that for test objects subtending small visual angles the brain centres for green and blue are linked together and are connected with the sense organs responding to green rays; while at the same time the sense organs responding to blue rays are temporarily put out of action.

17. *Nervous level of the mechanism.* A question which naturally presents itself concerns the position of this linking and cancelling mechanism. Is it situated in the retina, or in some part of the brain?

The following experiment points to a definite location. A grey test object is placed on a bright blue background in order to produce a yellow coloration of the former by simultaneous contrast. If now the distance between test object and observer be increased, it is found that the yellow coloration diminishes and at a certain distance disappears altogether, being replaced by white. This experiment shows that a subjective yellow behaves in the same way as a real yellow does with decrease in visual angle, and the mechanism producing the change must therefore operate on both. This mechanism must therefore be situated at a higher nervous level than the one which is responsible for simultaneous contrast. Now in Burch's celebrated experiment[6] in which, using a stereoscope, a grey test object on a blue ground was presented to one eye while another grey test object on a red ground was presented to the other, the two coloured grounds fused to form a single purple ground; but the grey test objects retained their individuality, that on the blue ground remaining yellow, that on the red ground remaining blue-green. This experiment showed that simultaneous contrast occurs at a nervous level below that at which binocular fusion occurs.

Now as we have said above, the mechanism for converting trichromatic to dichromatic vision appears to be situated at a higher nervous level than that responsible for simultaneous contrast. It might therefore be either between the levels for simultaneous contrast and binocular fusion or above both levels. Evidence has been obtained and will be described elsewhere that the former is probably the case.

I would like to express my thanks to those who have acted as observers for me.

[1] Hartridge, H., *J. Physiol.*, **52**, 175 (1918).
[2] König, A., *Acad. Wiss. Berlin*, 577 (June 1894).
[3] Willmer, E. N., *Nature*, **153**, 774 (1944).
[4] Hartridge, H., *Nature*, **155**, 391 (1945).
[5] Granit, R., *Nature*, **151**, 11 (1943).
[6] Burch, G. J., *J. Physiol.*, **25**, xvii (1900).
[7] Hartridge, H., *Nature*, **153**, 775 (1944).
[8] Pitt, F. H. G., *Proc. Roy. Soc.*, B, **132**, 101 (1944).

OBITUARIES

Sir Ambrose Fleming, F.R.S.

JOHN AMBROSE FLEMING was born at Lancaster on November 29, 1849, and died at Sidmouth on April 18. He was the eldest son of the Rev. James Fleming. His mother was a daughter of John Bazley White, an engineer who pioneered the manufacture of Portland cement in Kent. About 1856 the Fleming family moved to London and in 1863 Fleming entered University College School. He has recorded that he was always at the bottom of the Latin classes though quick at mechanics and science. Evidently in these respects he was nearer his maternal grandfather than his father.

In 1866 Fleming entered University College, but he had to leave before graduating. For a year he worked in a shipwright's drawing office and then for two years as a stockbroker's clerk. In his leisure he prepared for the B.Sc. degree. In 1871 he became science master at Rossall School, and in two years saved enough to allow him to enter the Royal College of Chemistry, South Kensington. There, under Franklin, he began his research career, and in 1874 read his first paper, on a form of voltaic cell, at the first meeting of the Physical Society of London. His funds being spent, he went as science master to Cheltenham College and in two years saved enough to enter St. John's College, Cambridge, at the age of twenty-eight, with the aid of an open exhibition.

He attended Maxwell's lectures in 1878 and 1879, the last two years of Maxwell's life, and worked in the Cavendish Laboratory on electrical resistance standards. He obtained a first class in the Natural Sciences Tripos in 1880 and became lecturer in applied mechanics in the new University engineering laboratories. He was made a fellow of St. John's in 1882. After a short time at Nottingham, where he held the professorship of physics, he returned to London to start a consulting practice in 1882. In 1884 he was invited to become the first professor of electrical engineering at University College, and he occupied this chair for forty-one years, the inaugural period of the electrical age.

Fleming began his consulting career at the age of thirty-three by becoming adviser to the Edison Telephone Company and continued with it after it was combined with the Bell Telephone interests. Later, when the Edison Electric Light Co. was formed, he became its adviser on the equipping of generating stations and distribution networks. After the carbon filament lamp was invented, he became the adviser of the Edison and Swan combination, particularly on the photometry of lamps. Later he advised a number of English towns on the adoption of electric light. He was also consulted by the London Electric Supply Corporation when it was installing the Ferranti alternating current system in London. In 1899 he became consultant to Marconi's Wireless Telegraph Company and took part in the design of the Poldhu Station, the first large wireless station in England. In the course of this work he devised new methods and new instruments for the measurement of high-frequency current, and he was the first to demonstrate that the thermionic rectifier could operate at radio frequencies. Thus during many years and in many directions he assisted in the adaptation of revolutionary electrical industries to English conditions, and aided the technical development of many fundamental electrical inventions. As fast as he gathered experience in these new technical developments, he passed it on in lectures to his students and to public audiences. He also read widely the expanding electrical technology and lucidly expressed its essence in his lectures. Some of his lecture courses were published as text-books. Among such books, one recalls with gratitude "The Alternating Current Transformer", "The Principles of Electric Wave Telegraphy", "The Propagation of Electric Currents in Telephone and Telegraph Conductors", "Electric Lamps and Electric Lighting".

In the midst of all these applications of science to engineering, Fleming found time and energy for a number of physical investigations—for example, the measurement of the electrical and magnetic properties of materials at the temperature of liquid air. Alto-

gether he wrote more than a hundred research and descriptive papers. He was elected to the fellowship of the Royal Society in 1892 and received the Hughes Medal of the Society in 1910; he was also awarded the Albert, the Faraday and the Duddell Medals; and in 1929 he was knighted.

As a teacher Fleming was superb. He had the gift of arranging his subject-matter attractively and of stating his facts and ideas emphatically. He talked straight on, without digressions, doublings, or repetitions, in a direct current of well-chosen words and rounded sentences. His delivery was very rapid; but his resonant voice and crisp articulation ensured that no one missed a word. Nor did anyone ever complain that his meaning was doubtful; everything was sharply defined. After middle age he became very deaf, but retained all his magic as a lecturer. This deafness, by the way, was utilized by his students when in jubilant mood; on such occasions a stranger passing the door of the lecture room might hear a sudden clamour and its sudden cessation, and if he lingered he would hear the uproar switched on and off at intervals. Inside the lecture room he would have seen that when the professor turned to the blackboard there was pandemonium, and when he faced his class there was silence. The timing had to be lively as Fleming was quick in his movements. This celerity was characteristic; even when he was in the middle seventies, one could see his linear figure threading swiftly a populous corridor in the College, intent on a goal, looking neither right nor left, overtaking everybody. Indeed in intellectual as well as material things, Fleming's main principle of action was, full-speed ahead. W. H. ECCLES.

Dr. David Randall-MacIver, F.B.A.

DR. D. RANDALL-MACIVER, the accomplished archæologist and anthropologist, was born in 1873, and educated at Radley and the Queen's College, Oxford, where in 1896 he obtained a first class in *Literæ Humaniores*. It had been his youthful ambition to devote himself to the pre-Columbian cultures of America, but as this seemed impracticable, he came easily under the influence of Sayce and Grenfell at Queen's, and learned the technique of Egyptian excavation with Flinders-Petrie. He was the first holder of the Laycock Studentship for Egyptology at Worcester College (1900–6) and in 1907 directed the Eckley B. Coxe, jun., Expedition of the University of Philadelphia to Egypt and the Sudan; publishing also with Arthur Thomson a detailed anthropometric study of ancient Egyptian skeletons.

When the British Association visited South Africa in 1904, Randall-MacIver was entrusted with a reconnaissance of the 'Zimbabwe' type of ruins in Rhodesia, and his rapid but careful and conclusive excavations on a few typical sites demonstrated their late date, and caused some indignation locally when they were published in his "Mediaeval Rhodesia". After some work in the Pennsylvania Museum, he became librarian of the American Geographical Society (1911–14), married an accomplished Virginian lady, and seemed to be settling down in New England.

But the War of 1914–18 recalled him to Europe as an efficient intelligence officer in France and in Macedonia—he spoke French, German and Italian with equal facility—and after 1919 he settled in Florence and devoted himself to the prehistoric antiquities of Italy, to which his attention had been attracted by another Queen's man, the late T. E. Peet, whom MacIver had sponsored in his early years, and with whom, in a manner, he changed careers, when Peet left Italian prehistory for Egyptology. Peet's "Stone and Bronze Ages in Italy and Sicily" (1909) was a pioneer survey of the earlier periods; Randall-MacIver took up the story in 1924 with a stately volume, "Villanovans and Early Etruscans", tracing through tangled and sometimes passionate Italian publications the main theme of the continuity of native Italian culture, and its gradual transformation by the Early Etruscan, which intruded on its region from the south. In 1927 came a companion study of "The Iron Age in Italy", dealing with the cultures of central and southern Italy, neither Villanovan nor Etruscan, which betray early and increasing signs of intercourse with regions east of the Adriatic.

In this way a new approach was prepared to the residual problem of the Greek colonization, and of the foreign imports which portend the first reconnaissance of 'Magna Graecia'. To this, Randall-MacIver had intended to devote a third memoir; but his many social and personal interests and the death of his wife in 1931 intervened; all that he left on this subject was a charming book of travel, "Greek Cities in Italy and Sicily" (1931). In 1936, he married another American lady, and on the outbreak of war in 1939 withdrew from Italy to New York, where he was able to do valuable services in the British war organization. There he died on April 30, 1945. JOHN L. MYRES.

Prof. Thomas J. Nolan

THE news of the death of Prof. Thomas J. Nolan on March 12, at the age of fifty-six, came as a profound shock to his colleagues and students.

Graduating in University College, Dublin, in 1909 with the highest honours in chemistry, Nolan commenced research work under the late Prof. Hugh Ryan and was awarded a travelling studentship in chemistry in 1911, his thesis dealing with a research on "The Higher Ketones and Secondary Alcohols derived from the Amides of Palmitic and Stearic Acids". In the autumn of 1911, Nolan proceeded to Geneva and commenced research under Amé Pictet on problems dealing with the "Constitution of Isostrychnine" and the "Application of Methylal in Ring Syntheses". Owing to the illness of Pictet this work was not completed. In 1912 he began research under Prof. Samuel Smiles in University College, London, on the "Isomerism of the Sulphides of β-Naphthol", the results being embodied in a series of five papers in the *Proceedings and Transactions of the Chemical Society*, London. In 1913, Nolan worked under Zincke in the University of Marburg and published in *Liebigs Annalen* a communication entitled "Saltpetersaürechinitrol aus 3. 5. 6 Trichloro-o-Kresol und Umwandlungsprodukte". His most distinguished work at this period was carried out in the Kaiser Wilhelm Institut in Berlin, where Willstätter was engaged on his classic investigations on the colouring matters of flowers and fruit. Under Willstätter's direction Nolan succeeded in isolating the pigments of the rose and peony in a pure condition and establishing their constitution. The outbreak of war in 1914 terminated these researches, and he returned to Dublin and was awarded the D.Sc. degree of the National University.