Cardiff at the University College at 8 p.m. The evening discourses by Sir R. T. Glazebrook and Sir Daniel Hall will be delivered in the Park Hall at 8 p.m. on Thursday and Friday respectively. The conference of delegates of corresponding societies will be held at 2 p.m. on Wednesday and on Friday in the assembly hall of the Technical College.

Three citizens' lectures will be delivered in the Park Hall at 8 p.m. on Monday, Wednesday, and Saturday, the lecturers being respectively Prof. J. Lloyd Williams ("Light and Life"), Prof. A. W. Kirkaldy ("Present Industrial Conditions"), and Dr. Vaughan Cornish ("The Geographical Position of the British Empire"). Members of the Association as such are not admitted to these lectures. The distribution of tickets, which are free, is in the hands of the Workers' Educational Association, and they may be obtained at the reception office during the meeting.

The programme of excursions is a varied one. The geologists are visiting Cefn On and Caerphilly on Tuesday, Penylan on Wednesday, the Barry Coast on Thursday, and Lavernock on Friday. Section E (Geography) will explore the Vale of Glamorgan on Wednesday, and the Taff and Rhondda Valleys on Thursday. The engineers will be shown over the Bute Docks on Tuesday, the Melingriffith Tinplate Works on Wednesday, the Dowlais Steelworks on Thursday, and the Great Western Colliery on Friday. Section H (Anthropology) will investigate the Roman remains at Caerwent (between Newport and Chepstow) on Wednesday. A botanical expedition to Wenvoe takes place on Thursday. The Section of Education will inspect the summer school at Barry on Friday. One or two demonstrations have also been arranged. On Wednesday Section I will be shown the new physiological laboratories of the University College, where a new electrokymograph will be demonstrated. On Thursday afternoon members of the Association, particularly those of Sections B, A, and I, are invited to the chemical laboratories of the Cardiff City Mental Hospital, where demonstrations will be given of some new chemical and physiological methods, and also of a modern high-powered X-ray installation equipped with auto-transformer and Coolidge tube. All these sectional excursions and demonstrations take place in the afternoons.

On Saturday, August 28, two general excursions of the Association will be made. One party will drive through the Wye Valley, taking lunch at Tintern and calling at Llanover, near Abergavenny, at the invitation of Lord Treowen, to take tea on the return journey. The other party will cross the Bristol Channel and visit the famous Cheddar caves, Wells Cathedral, and Glastonbury Abbey. The numbers in these excursions (and also in many of the sectional expeditions already mentioned) are limited. Members are requested to signify their intention of taking part in any of them as soon as possible after the beginning of the meeting. By so doing they will not only ensure their own participation, but also lighten the work of those responsible for organising the excursions, for in the present local conditions the difficulties of arranging transport are considerable.

Obituary.

Sir Norman Lockyer, K.C.B., F.R.S.

THE death of Sir Norman Lockyer on Monday last deprives the world of a great astronomer, and the nation of a force which it can ill afford to lose. Though it had been known for several months that Sir Norman was in a feeble state of health, his many friends cherished the hope that the vigour which was characteristic of him would revive, and that the devoted attention of his wife and daughter would preserve him to us for a few more years; but this was not to be. The alert mind and acute understanding which influenced so many men and advanced so much scientific work over a period of sixty years or so are now at rest, yet there remains to us a recollection which will not soon be effaced, and there stands in the archives of science a record of his achievement which will command admiration so long as the pursuit of knowledge is regarded as worthy human endeavour.

In the jubilee issue of NATURE in November last Dr. Deslandres, Sir Archibald Geikie, Sir Ray Lankester, and other distinguished men of science paid tribute to the work and influence of the founder of this journal, the volumes of which form an enduring monument to his memory. Sir Norman was not only a pioneer worker in the fields of science, but also an advocate of the claims of science to recognition in modern polity, and this rare combination was used to further scientific interests as well as to secure the progress of knowledge. He was the embodiment of mental activity, and never relinquished a task to which he had put his hand. Until a short time ago he was as eager to learn of developments and discoveries in astronomical work, and as ready to suggest new lines of research, as a man in the prime of life, and it is difficult to realise that this fund of energy is now no longer available to those of us who derived benefit from it. When Goethe wrote: "The quickening power of science only he can know from whose soul it gushes free," he must have had in mind a researcher of the type of him whose loss we now mourn.

Sir Norman Lockyer was born at Rugby on May 17, 1836. He was educated at various private schools, and in 1857 received an appointment at the War Office. His work there was so much appreciated that in 1865 he was entrusted with the editorship of the Army Regulations. In 1870 he was appointed secretary of the Duke of Devonshire's Royal Commission on scientific

instruction and the advancement of science. The reports of this Commission are most valuable records of the position and needs of science, and if the recommendations had been put into force this country could easily have been in advance of all others as regards scientific development. When the work of the Commission was completed in 1875 Sir Norman was transferred to the Science and Art Department. He afterwards became professor of astronomical physics in the Royal College of Science, and was director of the Solar Physics Observatory at South Kensington from 1885 to 1913. He was elected a fellow of the Royal Society in 1869, was Rede lecturer to the University of Cambridge in 1871, and Bakerian lecturer to the Royal Society in 1874, in which year he received the Rumford medal of the society. In 1875 the Paris Academy of Sciences elected him a corresponding member in the section of astronomy. He was a corresponding member of numerous national scientific societies, and honorary member of many others. He received honorary degrees from the Universities of Oxford, Cambridge, Glasgow, Edinburgh, and Aberdeen, and the Order of Knight Commander of the Bath was conferred upon him by the King in 1897.

Sir Norman Lockyer's early spectroscopic work was devoted to the sun. His first observations were directed to a scrutiny of the spectrum of sunspots as compared with that of the general surface. In the course of the paper in which these observations were described, read before the Royal Society on November 15, 1866, he remarked:—"May not the spectroscope afford us evidence of the existence of the 'red flames' which total eclipses have revealed to us in the sun's atmosphere, although they escape all other modes of examination at other times?" The spectroscope he then employed proved to be of insufficient dispersive power for his researches, but by the aid of the Government Grant Committee of the Royal Society an instrument of greater power, though not quite complete, was obtained on October 16, 1868. Four days later his efforts were crowned by the detection of a solar prominence by means of the bright lines exhibited in its spectrum. An account of this discovery was immediately communicated to the Royal Society and to the Paris Academy of Sciences. Meanwhile had occurred the total solar eclipse of August 18, and Dr. Janssen, who had observed with eminent success the spectrum of the prominences during the eclipse, came to the conclusion that the same mode of observation might enable one to detect them at any time, and he saw them in this manner the next day. The first account of the discovery, which was sent by post, reached the Paris Academy a few days after the communication of Sir Norman Lockyer's observation of October 20, and, as was described in NATURE of May 20 last, a medal was struck in honour of the joint discovery.

This notable application of the spectroscope revealed the prominences as local disturbances in the continuous luminous layer which Sir Norman Lockyer called the chromosphere, and from the field of research opened by his discovery rich harvests have since been reaped. The gas, named by him helium, commonly occurring in solar prominences, was not isolated on the earth until twenty-seven years later, when Sir William Ramsay extracted it from the mineral clèveite. Now, as Prof. McLennan has described in these columns, it is possible to obtain millions of cubic feet of helium per day from natural gas in Alberta, and there is every reason to believe that this supply will become of immense scientific and industrial value.

It is beyond the bounds of this general record of Sir Norman Lockyer's scientific services to venture into the field of astronomical physics which he made particularly his own. An appreciative account of that work will be contributed to a later issue by a spectroscopist familiar with its special significance and value. Here we need only remark that Sir Norman's meteoritic hypothesis of celestial evolution is chiefly responsible for the change of view which has taken place as to the nature of nebulæ and the existence of stars of increasing as well as of decreasing temperatures. Dark nebulæ—sheets or streams of non-luminous cosmic dust are no longer considered hypothetical, but are as real as dark stars, and the incipient luminosity of nebulæ in general represents the visible portion only of vastly more extensive congeries of invisible cosmic matter. Some of the most noteworthy discoveries of astronomical science in recent years are, indeed, those which suggest or demonstrate that space may include as much dark matter as bright, and they largely owe their origin to Sir Norman Lockyer's meteoritic hypothesis and the classification of stellar types based upon it.

In his work and conclusions upon the subject of dissociation, Sir Norman Lockyer was likewise much in advance of his times. Fifty years ago he was convinced by his spectroscopic observations that the view that each chemical element had only one line spectrum was erroneous, and that the various terrestrial and solar phenomena were produced by a series of simplifications brought about by each higher temperature employed. In his studies of dissociation he was really collecting facts concerning the evolution of the chemical elements, and he pointed out especially that the first steps in this evolution were probably best determined by observations of stellar spectra.

Sir Norman Lockyer was the chief of eight British Government solar eclipse expeditions, and organised the programmes of several others while director of the Solar Physics Observatory. His use of the slitless spectroscope during the eclipses from 1871 onwards provided a wealth of information for study. From the photographs obtained during the total solar eclipse of 1893 the wave-lengths of many chromospheric and coronal lines were determined, and a very complete series of pictures and spectra of the corona and chromosphere was obtained during the

eclipse of 1898, the true wave-length of the chief corona line being then determined as 5303·7. Further knowledge was secured from the eclipses of 1898, 1900, and 1905, and it was all brought into relationship with the laboratory work and discussions of stellar types carried on at the Solar Physics Observatory.

When the first Solar Physics Committee was appointed in 1879, reference was made to the desirability of an inquiry into the possible effect of solar conditions on meteorological phenomena, but it was not until 1898 that Sir Norman Lockyer undertook, with his son, Major W. J. S. Lockyer, a definite and searching inquiry into the most trustworthy meteorological records, with the view of discovering indications of solar influence on weather factors. It was established that the oscillations of annual pressure in South America are closely related to those of the Indian Ocean, but inverse in character, high pressure years in India being represented by low pressure years in Cordoba. This "see-saw" phenomenon was found to hold good for numerous other districts, and its importance for long-period forecasting is now being recognised. Drs. Helland-Hansen and Nansen refer particularly to the work of Sir Norman and Major Lockyer upon this subject in their valuable memoir noticed in NATURE of August 5, p. 715.

A report on the work of the Solar Physics Observatory during the period 1889–1909 was issued by Sir Norman Lockyer when the Solar Physics Committee was dissolved and the observatory transferred to Cambridge. This abrupt break in his life's work was acutely felt by Sir Norman, and he never really recovered from its effects, though he was as keen as ever upon progress in astrophysics. What he desired particularly was that the observatory should be transferred to a site which would permit increased opportunity for observation, and when, to his great disappointment, the institution to which he had devoted so many active years was summarily reorganised without consideration for his interests in it, and placed in a position little better than that which it had long occupied under his directorship, his hope for the development of astrophysical researches started at the observatory received a sudden and pathetic check.

Obstacles were, however, always used by Sir Norman Lockyer as opportunities. When the Solar Physics Observatory was taken from South Kensington to Cambridge in 1913, and his official connection with the observatory ceased, he devoted himself to erecting a new observatory at Salcombe Regis, Sidmouth, where he spent his declining years. Later, the Hill Observatory Corporation was formed to promote the development of this observatory and to carry on its work permanently. Sir Norman and Lady Lockyer gave the site of seven and a half acres upon which stand the present buildings, and there is ample room for extension, while the position of the observatory is as fine as could possibly be desired. Thanks chiefly to Sir Norman's gifts of instruments and to the generosity of Lt.-Col. Frank McClean, Mr. Robert Mond, and others, the observatory is already one of the best equipped in the country, and it could become one of the best in the world if wealthy benefactors here were as much interested in the promotion of astronomical science as they are in the United States, where the most notable work is now being done in astrophysics. No memorial to Sir Norman Lockyer could have a more appropriate object than that of providing means to increase the staff and develop the work of the Hill Observatory.

Sir Norman Lockyer's archæological observations are not so well known as they should be, for most of them belong to the first rank. In continuation of his work on the astronomical uses of Egyptian temples, he turned his attention to some of the stone circles and other stone monuments in this country, and he was able to establish the conclusion that such monuments were built to observe and mark the rising and setting of the sun and other heavenly bodies at different times of the year. The date of construction of Stonehenge was thus found to be between about 1900 and 1500 B.C., and it appeared that a thousand years before circles were built in Cornwall, commencing about 2400 B.C., avenues were erected in other parts of Britain.

When president of the British Association in 1903–4, Sir Norman Lockyer delivered at the Southport meeting a notable address on "The Influence of Brain-power on History." This address attracted wide attention, but the nation was not then ready to learn the lesson taught by it, and it has taken the greatest war of all time to awaken national consciousness to its significance. A strong plea was made to prepare by intellectual effort for the struggles of peace and of war, and it was added:—"Such an effort seems to me to be the first thing any national or Imperial scientific organisation should endeavour to bring about." Sir Norman Lockyer hoped that the British Association would expand one of its existing functions and become the active missionary body adumbrated in his address; but his appeal did not meet with the active support he expected from the council, most of the members of which were more interested in scientific work itself than in national aspects of it. With characteristic energy, however, Sir Norman set himself the task of establishing an organisation which would bring home to all classes of the community the necessity of making the scientific spirit a national characteristic to inspire progress and determine policy in affairs of all kinds, and as a result the British Science Guild was founded in 1905.

Throughout his career Sir Norman Lockyer's public activities made contact with national life at many points, and the British Science Guild is an institutional representation of them which remains to attain the objects at which he consistently aimed. The purpose of the Guild is to stimulate not so much the acquisition of know-

ledge as the appreciation of its value, and the advantage of applying the methods of scientific inquiry in affairs of every kind. Such methods are not less applicable to the problems which confront the statesman, the administrator, the merchant, the manufacturer, the soldier, and the schoolmaster than to those of the scientific worker. These were the convictions of Sir Norman Lockyer, and he had the satisfaction in recent years of hearing them proclaimed from the housetops, while the Guild itself stands as a monument of their power and his prescience.

In 1904 a large and influential deputation urged upon Mr. Balfour, then Prime Minister, the need for further assistance to university education and research, and in announcing that the grant would at once be doubled, as well as redoubled in the following year, Mr. Balfour stated that the increase, which represented a capital sum of 3,000,000*l.* at 2½ per cent., was given as the result of the appeal made in 1903 by Sir Norman Lockyer in his presidential address to the British Association at Southport. This represents one result only of his ceaseless activity on behalf of science and higher education; the pages of NATURE throughout its existence afford ample testimony of the use of the same zeal for progress.

"There must," he once said, "be only one kind of education—the best—and that is to be given to everybody." He expected the best work from everybody associated with him, and would not tolerate any lower standard for either individual or national aims. His fingers have now loosed their grasp upon the torch of science which he held aloft for so many years, but the light still burns on the bank of the dark river he has crossed; and in admiration, hope, and reverence it will be borne onwards by workers whom he inspired. His body will be laid to rest on Saturday morning at Salcombe Regis Church, Sidmouth, but his spirit will remain in the observatory on the hill-top near-by to stimulate others to reach out and touch the sky.

Sir Edward Brabrook writes:—

Among the many who have been honoured by the friendship of Sir Norman Lockyer and are in sorrow at his death, I count myself, as having had opportunities of being associated with him in more than one capacity. I was one of those members of the Civil Service whom he invited to join with him in a welcome to Mowatt, of the Treasury, on the occasion of his election as a member of the Athenæum. In the year when Sir Norman presided over the British Association, I was one of the sectional presidents, and was nominated by him as a member of the council. I warmly sympathised with the wishes he then entertained for the extension of the functions of the association, and when these were seen to be not realisable in the form in which he desired them, I accepted his invitation to join in the formation of the British Science Guild. Others will be better able than I to tell the story of his labours for that institution, and of the success that has attended them; but I may say a few words on another aspect of his untiring intellectual work, viz. his contributions to archæology. In this respect he was an example of the interdependence that exists between the sciences, for it was the pursuit of his favourite science of astronomy that gave the direction to his studies of ancient civilisation. In the temples of Egypt and in the stone circles of our own country he found evidence of the astronomical knowledge and purpose with which they were erected, and his own profound acquaintance with the problems they presented to him from that point of view led him to conclusions which, as in the case of fixing the date of Stonehenge, were closely verified by the evidence afterwards derived from excavations on the spot.

AGRICULTURAL chemistry has lost a distinguished exponent by the death of PROF. EDWARD KINCH on August 6 at the age of seventy-one. Prof. Kinch was educated at the Grammar School, Henley-on-Thames, and the Royal College of Chemistry, and successively occupied the following positions:—Chief assistant to the professor of chemistry (the late Sir Arthur Church) at the Royal Agricultural College, Cirencester, 1869–73; on chemical staff of Royal School of Mines, 1873–75; superintendent of minerals, India Museum, 1875–76; professor of chemistry, Imperial College of Agriculture, Tokyo, 1876–81; professor of chemistry, Cirencester, 1881–1915, when the Royal Agricultural College closed on account of the war. He published many technical papers on agricultural chemistry, in which he was a leading authority, always distinguished by the soundness of his judgment. As a teacher Prof. Kinch did much for his subject both in this country and in Japan, and he will be remembered with respect and affection by many generations of students and numerous former colleagues. His life was saddened by the premature death of his young wife (a daughter of the late Rev. Geo. Huntington), whom he married in 1889, and after this he led a somewhat retired life. Those privileged to be his intimate friends will not easily forget his many sterling qualities and quiet sense of humour.

J. R. A.-D.

WE regret to note that the death of MR. JOHN KIRKALDY is announced in *Engineering* for August 13. Mr. Kirkaldy was born in 1853, and was head of the well-known London firm of John Kirkaldy, Ltd. Quite early in life he took over the management of his father's business, and under his direction the firm played an important part in introducing fresh-water distilling apparatus for use on board ship. Plant of this kind was also designed for use in the Ashanti campaign, and in 1883 and 1885 in connection with the Egyptian campaigns. Mr. Kirkaldy was a member of the Institution of Civil Engineers, and also of the Institution of Mechanical Engineers.