consulting engineer, and in 1903 he was offered and accepted the post of electrical engineer-in-chief to the Admiralty. Here he was responsible for the electrical equipment of all his Majesty's ships and for the electrical lighting and power used in the dockyards, including Rosyth and all the naval air stations. In 1918 he left the Navy and resumed his consulting practice. He was consulted by many local authorities on traction and lighting projects. He also gave expert evidence and supervised the erection of several power stations.

Wordingham served for many years on the council of the Institution of Electrical Engineers and no one took a greater interest in practically all the committees. He was president of the Institution in 1917 and 1918, and laid down a standard of work which subsequent presidents have found it difficult to equal. He was very enthusiastic that the Institution should found a Proving House for all electrical apparatus and material, but many difficulties stood in the way. During his presidentship he helped to found the Society of Radiographers, which is doing useful work. He made many contributions to the technical journals and wrote a useful book on "Central Electrical Stations."

He was president of the Junior Institution of Engineers and always took the greatest interest in young engineers, doing his utmost to encourage them.

A vast amount of work was also done by Wordingham in connexion with the Engineering Standards Association, being chairman of the Electrical Sectional Committees. He also took endless pains in getting the Wiring Rules of the Institution of Electrical Engineers accepted by the authorities. He has died at a comparatively early age, leaving many of the projects in which he was enthusiastically interested half finished. He was very popular with his colleagues, and he will be grievously missed by every electrical engineer.

A. R.

MR. GEORGE ABBOTT.

GEOLOGY perhaps more than any other science needs all the assistance which careful amateurs can bring to the total sum of knowledge. Men living on the spot are of the greatest service to the official geologists when a re-survey takes place. George Abbott was one of the most painstaking of local geologists, whose help was always at the service of those who needed it. Born on March 25, 1844, he was in his eighty-first year when he died on January 12 at Tunbridge Wells, where he had lived since 1878. Scattered in various publications are many of his contributions to geology, but he was particularly interested in the various rock-forms which so often resemble organised life. From the magnesian limestone of Fulwell he obtained most of his specimens, and these he classified in so clear a manner that one was able to realise from his tables the series of stages by which such forms gradually grew to their familiar pseudo-organic shapes.

In 1896, in conjunction with the Rev. T. R. R. Stebbing, Abbott conceived the happy thought of creating a union of scientific and similar societies in the south-east of England for mutual help, and the first two of the South-Eastern Union's Annual Congresses were held at Tunbridge Wells. The Union grew into a vigorous organisation and has held its annual congresses regularly ever since, whilst its annual proceedings, *The South-Eastern Naturalist*, is now accepted as a responsible scientific publication. Some years later he founded a Geological Physics Society, but here apparently was a society which was not needed, for after a few years of vicissitude it ceased to exist. Its work is being done by other organisations, but as a protest against the overpowering study of palæontology it performed some useful work.

Abbott had suffered a good deal during the last few years, and his favourite study, apart from his medical duties, was a great comfort in the time that he was laid by. He founded the local natural history society, and supplied many specimens to the elementary schools of the borough, on the Town Council of which he served for some years. He also established the Eye and Ear Hospital at Tunbridge Wells, and was Hon. Surgeon from 1878 to 1886.

WE regret to announce the following deaths:

Prof. W. A. Haswell, F.R.S., emeritus professor of biology in the University of Sydney, and author, with the late Prof. T. Jeffrey Parker, of "A Text Book of Zoology," aged seventy.

Dr. N. Kulchitsky, lecturer in histology at University College, London, and formerly professor of anatomy in the University of Kharkov, on January 29.

Dr. D. B. Spooner, deputy director of archæology in India since 1919, on January 30.

Prof. Hermann Schunck, a former director of the Badische Anilin- und Soda-Fabrik at Ludwigshafen, who retired in 1923, on January 8, at Solln near Munich.

Current Topics and Events.

ELSEWHERE in this issue appears an account of a remarkable discovery which appears to afford *prima facie* evidence of the occurrence at a remote period in South Africa of a pre-human stock, neither chimpanzee nor gorilla, and possessing a series of characters differentiating it from any anthropoid hitherto known. Fossilised fragments from a limestone cliff formation at Taungs, 80 miles north of Kimberley, in Bechuanaland, when fitted together, have revealed a natural endocranial cast with almost the entire face of what at first sight appeared to be an anthropoid, but on closer examination is found by Prof. Dart to exhibit humanoid rather than anthropoid characters. The occurrence of a fossil anthropoid so far south would in itself be sufficiently remarkable, but the interest and importance of this discovery is enhanced by its remarkable divergence from the anthropoid and its approximation to the human stock. Not only is this exhibited in the character of the cranium as a whole, but it is also apparent in the formation of the brain, so far as this is indicated by the endocranial cast. The position of the foramen magnum, if correctly estimated, in itself would indicate that this sub-human type was well on the way towards acquiring the upright posture, and the inference of an increase in intelligence which would follow upon a

freer use of the fore-limbs is supported by the development of the association areas of the brain, which is such as to indicate a marked advance in the growth of intellect. So far are we taken by Prof. Dart's preliminary report and the photographs which accompany it. A detailed examination of the evidence upon which his conclusions are based must await the publication of the monograph now in course of preparation. Within recent years, South Africa, in the discovery of the Boskop and Rhodesian skulls, has added remarkable chapters to the history of early man; but even the interest of Rhodesian man may well be eclipsed if the claim of *Australopithecus africanus* be substantiated. In this event, we shall have advanced one stage further, and that a stage of the greatest importance, in the quest for the cradle of mankind, whether that eventually prove to have been in Africa or elsewhere.

THE series of extracts from Dr. Birch's "History of the Royal Society," that have been appearing in NATURE week by week during the past year, reached a conclusion with the article published last week. But to Lancelot, Lancelot succeeds; "Early Science at the Royal Society" will be followed by "Early Science at Oxford," a somewhat similar series of extracts taken from the Minute Books of the Philosophical Society at Oxford between the years 1683 and 1690. By some the Oxford Society is regarded as the origin from which the Royal Society sprang. Certainly it was a fully organised body, with a constitution and officers, more than ten years before the London Society received its first charter, or recorded proceedings; and even in the papers of the Royal Society itself there are occasional early references to "an ingenious assembly" meeting in Oxford. The gatherings were, however, somewhat irregular owing to the fact that the members having no proper meeting-house, had to rely upon private hospitality, which made it difficult for them to accumulate books or collections, or even to arrange experiments. The building of the Ashmolean Museum, with a chemical laboratory in the basement and a room for the study of natural history on the first floor, provided the accommodation that was necessary for further progress, and on October 26, 1683, "The Company meeting in ye Naturall History School, desired Dr. Wallis, to take on him ye trouble of ye Chair; and appointed Mr. Musgrave to take ye Minutes of their Discourse." Extracts from Mr. Musgrave's minutes are now published for the first time.

ON December 15 last the Foreign Secretary, in response to a question in the House of Commons asked by Mr. A. A. Somerville, M.P. for Windsor, issued a Return giving full particulars of the Boxer Indemnity (Hansard's Debates, Dec. 25, 1924, p. 641, price 6d.; or Christian Industrial Fellowship, 4 The Sanctuary, Westminster, price 1d.). The Return enumerates not only the Powers concerned and the annual quotas paid to each, but also, in the case of remitting Powers other than Great Britain, the operative instrument and the stated purposes of remission, together with the machinery set up. One notable point of this illuminating document is that all the other remitting Powers (United States, Japan, Russia, France) have defined the purposes of their remission by statute or other legislative process, leaving to committees the task of carrying into operation the purposes thus defined. Another point common to all, except France, is that the purposes of remission are declared to be exclusively educational or cultural: even France makes a similar declaration, but its action is postponed until the debts of a state-guaranteed bank have been discharged. The remitted quotas—all of which continue until 1945—vary from 1,000,000*l.* a year (Russia) to 150,000*l.* (United States), that being all that remains of her original share of 260,000*l.* To Britain is due 400,000*l.* a year. The German and the Austro-Hungarian quotas, 700,000*l.* and 30,000*l.* respectively, were cancelled by the allies as a result of the War. The China Indemnity Bill is down for second reading in the House of Commons on February 13. The Government will, it is understood, introduce the late Government's Bill, as amended in committee. If, when the Bill becomes an Act, the present meaningless description of purposes is retained, an advisory committee, and not Parliament, will determine whether "educational or other" purposes shall, for example, be interpreted to include railways. It is hoped, however, that the Government may be induced so to define the purposes as to exclude this possibility; for though such a use of part of the fund might benefit a few contractors and employ a few engineers in China, it would certainly lower our prestige and alienate those for whom our remission of a just debt has been made.

PROF. W. J. DAKIN'S inaugural address on "The Teaching of Biology in Secondary Schools," delivered before the Liverpool Biological Society and published in vol. xxxviii., 1924, of the Society's Transactions, is a forcible pleading for the inclusion of biology as a subject of general education in school curricula. Not botany alone, or zoology alone; but the study of life-processes as manifested both in plants and in animals, the mutual relations of the members of the two kingdoms, and the bearings of both on human welfare—this is the type of biology that he advocates. Since in many schools botany is already taught, a large portion of the address is devoted to showing how zoology may, with a little foresight and slight expense, be likewise included in the teaching scheme. Difficulties that are feared, and objections that have been raised by some teachers, are discussed; and useful suggestions are offered by which apparent obstacles may be surmounted. An emphatic denial is given to the statement made in the Report of the Investigators of the Secondary School Examinations Council that "the principles of Biological Science can be better illustrated by means of botany, especially as physiology occupies a far more important part in the subject than in zoology, which does not readily lend itself to experimental treatment." There will doubtless be differences of opinion among teachers regarding the exact stage at which biology, in the full sense recommended by Prof. Dakins, can most

advantageously be introduced into the school time-table; but it is to be hoped that this address will be taken to heart and widely applied in those classes to which such teaching is appropriate.

DR. W. P. DAVEY, the research physicist of the General Electric Company of America, has produced a crystallised form of copper the electric conductivity of which is 13 per cent. better than that of ordinary pure electrolytic copper. Prof. Bridgman, of Harvard, was the first to discover that copper could be produced in relatively large crystals by the method of slowly heating it in an electric furnace and then cooling it equally slowly. On December 31, Dr. Davey described to the American Physical Society his success in producing copper crystals nearly an inch in diameter and six inches long. These specimens could be bent without effort, but once bent they could not be straightened again. This is attributed to the effect produced by the bending in upsetting the balance of the atoms of copper. The crystals seem to readjust themselves into small crystals again, so that for all practical purposes it becomes a bar of ordinary copper and is equally inflexible. By X-ray examination it was shown that the prepared copper was simply one large crystal, the atoms being arranged in regular rows from end to end. When the crystal was hammered it lost its super-conductivity. The new copper has a greater conductivity than silver. At present its manufacture on a commercial scale is not feasible, but Dr. Davey thinks that the time is in sight when it can be used for ordinary dynamos and conducting mains. As less copper would be required for a given service, it would cheapen the cost of conduits in underground work and of the towers required for overhead conductors.

SCIENTIFIC addresses by Sir Robert Hadfield are usually of a most comprehensive and enlightening kind, and that delivered by him before the Oxford University Junior Scientific Club on January 21 will delight all who see it in its published form. The address was entitled "Metallurgy and its Influence on Modern Progress," and it occupies about 190 pages, of which only a portion was read and illustrated by lantern slides and moving pictures. Amongst the plates in the published volume is a particularly interesting one showing Roger Bacon (1214–1292), one of the early founders of scientific thought in Oxford; the illustration represents Bacon, who wrote letters "of the Secrets of Arts and Nature" to the Paris University, presenting a book to the Chancellor of that University. By kind permission of the War Office and Admiralty, Sir Robert was able to show, in the course of his address, a cinematograph picture, taken by himself and his staff, of loading and firing a 15-inch gun at the Government Proving Ground at Shoeburyness, including a view of the butt one sixteenth of a second later showing the impact on the plate; one half second later showing large numbers of fragments flying from the plate and the butt; and finally the unbroken projectile, weighing nearly one ton, after it had perforated the thick, hard-faced armour plate against which it was fired. The sections devoted to metallurgy in the book cover about one hundred pages, in which Sir Robert refers to the importance of iron in antiquity, and the rise and importance of alloy steels. He gives a history of the invention by himself of manganese steel, silicon steel, and other alloy steels, and refers also to the value of heat treatment and the history of the pyrometer. In concluding his address Sir Robert directed attention to the importance of effort, progress and international co-operation, and suggested that there should be an annual Science Day to impress upon the community the place of science in modern life.

SIR OLIVER LODGE'S third talk on "Ether and Reality," delivered on February 3 under the auspices of the British Broadcasting Co. from the London Station, 2LO, was devoted to the electric charge and the means by which electric charges act on each other. The following are extracts from his instructive address:—Discoveries of the present century have shown (what had already been suspected by Faraday and Maxwell in the last century) that electric charges are discontinuous, like matter, that they exist as separate particles, although their field or region of influence extends throughout space. Moreover, electric particles or corpuscles are of two opposite kinds, which attract each other, and when very close together blot out each other's field at a distance and form a neutral combination. Particles which attract each other need not fall into each other, any more than the planets fall into the sun. The negative corpuscles can revolve round the positive, and thereby constitute a neutral group, with which we are familiar as an atom of matter. That is what an atom of matter is; that is what is meant by saying that matter is electrically constituted. The particles of opposite sign are called electrons and protons and are joined by lines of force, which represent something going on in the ether; all electrical phenomena can be expressed in terms of these lines of force. Lines of force represent a state of the connecting medium which unites electrons and protons and causes their apparent attraction. Similar lines account for cohesion. Gravitational lines of force unite earth and moon. We should always look for a medium, and we always find the ether operative in the physical universe; whether it is active in the mental universe we are not so sure. Mind usually acts on mind through a physiological mechanism; whether such indirect mode of connexion is always necessary is a subject for investigation. The laws of mental action may be quite different from physical laws; we should not let mechanism dominate us, for we may have to enlarge our conceptions.

"THE Mountain Structure and Geographical Relations of South-eastern Asia" formed the subject of a discourse delivered at the Royal Institution on Friday, January 30, by Prof. John W. Gregory. Prof. Gregory stated that the continuity of the Alpine-Himalayan system has been proved from western Europe to eastern India. Its further eastward continuation, according to one view, is across central China to Bering Straits; and according to another through western Burma to Sumatra and thence along

the southern islands of the Eastern Archipelago. Its diversion from its eastward course has been attributed to the mass of Chinese Tibet, the structure of which is complex, being due to movements at two different dates. The later movements belong to the series which made the Alps and Himalaya and are geologically modern. The other group is much older and is represented in Asia by the Altaid mountains. The most direct proof of the Himalayan movements is afforded where rocks which, as in the salt basin of Yunnan, were not in existence when the Altaid mountains were made have been intensely folded. At the end of the Altaid uplifts, the site of the Indian Ocean was covered by Gondwanaland, which extended from South America across the Old World to Australia. This continent was broken up by successive subsidences; and the gulfs thus formed gradually became the Atlantic and Indian Oceans. These movements were accompanied by volcanic eruptions, which deluged equatorial Africa and western India under floods of lava, while East Africa was torn asunder by the formation of the Great Rift Valley. One difficulty in the explanation of these eruptions and fractures by the foundering of the floor of the Indian Ocean was the apparent absence of any corresponding phenomena on its eastern side. The evidence now shows that Burma and western China were disturbed by volcanic eruptions and fractures contemporary with those of East Africa. The geographical relations of the mountains of south-eastern Asia therefore indicate that the Alpine-Himalayan system is part of a belt of crumpling of the crust where the in-sinking northern dome of the world pressed against the tropical and subtropical belt.

AT a meeting of the Newcomen Society held on January 28 two historical papers were read, the first being by Mr. Hamilton, an American member, on "The Windmills of Cape Cod," while the second was by Mr. David Brownlie, and was entitled "Some Notes on a Neglected Worthy, John Patison of Airdrie." John James Patison was born at Leith in April 1828 and died at Inverkeithing in July 1905. Though his youth was passed in a bookshop and a bank in Edinburgh, he was able to start a salt works at Musselburgh, and afterwards, when he had removed to Airdrie, he began experimenting on the carbonisation of shale, and near Airdrie he established the Whiterigg Chemical Works. Mr. Brownlie referred to him as one of the earliest practical workers in the commercial development of the Scotch shale oil industry, though its real founder was, of course, James Young. The distillation of shale at Whiterigg ceased about 1864, a few years after the discovery of American petroleum. Patison was also the inventor of an internal screw conveyer retort, and Mr. Brownlie in his paper gives some interesting details of other inventors in the same field.

THE rainfall of 1924 is dealt with in the *Meteorological Magazine* for January, but at present it is only possible to outline the general features. Over the British Isles as a whole, the year was unusually wet; the average fall was 48·5 in., which is 117 per cent. of the normal. It was wetter than any year since 1903, when the rainfall over the British Isles was 52·5 in. or 127 per cent. of the normal. In 1924 the rainfall was only slightly heavier than in 1916 and 1912, when the percentage of the average was 115 and 116 respectively. In parts of Scotland and the north of England, there were fairly large areas where the 1924 rainfall was deficient, and at Louth in Lincolnshire the rain was only 89 per cent. of the average. In England and Wales the rainfall for the year was 121 per cent. of the average for the 35 years, 1881–1915; in Scotland it was 105 per cent., and in Ireland 122 per cent. More than 140 per cent. of the average occurred on Dartmoor, on the Cotswolds, and to the north of London at Maidenhead and Chelmsford. At High Wycombe, in Buckinghamshire, rain measured 38·94 in., which is 13·04 in. more than the average, and is 50 per cent. above the normal; it is the largest fall, with the exception of that in 1903, since records were commenced in 1846. The London rainfall, according to the Camden Square records, was 33·08 in., which is 8·61 in. or 35 per cent. above the normal, the largest rainfall since 1916. Rain fell in London on 188 days, and the duration of rain for the year was 539·6 hours. January, May, September, and December were all very wet, whilst February and March were unusually dry.

THE Hunterian oration in connexion with the Royal College of Surgeons of England will be delivered at the college on Saturday, February 14, at 4 o'clock, by Sir D'Arcy Power.

SIR WILLIAM B. HARDY will deliver a lecture on "Problems presented by Films on Solid Surfaces," under the auspices of the Chemical Society, at 8 P.M. on Thursday, February 26, in the lecture hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. Invitation has been extended to fellows of the Physical Society.

ON Tuesday, February 10, at 5.15 P.M., Prof. J. Barcroft, Fullerian professor of physiology, begins a course of four lectures at the Royal Institution on the colour of the animal creation. The Friday evening discourse on February 13 will be delivered by Dr. B. Malinowski on the forces of law and order in a primitive community, and on February 20 by Prof. T. H. Pear on acquiring muscular skill.

THE Minister of Agriculture and Fisheries has appointed a permanent committee to advise the Ministry on all questions relating to agricultural meteorology. The committee consists of:—Sir Napier Shaw (Chairman), Prof. V. H. Blackman, Mr. H. Corless, Mr. R. A. Fisher, Mr. J. C. F. Fryer, Mr. R. H. Hooker, Mr. R. G. K. Lempfert, Sir Thomas Middleton, Mr. J. Ramsay, Mr. H. G. Richardson; Mr. W. R. Black, of the Ministry of Agriculture, has been appointed secretary of the committee.

AT the annual council meeting of the National Union of Scientific Workers, which was held at the University of London Club on January 31, the president, Prof. G. H. Hardy, announced that the efforts which the Union has been making for some

time past to obtain an increase in the Treasury grant to the Royal Society, in aid of scientific publications, have been successful. It is understood that, in the estimates for the coming financial year, the Government will make provision for an increase in this grant from 1000*l.* to 2500*l.* a year. The Annual Report of the Executive Committee records many other activities of the Union which are of interest and benefit, not only to members, but also to the scientific world at large. During the past year, three new branches have been formed, and the number of new members elected has been considerably larger than in previous years.

LAST month Mr. A. Cobham made a flight over the Himalayas. The *Times* gives some details of his journey. Leaving Calcutta he reached Jalpaiguri in 3½ hours, the object of this part of the journey being to survey an air route to Darjeeling. From Jalpaiguri he started his reconnaissance over the Himalayas, passing over Darjeeling at a height of some 9000 ft. Flying towards Kinchinjunga, Mr. Cobham experienced difficulties at about 12,000 ft., but after turning and descending, he returned and climbed without difficulty to 17,000 ft. At that altitude breathing was not easy, but temperature was not so low as at 12,000 ft. After taking a series of photographs of the range, Mr. Cobham returned to Jalpaiguri, having occupied only 3½ hours in his flight. He believes that the whole Himalayan range could be accurately surveyed from the air at a relatively small cost, and that a flight over Mount Everest would be easy.

THE arrears due to the War in the great *Index Kewensis* are being rapidly overtaken. The last pre-War Supplement, covering the years 1906–10, was published in 1913, and it was not until nine years later that it was possible to issue Supplement V., covering the years 1911–15. But Supplement VI., covering the years 1916–20, is now complete, and printing has begun at the Oxford University Press. We learn from the publishers that their stock shows that a large number of sets of the work have not yet been completed to date by the addition of Supplement V. (published in 1921), and they ask us to direct the attention of librarians to this fact. The value of the work, both scientific and pecuniary, is, of course, seriously impaired by the failure to complete sets; and the relatively low price at which the Supplements are issued has been made possible by the support given by librarians and learned institutions all over the world.

INTERMITTENT bournes are flowing in chalk areas in the south-east of England, and the Croydon bourne is no exception. It is probably not yet at its highest, but broke out as usual in the garden of the Rose and Crown, at Warlingham. It is now gradually creeping up the valley. More interesting is the fact that the Addington-Wickham Bourne is again out. This, after disappearing for about 33 years as a flow of any magnitude, appeared in June 1916, and is now again flowing, but it has passed its maximum. The gravel-pit which has been made in its path was covered by water, but not to any depth, and it is subsiding. This bourne is not directly on the chalk, but wells up through a thickness of tertiaries, and hence does not appear until these have been saturated. It is noteworthy as being in the valley which must have been at one time an upper reach of the Ravensbourne. Sodden patches which have been let down near its source seem to show that underground solution is taking place to some extent.

Our Astronomical Column.

THE OPPOSITION OF EROS IN 1931.—This opposition will be much the most favourable since Eros was discovered in 1898. Dr. Witt, who discovered the planet, has been engaged on the study of its perturbations up to 1931, and announces that he has now completed this work. The German observatories are now making arrangements for the careful observation of stars that lie near the planet's track, as they will be required as reference stars; they are also inviting co-operation in other countries.

The details of Dr. Witt's work are not yet published, but the following ephemeris, based on earlier elements, gives a general idea of the conditions during the time that the planet is within 19 million miles of the earth.

		R.A.	Decl.	log Δ.
1931.	Jan. 5	10h 17m	25° 16′ N.	9·306
	,, 13	10 19	17 32	9·264
	,, 21	10 16	8 45 N.	9·236
	,, 29	10 8	0 24 S.	9·226
	Feb. 6	9 56	8 44	9·238
	,, 14	9 45	15 31	9·265
	,, 22	9 35	20 10 S.	9·307

The maximum parallax, on Jan. 29, is about 52″.

Longer preparation is possible on this occasion than at the 1901 approach, and the minimum distance is little more than half so great; thus we may hope for a corresponding increase in accuracy.

THE U.S.A. NAVAL OBSERVATORY, WASHINGTON.—The report of the superintendent, Capt. E. T. Pollock, for the year ended June 30, 1924, has been published. In the Nautical Almanac Department, special investigations have been made of the orbits of the satellites of Saturn and Neptune. In the latter 1633 observations, ranging from 1889 to 1923, are included. A new catalogue of 1504 standard stars has been constructed and half of it is in type. The positions of the stars are a decided improvement on those in Boss's General Catalogue. Most of the Nautical Almanac for 1927 is in type.

The details are given of work with two transit circles and several equatorials; with these last, satellites and minor planets were observed. There were two dates when the sunspot activity showed a minimum, February 1923 and the end of August 1923. Numerous observations were made with the Prime Vertical Instrument: three determinations of the constant of aberration from these observations are 20·54″, 20·55″, 20·58″. All appear to be on the large side.

The Department for Training Naval Officers includes branches for studying the gyro-compass and the magnetic compass.