Colour Vision Requirements in the Royal Navy" (Med. Res. Council Report, Spec. Series No. 185; 1933), it is stated that "the mildly anomalous trichromate can be considered a safe look-out. On the other hand, the unfit anomalous trichromate is, in many ways, a greater source of danger than the dichromate". The incidence of this anomaly is estimated, in the same report, as 6 per cent, which is stated to be a very conservative estimate. Both reports emphasize very strongly the fact that the anomalous trichromate behaves as if colour-blind when conditions are unfavourable, such as when mist, fog or smoke are present, and this is all the more disastrous because the individual is rarely aware that he suffers from any colour defect. The heightened contrast and the quick fatigue characteristic of such anomaly may well make the judgment of colour and the discrimination of colour highly erroneous. The testing and discovering of these cases of anomalous trichromatic vision is not easy, and necessitates very careful procedure, and generally not the application of one test, but of a battery of tests.

(To be continued.)

Obituary Notices

Sir David Orme Masson, K.B.E., F.R.S.

PROF. SIR DAVID ORME MASSON, who died at Melbourne on August 10, was born at Hampstead, London, on January 13, 1858. He was of mixed English and Scots descent. His father, Prof. David Masson, editor of *Milton*, *Goldsmith* and *De Quincey*, and *Historiographer-Royal* for Scotland, came of Aberdeenshire stock—there is a saying in the Don valley that "Eassons, Massons an' Kessons a' cam' frae Tarlandside". His mother, Rosaline Orme, had a forbear George Rutt, the father of

Joseph Priestley's biographer, John Towill Rutt; and it may be mentioned, as throwing some light on the family, that the home of the Ormes, in Avenue Road, Hampstead, was a favourite rallying ground of the Pre-Raphaelites. In 1865 David Masson migrated from the chair of English literature at University College, London, to the Regius chair of English in the University of Edinburgh, and so it came about that his son, David Orme Masson, was educated at Edinburgh Academy and afterwards graduated M.A. and B.Sc. at Edinburgh.

In his younger days Masson was a strong walker and swimmer, and he played golf, tennis and billiards. After a short period of research with Prof. Crum Brown, he left Edinburgh for Bristol in 1880, to become Prof. W. Ramsay's first assistant (in later days, his son, Irvine Masson, was to become Sir William Ramsay's last assistant, at University College, London). Before Masson returned to Crum Brown, he and Ramsay had laid the foundations of a lifelong friendship. Meanwhile he had acquired some further research experience at the University of Göttingen. During his second period at the University of Edinburgh, Masson, with R. Fitzroy Bell, founded the first Students' Representative Council in any university, of which Masson became the first Senior President. The ensuing revolutionary improvement in the students' behaviour at graduations, etc., led Principal Sir Alexander Grant to exclaim, at the end of the tercentenary celebrations: "Gentlemen, you have saved the Republic!" Masson was also a prime mover in the foundation of the Students' Union in the University of Edinburgh—again, the first in Great Britain.

In 1886 Masson was elected to the chair of chemistry in the University of Melbourne, a key appointment which he held with high distinction until he retired in 1923, to become professor emeritus. Orme Masson, and his contemporaries Baldwin Spencer and T. R. Lyle, must be numbered among the prime creators and moulders of Australian science; to them Australia in general and the University of Melbourne in particular owe a debt beyond computation. A brilliant and inspiring teacher, Masson built up Australia's most distinctive school of chemical research at Melbourne, and exerted a steady influence upon the development of Australian science through his pupils and research students; but this was only one side of his work. His remarkable clarity of vision, combined with his organizing and administrative ability, his interest in the wider aspects of science, and his flair for public work, naturally brought him out as a leader in the foundation of national scientific institutions in Australia. Among these were the Commonwealth Advisory Council of Science and Industry, of which he was deputy chairman from 1916 until 1920, and which merged later into the Commonwealth Council for Scientific and Industrial Research; the Australian National Research Council, of which he was president in 1922–26; and the Australian Chemical Institute, of which he was the original president in 1924. Masson was also president of the Australasian Association for the Advancement of Science in 1911–13, and was largely instrumental in bringing about the visit of the British Association to Australia in 1914. In addition to all this, he was active in the interests of Antarctic exploration from Australia.

Masson's researches were concerned chiefly with physical chemistry, more particularly with the theory of solutions, ionization, and chemical dynamics. With Ramsay, at Bristol, he worked upon atomic volumes at the boiling point¹. This investigation was followed, at Edinburgh, by some work with M. Hay on the composition of nitroglycerine², and

by a series of researches on sulphine salts, carried out partly in collaboration with L. Dobbin³. The latter theme was afterwards extended at Melbourne with J. B. Kirkland⁴. A paper on molecular volumes⁵ was followed by another early research at Melbourne, in which, with N. T. M. Wilshire, Masson came near discovering the celebrated organic synthetic reagents later associated with the name of Grignard⁶.

In 1891 Masson pointed out the analogies between solution and vaporization which are embodied in his term 'critical solution temperature'; at the same time he brought to notice certain other principles regulating the miscibilities of liquids⁷. He was a keen exponent of the ionic theory in its early days, and between 1897 and 1899 he developed the direct 'jelly-tube' method of measuring ionic velocities⁸. Later notable work emanating from the Melbourne laboratories under his inspiration included various observations on the decomposition of persulphates and of sulphine hydroxides in aqueous solution (Leila Green, Brenda Sutherland⁹), and studies on the viscosity and conductivity of some aqueous solutions (W. Heber Green¹⁰). Another interesting research (1909), dealing with the mechanism of urea-formation from cyanates, was carried out in collaboration with his son, Irvine Masson¹¹. During this period also, B. D. Steele and Kerr Grant¹² developed their quartz micro-balance in Masson's department; this was afterwards used by Ramsay and Whytlaw-Gray to measure the density of radium emanation.

It is not generally known that early in 1895 Masson evolved a modification of Mendeléeff's periodic system, which, apart from the treatment of the rare-earth metals, is practically identical with the later classification of Bohr. Masson's arrangement was printed immediately after Ramsay's discovery of helium¹³, and it contained spaces which were later filled by neon, krypton, xenon, and niton. "Helium and Argon," it is stated in an inset to the table¹⁴, "are placed in the new Group VIII, characterized by valence=0 and atomicity=1." It was probably a discussion between Masson and Ramsay in May, 1895, during a visit of Masson to Great Britain, which first gave Ramsay real confidence in the idea of this missing group of rare elements. Masson's arrangement was adopted by Ramsay and incorporated by him in a celebrated wall-diagram which he used in his lectures at University College, London (part of this diagram was reproduced in the well-known caricature of Ramsay by 'Spy').

Another example of Masson's prescience is provided by a paper published so early as 1921, in which he developed what was essentially a proton-electron statement of the composition of atoms and of the consequent form of the periodic classification¹⁵. This striking treatment of a fundamental problem failed to attract the attention it deserved. A similar remark applies to Masson's final contribution to physical chemistry. This work, which was summarized in a paper brought before the Australasian Association for the Advancement of Science in 1935, and afterwards printed, offered a new treatment of the facts of the electrolytic conductivity of strong

and feeble electrolytes, in strong and weak solutions, from which Masson deduced a simple general law based upon the viscosity aspect.

Masson's direct contacts with industrial chemistry were limited, but a constant stream of his students went forth into industrial careers in Australia and elsewhere. Through the close touch which he maintained with his former students and their firms, he exerted a wide influence in this field, directed particularly towards the scientific management of industrial concerns. Among his old students who entered academic chemistry may be mentioned his own successors at Melbourne, Prof. (now Sir) A. C. D. Rivett and Prof. E. J. Hartung, and elsewhere Prof. L. S. Bagster, Dr. A. C. Cumming, Prof. J. I. O. Masson, the late Prof. B. D. Steele, and Prof. N. T. M. Wilsmore.

Masson's work received early recognition in his election to the Royal Society in 1903. He became C.B.E. in 1918, K.B.E. in 1923, and LL.D.(Edin.) in 1924. He married Mary, daughter of the late Prof. Sir John Struthers, M.D., of Aberdeen and Edinburgh, who survives him; of his two daughters one survives; and his only son, Irvine Masson, is professor of chemistry in the University of Durham.

David Orme Masson was a man of great charm and urbanity, with a rare gift of lucid exposition and a lively and polished wit. Modest, versatile, and cultured as befitted his ancestry, he possessed an unusually wide range of interests and human sympathies. He was the doyen of chemistry in Australia, a great teacher in the University of Melbourne, and a much-loved citizen of his adopted country.

JOHN READ.

¹ *J. Chem. Soc.*, **39**, 49 (1881).

² *Trans. Roy. Soc. Edin.*, **32**, 87 (1883).

³ *J. Chem. Soc.*, **47**, 56 (1885); **49**, 233, 249, 846 (1886).

⁴ *J. Chem. Soc.*, **55**, 126, 135 (1889).

⁵ *Phil. Mag.*, [5], **30**, 412 (1890).

⁶ *Proc. Chem. Soc.*, **7**, 16 (1891).

⁷ *NATURE*, **43**, 345 (1891); *Z. phys. Chem.*, **7**, 500 (1891).

⁸ *Phil. Trans.*, A, **192**, 331 (1899).

⁹ *J. Chem. Soc.*, **97**, 2083 (1910); **99**, 1174 (1911).

¹⁰ *J. Chem. Soc.*, **93**, 2023, 2049 (1908).

¹¹ *Z. phys. Chem.*, **70**, 290 (1910).

¹² *Proc. Roy. Soc.*, A, **82**, 580 (1909).

¹³ *J. Chem. Soc.*, **67**, 1107 (1895).

¹⁴ Masson's table was published as a folding card by Melville, Mullen and Slade, London and Melbourne, n.d. A note states: "Atomic weights taken from the table of F. W. Clarke, revised to 1st January, 1895."

¹⁵ *Phil. Mag.*, [6], **41**, 281 (1921).

Canon B. H. Streeter

CANON B. H. STREETER, provost of Queen's College, Oxford, who was killed with his wife in an aeroplane accident in Switzerland on September 10, was one of the great Biblical scholars of the world. He was a many-sided man, and his intellectual interest was wide. Psychology, modern physics, anthropology, psychical research, the relations between religion and science, were all subjects in which he had read widely and become interested. He had a large circle of friends from whom he could acquire at first hand the information on these subjects he needed. He was, in particular, profoundly alive to the difficulties raised by the relations of science to

religious truth, and some of these were discussed by him in his most popular book, "Reality: A New Correlation of Science and Religion" (1926), more briefly also in "Adventure" (1927), and in the Bampton Lectures for 1932, "The Buddha and The Christ".

By 'religion' Streeter meant religion and not, as so often in similar discussions, theology. In religion as implying a quest for God, an apprehension of things beyond the limits of ordinary experience, he was a firm believer. In "Reality" he discussed the connexion between this and science, as he conceived it, clearly and simply. He held strongly that religion, like science and art, reveals to us genuine aspects of reality. Science, he said, gives us a representation of ultimate reality diagrammatic rather than pictorial; religion the reverse—it gives us the picture, not the exact diagram. The two aspects are there; in a sense they are complementary; they are not, however, commensurable. He put it in another way. Science is concerned with the metrical aspects of existence, religion (as art) with non-metrical or qualitative aspects, with values that are mostly ethical. Science states definitely; religion suggests. One tries to explain what is observed by finding laws covering individual cases; the other isolates an individual event or circumstance and makes it symbolic of some aspect of reality. For Streeter the truth of religion lay mainly in the quality of the myths (in the Greek sense) it embraces. The values enshrined or symbolized there are inherent in reality to the extent that the religion is true.

In the eighth Bampton Lecture Streeter, discussing psychical research, gave some of his own experiences of suggestion, mass-hypnotism and telepathy. In particular he discussed the 'levitation' of D. D. Home in 1871 witnessed by the Master of Lindsay and two friends present. He suggested from his own successful repetition of this exploit that Home probably gave each of the three a 'waking suggestion' which effectively convinced them that what they attested actually occurred.

Streeter was born at Croydon in 1874 and educated at King's College School. He went to Oxford as scholar of Queen's College in 1893 and thereafter spent most of his life there. As undergraduate he obtained three first classes and many university prizes. He was fellow of Pembroke from 1899 until 1905 and of his old college, Queen's, from 1905 until his appointment as provost in 1933. He was a fellow of the British Academy and honorary doctor of several universities. He married in 1910 but had no children.

A. S. R.

WE regret to announce the following deaths:

Dr. J. R. Airey, formerly principal of the City of Leeds Training College, on September 16, aged sixty-nine years.

Prof. de Burgh Birch, C.B., emeritus professor of physiology in the University of Leeds, on September 18, aged eighty-five years.

Mr. F. A. Potts, University lecturer in zoology in the University of Cambridge, on September 15.