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Economics of the Coal Industry.

MR. FRANK HODGES recently addressed the Royal Society of Arts upon the all-important subject of the economics of the coal industry, and his very thoughtful and well-reasoned address may be unreservedly recommended to all interested in the matter, that is to say, at this moment to every thinking man throughout Great Britain. The authoritative statistics which Mr. Hodges produces show more clearly than words the basal reasons for our difficulties, and most of them are summed up in the following quotation:

"The Ruhr hours are 8 hours for each man, and those of Upper Silesia, in Poland, are 8½ hours for each man. Wages costs in Great Britain are per ton 12*s.* 3*d.*; in the Ruhr they are 7*s.* 10*d.*; and in Poland 3*s.* 8*d.* The wages of all persons employed in British mines are 10*s.* 5*d.*; in the Ruhr 7*s.* 4½*d.*; in Polish Upper Silesia 3*s.* 6*d.* per shift.

The latest figure of output per shift in Great Britain was 18·4 cwts.; in Germany 21 cwts.; in Upper Silesia 22·06 cwts."

Mr. Hodges points out the inevitable result of these figures, namely, that in the coal export trade "Great Britain has lost both relatively and absolutely in the coal business of the world." It is not so many years ago since a general strike in Great Britain would have produced something like a panic, not only in this country but also throughout industrial Europe, which at one time was practically dependent upon Great Britain for its coal supplies. To-day, Europe cares nothing whether the British coal mines are working or idle; nay, more, the rest of the world is quite capable of supplying British needs. Mr. Hodges points out cogently that this unpleasant fact is due to our high prices and low output per man. He does not deal with the contributory cause, namely, that British coal miners have by repeated strikes taught the rest of the world how to do without British coal. It is because of these strikes that other nations have been forced to develop their own coal resources as well as other sources of power, notably water power, which have replaced British coal. A notable example in point is Switzerland, which has developed its hydro-electric powers and electrified its railways, mainly because, as a Swiss engineer put it, they are determined to have a source of power that *will not go on strike.*

The point cannot be too strongly stressed that a definite proportion of the old-time export coal trade of Britain is gone for ever. The only way to secure some share in what is still left is to bring down British prices of coal production to a competitive basis. Mr. Hodges seems to think that some relief may be obtained by a better use of the coal so as, in his words, to "bind

up production of the raw fuel with the production of electricity and gas and by-products." At best, however, this remedy can only be a palliative; however well the coal is utilised when it is produced, nothing will ever avail to counterbalance the cardinal fact that British coal costs too much to produce. Other nations can use coal as effectively as we can, and if they produce it more cheaply than we do, they will still be ahead of us in world competition. In justice to Mr. Hodges, it must be said that he appears to appreciate this fact, and is clear on the point that the only remedy is lower wages or longer hours of work. He has come to the conclusion that, of the alternatives, "a modification of hours . . . is the least of two evils." His proposed remedy is a 45 or 46 hour week; it is highly probable that many of those who have studied the subject carefully will scarcely be inclined to agree with him that this is going quite far enough, or to hold, as he does, that if the working week is increased to 48 hours, other countries in Europe will increase their hours also. This proposition may well be doubted in view of the fact that wages per hour in Britain are practically twice as high as they are even now in the Ruhr.

There will no doubt be a general consensus in favour of Mr. Hodges' suggestion that there should be a five-years' agreement in order to get the industry back on to a sound basis. He realises quite clearly that reorganisation of the collieries, where such is required, cannot be done without an influx of fresh capital, and that to get such an influx, terms acceptable to the capitalist must of necessity be offered. Mr. Hodges, like every other intelligent man, sees that British coal miners must accept the inevitable, and that it is useless to fight against natural laws and economic facts. Our only hope of salvation lies in producing coals more cheaply; whether the coal miner prefers to attain this end by working longer hours or by accepting lower wages, is a question which he ought to be allowed to decide for himself. One or other alternative, or a compromise involving something of each, is the inevitable solution, and it is for the coal miner to say which he prefers. If neither is accepted, then we must be prepared to contemplate an end to British coal mining.

The Protection of Wild Life in Australia.

Save Australia: a Plea for the Right Use of our Flora and Fauna. By various Writers. Edited by Sir James Barrett. Pp. viii+231. (Melbourne and London: Macmillan and Co., Ltd., 1925.) 8*s.* 6*d.* net.

THE march of civilisation inevitably betokens the retreat of the native plants and animals of a country. For long the retreat passes unnoticed: the early settlers, battling with Nature for a foothold, have little inclination to survey any but the most immediate effects of their handiwork, and it is left for their more leisured successors to develop the æsthetic sense which laments the disappearance of the primeval natives of the land. It is on this account the more gratifying to find that a comparatively new country like Australia, with its unique fauna and flora, has tackled the problem of its disappearing animals and plants with an energy which puts to shame the puny efforts made in the 'old country.'

Four main causes are said to account for the disappearance of Australian animals. Two are inevitable, and are practically beyond the modifying power of man. (1) His settlements and cultivation open up the country at the expense of the shelters, the feeding-places and the breeding-places of many of the wild animals. (2) Epidemic disease may sweep with dire effect through the populations of large areas, as in 1898–99 and 1901–2–3, when koalas, dasyures, certain bandicoots and other forms were almost exterminated in a tract from central Queensland to Victoria. The other two causes are looked upon as equally serious, and they are preventable. (3) The deliberate introduction and setting free of such aliens as the fox, the cat, the rabbit, and many species of European birds has, either by direct destruction or by the consumption of the food-supply and occupation of nesting sites, played havoc with many of the natives. Mr. Le Souef alleges that the fox has cleared off practically all the small ground animals outside the coastal districts in eastern and southern Australia, and the immunity of the inhabitants of the coastal districts is due to the presence of the poison tick, *Ixodes holocyclus*, which is fatal to foxes and dogs. (4) Deliberate destruction for the fur trade is making heavy inroads upon the native stock. From 1919 to 1921 the exported pelts of a few typical animals were: opossum, 4,265,621; ring-tailed opossum, 1,321,625; koala, 208,677; wallaby, 1,722,588. There is at present no control of, or any check upon, such exports, and slaughter on such a scale can end only in virtual extermination. Some half-dozen marsupials in Western Australia are now on the verge of extinction, though their disappearance cannot readily be attributed to man's interference.

Each of the Australian States has set about protecting its own fauna in the only way in which a fauna can be adequately safeguarded, that is, by the creation of reserves in which the animals are immune from any but controlled interference. The reserves are created by the legislature, but the system of control lacks unity, in so far as it is vested in two or more independent departments of the State, while in many places the

difficulty of policing large areas with inadequate staffs plays into the hands of unscrupulous collectors. There is something to be learned, however, from the graded system which has been adopted, and of which the Western Australian reserves may be taken as examples.

Here there are four types of State-protected areas, differing a little in stability, in the primary purposes for which they were created, and in control. Class A Reserves comprise national parks, sanctuaries for native plants and animals, and cave and scenery reserves, so created that they cannot be alienated except by special Act of Parliament, an unlikely event in the present state of public feeling towards the protection of wild life. The ordinary reserves, for the preservation of the native fauna and flora, are under the control of the Ministry of Lands, and are less assured in standing, since they may be alienated by the Governor and Executive Council, without reference to Parliament. Mr. W. Catton Grasby, however, is of opinion that most of these will ultimately become permanent. Of these two types, in Western Australia alone there are some forty reserves, covering in all an area of more than a million and a quarter acres. In addition to the set reserves there are forest reserves, under the Forestry Department, and game sanctuaries (thirty-six in number) under the Fisheries Department, in each of which protection is enforced.

Queensland has well over a hundred sanctuaries, including such large areas as Hinchinbrook Island (97,280 acres), Bellenden Ker Reserve (79,000 acres), and Stradbroke Island (78,720 acres); New South Wales possesses about fifty reserves, the largest of which is practically the whole of Cumberland county, with its two National Parks, specially patrolled; and each of fifteen principal sanctuaries in South Australia represents a fair-sized area of country.

The legislation adopted for the protection of native animals differs in the different States. In some (*e.g.* Western Australia) a long list of protected animals and birds is scheduled, and there even the owner of land cannot take or kill except under certain specified conditions, the general principle being laid down that all native game, whether on Crown lands or not, is the property of the Crown. Queensland, on the other hand, through its Department of Agriculture and Stock, has adopted what is known as the "black list" system, the names of non-protected creatures being listed, while emphasis is laid on the fact that all other "wild animals and birds" are totally protected throughout the whole year. Already every Queensland trapper has to obtain a permit, and every 'bird and animal' dealer a licence.

Another noteworthy step in the progress of Australian protection was marked by the passing in 1912 of a special Act for the conservation of the native flora of Western Australia. It is a model of thoroughness. Scheduled trees, shrubs and plants may not be destroyed or mutilated on Crown lands or lands reserved. No flowers that bear evidence that the plant from which they were taken was mutilated may be sold or exposed for sale. The police may examine and retain such flowers and plants, and the Government railways may refuse to carry them.

Thanks to the efforts of the Australasian Association for the Advancement of Science, the Royal Societies of South Australia and Western Australia, and other learned bodies, backed by strong public opinion, steps have been taken which should go a long way towards conserving the native fauna and flora for all time, so far as conservation lies within the power of man. These fine efforts make a strange contrast with the indifference of the British legislature to the native animals and plants of Great Britain, the existence of many of which is even more seriously threatened. The law has made not a single effort to protect our unique or disappearing plants, fishes or mammals, except in a statute, precariously renewed year by year, on behalf of the grey seal. Surely the time is approaching when the State, following the lead of its own colonies and of almost every other nation in the world, must cease leaving to private ownership the responsibility of safeguarding our native possessions, and must take steps, by creating national reserves or otherwise, to perpetuate the interesting fauna and flora as well as the notable Nature monuments of Great Britain.

JAMES RITCHIE.

The Peoples of Northern Nigeria.

The Northern Tribes of Nigeria: an Ethnographical Account of the Northern Provinces of Nigeria, together with a Report on the 1921 Decennial Census. By C. K. Meek. Vol. 1. Pp. xviii+312+61 plates. Vol. 2. Pp. viii+277+25 plates. (London: Oxford University Press, 1925.) 36*s.* net.

THE facts embodied in this book were for the most part collected during the census of 1921, though they have very little to do with the ideas that are commonly attached to the word 'census,' for the officers concerned were encouraged to combine with their statistical work as much ethnological investigation as was possible. Mr. Meek thus had an immense amount of territory to cover, and this presumably is the reason for the somewhat scrappy quality of much of the work, as well as the difficult and even illogical arrangement of the chapters. This said, there is little but praise for the book, which brings a large number

of new facts before the anthropologist for comparative use, and may for years be trusted to act as a dictionary which should be put in the hands of every officer in Northern Nigeria.

After a short account of the anthropo-geography of the country, extending over an area of some two hundred and fifty-four thousand square miles, the author, having mentioned some of the chief tribes, considers the 'racial elements' composing them: Negro, Hamite, Semite, with perhaps an evolving Semito-Negroid, which he thinks may in time become a definite type. The Nupe and the Yoruba are recognised as having a non-negro element, while among the negroes great diversity appears in the physical characters. Thus the brachycephalic Bantu-speaking Bafum from the Cameroons are almost pygmies, and the tall massive Jukun seem to approximate to the tall Nilotes of the Sudan. With such extremes, and with so little knowledge of the tribes, the author was probably wise to adopt a temporary classification based on language. A chapter headed "History and Tradition" is to be taken in its broadest sense; beginning with palæoliths, and including celts and arrow-heads, it continues with a discussion of objects which are certainly no later than Muhammadan times. Mr. Meek pays considerable attention to early foreign influence, and here perhaps is at his least critical: "Objects dug up in the Yoruba country by Frobenius have been dated by Egyptologists as belonging to the sixth century B.C." Again, "Egyptian goods had penetrated to Kordofan as early as 3000 B.C."; *i.e.* in common chronology, in proto-dynastic times. Surely all this requires revision? On the other hand, the author's treatment of Muhammadan history and tradition is excellent, and makes clear the complicated relations which have brought about the present condition of the northern Muhammadan states —Bornu, Kano, and Sokoto.

This roughly covers the first half of the first volume; then come chapters on technology—including an account of glass-making—followed by others on social organisation. The first chapter of the section headed "Social Organisation" is devoted to animal and plant taboos. Here the author points out that these beliefs occur among the Muslim as well as the pagans:

"Animal tabus are universal in Nigeria . . . Muslim families still have their sacrosanct animals. They are known in the *lingua franca* as *kan gidda*, which means 'the head' or 'the source of the house.' Muslims have told me that the totem witnessed the foundation of the house. They will not usually go so far as to say that their family was actually descended from the totem, but I have known professing Muslims who said that the totem contained the spirits of their forefathers. The *kan gidda* is . . . the family badge. The species is sacrosanct; it is therefore never eaten (any one inadvertently eating the flesh of his totem would immediately vomit). The revered animals are usually non-domestic, but no Zaberma will eat the camel's flesh, and the Toronkawa—a Fulani Muslim sub-tribe to which belongs the royal house of Sokoto—abstain from the flesh of goats. . . . Thus . . . in spite of their professed religion, many Muslim tribes retain a strong sense of mystic relationship with their totemic animals."

Among the pagan, perhaps the most interesting examples of animal taboos are those connected with the leopard. Thus among the Longuda—

"certain individuals who believe themselves immune from attack by leopards will refrain from eating leopard's flesh, though they will take part in a leopard hunt. A Wukari Jukun who kills a leopard parades the town with the dead animal mounted on a mat. The people salute the animal with the uplifted arm as they would a chief. Though the slayer of the leopard is given numerous gifts, he is nevertheless required to perform propitiatory rites, which include three days' solitude in the bush."

Rites indicating the royalty of the leopard also occur in East Africa; *e.g.* among the Acholi.

Mr. Meek's suggestion that the term 'animist' should be substituted for pagan does not seem very desirable, while with regard to the names of the different forms of cult of the dead, it seems doubtful whether most of these do not interdigitate in one tribe or another. A considerable number of tribes worship the sun, and of these Mr. Meek states:

"The Sun is their Supreme Deity, the All Father, the Giver of Rain, the Ripener of Crops, but so remote and otiose that he can only be approached through the host of intermediaries already described—the spirits of ancestors who dwell near him, and those nature spirits who are demi-gods and his servants. He is too far removed to need the propitiation of sacrifice; but in times of stress his devotees vaguely hold out their hands to him in prayer. The Sun-worshippers seem to regard the Sun primarily as the Ripener of Crops."

The distribution of sun worship in Africa is of great interest, though too wide to be discussed here; but it is noteworthy that, while absent among the Nilotes, traces of it are to be found in the Sudan in the hill districts of Kordofan, while it is well developed in Dar Fung. In addition to the cult of numerous spirits and fetishes, and even personification of qualities (such as hunger among the Waja), the author states that all tribes recognise a supreme deity, remote and not to be approached directly; he is usually sky-dwelling, and is sometimes actually the sun; in some instances he may be considered to have charge of the souls of the dead.

The section on marriage is particularly interesting, though perhaps it is one of the most tantalising in the book; for here are given items of importance from

the marriage regulations of various tribes. Such items are of some value as indicators of custom, but not much more while they remain isolated from the social system in which they occur. However, there is much in the information that Mr. Meek has given to modify the generalisation that he himself has made on the extremely low status of women (cf. pp. 201, 204): that they are mere property to be acquired in marriage, and that the higher the bride-price the lower the status of woman, as an object to be bargained for. Among the cattle-owning tribes of N.E. and S. Africa the reverse is certainly true: a high bride-price is an honour to a woman, and so great is the esteem for cattle, so sacred their character, that the transaction of the bride-price is not really one of purchase at all. It is possible that in Nigeria, where the bride-price is usually paid in cowries or cash, it does more nearly approximate to a purchase; but from the customs that Mr. Meek quotes, it is clear that wives, though they may be inherited, are not treated as slaves, and that the bride-price acts in Nigeria, as it does elsewhere in Africa, as a guarantee of the stability of marriage. Patrilineal peoples usually consider that the bride-price secures the children for the husband, whether he is the actual father or not.

Marriage by exchange, as well as a legalised form of wife-stealing, are described. The former, by which two men exchange sisters instead of paying a bride-price, though found in other parts of the world, is rare in Africa; it has, however, been recorded among the Senoufo of the French Sudan. The function of the extended family, and its bearing on the economic life of the people, is well described. These are factors not usually sufficiently realised by administrators.

The divine character of the king is recognised in Northern Nigeria, and associated with divine kingship are those customs and beliefs that seem to be essential to high authority in Africa. The king is responsible for the rain supply, and the fertility of the land is intimately connected with the king's own virility; hence the king must not be ill or grow old, and so is killed ceremonially either before old age approaches or after reigning a definite period. The most perfect example that Mr. Meek gives is that of the Jukun. Here the king controls the rain; he is so sacred that if he touched the ground with uncovered hand or foot the crops would be blighted. At the end of seven years, at the harvest festival, the king was slain ceremonially (it is interesting to note that quite recently the Jukun chief refused to hold his festival for fear of having to submit to the ancient rite). Two women are associated with the king. One, the king's sister (in the classificatory sense), is also able to control the rain, and is treated with deference by the king himself. The other is the favourite wife of the late king, and is thus the reigning sovereign's official 'mother.' She is consulted on all important matters, and has great privileges; should she not be treated with due respect, the spirit of her late husband would take vengeance on the country. Among several other tribes the divine kingship is quite as definite, though in some cases the king himself takes poison instead of being killed. An interesting case where the rite has become symbolised is given: the Daura have a tradition of killing a dragon, but the dragon's name was Sarki, and the dragon-slayer called Ma-kas-Sarki, Hausa words for 'chief' and 'slayer of the chief.'

There is a section on languages by Mr. N. W. Thomas. The last ninety pages of the work are devoted to the census proper.

The scope of these two volumes indicates the vast amount of anthropological work that remains to be done in Nigeria, and it is to be hoped that Mr. Meek may himself be able to undertake some of it in detail.

B. Z. S.

Upper Air Phenomena.

The Uppermost Regions of the Earth's Atmosphere: being the Halley Lecture delivered on 5 May 1926. By G. M. B. Dobson. Pp. 22+4 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2s. 6d. net.

THE publication of Dr. Dobson's Halley lecture is opportune, since it reviews, in such detail as is possible in small compass, the present state of our knowledge of the constitution of the upper atmosphere and of the chief natural phenomena occurring above the isothermal layer. Some of the phenomena, such as those due to the aurora and to meteorites, are directly visible to the eye, while others, such as the occurrence of ozone and the presence of ionised conducting layers, are appreciated by observation with special apparatus. Apart from the relation between radio and ionisation in the upper atmosphere, the public may find some interest in the fact that the natural phenomena occurring in this region are associated with an important shielding action exerted by our atmosphere, since it is the absorption of the medley of electromagnetic waves and radiations of α, β and γ type, as well as uncharged matter derived from the sun and cosmic sources, which is responsible for the effects observed. The more scientific public will welcome the publication as a concise review of the main facts in a field of endeavour to which Dr. Dobson has made extremely important contributions.

The complete interpretation of the observations demands not only a knowledge of the types of the waves, radiations and matter projected into the

atmosphere, but also of the absorbing material—the density and constitution at great heights. Neither of these two can be calculated unless the temperature is known, as well as the proportion of light gases in the lower layers.

The author deals first with the aurora and considers there is little doubt that it is due to electric discharge caused by charged particles projected from the sun, and points out that a knowledge of the nature and velocity of the radiations would enable more information to be obtained by spectroscopic means about the layers in which they are being absorbed. However, the presence of some lines due to nitrogen has been established, though the origin of the most prominent green line is still the subject of discussion and experiment in cryogenic laboratories. Reference is also made to the measurements of auroral height by simultaneous photographs from widely separated stations (illustrated by photographs), and to the faint green line observed in the light of the night sky and considered to be unconnected with the polar aurora.

The information obtained from observation of the small particles of iron or stony material known as meteors, while being vaporised by the high speed of their travel through the atmosphere, is next considered. Observation at two stations of the apparent path among the stars enables the height of appearance and disappearance, the length of path, speed and brightness to be determined. By calculation from these, it is possible to infer that the temperature of the isothermal layer (about 220° Abs.) continues to a height of some 55 km. in mean latitudes, while the temperature rises to about that at ground level above 60 km. Confirmation of a discontinuity in the atmosphere at this height is given by the fact that very few meteors disappear about the level of 55 km. The suggestion is that this rise in temperature is due to the formation of ozone from oxygen by the action of ultra-violet radiation from the sun, and by the absorption of some of the sun's rays by the ozone so formed. It is the layers ionised by ultra-violet radiation from the sun, and the electric currents set up in these ionised layers by tidal movement of the atmosphere, which are considered to be responsible for the diurnal variation of the earth's magnetic field. Reference is not made to the large variation observed at stations near the auroral zones and its great enhancement in winter on magnetically disturbed days. The importance of this observation lies in the possibility that the ionisation due to the aurora in these zones may be comparable with that due to sunlight—a matter of possible interest in the transmission of radio signals within and across the polar regions.

The author includes brief references to night luminous clouds and the propagation to great distances of the sound caused by large explosions, quoting with approval Mr. Whipple's suggestion that the temperature increase above 60 km. may be responsible for the bending down of the sound waves which have penetrated to this height.

The paper naturally does not discuss in any detail the most recent views regarding the effect of the ionised layers and their height on radio transmission. We can, however, regard it as a matter for congratulation that the increasing use of radio is likely to enhance general interest in the study of those natural phenomena which cause ionisation in the upper atmosphere.

Our Bookshelf.

Allen's Commercial Organic Analysis. Edited by Samuel S. Sadtler, Dr. Elbert C. Lathrop, and C. Ainsworth Mitchell. Vol. 4: Special Characters of Essential Oils; Resins, India-rubber, Gutta-percha, Balata, and allied Substances; the Constituents of Essential Oils, and allied Substances; the General Characters and Analysis of Essential Oils. By the Editors and the following contributors: E. K. Nelson, G. A. Russell, Ernest J. Parry, John B. Tuttle. Fifth edition, entirely rewritten. Pp. x+648. (London: J. and A. Churchill, 1925.) 30*s.* net.

AN increase of 174 pages in this volume compared with the corresponding volume in the previous edition, published sixteen years ago, gives some indication of the advance in the chemistry of essential oils in recent years. Except for a short section of 55 pages on rubber, this book is practically confined to the subject of essential oils and resins. In its present form it is indispensable as a reference book. With a more intimate connexion between the sections than in earlier volumes, it has been possible to restrict the number of contributors so that more uniformity in the general treatment might be expected. The only British contributor is Ernest J. Parry, the well-known authority on essential oils. He has written the sections on (*a*) resins, (*b*) the constituents of essential oils and allied substances, and (*c*) the general characters and analysis of such substances. His contributions cover more than half the whole book.

The unsatisfactory arrangement in the fourth edition, with special consideration of hydrocarbons and ketones only, has been changed and a more general treatment of the subject given. Some repetition in methods and descriptions occurs and a fair number of misprints and small errors have been noticed. The statement (p. 68) that spike (lavender) oil is dextrorotatory or that West Australian sandalwood oil (p. 133) "is practically identical chemically" with oil from other sources, does not agree with the reviewer's observations. It is hoped that in later volumes improvements may be made in the index, which is not sufficiently complete for a standard reference book, while some attempt might be made to give cross-references to other volumes in the complete work. J. REILLY.

The Sacred 5 of China is the 5th Book on China. By Dr. William Edgar Geil. Pp. xix+355+56 plates. (London: John Murray, 1926.) 24*s.* net.

As Dr. Geil's title-page indicates, he is the author of several books on China, of which "A Yankee on the Yangtze" is perhaps the best known. In explanation of his present title he says "5 is a number most remarkable to the man of the Central Kingdom." Here he deals with five sacred mountains, the peaks of East, South, Centre, West, and North—Tai Shan, Nan Yo, Sung Shan, Hua Shan, and Hêng Shan—associated with the five elements wood, fire, earth, metal, water, and the colours green, red, yellow, white and black. These mountains are all centres of pilgrimage. Of these sacred sites the importance for the student of Chinese culture lies in the fact that, like similar sites in other lands, they have been regarded as sacred from time immemorial. Like the holy wells of the British Isles, they represent a cult—and preserve survivals of it—which belongs to a stage of development infinitely more primitive than that of the official religion. So, says Dr. Geil, with the sacred mountains of China; beneath the thin rind of Buddhism, and far earlier than Confucianism, is the core with "an immemorial flavour of sanctity, the cult of the mountain spirit."

Dr. Geil, complying with the convention, ascends each mountain in five stages, but his description is not merely topographical or descriptive of the shrines and temples encountered on the way. He gives his readers a selection in each case from the legends, the history, the literature, the elements of ritual and cult associated with each peak, quoting liberally from the classics with such comment as suggests itself by the way. His book may well serve as an introduction to certain sides of the distinctive types of Chinese mentality, delicate in wit and instinct with an intellectuality peculiarly its own. The illustrations are numerous and excellently reproduced.

Die Tierwelt der Nord- und Ostsee. Herausgegeben von G. Grimpe und E. Wagler. Lieferung 2 (Teil 2. d_1, 12. h_1). Teil 2. d_1: *Noctiluca*, von A. Pratje; Teil 12. h_1: *Teleostei Physoclisti*, 10. *Heterosomata*, von W. Schnakenbeck. Pp. 12+60. 4·50 gold marks. Lieferung 3 (Teil 9. c_1, 9. c_2, 12. i_1). Teil 9. c_1: i. *Opisthobranchia*; ii. *Pteropoda*, von H. Hoffman; Teil 9. c_2: *Scaphopoda*, von Tera van Bentham Jutting; Teil 12. i_1: i. *Amphibia*; ii. *Reptilia*, von R. Mertens. Pp. 66+14+20. 7·80 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.)

EACH group of animals dealt with in this new and admirably planned series is treated along definite lines; first the characters of the animals are described, then their systematic position, in some cases the best methods of fixation, the structure, the distribution, the method and powers of movement, the mode of feeding with details of the physiology of digestion and of excretion and an account of the food, the sense organs, reproduction and development, bionomics and relation to their surroundings with especial reference to parasites. Good bibliographies are provided, while excellent line drawings and maps to show the distribution illustrate the text. As a result of this mode of treatment, we are being provided with a well-balanced account of the fauna of the North and Baltic Seas, compact and yet far removed from the old-fashioned catalogues of genera and species. Points of particular interest, such as light production in Noctiluca, the growth rings on otoliths and scales in fish and the methods of marking flatfish with metal discs, are treated in detail. Further additions to this series will be awaited with interest by all workers in marine biology.

Le tremblement de terre. Par Edmond Rothé. (Nouvelle Collection scientifique.) Pp. xxxiv + 248. (Paris: Félix Alcan, 1925.) 10 francs.

M. ROTHÉ has given us in this little book a very clear account of the latest developments of seismology, especially of the instruments that have been designed for recording distant earthquakes, the methods of locating the epicentre, the forms of seismic rays, and their bearing on the structure of the earth's interior. If it were for these chapters alone, the book would be worth possessing.

The phenomena of ordinary earthquakes are treated at less length, and there are some curious omissions, but the author has wisely chosen in illustration two recent earthquakes that are not likely to lose their interest for many years to come, namely, the Chinese earthquake of 1920 and the Japanese earthquake of 1923. The book is perhaps not altogether well balanced. One could wish, for example, to see less use made of the work of Perrey, Montessus and other French authorities—fully one-third of the references are to French writers—and more to the valuable work done in Italy and Japan. The illustrations are in some cases rough and poorly reproduced, and it is difficult to see the use in a scientific text-book of pictures of Tokyo in flames or of heaps of corpses lying about the streets of the city. The preface, it may be added, contains a brief, though interesting, outline of the history of seismology. C. D.

Migraine and other Common Neuroses: a Psychological Study. By Dr. F. G. Crookshank. (Psyche Miniatures, Medical Series, No. 1.) Pp. 101. (London: Kegan Paul and Co., Ltd., 1926.) 2*s.* 6*d.* net.

THE average general practitioner has little time and opportunity for the study of text-books on the complicated, and in these days bewildering, subject of psychotherapy. To him, therefore, will be of especial value the publication of Dr. Crookshank's two lectures on migraine and other common neuroses. The book is a small one; it can be read in an hour, and the author's style is delightfully attractive. His views—even as expressed in the title—will, of course, arouse controversy, and some of his statements can be described only as startling. His reasoning that the mind may be the deciding factor in the etiology of dementia paralytica, because mental symptoms usually precede the appearance of physical signs, is unconvincing. Yet there is nothing in these pages which the neurologist or psychologist could dogmatically deny; and if the author's efforts to demonstrate the supremacy of the psychological factor in migraine should only turn the attention of physicians to the psychical aspect of all who are sick, the book will have served its purpose.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

X-Rays—Internal Absorption and 'Spark' Lines.

In recent work by Mr. A. M. Cassie and myself (now being prepared for publication), it has been possible to study some of the details of the process of 'internal' absorption of an X-ray by the atom in which it is excited. This type of absorption has played an important part in the elucidation of β- and γ-ray spectra, and has been fully discussed, notably by Ellis and Skinner in Great Britain, and by Meitner, de Broglie, Thibaud, and others. An excellent summary of the work on the X-ray side is to be found in Bothe's article in vol. 23 of the new Geiger and Scheel "Handbuch."

In the X-ray domain the effects of internal absorption have been beautifully demonstrated by P. Auger in his Wilson tracks produced by X-rays in heavy gases. Auger's results show that in the K excitation of argon, about 90 per cent. of the fluorescent K quanta are absorbed by the atoms in which they are excited, with emission of tertiary photoelectrons: this "specially privileged" absorption becomes less marked with heavier elements (about 50 per cent. for krypton, and, according to Meitner, about 10 per cent. for elements of atomic number round 85), but is in any case amazingly high.

In our experiments, the secondary cathode rays emerging from a 'target' irradiated by X-rays are drawn out into a magnetic spectrum, and their energies are measured as in earlier work by de Broglie, Whiddington, Robinson, and others. In the present work a great deal of 'white' radiation is allowed to remain in the X-ray beam, and in consequence the fluorescent X-ray spectrum of the target is strongly excited. The corpuscular spectra show many lines which are due to the internal conversion of the fluorescent X-rays, or, alternatively, to radiationless (Rosseland) readjustments within the atom which lead to the expulsion of 'photoelectrons of the second kind.' For brevity these lines may be called 'fluorescent' lines, to distinguish them from the 'normal' lines arising from the external absorption of the constituents of the primary X-ray beam.

There are very many of these fluorescent lines, some of them very faint and difficult to resolve, and the measurements are not yet complete. It is certain, however, that most of these electrons emerge with considerably less energy than would be expected if they came from a normal atom: the deficiency is of the order 50-100 electron-volts—far too big for experimental error. There can be little doubt that they come from atoms which were already ionised, and, therefore, had abnormally high energy levels. This energy defect would be inappreciable in a fast β-ray, and scarcely detectable from the Wilson tracks.

The processes taking place are easily visualised; for example, as a possible sequence we may have in successive stages following the ejection of a K electron from the target—(1) an L_{III} electron falling into the vacant place with emission of a $K\alpha_1$ quantum of fluorescent X-radiation; (2) internal absorption of this quantum, with expulsion of a photoelectron from an L, M . . . shell, either while the vacant place in L_{III} is still untenanted, or after L_{III} has been completed (say by an M electron), but while the atom is still ionised in an outer shell. This is typical of many possible processes of the same kind (cf. Auger, *J. Phys. et le Radium*, June 1925), all leading to atoms which are multiply ionised in their X-ray shells. So far as the final result is concerned, it is immaterial whether this takes place as above, or by way of radiationless changes.

The multiply ionised atoms produced in this way ought to be competent to account for at least some of the abnormal lines observed in nearly all X-ray spectrograms (Coster's 'non-diagram' or Wentzel's 'spark' lines) as faint satellites on the high frequency sides of the series X-ray lines. Wentzel has worked out in detail the theory of these 'spark' lines, on the assumption that they are due to multiply ionised atoms. While there can be no doubt of the essential accuracy of Wentzel's work, the experimental evidence as to the manner in which the multiple ionisation is brought about is still very unsatisfactory (cf. Bäcklin, *Zeit. für Physik*, 27, p. 30). Dr. Wentzel suggested to me some time ago that my corpuscular spectra might show traces of multiple ionisation produced by a single X-ray quantum, but so far I have got no evidence of this (in any case these lines would be very faint). Internal absorption obviously could not account for the production of spark lines in the K series; that is, it could not be expected to produce atoms in the K^2, KL . . . conditions required by Wentzel—but it certainly could account qualitatively for the existence of L spark lines. As shown in the above example, once the K excitation limit is reached, there will be large numbers of atoms in L^2, LM . . . conditions: this provides a very satisfactory explanation of the effect observed by Siegbahn and Larsson (*Ark. Mat., Ast. och Fysik*, 18, 1924). These experimenters, investigating the L spectrum of molybdenum with a tube operated at different voltages, found no new spark lines between 4 and 20 kilovolts. At 20 kv. a new line first appeared, and no further line appeared even at 40 kv. 20 kv. is just more than is required to excite molybdenum K, and is certainly insufficient for simultaneous K, L ionisation.

We have obtained direct and very striking evidence of the fundamental difference between internal and external absorption, by experiments in which a thin copper target was exposed under identical conditions to (1) copper $K\alpha_1$ primary rays and (2) white radiation from a molybdenum tube operated at high voltage. In case (1) we get the normal copper L lines, L_I and (L_{II}, L_{III})—the latter pair as an unseparated doublet—resulting from external absorption of the primary copper $K\alpha_1$. In case (2), following the ejection of a K electron, we have internal absorption of the same quantum. The corresponding L lines of the 'fluorescent' spectrum are definitely displaced 0·6 mm. (about 60 to 70 volts) on the plates in the direction of smaller energy, and there is no visible trace of the 'normal' lines. Further—and this is most significant—the intensity ratio is entirely changed: with external absorption of $K\alpha_1$, L_I is slightly more intense than (L_{II}, L_{III}) (cf. Robinson, *Roy. Soc. Proc.*, 1923). In case (2) the doublet (L_{II}, L_{III}) is by far the more intense.

Similar effects have been noticed in β-ray spectra, but in our experiments the phenomenon is naturally under greater control, and the interpretation more direct.

H. ROBINSON.

Physical Laboratory,
The University, Edinburgh,
July 27.

A New Type of Absorption Spectrum: Double Rotational Quantification in Formaldehyde.

THE quantification of the rotational motion of an assymmetrical molecule having three different moments of inertia, J_0, K_0, L_0, is a very difficult problem and has not yet been resolved mathematically. However, if two of the moments are equal, $K_0 = L_0$, the problem lends itself to solution, as has been shown by Sommerfeld, Born, Reiche, and others. The rotational energy of a molecule having an axial symmetry is equal to

$$W_{m,q} = \frac{h^2}{8\pi^2}\left[\frac{q^2}{K_0} + m^2\left(\frac{1}{J_0} - \frac{1}{K_0}\right)\right],$$

where m and q are quantum numbers.

The absorption lines corresponding to the different possibilities of rotational transitions of a molecule of this kind form a very complicated spectrum. This may be represented by the juxtaposition of two systems of parabolic branches:

$$\left.\begin{aligned} R(m) &= \nu_0 + (c_0 + c_1)m + c_2m^2, \quad \ldots\ m - \tfrac{1}{2} \to m + \tfrac{1}{2} \\ P(m) &= \nu_0 - (c_0 + c_1)m + c_2m^2, \quad \ldots\ m + \tfrac{1}{2} \to m - \tfrac{1}{2} \\ Q(m) &= \nu_0 + c_2m + c_2m^2, \quad \ldots\ m + \tfrac{1}{2} \to m + \tfrac{1}{2} \end{aligned}\right\} q = \text{constant},$$

where

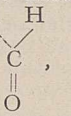
$$c_0 = \frac{h}{8\pi^2 c}\left(\frac{1}{J_0} - \frac{1}{K_0}\right), \quad c_1 = \frac{h}{8\pi^2 c}\left(\frac{1}{J_1} - \frac{1}{K_0}\right),$$
$$c_2 = c_1 - c_0, \quad c = 3 \times 10^{10} \text{ cm.}$$

$$\left.\begin{aligned} R(q) &= n_0 + (\sigma_0 + \sigma_1)q + \sigma_2q^2, \quad \ldots\ q - \tfrac{1}{2} \to q + \tfrac{1}{2} \\ P(q) &= n_0 - (\sigma_0 + \sigma_1)q + \sigma_2q^2, \quad \ldots\ q + \tfrac{1}{2} \to q - \tfrac{1}{2} \\ Q(q) &= n_0 + \sigma_2q + \sigma_2q^2, \quad \ldots\ q + \tfrac{1}{2} \to q + \tfrac{1}{2} \end{aligned}\right\} m = \text{constant},$$

where

$$\sigma_0 = \frac{h}{8\pi^2 c} \cdot \frac{1}{K_0}, \quad \sigma_1 = \frac{h}{8\pi^2 c} \cdot \frac{1}{K_1}, \quad \sigma_2 = \sigma_1 - \sigma_0.$$

Hitherto, no one has reported an absorption spectrum of this kind, and it is not known if there may exist a double quantification of the rotation of molecules.

We have found that the ultra-violet absorption spectrum of formaldehyde vapour,  , corresponds exactly to this type of rotational spectrum, with two quantifications.

The absorption spectrum consists of 32 bands situated between 3550 and 2500 Å.U. Each of these bands is formed by hundreds of fine lines. These lines are of two types: type *a* consists of the more intense lines distributed through the whole band. The other type, *b*, consists of a great number of very fine, closely grouped lines forming regular series with accumulations near each line of type *a*.

The molecule of formaldehyde has, to a first approximation, an axial symmetry about the axis passing through the carbon and oxygen atoms. The moment of inertia, J_0, about this axis is expressed by $J_0 = 2 \cdot r^2_0 \cdot m$, where $2r_0$ is the distance between the two hydrogen atoms, and $m = 1{\cdot}66 \times 10^{-24}$ gm. The other two moments, K_0 and L_0, have very nearly the same value. This value depends upon the distance between the carbon and oxygen atoms, and upon the angle, $2a$, between the bonds of the hydrogen atoms to the carbon atom, so that $K_0 \gg J_0$.

The physical interpretation of the spectrum is that the stronger lines (type *a*) are produced by rotation about the axis of symmetry, with the smaller moment J_0. The closely grouped fine lines (type *b*) correspond to the rotations about a perpendicular axis with the moment K_0.

The analysis of the distribution of the lines in the different bands has given a very satisfactory confirmation of this interpretation. We have found, for example, for the band $B(\lambda = 3418$ to $3378)$ that the stronger lines form a doublet system of three parabolic branches each, the null-lines being $\nu_0 = 29465{\cdot}1$, $\nu'_0 = 29422{\cdot}0$, $\lambda_0 = 3393{\cdot}85$, $\lambda'_0 = 3398{\cdot}82$ Å.U. intern. vac., and the formulæ of the parabolas

$$\begin{aligned} R(m) &= 29465{\cdot}1 + 35m - 2m^2, \\ P(m) &= 29465{\cdot}1 - 35m - 2m^2, \\ Q(m) &= 29465{\cdot}1 - 2m - 2m^2, \\ R'(m) &= 29422{\cdot}0 + 35{\cdot}5m - 1{\cdot}5m^2, \\ P'(m) &= 29422{\cdot}0 - 35{\cdot}5m - 1{\cdot}5m^2, \\ Q'(m) &= 29422{\cdot}0 - 1{\cdot}5m - 1{\cdot}5m^2, \end{aligned}$$

where $m = 1, 2, \ldots 8$. The correspondence between the calculated and the observed values is very good ($\Delta\frac{1}{\lambda}$ calculated – observed $< 1{\cdot}0$ cm.$^{-1}$). The distribution of the intensities is also quite regular and conforms to the theoretical one.

We deduce from these formulæ the following values for the constants:

$$c_0 = 18{\cdot}5, \; c_1 = 16{\cdot}5, \; c'_1 = 17{\cdot}0,$$

and therefore

$$\frac{1}{J_0} - \frac{1}{K_0} = 0{\cdot}67 \times 10^{+40}, \quad \frac{1}{J_1} - \frac{1}{K_0} = 0{\cdot}60 \times 10^{+40},$$
$$\frac{1}{J'_1} - \frac{1}{K_0} = 0{\cdot}62 \times 10^{+40}.$$

A series of lines of type *b*, distributed in parabolic branches $R(q)$ and $P(q)$, correspond to each line of these six parabolic branches. The value of $\sigma_0 + \sigma_1$ is 2·4 cm.$^{-1}$ with a precision of $\pm 0{\cdot}4$ cm.$^{-1}$.

We have, therefore, $\frac{1}{K_0} = 0{\cdot}04 \times 10^{+40}$.

The two moments of inertia of the normal molecule of formaldehyde are $J_0 = 1{\cdot}41 \times 10^{-40}$ and $K_0 = 25 \times 10^{-40}$. Therefore, the distance between the hydrogen atoms is $2r_0 = 1{\cdot}30 \times 10^{-8}$ cm., and between the carbon and oxygen $1{\cdot}0 \pm 0{\cdot}1$ Å.U. In the molecule of water the distance between the hydrogen atoms is 1·64 Å.U., and in the carbon dioxide molecule the distance between the carbon and oxygen atom 1·02 Å.U.

For the activated molecule we find two values of the moments of inertia: $J_1 = 1{\cdot}56 \times 10^{-40}$ and $J'_1 = 1{\cdot}51 \times 10^{-40}$. The branches R, P, Q correspond to the transitions from the normal energy level to the state with the moment J_1, and the branches R', P', Q' to the transitions from the same normal state to the energy level with the moment J'_1. The distance between the hydrogen atoms is increased by the activation from 1·30 to 1·37 Å.U.

This general structure of a rotational spectrum with two simultaneous quantifications has been observed by us for several other molecules belonging to the type of 'Y-molecules'; for example, phosgene and thiophosgene. Together with Prof. J. Errera, we have found the same type of absorption spectra for different para-derivatives of benzene.

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Surveys of the Great Pyramid.

IN an article in NATURE of December 26, 1925, Sir W. M. Flinders Petrie compares unfavourably the recent survey of the Great Pyramid carried out by Mr. J. H. Cole, of the Survey of Egypt, with his own survey of 1881. He points out that the closing error in the eight angles of Mr. Cole's traverse around the pyramid, which amounts to 9·6 inches, is equal to a difference of 2·7 inches "if on the whole distance." This statement would only be relevant to his argument if the traverse were an open one run, more or less, in a straight line, and if the angular error were located entirely in the initial angle. In fact, when the measured quantities (angles and lengths) are taken as observed, the closing error of the traverse amounts to 0·7 inch, and when the traverse is adjusted to self consistency, the greatest corrections applied are 0·04 inch to a measured length and 2·7 inches to an observed angle.

In Sir Flinders Petrie's book, "The Pyramids and Temples of Gizeh," he explains in Appendix II. the methods he used for determining the precision of his work and for weeding out "occasional errors." In the example he gives, on page 230, the four observations he rejects would have been retained by such authorities as Wright and Hayford or Brunt, who only reject observations the residuals of which are at least five times as great as the probable error of a single observation, unless there are physical reasons (wrong sightings, movement of instrument, etc.) for doubting the work. In the 1881 survey, out of 108 sides of triangles around the Great Pyramid, the mean observations of no less than nine were rejected. This excessive number of rejected observations should never have been tolerated.

I have little doubt that the high precision claimed by Sir Flinders Petrie has only been obtained by the unwarranted rejection of observations with large residuals, which has decreased his computed probable error but at the same time has certainly diminished the precision of his results.

Mr. Cole's survey has now been tied up to points O, Q, and W of the 1881 survey. The bronze bolt U has gone but another bolt has been leaded into the same hole in the floor of the south-east corner socket and must agree within half an inch with point U. When the two surveys are fitted together by means of the points common to both, Sir Flinders Petrie's point on the casing edge on the east of the pyramid falls 2·7 inches to the east of the casing edge as surveyed in 1925. The other three points on the casing edge agree within one inch.

Accepting the accuracy of Mr. Cole's survey as deduced from the closure of the traverse, and from our knowledge of the precision of the methods employed, this large discrepancy on the east can only be attributed to an error in the 1881 survey.

In the course of this investigation several discrepancies in Sir Flinders Petrie's work have come to light. For example, the eastern side of the Great Pyramid is given as 9067·7 inches. On Plate X. the N.E. socket corner is stated to be 30·2 inches north and the S.E. socket corner 35·5 inches south of the corresponding pyramid corners. The eastern socket side should therefore be 9133·4 inches and not 9130·8 inches as given.

Mr. Cole's survey was an attempt to determine the exact shape and size of the pyramid as it was built. Sir Flinders Petrie, on the other hand, reconstructed the pyramid as, in his opinion, it should have been built. He remarks "we only need to compute a square that shall pass through the points of the casing found on each side, and having also its corners lying on the diagonals of the sockets."

This being the case, there is nothing to be gained by dealing with Sir Flinders Petrie's arguments published in NATURE. However, his statement that "it would be easier to achieve equality of length than of level" is, in my opinion, not true.

I therefore conclude that Sir Flinders Petrie's survey of 1881 is not nearly so accurate as he claims, that it contains errors amounting to so much as two inches, and that Mr. Cole's survey, whatever slight inaccuracies it may possess, is the most precise survey of the Great Pyramid that has yet been made.

I agree with Sir Flinders Petrie that it is highly desirable that a survey should be made joining the existing casing edge on to lines laid out close to the base, but this will have to wait until several thousands of tons of debris have been cleared away. I hope this will be done in the near future.

F. S. RICHARDS,
Director, Computation Office.

Survey of Egypt,
El-Giza (Mudirîya),
June 12.

THE first point raised by Mr. Richards refers to my remark that the method of placing a single triangle of survey round a pyramid (as in the 1881 survey) was better than a line of eight lengths of traverse carried on by dead reckoning round the base, as in 1925. The effect of the error being possibly caused in the first of the eight angles, was only stated by me to illustrate the unsatisfactory principle of the method.

The exclusion of anomalous observations of five times the probable error is held up as a pattern. That would be true enough on a series of 4000 observations. On a series of 109 the limit of normal variation would be much smaller. No arbitrary rule should be followed. I excluded anomalies, one by one, until the whole series became almost normal in distribution. I still think that this is the probable road to the truth. The casual causes were due to lateral lighting and refraction of hot air. I prefer not to vitiate results by including anomalies, which are detected by the distribution of errors.

The points O, Q, W, in common on the surveys of 1881 and 1925, are stated to have been now fitted together (without quoting a difference), and the only difference is on a point plumbed up from a deep hole in 1881, which was by no means the same place as was fixed and seen on that base side in 1925. The discrepancy pointed out between the socket length and the base side which was deduced from it, on the east, is due to some misprint or slip in mere addition, and has nothing to do with the accuracy of survey. There is, therefore, no ground for claiming that there are errors amounting to two inches in the 1881 survey.

FLINDERS PETRIE.

Magnetic Susceptibilities and Dielectric Constants in the New Quantum Mechanics.

IT is well known that the conventional quantum theory must be modified in accordance with the matrix dynamics developed by Born, Heisenberg, and Jordan, and by Dirac. The purpose of the present note is twofold, namely: (1) to show that in the new theory the spacial quantisation relative to the applied field has no direct effect on the magnetic susceptibility (or the dielectric constant), and (2) to give the results of the calculation of the dielectric constant of a diatomic gas by means of the new mechanics.

(1) It has been generally supposed that in a gas or liquid the orientation of atoms or molecules is random in the absence of a field, and that consequently there may be a change in the susceptibility when the field exceeds the critical value requisite for spacial quantisation. We shall show, however, that in the matrix theory the susceptibility is the same with spacial quantisation relative to the applied field as with random orientations. Let us first suppose the magnetic body is composed of atomic rather than molecular aggregates (*e.g.* monatomic ions in solution). If a magnetic field is applied along the z-axis, the paramagnetic susceptibility per atom is proportional to the average value of M_z^2/kT, where M_z is the z-component of the resultant angular momentum M. With spacial quantisation we have $M_z = mh/2\pi$, and, if j denotes Sommerfeld's inner quantum number, there are $2j+1$ possible orientations. The average value of M_z^2 is then

$$\frac{1}{2j+1}\sum_{m=-j}^{+j}\frac{m^2h^2}{4\pi^2} = \tfrac{1}{3}j(j+1)\frac{h^2}{4\pi^2} = \tfrac{1}{3}M^2,$$

which is obviously the same result as with random orientations. Although the ordinary Langevin formula is thus still applicable even with spacial quantisation, the numerical values of susceptibilities are the same as those calculated by Sommerfeld with the older quantum theory, for his correction factor for the effect of spacial quantisation is the same as the factor by which M^2 differs from $(jh/2\pi)^2$ in the new theory.

The preceding argument can be extended to show that spacial quantisation does not change the susceptibility of paramagnetic molecules, diamagnetic susceptibilities, or the dielectric constant of molecules with an electrical moment, such as HCl. This perhaps explains why Lehrer (*Zeits. f. Phys.*, 37, 155, 1926), on repeating Glaser's experiments, finds no variation of the diamagnetic susceptibility of argon or carbon dioxide with pressure, and especially why the dielectric constants of polar gases do not ordinarily vary with the pressure or field-strength despite the fact that at atmospheric pressure the intervals between collisions are small compared to the precession period.

(2) Let us suppose we have a non-gyroscopic diatomic molecule with an electrical moment μ in the direction of the axis of figure. Using the amplitude matrices for the rotating dipole given by Miss Mensing (*Zeits. f. Phys.*, 36, 814, 1926), or by Dennison (*Phys. Rev.*, August 1926) we can calculate the dielectric constant with the perturbation methods developed by Born, Heisenberg, and Jordan. The remarkable result is obtained that only molecules in the state $j = o$ of lowest rotational energy make a contribution to the polarisation. This corresponds very beautifully to the fact that in the classical theory only molecules with energies less than μF contribute to the polarisation (Alexandrow, *Phys. Zeits.*, 22, 258, 1921).

The formula for the polarisation takes the simple form

$$P = \frac{8\pi^2 I\mu^2 F}{3h^2}n(T),$$

where F is the field-strength, I is the moment of inertia, and $n(T)$ is the number of molecules in the lowest rotational state. Here and elsewhere we use the term polarisation in the restricted sense of meaning only the part of the actual polarisation which is attributable to the permanent moment of the dipoles. There is, of course, in addition the 'induced' or 'electronic' polarisation, which is approximately the same for all rotational states and hence independent of the temperature. The ratio of $n(T)$ to the total number N of molecules is given by the Boltzmann formula, and from the asymptotic value of this ratio it follows that at high temperatures our formula for P reduces to the Langevin expression $N\mu^2F/3kT$. This is a much more satisfactory result than in the older version of the quantum theory, in which both the calculations of Pauli with whole quanta (*Zeits. f. Phys.*, 6, 319, 1921) and of Pauling with half quanta (*Phys. Rev.*, 27, 568, 1926) yielded results diverging from the classical Langevin theory even at high temperatures.

Similar calculations can be applied to the paramagnetism of molecules, expect that is probably necessary to suppose the molecule gyroscopic. The formula for the susceptibility is then more complicated, as it contains contributions from all the rotational states, but still reduces to the Langevin formula at high temperatues. Details of the calculations will be published elsewhere.

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The Attractions of the Ends of Chromosomes in Trivalents and Quadrivalents.

I HAVE lately investigated the chromosome configurations at the metaphase of the first division in the pollen mother-cells of about sixty species and varieties of plants (including triploids, tetraploids, and $2n+1$ forms). The method used guaranteed perfect fixation, and the homologous chromosomes were usually clearly distinguishable at the metaphase. The following facts have been observed (omitting those few plants in which the pairs of chromosomes at the reduction metaphase were joined elsewhere than at the ends):

(1) In diploids (upper line of Fig. 1) the two

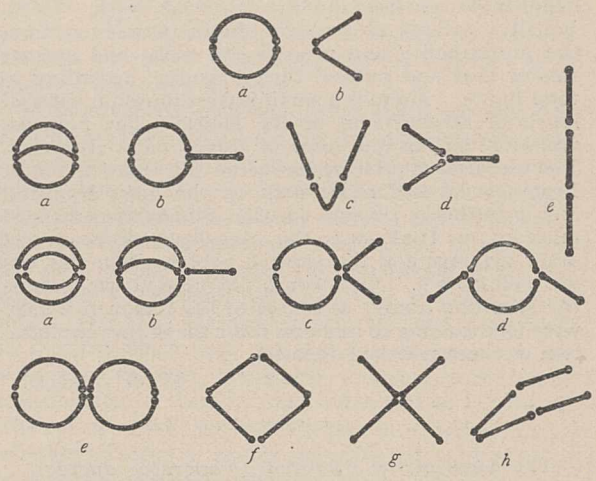

FIG. 1.—Configurations of chromosomes found in diploid, triploid, and tetraploid sets, at the first metaphase of the maturation divisions in the pollen mother-cells.

homologues are nearly always joined at both ends (*a*). Those joined only at one end (*b*) are rare.

(2) In triploids (second line of Fig. 1), *c* is the most common configuration, and together with *b* and *d* forms the bulk of the configurations; *a* being quite rare. This shows either that the combination of *two* chromosome ends is more stable than the combination of *three*; or that the attractions of the chromosome ends are partly neutralised by contact, so that when two ends are combined there is less attraction for a third. Thus the greater number of the junctions in the trivalents are of two chromosome ends, not of three; and in consequence free ends are common.

(3) In quadrivalents (lower two lines of Fig. 1), *e* is the most common form, *b*, *c*, *d*, and *f* being rare. Thus junctions of two ends are as common as those of four or three, and free ends are abundant.

(4) In agreement with these results is the fact that the frequency of separate single chromosomes at the first metaphase is least in the diploids, where they are rare. It is greater in triploids, where separate chromosomes may sometimes occur almost in every other cell. In tetraploids, however, separate chromosomes are usually so common that it often requires a search to find a cell with *n* quadrivalents.

JOHN BELLING.

Carnegie Institution of Washington,
Cold Spring Harbor, N.Y.

Scientific Neglect of the Mas d'Azil.

THE other day in the course of an automobile tour I visited the Mas d'Azil. I would like to direct the attention of the readers of NATURE, and particularly of those with money and organising power, to the very unsatisfactory state of affairs in this beautiful and incomparable treasure-house of archæological material. Practically there is no control, no protection and no organised excavation whatever at Mas d'Azil. There are masses of valuable material, but none of it is being worked at properly. Much of it, I fear, is being wasted and muddled up. There is a 'guide,' a pleasant untrained man, who pokes about in the caves, digs out bones which, as he remarks, fall to pieces, and presents the casual visitor with teeth or flint implements he has found in his own researches. He has no regular salary. He has to supplement his fees and tips by other work. Occasionally, isolated individuals obtain permission from the municipality and prod in the rocks and extract this or that and publish their 'results,' according to their lights. There is a small useless museum without labels or arrangement at the Mairie. The financial situation forbids the hope of Government direction. The essential trouble seems to be the want of funds. From Mas d'Azil came some of the most beautiful and interesting objects in the admirably arranged museum in Toulouse; the carved horse head and other carvings and the painted pebbles from this site are well known. One would not need to go outside the scientific ability available in the region if money were forthcoming to mobilise it for the proper exploitation of these priceless deposits.

H. G. WELLS.

The Eggs of the Pilot-fish (*Naucrates ductor*).

IN *Ann. Mag. Nat. Hist.* (9) 2, p. 114, 1918, Dr. Gilchrist described the egg of the Pilot-fish as having a long filament attached to the pole opposite the micropyle, and he states that it serves to attach the egg to the wall of the ovary. Further, the egg was stated to be oval, with a large perivitelline space, but without any oil globule. From the presence of the filaments on the eggs, Dr. Gilchrist presumed that the eggs were attached to floating objects and offered a plausible explanation of the well-known, but hitherto unexplained, habits of the Pilot-fish.

In November last a ripe female of the Pilot-fish was received at this Museum, and I was able to obtain a large quantity of eggs. To my astonishment these eggs differed from those described by Dr. Gilchrist in the two main characteristics mentioned: they possessed no trace of any filaments, but a distinct oil globule was present. On the other hand, they agreed in their more or less oval shape and the large perivitelline space. They floated in sea water. An examination of the ovary disclosed no "grape-like clusters" such as Dr. Gilchrist found, but only the normal structure.

In the case of such a well-known fish as the Pilot-fish, misidentification can be excluded. Another very unlikely possibility occurred to me, namely, that by a slip of the pen *Naucrates ductor* was written instead of *Echeneis naucrates*, the latter fish also being known in these waters as 'Lootsman' and found in association with sharks. To be certain, I examined the Museum material of this and allied species, the eggs of which are apparently still undescribed. Only two females with ripe ova were found and these lent no support to the suggestion of a misnomer having occurred. The ovary showed normal structure and the loose ripe eggs showed no trace of filaments.

The explanation of these diametrically opposed observations can only be found by the study of further material, and it is in the hope that ichthyological students will take the opportunity of examining fresh material and material preserved in Museums, that this letter is written.

KEPPEL H. BARNARD.

South African Museum,
Cape Town, July 19.

Spinning Electrons.

IN view of the recent correspondence in NATURE concerning the spinning electron, it may be of interest to consider the effect of free electrons possessing a magnetic moment on the magnetic susceptibility of metals.

If the magnetic moment of the free electron is one Bohr magneton, and the orientation of its axis with respect to an external magnetic field is assumed to be given by the Boltzmann distribution law, then the paramagnetic contribution to the molecular susceptibility (on the basis of the Pauli-Sommerfeld averaging) will be $1378 \times 10^{-6} P$ at 273° K, where P is the ratio of the number of free electrons per gram-molecule to Avogadro's number. Copper and silver have molecular susceptibilities of $-5{\cdot}7 \times 10^{-6}$ and $-20{\cdot}5 \times 10^{-6}$ respectively. The contribution to the diamagnetic susceptibility of such atoms or ions as may exist in the metal can scarcely be more than $-29{\cdot}8 \times 10^{-6}$ (the molecular susceptibility of Rb^{+}) in the case of copper, and -37×10^{-6} (Cs^{+}) in silver.

It must be remembered, in addition, that the normal atom in copper and silver has a magnetic moment of one Bohr magneton. Unless we assume that in the solid metal these elements exist in a form very different from their normal atomic state, and further, that the number of free electrons does not exceed 3 per cent. of the total number of atoms, the hypothesis of the spinning electron leads to some difficulties in understanding the diamagnetism of these metals, and of the alkalis as well.

Since the contribution to the susceptibility of the spinning free electrons would obey the Curie law, namely, that the paramagnetic susceptibility is inversely proportional to the absolute temperature, any considerable contribution to the susceptibility would therefore show itself in a temperature variation in the total diamagnetic susceptibility of a much higher order than that actually found by experiment.

I. I. RABI.

Columbia University,
New York City,
June 22.

Biology and the Training of the Citizen.[1]

By Prof. J. GRAHAM KERR, F.R.S.

I PROPOSE in this address to depart somewhat from precedent, and to devote it neither to a general review of recent progress in our science, nor to the exposition of my own special views on problems of evolutionary morphology, but rather to a more general subject—one which I believe to be at the present time of transcendent importance to the future not merely of our nation but, indeed, of our civilisation—namely, the relation of biology to the training of the future citizen. Speaking as I do from this chair, I need scarcely say that by biology I mean more especially animal biology.

It is unnecessary to emphasise at length the enormously important part which biological science plays in the life of our modern civilised state. The provision of food for the community—crop-raising, stock-breeding, the production of dairy products, fisheries, the preservation of food by canning and freezing, and so on—is obviously an immensely complicated system of applications of biological science. So also with the maintenance of the health of the community—the prevention of disease, much of which is now known to be due to the machinations of parasitic microbes, often transported and spread by other living organisms, and the cure of disease by the modern developments of medicine and surgery—these again are applications of biological science. When we contemplate merely such simple facts known to everyone, when we see to what an extent the results of biological science are woven in and out through the whole complicated fabric of modern civilisation, when we contemplate further the gigantic expenditure in money devoted to the school training of our future citizens, it must surely strike us as an extraordinary fact that biological science enters scarcely, if at all, into the school training of our average citizen.

What I have said indeed applies, if only in lesser degree, to the subordinate position occupied by science as a whole in our school training. In the early stages of human evolution, as we see illustrated on the earth of to-day by those comparatively primitive savages who still remain in the nomadic hunting phase, what we should now call science plays an all-important part in the education of the young individual: he is taught to observe accurately the phenomena of Nature, dead and living, to draw the correct conclusions therefrom, and to regulate his actions accordingly. In our own early history, science undoubtedly played an equally important part in the training of the young. Even down into the Middle Ages it supplied an appreciable part of the curriculum of the educated man, the seven liberal arts of these days containing a large infusion of what we now call science. In later times, however, from the renaissance of classical learning onwards, science has been kept in the obscure background of our educational curriculum, and in spite of much tinkering of detail in recent years, that curriculum continues unchanged in its main features: it remains preponderatingly literary and classical. Even to-day, if we listen to contemporary discussions on education, we commonly hear arguments as to the relative merits of different constituents of the current curriculum, but the general framework of that curriculum seems to be regarded as sacred from all interference.

Yet these recent years have witnessed the most tremendous advances in the evolution of our social organisation, and, as the position now is, it seems as certain as anything can be that unless further advance is accompanied by a corresponding evolution in the training of our future citizens, a condition of instability will soon be reached such as to involve the risk of complete disaster. Probably the factor in our modern social evolution which has brought in its train the greatest danger is the development of what in general terms we may call means of intercommunication—the means by which transport is effected—on one hand of material things, on the other hand of ideas. Primitive man in the hunting phase of his evolution is a nomad, but a nomad within a restricted area: his wanderings are limited by the more or less vague boundaries between his own territory and that of neighbouring tribes. He is entirely dependent for food and raiment upon what Nature provides within these limits: he knows little of the world beyond except that it is peopled by strangers of varying degrees of hostility: his code of ethics is limited by the same boundaries—highly developed as regards intercourse with his own tribe it ceases to exist in his intercourse with those outside. His dominating idea is loyalty to his own kinsfolk and fellow tribesmen, and for this idea he is ready to make any sacrifice.

With advancing evolution, when the communal unit is no longer the clan or tribe but the nation or federation of nations, geographical and political boundaries still exist; but with the evolution of means of transport by road and rail and sea they cease to form impassable barriers—men and goods are able to pass them freely. Of even greater moment to citizenship than the transport of material things is the transmission of ideas. The great developments in this have come about in the first place with the evolution of language, the vehicle of thought, which has rendered possible the transmission of thought from individual to individual. The use of visible material symbols of a lasting kind—whether pictorial or simply conventional, as in modern writing and printing—while facilitating still further the transmission of thought from individual to individual and from place to place, has done far more, for it has enabled the achievements of each generation to be handed on to its successors with a completeness that was quite impossible by the merely spoken word.

While these advances in the methods of transmitting thought have played an all-important part in rendering secure the orderly progress of human knowledge, they have brought in their train, curiously, one of the most potent disturbing factors to the progress of communal evolution. This disturbance is brought about through interference with the workings of one of the great principles of communal evolution—that of leadership.

[1] From the presidential address to Section D (Zoology) of the British Association delivered at Oxford on August 6.

LEADERSHIP.

Already in the primitive tribal community we find this factor at work. Tribes differ in their size and power—their men may number a mere half-dozen or several hundreds—and the main factor in this is the personality of the tribal chief. Among his own men the chief stands out by his capacity, mental and physical: a quick and accurate observer, he is also quick and accurate in drawing his deductions: he is wise, he is rich in knowledge and in its bearings; while alert and quick in decision, he is of steady nerves, has a good sense of balance, and is reliable in emergency. So it is onwards through historical evolution—the chief, the ablest man of his tribe, finds his successors in a long sequence of natural leaders of men.

It is the more modern developments concerned with the transmission of thought—printing, telegraphy, radio telephony, kinematography, and so on—that constitute the great disturbing factor, inasmuch as they have given enormously increased importance to elements of individual personality quite distinct from general strength and capacity, mental and physical. Amongst such elements there stand out conspicuously oratorical power and skill in the method of advocacy. The leader is no longer forced to the front by the sheer power of his outstanding constructive ability; the place of this is to a great extent taken over by the power of effective and persuasive writing and speaking. The most responsible posts in the leadership of the modern State have been rendered accessible to the skilled orator, even though his constructive ability in statesmanship may not be of the highest.

That this development involves serious dangers is obvious; it seems equally obvious that one of the main tasks confronting the community is the devising and setting up of the educational safeguards which alone can be efficient against these dangers. The task will, indeed, be no easy one: it will clearly, for its satisfactory accomplishment, call for the best intellects the community can provide. However great the ability of those to whom the task is entrusted, it will prove one of high complexity and much difficulty; but certain inevitable conclusions seem to be visible, one of the chief of these being the need of drastic cutting down of the number of subjects at present inflicted upon the young citizen in training during his school period. How exactly this is to be done will have to be worked out carefully; but it seems clear that at present an immense amount of time is given, during the early stages of the curriculum, to subjects which might profitably be replaced by others of greater value in mind-training during these earlier stages. If postponed to a later stage of mental development, such subjects can be mastered in a small fraction of the time required in the earlier stages—when, by the way, their prolonged and wearisome study is but too apt to kill effectively all interest on the part of the pupil in the particular subject.

While I am in complete agreement with those who desire to see the school curriculum greatly lightened as regards number of subjects and wish to see 'snippets of many subjects' replaced by more thorough training in a few, my special task now is to urge the necessity of including in the training of every citizen before the completion of his school period at least a grounding in the main principles of biological science.

It is necessary in approaching any such question to keep clear in our minds the two main functions of education: (1) the educative function in the strict sense—the training and development up to the highest attainable level of the brain-power which Nature has provided, and (2) the informative function—the providing the mind with an equipment of information which will be of use to it later on.

SCIENCE AND THE CURRICULUM.

It is again necessary to glance for a moment at the general question of science in relation to education. I am, of course, one of those who believe that the almost complete exclusion of science from the elementary education of the young which has persisted over a prolonged period has been a real tragedy. In the life of the ordinary active citizen, as opposed to that of the mere scholar and recluse, some of the most important faculties are those which training in science is specially adapted to develop. Such, above all, are the powers of accurate and rapid observation, and of the accurate and rapid drawing of conclusions from observation.

I do not, however, wish to press the claim of biology to an important place in the basic stage of school education, which should have to do with the early development of these powers. On the contrary, I harbour no doubt in my mind that the department of science to be used for this purpose is not biology but physical science. For the early training of the powers of observation there are two essentials: (1) that the phenomena observed should be capable of numerical expression to a high degree of accuracy, or, in other words, that they should be measurable; and (2) that a given observation should be capable of repetition over and over again under approximately the same set of conditions. Biological observation fails as regards both of these essentials. When we proceed to apply the method of measurement to something that is alive or that has once been alive, or to some form of vital activity, we find ourselves confronted not with a phenomenon of comparative simplicity, but with a complex of extreme and, in great part, unknown intricacy.

It is rather in the later stage of education—the informative stage—when the individual has already had his powers of observation and reasoning developed in the earlier stages, that biology should be called upon to play its rôle.

What is required is by no means the storing of the memory with a vast array of separate facts. It is rather that the budding citizen should be given a grasp of broad principles, as accepted by the competent authorities of the day. Such broad principles are generalisations from immense masses of detail. The probable soundness of the generalisation is intimately related to the broadness of its basis of fact. It is, of course, impracticable to place before the pupil the entire body of facts that constitute this base, and if it were possible it would be useless, for it is only a master who is able to perceive clearly the relations of superstructure to base. The object of the teacher is then not to attempt the vain task of demonstrating the truth of the general principle in the short period available: such facts as are introduced should serve merely to illustrate the particular principle and facilitate its appreciation.

I know that there are many who will criticise as unscientific and unsatisfactory such a simple manner of approach to general biological principles. They will say you cannot really instil such principles unless you make the pupil go through an elaborate course of laboratory training in dissection and microscopic observation such as we impose upon the specialist student of biology. I do not agree. My experience has been that an audience, whether of youths or of adults, of ordinary average composition such as we get in a public lecture in a big industrial city, appreciates the points and follows the argument perfectly satisfactorily without such elaborate preparation, provided always that the argument is clothed in plain, non-technical English.

Biology in the Curriculum.

The question may now be put: What exactly are the biological facts and principles that should be introduced into such a course of instruction?

(1) First, the great fact of evolution. We still see with tiresome frequency in magazine articles the statement that evolution is not a fact, but merely an unproved hypothesis. No doubt it may be said with perfect accuracy that in one sense absolute proof is unknown to science, except in relation to successive steps of an operation in pure mathematics. Taking, however, the word 'proved' as we use it in ordinary life, *e.g.* in relation to a matter inquired into by a Court of Law, then we are completely justified by the data of embryology and palæontology in stating that evolution is a definitely proved fact. The realisation that it is a fact admitted by all competent judges should be incorporated in the mental equipment of every citizen at an early stage of his training.

(2) Secondly, the broad fact of inheritance: the fact that the offspring repeat the characters of the parent—physical, mental, moral—but that this repetition is never so complete as to amount to identity as regards such characters. It is not always realised that, were the repetition actually exact and complete, it would constitute a fact that would shake our whole biological philosophy to its foundations!

The biologist habitually using the 'species' as his classificatory unit involuntarily becomes dominated by his mental picture of the ideal member of the species, conforming exactly to description, and an individual which obviously does not so conform impresses him as a departure from his ideal. He comes in this way to think of variation as being an active positive process by itself, instead of an inherent characteristic of life and of inheritance. It would not occur to him to decry the science of physiology because it does not know the ultimate nature of the phenomena of life with which it deals, but yet he will sometimes attempt to discredit our evolutionary philosophy because it is similarly without any clear idea as to the ultimate nature and cause of the variation which is the necessary accompaniment of life.

This instability of living things which finds its expression in the constantly fluctuating incompleteness of inheritance has to be driven well home—in the first place because it constitutes the raw material of evolutionary progress, and in the second place because its proper appreciation provides the citizen with his surest safeguard against the talk of those who make it their business to belittle, if not to deny, the ever-present differences in the capacities of their fellow-men.

(3) Thirdly and lastly, the fact of the struggle for existence in Nature and the consequent elimination of the less fit. To the biologist and, indeed, to any one who devotes thought to the matter, the struggle for existence and the consequent elimination of the unfit is an obvious truism, apart altogether from the question whether or not he accepts the Darwinian view of its potency as a factor causing evolutionary change; but yet among our fellow-citizens interested in sociological questions there is a very prevalent lack of appreciation of the widespread nature and the intensity of the struggle, induced in many cases by the perusal of charming descriptions of mutual aid in the animal kingdom, combined with ignorance of the fact that such mutual aid is restricted to the individauls of a community, and that it actually constitutes an important factor in rendering the community efficient in holding its own in the struggle with other communities.

When once the pupil has fully grasped the three great primary facts I have mentioned, he can profitably pass on to elementary notions of the biology of communal life. Gateways leading to these may be found by way of the fascinating phenomena presented by communities of social insects such as bees and ants and termites. Still better in some ways is the study of cell-communities, culminating in the immensely complex cell-communities that constitute the bodies of the higher animals. By whichever route, the pupil is easily led to the three great principles of communal evolution: (1) increase in the size of the community, (2) increased specialisation of its constituent individuals, (3) increased perfection of the organisation by which the constituent individuals are knit together into the communal individuality of a higher order. In some animal communities this organisation is of a material kind, the individuals being linked together by strands of living substance, in others the connexion is not material but is of the nature of social inter-relationships.

When once these basic principles are clearly apprehended an approach may profitably be made to the study of human society, where the same principles are seen clearly at work—the simple nomadic group with its individuals few in number, showing scarcely any trace of specialisation, and so loosely knit together that they separate from one another under stress of circumstances, such as attack by a hostile tribe—leading up to the complex modern civilised State with its millions of inhabitants, intensely specialised for the performance of the various communal functions, and knit together by an immensely complex social organisation.

The Inter-communal Struggle.

The appreciation of the fact that our civilised community has come about by a long process of social evolution paves the way to an appreciation of the further fact that human societies are still in process of evolution—States becoming larger and larger, the specialisation of their citizens becoming ever more pronounced, their social organisation more complicated—and that here again a great driving force is the struggle for existence, in this case an inter-communal struggle.

It is surely one of the saddest experiences a biologist can have, to live amongst men whose communal evolution has lagged behind, and to see how, unless helped in their struggle with competitors at a higher level of social evolution by some natural protective feature such as geographical isolation or immunity to local diseases, they are doomed to disappear. Innumerable examples of this are seen in the continents of the New World, where the relatively primitive communities of red men have been displaced by whites in a higher stage of communal evolution. The same process has taken place in the past, races that lagged behind in their communal evolution giving place to others more progressive.

The realisation of the importance of this inter-communal and inter-racial competition is of use indirectly as a safeguard against falling into the common error of shutting our eyes to differences—in material interests, in racial prejudices, in religious beliefs—those troublesome factors which, in actual practice, form obstacles of the most serious kind in the way of those who would find in signed agreements between different nations a sure shield against the danger of war.

The Biological Outlook.

Finally, our training, if successful in inducing in our citizen's mind what we may call the 'biological outlook,' enables him to take a fresh and an enlightening view even of that distressful subject, economics. He appreciates more fully how the customary units of the economist, pounds and dollars, are merely tokens with local values dependent on their power of purchase. In a remote spot on the earth's surface, a pile of golden coins becomes merely so much workable material out of which articles useful or ornamental may be fashioned; a bundle of scrip becomes material of possible use for kindling a fire. Their actual value bears no relation whatever to their token value in other circumstances.

Our citizen from his biological view-point looks beyond this veil of make-believe and realises that the true unit of value is the capacity of the human individual. He sees in each individual a biological capitalist. His store of capital may be small or large. It may consist of the precious bullion, intellectual power, or the humbler metal, bodily strength. The store, small or great as it was to begin with, may have been simply left like talents buried in the earth, or by education it may have been increased in amount and coined into the kind of currency, such as skill in handicraft or other form of social activity, which gives it its greatest local value in the community.

To what End?

Now the question may fairly be put: What good would come of it all were the biologist given his way, and his subject, resting on a basis of elementary physical science, accorded the place in the ordinary school curriculum that he claims for it? How might it fairly be expected to work out in practice to the advantage of the community and of the individual citizen?

To attempt to state adequately the answer to this question would exhaust the time not merely of one address but of many, and I can only indicate one or two points which the answer would include. The scientific training we are arguing for would in the first place be a potent power on the side of social stability, inasmuch as it would help to develop the scientific habit of mind with its constant distrust of the ably stated 'case.' There is no more potent defence against the plausible rhetoric of the advocate than infusion of the scientific habit of bringing verbal statements up against the touchstone of actual fact.

With recognition of the principle that the welfare and happiness of the individual citizen is by no means independent of the material prosperity of the community, proper attention would be given to biological economics. It would be recognised that the training of the individual citizen must include the scrutiny of the nature and amount of his biological capital, and the taking of appropriate measures to increase his stock and to ensure its being minted into the most suitable form of currency.

Individual scrutiny would in turn drive home the necessity of confining within as narrow limits as possible the workings of the principle of mass production in education. The application of that principle plays a great part in industry, but its introduction into the sphere of education is apt to be accompanied by forgetfulness that its success in industry is entirely conditioned by one basic factor, namely, uniformity of raw material. Without such uniformity the practice of mass production is recognised as absurd. The clearer realisation how completely wanting this uniformity is in the human raw material on which education works will serve to impress upon us all the desirability of confining mass education within the narrow limits at the commencement of the educational period when it is for practical reasons unavoidable.

The fostering of the biological element in education would do something to quicken into renewed life the primitive relationship of parent and offspring which has tended to become deadened under the influence of modern civilisation and more especially of mass education. The parent would be no longer encouraged to regard his child as merely number so-and-so in a vast number of units poured into the hopper of the educational mill. He would be encouraged to keep up his natural sense of responsibility for the welfare and interests of his offspring—the slackening of which in our present system is responsible for so much that is deplorable—and incidentally he would be stimulated to take a live interest in the education of his children, in the selection of those responsible for the ordering of that education, and in the subject of education as a whole.

This greater interest would lead the parent to a better appreciation of many things connected with education. One of those of which a deeper appreciation is greatly needed has to do with the reciprocal relations of physical and mental deportment. Passing along a city street the biologist is constantly having his attention caught by little peculiarities of attitude and movement which reveal to him the existence of peculiarities of quite another kind—stability or instability of character, mental sluggishness or alertness. He realises to the full the reciprocal relations between mind and body.

The training of the individual to the highest attainable degree of biological aptitude as a citizen involves naturally his relations to other members of the community. He must be fit not merely to play his part as an isolated individual, but also to carry out

smoothly and efficiently his communal activities. As communal evolution progresses, these latter relations become relatively more and more important. In the primitive savage phase the individual is still subject to the ruthless pressure of natural selection. His whole organisation—his bodily health and strength, the acuity of his senses, his mental alertness—is kept up to the highest pitch. As communal evolution goes on, however, the pressure of natural selection becomes modified. In one particular respect no doubt it becomes intensified, for the crowded community provides greatly increased liability to the attacks of pathogenic microbes, and consequently we find active evolution proceeding in the direction of increased immunity to such as are prevalent and dangerous.

While, however, in this particular respect evolution proceeds actively in the more advanced communities, it is not so in other respects. The individual no longer depends on his perfect bodily fitness, on the acuity of his senses, on the alertness of his mind, to survive and reproduce. As a result, as seems beyond question, the individual necessarily deteriorates with high civilisation in his all-round fitness both mental and physical, and this retrogression renders him correspondingly more and more dependent upon the community for his welfare. Emerging from this consideration, we have the conclusion that with higher and higher communal evolution, with more and more intimate dependence of the individual upon the community, we should have greater and greater attention paid in our educational system to these subjects which have to do with the citizen's relations to and duties towards the community—such as discipline, ethics, patriotism and loyalty to country and comrades, and the past history of the community and race.

The last of these, in fact, the history of our own people, is one of the subjects of the present school curriculum which the biologist would be particularly anxious to see retained, and even accorded increased importance. His natural sympathies go out to it, for his own philosophy—evolution—is but history of a larger growth. No doubt he would sometimes wish its teaching to be modified in detail: he would like to have less attention devoted to brawls and murders—on however great a scale—and to have a little space spared for the achievements of science. In my own city of Glasgow I often wonder how much the average child is taught regarding the two great events of the world's history which took place in that city—I mean, of course, James Watt's improvement of the steam engine and Joseph Lister's inauguration of antiseptic surgery.

In these flippant days there is a tendency to scoff at pompous lines regarding 'lives of great men,' and so on; but are we quite sure that our children are not greatly the losers by hearing so little in their school days regarding the dedicated lives of great heroes of science like Darwin or Lister?

In this address, which I must now draw to its close, I have touched upon some of the general considerations which naturally come to the mind of the biologist when he thinks of his subject in relation to this great and, as it has become, vitally important problem of the training of the future citizen. Some matters that at once suggest themselves I have deliberately avoided: eugenics—there are others who speak of that; sex—the whole air is abuzz with discussions on sex. The importance of every citizen being given a little elementary knowledge of the biological aspects of health and disease; the importance of the school paying more attention than it generally does to training the power of prolonged and concentrated effort upon dull bits of work; neither of these points requires any special emphasis.

There are, however, many other aspects of the problem which I refrain from developing, only because forbidden by the tyrant Time. Summing up the more important of these, I would say that the biologist would like to see a movement of our whole educational system away from the merely literary, doctrinaire, academic regions, in which it is apt to be out of touch with the reality of biological fact and practical affairs. He would like to see a far more general recognition of the fact that the primary object of education is to make the individual able rather than learned. A learned individual may be, and often is, a stupid one. And in any case the development and the training of general brain-power fits biologically into the earlier years of life in a way that is not the case with the acquirement of mere learning.

He would regard as another prime object in the training of the citizen the getting him back towards the primitive habit of thinking constantly. The primitive savage is kept constantly alert by ever-present danger. He is constantly thinking about the meaning of what he sees and hears. Civilised man, freed from the stress of savage life, gets into the habit of not thinking. His actions become automatic. He gulps down whatever is served up to him. If he were only to think he would promptly discriminate as to what is worthy of acceptance and what is not.

The biologist would like to see still another reawakening of ancient custom, namely, the more effective shackling of personal liberty in the bonds of duty towards the community. A biologically educated community, while according to the individual in his ordinary affairs the widest range of personal freedom, would take measures to prevent effectively its interference with the public welfare, whatever might be the form of this interference.

There is one other argument I would use for the biological factor in training the citizen. As social evolution progresses, the natural differences between men become more and more marked, as does also the material expression of these differences. One individual—say a Lister—is worth to the community many millions of pounds; another is worth little or nothing, or in some cases his value may be expressed by a negative quantity. Along with this increase of inequality there comes, unhappily, the deteriorating nervous balance which accentuates discontent and social friction. The biological outlook I believe to furnish a most potent aid towards the smoothing away of such social difficulties and the lubrication of the social mechanism, for it enables us to see with clear vision through the obscuring veil of superficiality that separates class from class, and shows us how our fellow-citizens beyond, in spite of their differences in manners and clothes and language, are after all, on the average, merely human beings like ourselves, fitted out with the same strengths and trammelled by the same weaknesses as our own.

Domestic Refrigeration.

THE origin of the discovery of refrigeration as a method of food preservation is lost in the mists of antiquity. The earliest record we have of the use of cold is that the Emperor Nero employed slaves to bring snow down from the mountains to cool his wines, so it is evident that the Romans appreciated the value of refrigeration as a means of enhancing the amenities of life in hot climates. Many centuries later the story is told by Sir Walter Scott that Saladin, leader of the Mohammedan armies, sent a frozen sherbet to Richard the Lion Hearted, much to the amazement of that doughty monarch. One hopes that such a good story is not legendary.

In the thirteenth century, Marco Polo is said to have brought back to Europe recipes for water and milk ices. It is not, however, until the sixteenth century that we obtain definite evidence of refrigeration being tried as a method for arresting the chemical processes which take place in animal tissue after death. The classic experiment of Francis Bacon is worthy of note. He stuffed snow into a chicken to see if the chicken would keep fresh. This experiment had tragic consequences for Bacon; for it is related that he caught his death of cold by alighting from his carriage one winter day to try the process.

From this simple experiment a gigantic industry has arisen, and, to illustrate the magnitude of the refrigeration industry at the present day, it may be remarked that Great Britain in 1924 imported chilled and frozen meat to the value of forty-seven million pounds sterling. In spite of this rapid commercial development, progress on the purely biological side has been slow, for very little is known as to the nature of the changes which take place in flesh chilled or frozen in the course of long periods of time.

We have evidence that flesh preserved by cold from prehistoric times is at least edible, for exploration has brought to light some remarkably well preserved specimens of the mammoth. One of these found at Beresorka, Siberia, was in such a state of preservation that the frozen meat was eaten by animals and men without any ill effects. It is supposed that the creature slipped into a crevasse in a glacier which may have been covered by vegetation as in the Malapina Glacier of Alaska. It is evident that the unfortunate creature met with a violent death. The hip bone and one foreleg were broken and there was grass between the teeth and even upon the tongue.

At the present time all we can definitely say is that refrigeration as a method of food preservation is the one which causes the minimum of alteration of the desirable food properties and consequently it is to be recommended in preference to the use of preservatives.

Whilst the commercial side of the cold storage industry is well developed, and stores of enormous capacity are available, little progress has been made in Great Britain in applying refrigeration for household purposes. In the United States the domestic refrigerating plant has been pushed vigorously during the past few years. It is stated that the production of household machines in the States has increased about 100 per cent. each year for many years, and that the total now amounts to something in the neighbourhood of 100,000.

Fascinating though the subject of the domestic refrigerating plant may be from an engineering point of view, when regarded from the purely utilitarian aspect, one must recognise that great practical difficulties are involved in the introduction of the mechanical refrigerator into the household. In the first place, as British climate is not one that calls for refrigeration for any lengthy periods in the year, the machine would need to be designed so as to be ready to operate after prolonged disuse. Furthermore, it should be proof against the attentions of the too enthusiastic owner and be unaffected by neglect whilst in the care of the cook.

The 'service' required for the maintenance of a group of plants may prove to be the most serious obstacle to the successful commercial development of the domestic machine. So, whilst there can be no doubt as to the benefit of refrigeration in the home, the means of attaining it needs careful consideration. A regular and cheap supply of ice, or a cold brine supply, from one large refrigerating plant adequate to the needs of a block of buildings, may be formidable rivals to the small mechanical plant of the future.

In the present article it is proposed to give a brief sketch of two of the many refrigerating plants now on the market. The designers of such plants have approached the problem with great originality of outlook, and consequently the resulting machines bear little resemblance to the large industrial installations.

In the choice of refrigerating fluid we also find great diversity; for example, ammonia, sulphur dioxide, ethyl chloride, methyl chloride, and a mixture of ethyl chloride and methyl bromide. The properties of ammonia are so well known as to need no description. Sulphur dioxide is greatly favoured for small plants, because the working pressures are lower than is the case with ammonia machines. It is also unique among refrigerants in so much that in the liquid state it has the properties of a lubricant. The serious drawback of sulphur dioxide is its affinity for water.

The high boiling point of ethyl chloride well adapts it for use in hot climates. A disadvantage is the necessity for using as lubricant glycerine, which is hygroscopic.

Methyl chloride is a gas condensing to liquid at $-23{\cdot}7^{\circ}$ C. The admixture of methyl bromide with ethyl chloride renders the mixture non-inflammable.

The primary requirement in the case of the small plant is reliability. Certain manufacturers have produced compressor type machines which are designed so that they cannot receive any adjustment in the hands of the user beyond the turning on and off of a water tap and switch, whilst others have based their designs on the assumption that, if motive power is entirely eliminated, skilled attention becomes unnecessary. It is two of the latter type, known as absorption machines, that are described in the present article; reference may be made to the *Journal of Scientific Instruments* (August 1925) and the *Proceedings of the British Cold Storage and Ice Association*, 1925, for a description of the former class.

The absorption type of refrigerating plant is very simple in principle: ammonia gas is driven off by heat from a solution of ammonia and water; the ammonia

is condensed and the liquid ammonia then allowed to boil in an evaporator, thereby producing 'cold'; the gas is absorbed in the dilute water ammonia solution, which is now cooled by water circulation. The cycle is repeated periodically.

Many attempts have been made to render the absorption machine automatic in action, and some remarkably ingenious machines have been produced. In one, known as the Keith, the boiler and evaporator are connected by steel pipes and the whole arrangement is mounted on a pivot point so as to allow it to rock. Starting from the condition when the evaporator contains a charge of ammonia and is ready to produce 'cold' by evaporation, the following is the cycle of operations:

A stud projecting from the evaporator cools and freezes water surrounding it in a small cup attached to the wall of the cool chamber. This holds the evaporator in position until all the liquid ammonia has boiled away and is absorbed by the water in the boiler now maintained cool by water circulation. When the temperature rises the ice lock is released by the melting of the boundary of the ice in the cup and, as the boiler is several pounds heavier than the evaporator, the whole unit tilts on the pivots.

This motion switches on the electric heating to the boiler and the water on to the condenser. The ammonia vapour from the boiler is condensed in this cooler and arrives as a liquid in the evaporator. After a period of about three-quarters of an hour, the charge of ammonia has been distilled over from the boiler and condensed in the evaporator. The weight of the evaporator overbalances the boiler and the machine rocks over to the position ready for a new cycle of cooling. The operation of switching over cuts off the electric supply and switches over the water so that it circulates through a coil of pipe in the boiler.

The machine has several novel features; one is a mercury seal which is so arranged that the ammonia vapour from the evaporator is passed beneath the surface of the water in the boiler during the refrigerating part of the cycle so as to produce rapid absorption.

Another feature of the machine worthy of note is the arrangement for manufacturing a supply of small blocks of ice which can be used for cooling beverages, etc. Copper studs project from the evaporator, and project at an angle of 45° into cups. When the evaporation is complete, the ice blocks thaw slightly around the sides and are freed from the cups, permitting the machine to rock. The blocks are carried up on the studs because they are at an angle and ultimately slide off into a hopper which delivers them to an ice container located on the top shelf of the refrigerator. All the cups are automatically filled with water.

Many other attempts to render the absorption machine automatic in action have been made. Recently the problem of rendering the absorption plant both automatic and continuous in operation has been studied by two Swedish inventors, Messrs. Platen and Munters. Their machine overcomes the practical difficulties encountered by Geppert, who attempted to solve the same problem in 1899, by introducing an inert gas into the system.

A diagram of the Platen-Munters machine is given in Fig. 1. The action is as follows:—When the generator (1) is heated by a heating coil projecting into the re-entrant tube (6) the ammonia dissolved in the water evaporates, rises and enters the condenser (4), where it is liquefied. Any admixture of water vapour is condensed and separated from the ammonia in a rectifier (9) and flows back into the generator. The liquefied ammonia flows down through the condenser into the upper part of the evaporator (3), where it is met by hydrogen, which is continuously transmitted from the absorber (2) through a pipe inlet (12). The liquefied ammonia thereupon flows over a number of discs (14), placed inside the evaporator, where it evaporates in, and diffuses into, the hydrogen. This evaporation and mixing goes on until the ammonia vapour has reached the partial pressure in the mixture of gases, which corresponds to the existing conditions of temperature

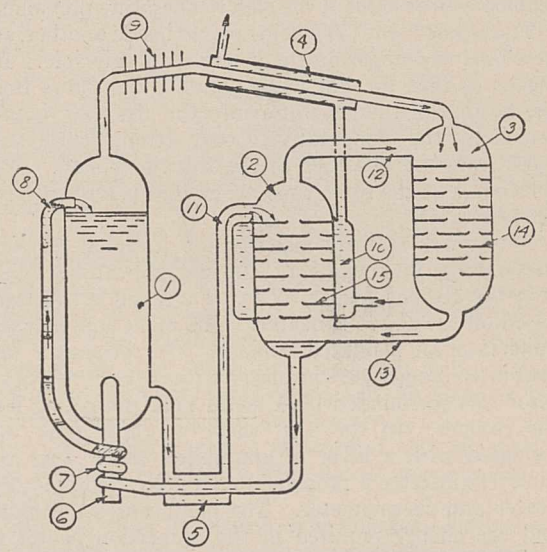

FIG. 1.—Diagram of cooling unit. 1. Generator; 2. absorber; 3. evaporator; 4. condenser; 5. heat exchanger; 6. heating medium; 7. thermo-siphon; 8. strong liquid inlet; 9. rectifier; 10. cooling jacket; 11. weak liquid inlet; 12. hydrogen inlet; 13. mixed gas outlet; 14. discs in evaporator; 15. discs in absorber. (By courtesy of Electrolux Ltd.)

and pressure in the evaporator. As the ammonia thus diffuses into the hydrogen, its partial pressure falls, but the total pressure in the evaporator remains the same as in all other parts of the apparatus. The gas mixture, consisting partly of hydrogen and partly of ammonia, is of a higher specific gravity than pure hydrogen, and therefore sinks down through the evaporator.

During the passage through the evaporator the heat-absorbing evaporation of the ammonia takes place, and accordingly heat is taken up from the surroundings through the walls of the evaporator.

From the bottom of the evaporator the gas mixture flows through a pipe (13) into the absorber (2), where it is met by a shower of water practically free of ammonia coming through a pipe (11), and passing over the discs (15) in the absorber. This water, which, by its gravity, has flowed from the generator to the absorber through the pipe (11), readily absorbs all the ammonia in the gas mixture. The hydrogen, thus denuded of ammonia, assumes thereafter the total pressure in the upper part of the absorber. The hydrogen, thus released, naturally rises, and thereby again finds its way into the evaporator. Consequently, the hydrogen rises in the absorber and sinks in the evaporator, where it

is again mixed with ammonia vapour, and in this way a continuous circulation of hydrogen between these two vessels is maintained. No hydrogen can remain in the generator while the apparatus is working, as it would be expelled by the ammonia vapour.

The return of the strong absorption liquid, from the bottom of the absorber to the generator, is provided for in a very simple way. The pipe (7-8) acts as an effective 'thermo-syphon,' by means of which the strong liquid is automatically transferred back into the upper part of the generator. The heat supplied not only lifts the liquid from the level in the absorber to the higher level in the generator, but also again releases the ammonia from the water to pursue its cycle.

It will be noticed that the weak solution when leaving the lower part of the generator is practically free from ammonia on account of the high temperature prevailing.

The pipes (5) and (11), being placed inside another, act as a heat exchanger on the counterflow principle. By means of this, the hot weak liquid, which flows from the bottom of the generator into the absorber, is pre-cooled by the comparatively cold, strong liquid that flows from the absorber to the thermo-syphon. This solution is at the same time pre-heated before entering the generator.

A test was recently made at the National Physical Laboratory on behalf of Messrs. Electrolux Ltd. (153-155 Regent Street, W.1), of a small refrigerator based on the above principle. The plant supplied was built into an insulated cabinet. The generator and heat interchanger were insulated with cork. The evaporator was surrounded by a metal tank projecting into the cabinet. In the test, the evaporator tank was insulated with a layer of granulated cork. Into the tank was inserted a propeller and an electric immersion heater and thermometer. The plant was set running and the energy required in the immersion heater to maintain the tank and its contents at $-5°$ C. was determined by trial. Then the heat abstracted by the plant under these conditions is the sum of the energy dissipated in the immersion heater and that conducted into the tank through the cork insulation. The tests were repeated at several values of the cooling water temperature.

The correction for the heat conducted into the tank was determined as follows :—After the temperature had been maintained at $-5°$ C. for some time, the plant was switched off, and the rate of rise of temperature of the stirred liquid in the tank was observed for a considerable period. By extrapolation back of the rate of rise at various temperatures, the value of $-5°$ C. was deduced. The heat capacity of the tank and its contents was then determined by the electrical method, the temperature rise from an initial steady temperature, due to the generation of a known quantity of heat, being measured, when the plant was not working. This, together with the rate of rise of temperature at $-5°$ C., gives data for the rate of leakage of heat at that temperature.

The table below summarises the results.

TANK AT $-5°$ C.

Electrical input in heating coil, 300 watts.

Inlet temperature of cooling water. (° C.)	Air temperature. (° C.)	Heat dissipated in tank around evaporator. (Kilo. cal. per hr.)	Heat leakage into tank. (Kilo. cal. per hr.)	Total refrigeration effect. (Kilo. cal. per hr.)
7·35	8·6	58·1	39·6	97·7
11·95	8·75	47·5	40·9	88·4
17·4	8·8	37·1	41·4	78·5

Hence it will be observed that at a cooling water temperature of 17·4° C., a total refrigeration effect of 78·5 kilo. cal. per hour is obtained for an expenditure of 258 kilo. cal. per hour in the form of electrical energy.

An ideal heat engine working between the same temperature limits and supplied with the equivalent amount of energy would give a refrigeration effect of 3090 kilo. cal. per hour.

Whether this simple ingenious machine will solve the problem of the domestic refrigerator time alone can tell. It must be realised that it is essentially an absorption type machine and, in spite of sixty years of development, this type of machine has failed to hold its own against the compressor type in the larger sized units, except where waste steam is available. An annoying trait in the older machines was the tendency for water vapour to be carried over and accumulate as ice in the evaporator.

Science in Antiquity.[1]

By Dr. J. NEWTON FRIEND.

MAN is a curious creature, at once apprehensive and superstitious. His early observations were so closely interwoven with imagination that from his records it is oft-times difficult to sift out the wheat from the chaff.

It is to Egypt that one naturally turns for the early history of science. Learning was concentrated in the temples and in the royal courts. Magicians and necromancers were intimately associated with the ruling spirits. This is well illustrated by a story in the Westcar Papyrus, concerning Seneferu, the first king of importance in the Fourth Dynasty, *circa* 3100 B.C., and the immediate predecessor of Khufu or Cheops, the builder of the Great Pyramid. It appears that upon one occasion the king was sad, and refused to be comforted by his nobles. So the magician Tchatcha-em-ankh was sent for, who advised the king to indulge in a row on the lake with a bevy of beautiful virgins. Whilst basking in the sunshine one of the maidens accidentally dropped a turquoise ornament into the water. The king, becoming acquainted with the loss, called the magician and asked him to recover

[1] Substance of a lecture delivered by the author at the Royal Institution on June 10.

the precious thing; whereupon Tchatcha-em-ankh spoke words of power, the waters of the lake heaped themselves up on one another, and the dry bed of the lake appeared with the ornament resting in the middle. This was recovered, and Tchatcha-em-ankh again spoke words of power, the waters fell back, and all was again as before. That Moses should be credited with having performed a similar miracle by making a pathway through the sea when leading the Hebrews out of Egypt need occasion no surprise. The power of a deity was measured by that of his priests, and, in the opinion of the Hebrews, Moses was no whit inferior to the followers of Amen or of Ra.

It is worthy of note that although commerce and religion demanded the use of balances in very early days, it was only about a hundred and fifty years ago that the value of the balance was generally recognised as a necessary adjunct to the systematic study of chemistry. In the Egyptian "Book of the Dead" the heart of the deceased is figured as being weighed in the Judgment Hall of Osiris, the counter-weight being truth, as typified by the ostrich feather. The balance bears an indicator, the movement of which, observed by Anubis, the Jackal-headed god of the Tomb or of embalmment, is recorded by Thoth, the Ibis-headed god, inventor of writing and science.

A similar idea of weighing good and evil runs through the Old Testament; as witness Belshazzar, who, we are told, was weighed in the balances and found wanting. It was regarded as grossly impious to use unjust weights and balances. In Hebrews ix. 4 we learn that the Ark contained Aaron's Rod, a Golden Pot, and two stones engraved with the Ten Commandments. Petrie very aptly suggests that these may have constituted the recognised Hebrew standards of length, volume, and weight respectively, which would naturally be kept under priestly control. In the Koran, written *circa* A.D. 600, the writer is evidently familiar with the conception of accurate weighing. Thus in Sura xxi. we read that "Just balances will be set up for the day of the resurrection, neither shall any soul be wronged in aught; though were a work but *the weight of a grain of mustard seed*, we would bring it forth to be weighed." About this time the Arabs appear to have had excellent balances, and some of their glass coin weights, dating back to the eighth century, have been tested in recent years and found to be remarkably accurate. Thus, three weights corresponded to 32·662, 32·665, and 32·667 grains respectively, a truly wonderful agreement (see NATURE, 1925, 115, 963).

In A.D. 1121 an Arab, Al-Khazini by name, discussed the balance in a work entitled the "Book of the Balance of Wisdom," and gave the density of lead as 11·33. Modern values range from 11·33 to 11·35. Further, it is interesting to note that Al Jildaki, who died about A.D. 1360, stated that "substances do not react except by definite weights." A short step further and Dalton's law would have been discovered and a bridge erected over a gulf of some four hundred and fifty years.

The ancient Druids of Cæsar's time were an intelligent set of men whose schools appear to have been famous amongst the Gauls. So great was their renown that young men came over to Britain from the continent to receive instruction at first hand from them. England was the Charlottenburg of western Europe. We have too often been led to despise the Druid, who is supposed to have burned his victims wholesale in wicker cages. Even if he did, he was but in keeping with the spirit of the times. Such a death would be less lingering than crucifixion, as practised by the Romans; and certainly no more painful than the cruel Assyrian practice of flaying alive, as illustrated on their monuments.

For many reasons we may be proud of the Druids. Amongst other things they studied astronomy. To this end clocks were necessary. In the East, sun-dials were used by day and the stars by night, to tell the time; but in a climate such as that of Britain, clocks independent of the weather were a necessity. The Egyptians had two types of water-clock, but both were based on the principle that water falling into a vessel at a constant rate will uniformly raise a float, the upward movement of which is directly proportional to the time. British water-clocks, as recently shown by R. A. Smith of the British Museum, differed entirely in principle from the above, and were probably a British invention. The clock consisted of a small bronze bowl through the bottom of which a small hole was made, as in a modern flower-pot. This vessel was then floated on water in a large bronze bowl, the water slowly entering through the hole, and eventually causing it to sink. The clock appears to have been attended constantly by a slave, who would perhaps call out or strike a gong every time the vessel sank, thereby recording the time, much in the same way as the watchmen many centuries later called out the hours of the night. Vessels of bronze, somewhat resembling frying-pans, have been found in association with the bowls, and these are believed to have served as gongs for the purpose mentioned.

Alchemy may be viewed as a link between ancient and modern science. It was regarded as a divine gift, but this is not surprising when it is remembered that knowledge was mostly vested in the monasteries, and thus intimately connected with devotion. Early recipes frequently postulate that a decoction shall be heated up or otherwise treated during the recitation of a certain number of paternosters. This, of course, was to ensure that proper time was allowed for the necessary reactions to take place, and incidentally throws an interesting light on the monkish conception of time. From this it was but a short step for the superstitious to believe, or for the quack to declare, if an experiment failed, that the cause lay in lack of devotion rather than in ordinary material experimental error.

Assisting this confusion of ideas there was also a curious mystic effect due to the contact of East with West. The Eastern mind is wildly imaginative, revelling in figures of speech and parables. The more matter-of-fact Westerner, on coming into contact with Eastern science, derived, it is true, much information that was valuable, but also accepted at its face value much that was purely mystical. It was not until the time of Boyle that he was able to shake himself free from its fetters, to study Nature from a less prejudiced point of view, and thus to enter into the realm of modern science.

The British Association at Oxford.

THE history, traditions, and amenities of Oxford mark it out as a place well suited to be the scene of the annual gathering of a body like the British Association; and it may safely be pronounced that the meeting that has just come to an end is not the least successful of those that have taken place since the Association has outgrown the questionings and misgivings that accompanied its earliest activities, and has made good its claim to efficiency and usefulness in the cause of commending the results of scientific research to the consideration of the community at large. This end has been met by the more technical and specialised communications that have formed the principal business of the sections, combined with the evening discourses delivered by men eminent in their own departments of science, with public lectures in Oxford and in neighbouring towns, and with lectures specially arranged for the benefit of older scholars from the elementary schools in the city.

The fulfilment of these various purposes has been the object of much careful deliberation and contrivance during the past year, and it is the hope of those concerned in the necessary preparations that their efforts to make the present occasion a notable one have been crowned with some measure of success. Great expectations were raised by the announcement that His Royal Highness the Prince of Wales had consented to occupy the presidential chair; and it may be said at once that those expectations were amply realised. His inaugural address provided fresh evidence, if such were needed, of the interest taken in scientific progress by the highest personages in the land, and of their sense of the important bearing of a knowledge of the facts of Nature upon the welfare of the whole body of humanity. The address, admirable alike in matter and in manner, is certain, from the interesting character of its substance and the wideness of its appeal, to be of immense service in encouraging a healthy appreciation of the aims and methods of science. Nor did the good offices of the president in the same cause end with the delivery of his address. By the readiness with which he entered into the social developments of the occasion, by his accessibility, and the gracious cordiality which he showed towards all with whom he came in contact, he has done very much to promote that kindly intercourse and encourage that fellow-feeling which should affect all those who are engaged in the common task of investigating and interpreting the phenomena of Nature.

It is the opinion of many who are well qualified to judge, that the social side of these meetings, though at first sight it may seem to bear merely the appearance of a concession to the demand for amusement, has its own peculiar value in aiding that personal interchange of views and comparison of experience for which the more formal atmosphere of a scientific sitting gives often too scanty an opportunity. It is a great point gained when one scientific worker gets to know another personally. At a reception, a garden party, or on a country excursion, it very often happens that misunderstandings are removed, that causes of irritation die down, that difficulties arising from difference of temperament are smoothed over. These surely are objects worth taking some trouble to attain; nor should it be forgotten that the coming together on terms not only of scientific but also of personal sympathy may act upon the younger worker as an inspiration, and on the elder as a quickening of his interest in the new points of view that appeal to the rising generation. These ends have been well served by the Oxford meeting.

The story of St. Frideswide may be accepted as legend with some foundation in fact; and there is no reason to doubt that the schools established in connexion with her priory, the origin of which dated from the eighth century, formed the germ of the present University. Authentic history of the city begins with the raising of the castle mound by Ethelfleda, the "Lady of the Mercians," and her surrender of Oxford to her brother Edward the Elder (A.D. 912). By the end of the twelfth century Oxford was a well-known seat of learning, and before the end of the thirteenth, the noble foundation of Walter de Merton, the model of all later collegiate establishments, had started on its way. With an academic and civic history reaching back for more than a thousand years, it is perhaps strange that Oxford should have no building capable of containing more than a very moderate-sized assembly; especially when it is remembered that among the many events of historic importance that have taken place within its walls was the session of the King's parliament of 1644; this, however, was not a numerous body. But the deficiency in question was felt as a somewhat serious inconvenience when it came to be necessary to find accommodation for all those members of the Association who wished to hear the president's inaugural address, and also for those who purposed attending at the official academic and civic receptions.

The peculiarities of an ancient University, much of the life of which is embodied in colleges—all bodies with an individual constitution, in each case largely independent of that of the University—made a certain want of concentration inevitable in the space and other facilities allotted to the purposes of the meeting. A partial remedy for this inconvenience was found in the organisation of a special system of transport, by which it was possible to reach the outlying spots in the occupation of the Association without great loss of time.

It may, on the whole, be said that these and other difficulties inherent in the situation were successfully dealt with, and that the Oxford meeting of 1926 will take its place in the records of the British Association as having contributed in a remarkable degree to the maintenance and advancement of the objects of that body. A standard has been set in this and other recent annual meetings which Leeds, the seat of the next annual gathering on August 31-September 7, 1927, may be confidently expected to follow. The meeting in 1928 will be held at Glasgow.

F. A. D.

News and Views.

AT all points where popular and professional opinion has ground for complaint against the present lunacy administration, the recently issued report of the Royal Commission on Lunacy affords clear and wise guidance to Parliament. The recommendations cover a wide field—public, private, and medical—and are fairly free from pettifogging and meaningless phrases. A certain vagueness appears over at least one of the more radical suggestions, namely, that concerning the end to which reorganisation of the Board of Control should be directed. But generally the advice offered is detailed and practical, or limited to the mere intimation that in particular directions improvement is desirable. The importance of provision for early treatment and for treatment without certification is generously recognised, the Commission advocating a recasting of the lunacy code "so that treatment of mental disorder should approximate as nearly to the treatment of physical ailments as is consistent with the special safeguards which are indispensable when the liberty of the subject is infringed." To this end detailed proposals are framed. The need for improving the status of asylum medical officers is expressed in terms equally explicit; so is the necessity for protecting medical practitioners, who at present undertake the duty of certification with increasing reluctance. The cost and responsibility of maintenance should, in the opinion of the Commission, be transferred from the Poor Law to the County authorities. No support is given to propagandist allegations of abuses in the administration of the Lunacy Act. On the question of the abolition or reorganisation of licensed houses, the Commission is divided. An Exchequer grant is proposed to meet the additional expenditure involved in a lunacy service such as the report envisages, and the hint is thrown out that an increase in recoveries following early care and the discovery, by research, of new possibilities of cure, will render such expenditure not wholly unremunerative. Further the Commission does not go, and it remains for its successor to present the problem of national fitness in its broader aspects as one of the major political problems of the modern State.

IT is a significant fact that one of the principal founders of the British Association over which the Prince of Wales is now presiding should have belonged to his own college in Oxford, and should have preceded him at that college by almost exactly one hundred years. Dr. Charles Daubeny was up at Magdalen as a Demy from 1810 until 1814, exactly a hundred years before his successor in the presidential chair this year. This is not the time to discant upon the many-sidedness of Dr. Daubeny's work within the University. In the words of his biographer: "In his whole career Dr. Daubeny was full of that practical public spirit which delights in co-operation, and feeds upon the hope of benefiting humanity by associations of men. When the British Association came into being at York in 1831, Daubeny alone stood for the universities of England, and so standing, boldly invited that body to visit Oxford in 1832. In 1856 he became president of the Association at Cheltenham, in his native county, amidst numerous friends, who caused a medal to be struck in his honour, the only occurrence of this kind in the annals of the Association." During the recent meeting a memorial wreath was placed upon the grave of the illustrious predecessor of the present president of the Association immediately within the entrance to Magdalen College, where a simple stone inscribed "C.G.B.D." marks the place in accordance with his own wish "that he might not be separated in death from a Society with which he had been connected for the greater part of his life."

HERR RASMUSSEN, the Danish Minister of Defence, who is shortly paying an official visit to Denmark's colony, the Faroe Islands and her sister State, the republican kingdom of Iceland, intends thereafter to proceed to the lonely, uninhabited island of Jan Mayen, lying between Greenland, Iceland and Norway. The announced object of the Minister's visit is to arrange for the erection there of a Danish seismographic station. The Danish Government owns the buildings on the island, which were given to them, it is said, by the Austrians, who once occupied Jan Mayen. It was made the station of the Austrian polar expedition of 1882–83, but has apparently remained unclaimed ever since, though Great Britain and Norway together established a 'close season' for the seal fisheries. The whale and seal fisheries off the east and north coasts are very important during the summer. Jan Mayen land, which was discovered in 1611, by the Dutch navigator of that name, is of volcanic origin, is some 35 miles long, and practically covered with immense glaciers and, in winter, frozen waterfalls. Its highest point, an extinct volcano, is 8350 feet high. Lord Dufferin refers to the island in his book, "Letters from High Altitudes," published in 1857.

THE first attempt in Great Britain to utilise the aeroplane for spraying operations in connexion with agriculture is recorded in the *Times* of August 4. Mr. George Caudwell, of Weston, near Spalding, Lincolnshire, chartered a private aeroplane piloted by Major Savage, and 40 acres of Majestic potatoes were sprayed in 25 minutes, in contrast to the two days which would have been occupied for the same operation by ordinary methods. The machine flew so low that at times it almost touched the potato tops, and the spray, in the form of a fine powder, was blown on to the leaves of the plants through two pipes on either side of the fuselage. Although this method of spraying is new to Britain, it has been applied on a large scale in the United States for the control of insect pests, extensive areas of cotton being treated in this way with considerable success. Experiments are being carried on with the view of extending the scope of application of the method to deal with a larger range of plant pests. So far as Great Britain is concerned, the report of the success of

Mr. Caudwell's initial experiment will be awaited with great interest. It would seem, however, that practical difficulties may limit the application of aerial spraying in those parts of the country which are subdivided into relatively small fields with dividing hedges, but where large open areas are available much time and labour would be economised if success is attained.

AT the recent graduation ceremonial of the University of Edinburgh an interesting address to the new graduates was delivered by Prof. J. H. Ashworth. In tracing the historical development of the Edinburgh School of Zoology, Prof. Ashworth emphasised the debt it owes to three of its professors of anatomy—Monro, Monro *secundus*, and Goodsir. The first two of these were responsible for discoveries of fundamental importance to morphological science. It was Monro who demonstrated the absence of free interchange of blood between the fœtal and the maternal parts of the placenta: it was Monro *secundus* who anticipated by eighty years the discovery by Kühne of the motor nerve-endings in muscle. The same observer, whose name is permanently registered in anatomical text-books by the 'foramen of Monro,' was also the author of the great monograph "On the structure and physiology of fishes, explained and compared with those of man and other animals." Having traced the past history of his subject, Prof. Ashworth alluded to the generous contribution of 20,000*l*. by Dr. Laurence Pullar, which, with an allocation of 18,000*l*. by the Carnegie Trust, made it at last possible to contemplate the housing of the University Department of Zoology in a building fully adequate for the special needs of zoological teaching and research. The latter part of the address was devoted to emphasising the importance of the contribution which the subject of zoology is now making to the training and outlook of the medical man on one hand, and to the general progress of mankind on the other. Zoology has established itself as an integral part in the scientific foundation of preventive medicine: it is playing a part in the advancement of civilisation and in the amelioration of the conditions of life in various parts of the world to an extent that would have been inconceivable a generation ago.

A MONUMENT to the memory of John Ericsson, the famous Swedish-American engineer, was recently unveiled at Washington, D.C., by the Crown Princess Louise of Sweden. The ceremony was under the auspices of the American Society of Swedish Engineers. Erected not far from the memorial to Lincoln, the monument consists of a group symbolic of vision, adventure, and labour, standing on a massive granite pedestal, in the front of which is a statue of Ericsson, who is depicted sitting in contemplative mood. President Coolidge, responding to the speech of the Swedish Crown Prince, remarked: "Great men are the product of a great people. They are the result of many generations of effort, toil, and discipline. They are the incarnation of the spirit of the people." An unusually precocious boy, Ericsson was born in 1803 at Filipstad, Sweden, and when quite young was employed on drawings and levelling in connexion with the Göta Canal. He resided in England from 1826 until 1839, while the rest of his life was spent in the United States. His locomotive *Novelty* competed with Stephenson's *Rocket* in 1829; he was one of the chief promoters of screw propulsion, and a pioneer in the use of hot-air engines. He is best known, however, for his design and construction of the *Monitor* turret vessel.

THE annual report of the Zoological Society of Scotland for the year ending in March last is a record of the most sucessful year in the history of the Society. The large increases in the number of visitors to the Zoological Park at Edinburgh, and in the number of new fellows admitted, witness to the growing popularity and interest in its work. During the year the new Tropical Bird House and the new Reptile House were completed, and a start has been made on the Carnegie Aquarium. The latter is being built with the aid of a grant from the Carnegie Trustees, and it is hoped to have it ready for opening at the end of the year. It will add enormously to the attractions of the gardens. In spite of the rigours of the northern winter, the stock in the gardens appears to flourish and breed in quite a satisfactory manner. The number of deaths is below the average, and a good proportion of the young animals born during the year was successfully reared. One of the most notable of the deaths was that of one of the original King penguins, which proved unable to survive the strain of incubating and rearing its last chick. The financial statement reveals a healthy condition of things, and a substantial surplus from last year's activities is to be devoted to capital purposes.

A SECOND report has been issued by the Medical Research Council on the gold treatment of tuberculosis. The drug employed was sanocrysin and the report deals almost entirely with clinical experience, based on about 140 cases treated. As a result of previous experience the dangers attending the use of the drug have been greatly lessened. There is necessarily a conflict of opinion, some clinicians believing that little benefit results from the treatment. Others, however, are very emphatic in the opinion that sanocrysin did cause unusually rapid amelioration of symptoms, particularly in the lessening of sputum and disappearance of tubercle bacilli in pulmonary tuberculosis.

THE success of the Department of the Interior of Canada in its efforts to save the buffalo from extinction is shown in the fact that the great park at Wainwright, Alberta, is unable to support a further increase in the herd at present there. This park is approximately 15 miles long and 13 miles wide, and was thought by many, even a few years ago, to be ample for all time. Provision will now have to be made for the disposal of the annual increase in the herd, and the action taken by the Department will be watched with interest.

IN connexion with the recent meeting of the British Association at Oxford, the honorary degree of D.Sc. (Oxon.) was conferred upon the following distinguished visitors: Prof. Niels Bohr, professor of physics in the University of Copenhagen; The Abbé Breuil, professor of the Institute of Human Palæontology, Paris; Sir Frank W. Dyson, Astronomer Royal; Prof. A. S. Eddington, Plumian professor of astronomy in the University of Cambridge; Sir Daniel Hall, Chief Scientific Adviser to the Ministry of Agriculture; Prof. Henry Fairfield Osborn, research professor of zoology in Columbia University; Sir Edward A. Sharpey-Schafer, professor of physiology in the University of Edinburgh; Mr. F. E. Smith, Director of Scientific Research, Admiralty; Sir Josiah Stamp; Prof. Vito Volterra, professor of mathematics in the University of Rome and president of the Royal National Academy of the Lincei; Prof. Wilhelm Wien, professor of experimental physics in the University of Munich.

THE Earl of Midleton will open the new buildings of the Haslemere Educational Museum, Haslemere, Surrey, on August 27 next. A memorial tablet to Sir Jonathan Hutchinson is to be unveiled by Dr. F. A. Bather on the same occasion.

PROF. JOCELYN F. THORPE, professor of organic chemistry in the Imperial College of Science and Technology, South Kensington, has been appointed chairman of the Explosives in Mines Research Committee, in succession to Sir Frederic L. Nathan, who has resigned. Mr. F. E. Smith, Director of Scientific Research under the Admiralty, has been made an additional member of the Committee.

AN autumn meeting of the Institute of Metals is to be held at Liége on September 1-4. A number of papers on the constitution and properties of non-ferrous metals and alloys will be read and discussed, and visits to works and to places of interest in the neighbourhood have been arranged. Particulars can be obtained from the secretary of the Institute at 36 Victoria Street, London, S.W.1.

THE trustees of the British Museum have revived the office of secretary, which since 1851 has been combined with that of principal librarian. In future the secretary will act as assistant to the director and principal librarian, with the status of a keeper. Mr. Arundell Esdaile, hitherto assistant keeper in the Department of Printed Books, has been appointed secretary.

THE Duke of York will visit the Harper Adams Agricultural College, Newport, Shropshire, on Wednesday, November 3, for the formal opening of the National Institute of Poultry Husbandry, established at the College under the joint auspices of the Ministry of Agriculture and the National Poultry Council. This signal recognition of the importance of the recent advances in the provision of adequate facilities for advanced education and experimental work in poultry husbandry will be warmly appreciated by all engaged in the industry.

AN Order of Council has been issued altering the composition of the Committee of Privy Council for Medical Research, the ministerial body under which the Medical Research Council conducts its work. The Committee originally consisted of the Lord President of the Council, the Minister of Health (England and Wales), the Secretary for Scotland, and the Chief Secretary for Ireland, but the last-named office has become obsolete as a result of the changes in the government of Ireland. In view of this vacancy, and of the increasing relation of the Medical Research Council to research work in overseas parts of the Empire and in industrial medicine, the Secretaries of State for Home Affairs, for Dominion Affairs and for the Colonies have now been added to the Committee.

DR. A. W. HILL, Director of the Royal Botanic Gardens, Kew, sailed on Saturday last for the United States, where he is attending the International Congress of Plant Sciences (the fourth International Botanical Congress) at Ithaca, N.Y., on August 16-23, as one of the official delegates of Great Britain. Dr. E. J. Butler (Imperial Bureau of Mycology), Dr. A. B. Rendle and Mr. J. Ramsbottom (British Museum (Natural History)) and Mr. Sprague (Kew) are also attending the Congress in an official capacity. After the Congress, Dr. Hill is going on to the Missouri Botanical Garden and the University of California, Berkeley, where he is to deliver three lectures, and returning via Vancouver, Toronto, Washington, D.C., and finally New York, where another lecture will be given in the Botanical Garden.

THE centenary year of Lord Lister's birth will be celebrated in Edinburgh in July 1927 during the meeting of the British Medical Association. The Committee responsible for the celebration is anxious to interest students and young graduates in the significance of Lister's work, and is offering a prize of a gold medal and 25*l.* for the best essay upon the subject, "The Influence of Lister on the Evolution of Surgery." The prize is open to registered students and graduates of not more than one year's standing of any medical school of the British Empire. Essays must be submitted by May 1, 1927, to Prof. J. Fraser, Convener of the Lister Memorial Committee, 32 Moray Place, Edinburgh. The award of the prize will be made at the Lister Celebration meeting, July 1927.

THE report of the sixth International Congress of Photography has been published by the Société Française de Photographie, 51 rue de Clichy, Paris (9e). It contains an account of the proceedings at each meeting, and the papers and reports that were presented to the Congress, but the final resolutions as to standard methods of sensitometry, and procedure in other matters in which uniformity is desirable, will be issued later. The subjects treated of at the Congress are classified under the following heads: Sensitometry, optics, photochemistry, history and documentary, and kinematography; in each case the

practical applications are dealt with as well as the fundamental theories. The membership of the Congress numbered about 240, and was well representative of all the centres of scientific photographic activity.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chemist and metallurgist in the Government Assay Office in Cairo—A. G. Innes, c/o Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1 (August 17). A lecturer in economics at the Imperial College of Tropical Agriculture, Trinidad — The Secretary of the College, 14 Trinity Square, E.C.3 (August 24). An assistant to the professor of surgery in the University of Bristol — The Registrar (August 28). An extra mural organiser at Armstrong College, Newcastle-upon-Tyne — The Registrar (August 31). Junior assistants at the National Physical Laboratory, preferably with some research or technical experience in either physics, engineering or electrical engineering—The Director, National Physical Laboratory, Teddington (September 4). An assistant lecturer in textile engineering at the Manchester Municipal College of Technology — The Registrar (September 20). An assistant secretary of the Oxford University Appointments Committee—The Secretary, 40 Broad Street, Oxford (October 1). A full-time assistant, or two part-time assistants, in the Department of History and Method of Science of University College, London —The Secretary, University College, Gower Street, W.C.1. Evening teachers in electrical engineering and mechanical engineering at the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon. Full-time teachers in the Physics and Chemistry Departments of the Northern Polytechnic — The Clerk to the Governors, Northern Polytechnic, Holloway, N.7.—A junior assistant under the directorate of Metallurgical Research, Research Department, Woolwich, for work mainly in connexion with technical records, reports and literature —The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

FINLAY'S COMET.—This periodic comet was discovered by Mr. Finlay, Chief Assistant at the Cape Observatory, in 1886, and was observed again in 1893, 1906, 1919. S. Kanda and S. Hasunuma, of Tokyo Observatory, calculated from the 1919 observations the conditions of the present return, the perturbations by Jupiter in the interim having been considerable, producing an increase of about 6 weeks in the period. With the aid of their ephemeris, Dr. J. Stobbe succeeded in photographing the comet on August 3 at Bergedorf Observatory, near Hamburg. Its magnitude was 11·5, and its position at $0^h\ 40{\cdot}6^m$ U.T. was R.A. $4^h\ 3^m\ 48^s$, N. Decl. 17° 48′. The position indicates that perihelion occurred Aug. 7·9 U.T., which is 0·7 day later than the Tokyo prediction.

The following ephemeris is for 0^h U.T.

	R.A.	N. Decl.
Aug. 15.	$4^h\ 56{\cdot}3^m$	20° 33′
19.	5 12·8	21 14
23.	5 28·6	21 47
27.	5 43·9	22 13
31.	5 58·8	22 32

The comet is a morning object passing near ζ Tauri on August 23, and entering Gemini on August 31. It is well placed for observation, but is growing slowly fainter, since the distance from both sun and earth is increasing.

A plate was exposed by Mr. F. J. Hargreaves of Kingswood, Surrey, on July 21 at $1^h\ 53{\cdot}5^m$ U.T. At first the comet was not detected upon it, but with the guidance of Dr. Stobbe's position, Mr. P. J. Melotte found a faint impression of the comet in R.A. $3^h\ 2^m\ 30{\cdot}8^s$, N. Decl. 13° 19′ 36″ (Equinox 1926·0).

THE NEW SOLAR RADIATION STATION IN SOUTH AFRICA.—A bulletin issued by the Smithsonian Institution describes Dr. C. G. Abbot's journey of 30,000 miles in search of the most suitable station in the eastern hemisphere. The desiderata were an elevated region, dry clear air, reasonable accessibility, and absence of wild tribes. This last consideration caused the rejection of Khojak Peak, 70 miles northwest of Quetta, though the sky conditions were superb. Stations in the Sahara, Egypt, and Mt. Sinai were visited and rejected. His choice fell on Mt. Brukkaros in South-West Africa, 200 miles south of Windhoek, and 20 miles from the railway. It is an isolated peak 5200 feet above the sea, and 2000 feet above the surrounding plain. The sky was found to be remarkably clear, the stars being brilliant right down to the horizon. The rainfall is very small, none having fallen for ten months. There is a crater at the top with a gap to the south-east, which was found to be suitable for the excavation of a tunnel for the bolometer. The sun will be observable an hour after sunrise. A neighbouring cave will be converted into a residence for the observers, Mr. W. H. Hoover and Mr. F. A. Greeley.

Mr. A. Dryden, Public Works Inspector, S.W. Africa, has undertaken the preparation of the building, and it is hoped to commence observations in September. There are prospects of daily observations for ten months in the year, and for three-quarters of the days in the remaining two months (the so-called rainy season). The Observatory is to supplement, not to replace, the stations already existing in Chile and California.

PROPER MOTIONS OF SOUTHERN STARS.—*Memoirs of the Royal Astronomical Society*, vol. 64 (part 2), contains a catalogue of proper motions in declination of 1738 southern stars by Dr. J. E. de Vos van Steenwijk. The recent observations of the stars were made by himself at La Plata. They are compared with older observations made at the Cape, Parramatta, Santiago, Madras, and other southern observatories. The systematic corrections given by Boss have been applied. The magnitudes range from $5{\cdot}8^m$ to $8{\cdot}8^m$. The probable errors of annual motion are given; they are mainly in the neighbourhood of 0·006″.

The following seven large motions are believed to be new: No. 166, mag. 6·1, type F8, P.M. + 0·245″; No. 200, mag. 6·4, type Go, P.M. + 0·457″; No. 470, mag. 6·9, type F8, P.M. + 0·713″; No. 631, mag. 7·4, type F8, P.M. + 0·593″; No. 1529, mag. 7·9, type B3, P.M. − 0·370″; No. 1774, mag. 7·0, type Ko, P.M. − 0·814″; No. 2664, mag. 7·2, type B8, P.M. − 0·490″. It is unfortunate that the motions in R.A. are not given.

Research Items.

THE PSYCHOLOGY OF AMUSEMENTS.—In the *Nineteenth Century* (July 1926) M. Willson Disher discusses the 'Psychology of the Show.' He points out the antiquity of the show or circus, a form of entertainment referred to in Homer, and its almost universal appeal. He finds that the various incidents resolve themselves into means whereby the visitor can experience novel sensations, or normal sensations in an intenser form, and so obtain a heightened thrill. Normal behaviour is overturned, people delight in seeing men, beasts, and things put to any but their ordinary uses, and they prefer to be deceived. The means employed vary with the advance of knowledge, but the experiences aimed at remain the same. The power moving the roundabout may change, but the general appearance has changed but little. Men on holiday bent prefer to be able to return to the attitude of childhood, and this can best be secured by similarity of outward appearance. Hence attempts to 'show up' the tricks of the show have but little effect on the show. People are seeking, not an appeal to their reason, but an appeal to their primary emotions, and are not grateful to those who would deprive the stimulus of its power. Perhaps Prof. Karl Groos' famous theory of play may be suitably recalled in this connexion. After his theory of the play of children and animals, which suggests that, biologically, in play, instincts are exercised for later use, he urges that in adult play we seek (i.) 'completion of life,' *i.e.* to experience sensations and emotions which normally in our work receive little or no gratification; (ii.) freedom from the constraint of 'must.' Fear in a limited degree, which we invoke by our own will, is very different from the fear which we experience in defiance of our will. This the show can do for us: we need not go, we can depart when we like. There is, therefore, for a short space of time, granted to us the power to feel masters of ourselves.

CRANIOMETRY OF SINGAPORE COOLIES.—Dr. Gordon Harrower of Singapore has contributed to Vol. 54, Pt. 3, of the *Trans. Roy. Soc. Edinburgh* the results of an examination of the skulls of 54 male Tamils and 36 male Hokien obtained from unclaimed bodies of coolies. In cranial capacity the Hokien is on a par with the most intellectual races, and cannot be regarded as falling within the mesocephalic group in which Chinese skulls are generally classed. The Tamil, however, is on the border line of the meso- and microcephalic groups, approaching the modern negro. Yet the Hokien and Tamil skulls are approximately equal in length, the difference coming out in the breadth. In the different races compared, the Tamil is the second lowest, being only 0·9 mm. more than the Australian, while the maximum breadth of the Hokien is exceeded only by certain of the Burmese and the Ainu groups. The skull is markedly mesaticephalic. According to the view of Chinese ethnological history now generally held, the Hokien, who are natives of the Province of Fu-kien, are survivors of the aborigines who were driven into the highlands when the early invaders of northern China from eastern Turkestan had penetrated to the south of the Yangtze-kiang. The result of the present investigation strongly supports this view. The Hokien are a pure type, brachycephalic with high cranial capacity, narrow frontal region, well-marked prognathism, and distinctly sinotic megaseme orbits. The palate is primitive. In the Tamil skull the most noteworthy feature is the position of the foramen magnum, which is relatively far back. It appears to be a pure type characteristic of the Dravidian, and shows no element incompatible with the current view of the ethnological history of southern India.

DECCAN VILLAGE LIFE IN THE EIGHTEENTH CENTURY.—Interesting side-lights are thrown on the customs of the Marâṭhâs by selections from the diary of the Râja of Satâra, Sivâji II. or Shâhu, who reigned 1708–1749, which are quoted by Mr. S. M. Edwardes in the *Indian Antiquary* for June. The position of *pâṭel*, or headman of the village community, is shown to entail both responsibilities and privileges of no little importance. He took precedence in various functions, such as the presentation of the ritual cake at the *Holi*, the annual procession in honour of Gaṇésa and Gauri, at the annual *Poḷa* procession, when the *Poḷa*, a bull dedicated to the gods, was marked with a trident and discus and allowed to roam at large. He held a prior claim to the decoration of his house with festoons of flowers by the Mâng and with red-ochre by the Mahâr, and to the supply of water by the village Koḷî or hereditary village servant, who was the recognised water-carrier. One of the processions in which the headman claimed precedence was the annual Śirâḷśet procession, Śirâḷśet being a legendary corn-chandler who became king for a short time, and an earthen image of whom was worshipped, carried in procession, and then thrown into a well or tank. An important rôle was filled by the headman in disputes about village boundaries. In a dispute of this nature in 1744, when other evidence failed to establish the facts, the *pâṭel* was ordered to put a cowhide over his head and shoulders and, so adorned, to walk step by step over the real boundaries of the village. He was then kept under watch for fifteen nights. As nothing untoward happened to him he was declared to have indicated the boundary truthfully. The underlying idea was that the *pâṭel*, having put the hide over his head and shoulders, became imbued with the divine influence of the sacred animal and must therefore speak the truth. In Mysore, in similar circumstances, an inferior village servant of the Holeya tribe had to carry on his head a ball of earth, scooped up in the village, with water in the middle, in which was the divine presence of the village goddess. If he went beyond the true boundary this ball of earth, it was believed, would fall to pieces, and he, having incurred the wrath of the goddess, would die in a fortnight and his house become a ruin.

A NEW ISOPOD FROM THE CHATHAM ISLANDS.—Prof. C. Chilton (*Records Canterbury Mus.*, New Zealand, vol. 11, pp. 321-326, 1925) has found among the Isopoda collected at the Chatham Islands five small specimens from a fresh-water stream, for which he establishes a new genus Paravireia in the subfamily Sphærominæ. The body is very convex and capable of rolling into a ball, but this genus differs from all other members of the subfamily in having five separate segments in the abdomen. A detailed description is given of a male specimen. The group (Monolistrini) to which this new genus belongs is probably an ancient one that has survived owing to the adoption of a fresh-water, and, in most cases, an underground, mode of life. The author directs attention to the interest attaching to the occurrence of this new genus in the Chatham Islands and the genus Vireia in underground waters in Europe—two very nearly related forms in localities so remote from each other.

VITALISM AND MECHANISM.—The editor of *Scientia* returns in the issues of his review for April and May

to the consideration of vitalism and mechanism, and seeks a solution of an intermediate character. In the June issue M. Leclerc du Sablon briefly examines the principal criteria which serve to distinguish living matter, and points out that in essence they are the transformations of matter and of energy which take place in the protoplasm of living beings. He believes that it is permissible to hope that the progress of chemical knowledge, which has already elucidated so many matters which appeared to our intelligence mysterious and inaccessible, may one day reveal to us the mechanism of life. He holds that it is a purely verbal solution to attribute the activity of living matter to a vital force. Every progressive step has permitted a deeper penetration into the knowledge of the phenomena which characterise life, and it is only by the slow and empirical method—as in the case of physics and chemistry—that our ideas of living matter can become more clear and more adequate. No other way can be adopted without going outside the prescribed limits of science. He concludes that the nature and origin of life may serve as a theme for the speculation of philosophers; they are not subjects of study for biologists.

THE CONTROL OF LOBSTER FISHERIES.—The interim report recently issued of the Interdepartmental Committee appointed by the Minister of Agriculture and Fisheries and the Secretary for Scotland to inquire into the crab and lobster fisheries of Great Britain (London: H.M. Stationery Office, 1926. 2*s*. 6*d*. net) gives the results of the Committee's inquiry into the lobster fishery only, the crab fishery being left until further evidence, which is to be obtained, has been considered. In accordance with the terms of reference, the Committee deals at some length with the question of further protection of the lobster of both sexes by an increase in the size below which the animal may not be taken, and of the berried female by forbidding its landing and exposure for sale during the whole or parts of the year, and the opinion is expressed that a real protection of the berried lobster would materially help to maintain an adequate lobster population. At the same time, it is held that the present position of the lobster fishery and such statistics as are available do not warrant immediate legislation in this direction. In a minority report Prof. A. Meek gives statistical evidence, accumulated since 1905 by the Northumberland Sea Fisheries Committee, which he regards as adequate grounds for the framing of an act to protect the berried lobster. An undersized lobster is of little commercial value, and, so far as the writer's experience goes, there is but little contravention of the law forbidding its landing and sale; but fishermen strongly resent, as an interference with their calling, the imposition of a penalty for the landing and sale of a berried lobster. The Committee feels that the experiments which are being made in various countries in the artificial hatching of lobsters should be closely followed.

PARASITIC FUNGI IN BRITAIN.—The latest report on the occurrence of fungus, bacterial and allied diseases of crops in England and Wales, covers the three years 1922–1924 (G. H. Pethybridge, *Miscellaneous Publications* No. 52, Ministry of Agriculture and Fisheries). More diseases are listed than in the previous report, chiefly because additional host plants have now been admitted, these being mostly pasture and horticultural crops. Diseases which are new to the survey and in some cases new to Britain are indicated, and special reference is made to the downy mildew of the hop, *Pseudoperonospora Humuli* (Miy. and Tak.) Wilson, first noticed in Great Britain in 1920, which is now considered to be a probable native species which, up to the present, has been overlooked. Attention is also directed to the discovery that apple and pear scab are able to overwinter on dead fallen leaves and to produce on them their ascigerous stages which serve as centres for early spring infection. The concluding index of parasitic diseases is intended to provide as clear an idea as possible of the number and nature of the parasites associated with the crops dealt with in this survey, as a contribution towards a more complete list of British parasitic fungi than at present exists.

PENETRATION OF LIGHT INTO THE SEA.—The second number of the *Journal du Conseil International pour l'Exploration de la Mer*, published in May at Copenhagen under the editorship of Dr. E. S. Russell, continues the high standard of the first number, which was reveiwed in NATURE of May 22. In a paper by Dr. W. R. G. Atkins, researches are described dealing with the penetration of light into the sea and the increase in the coefficient of absorption on approaching land, owing to the presence of more particles in suspension. Since plant growth is dependent upon an adequate supply of light for the endothermic process of converting carbon dioxide into carbohydrates, the depth of the layer which is adequately illuminated is a major factor controlling the abundant flora of minute plants suspended in the water which the sea supports. As on land, the fauna are ultimately dependent upon the flora for their food supply, so a consideration of the conditions of plant growth in the sea is of fundamental importance for any inquiry concerning the fertility of particular areas of the ocean. The author also discusses the importance of the thermal stratification of the water, which restrains the mixing of bottom water, where the necessary phosphates and nitrates are regenerated from dead organisms, with the upper illuminated layers. An interesting point which has evolved is that a white disc let down into the sea is no longer visible from above after it reaches a depth at which the intensity of light is approximately one-third of that in air at the surface.

AGES OF RADIOACTIVE MINERALS FROM AUSTRALIA.—The *American Journal of Science* for July contains a very interesting record of the analyses of Australian radioactive minerals compiled by Prof. L. A. Cotton. Unfortunately the lead-ratios are not given, and the ages are calculated from the formula $8000 \cdot Pb/(U + 0{\cdot}384 \cdot Th)$ million years. The best modern data suggest that the factor 8000 should be about 6600. Making this correction, the pre-Cambrian mackintoshite and thorogummite from Wodgina are calculated to be about 1200 million years old. This result is probably a little high, for altered uranium minerals generally tend to lose more uranium than lead, proportionately. It agrees fairly well, nevertheless, with the ages of other minerals from the early Proterozoic era. The monazite from Normanville is also pre-Cambrian and gives a (corrected) age of 930 million years, a figure that agrees closely with the ages of permatitic minerals from Scandinavia, India, Ontario, and other localities. Results are given for other minerals, but as these are recognised to be altered, their evidence is not of immediate value for either age determinations or correlative purposes.

DUST IN MINES.—The Safety in Mines Research Board has issued its fourth annual report showing the researches in progress and the numerous subjects that are being dealt with, and including the report for 1925 of the Health Advisory Committee (London: H.M. Stationery Office, 1926. 1*s*. net). So far only

one research appears to have been completed, and a separate pamphlet, Paper No. 23 (Mines Department: Safety in Mines Research Board. Paper No. 23: A Method of Trapping the Dust produced by Pneumatic Rock Drills. By P. S. Hay. London: H.M. Stationery Office, 1926. 6*d*. net), has been issued descriptive of it. It consists of an appliance for trapping the dust produced in rock drilling. As is well known, the fine dust produced in drilling siliceous rocks is a serious menace to the health of the men engaged in the work, being the source of the dangerous disease known as miners' phthisis. The invention consists of a cap placed over the hole which is being drilled, the cap being connected by a suitable flexible pipe to a filter bag, whilst the necessary suction is produced by the exhaust air from the rock drill. Experiments tried with the appliance in actual underground mining operations have been highly satisfactory, and seem to have demonstrated that the apparatus is practical and convenient, and that by its use the air within the working in which the drilling is being done can be kept free from dangerous dust particles, so preventing any risk to the health of the men engaged in the work.

THE GROWTH OF SURFACE TENSION IN SOLUTIONS OF COMMON SALT.—The growth of the surface tension in newly formed surfaces of pure water has been investigated by Messrs. Hiss, Schmidt and Steyer, and Dr. E. Kleinmann in the *Annalen der Physik*, June 2, describes measurements, using the same method, on solutions of common salt. A tube with a fine and accurately measured opening at the top dips in the liquid, which can be raised and lowered on a slide. A stream of air blown horizontally across the opening causes the liquid to rise through the same, where it is blown away in spray. The air stream can be cut off electrically by means of a contact carried on a Helmholtz pendulum, which has a second movable contact producing an electric spark to illuminate the hole shortly after the air current has been shut off. The newly formed meniscus can be observed by means of a microscope, and its behaviour shows that the increase in surface tension follows an exponential law, the full value being reached in a small fraction of a second. The differences between the behaviour of water and salt solutions are studied, and some theoretical conclusions are drawn.

ALUMINIUM ANODE FILM DIELECTRIC.—It is known that various types of electrolytic cell possess unilateral conductivity, that is, they allow the electric current to pass through them much more readily when it flows in one direction than when it flows in the other. Such a device can be used to rectify alternating current into current pulsating in one direction. When we have, for example, one electrode of aluminium and one of some other conducting substance in a bichromate solution, then, when the aluminium electrode is at the higher potential, practically no current flows through the cell, provided that the potential difference is less than a certain critical value. When the potential difference is reversed a large current flows. Devices of this nature are largely used for 'lightning' arresters in electric traction. Mr. Subramanian has published in vol. 8B of the *Journal of the Indian Institute of Science* an interesting paper on the aluminium anode film dielectric. He finds that the leakage resistance of the film formed on the aluminium electrode is inversely proportional to the applied voltage for a given formation voltage and is directly proportional to the formation voltage. This resistance also is nearly independent of the frequency. The film when subjected to a voltage exceeding the critical value collapses, the breakdown being accompanied by flashes of light and crackling sounds, the pitch of which appears to be an octave higher than the frequency of the supply voltage. The electrostatic capacity of the double film in ammonium borate increases slowly with the time.

THE SYNTHESIS OF NITROUS OXIDE.—The first direct synthesis of nitrous oxide has been carried out by a method due to D. L. Chapman, R. A. Goodman and R. T. Shepherd, which is described in the *Journal of the Chemical Society* for June 1926. The gas is obtained when nitrogen at low pressures is submitted to an electric discharge in a quartz tube, the walls of which have been impregnated with oxygen by means of the discharge. The gas is analysed by heating a platinum wire in it, when the volume increases in the ratio of 2 to 3. When the decomposition products are exploded with hydrogen, it is found that the proportion of nitrogen to oxygen is 2 to 1, leaving no doubt that the gas is nitrous oxide.

DETONATION TEMPERATURES IN CLOSED VESSEL EXPLOSIONS.—No. 1005 (E. 17) of the Reports and Memoranda of the Aeronautical Research Committee (Note on 'Detonation' Temperatures in Closed Vessel Explosions, by R. W. Fenning. I.C.E. 519. London: H.M. Stationery Office, 1926. 6*d*. net) supplements a former report on the temperature and pressure of the unburnt residue of the charge at the start of detonation in closed vessel explosions. The records of the experiments performed by R. W. Fenning make it quite clear that the chief factor in the production of explosions in mixtures of air with petrol, hexane, pentane or heptane is the temperature, the pressure having little or no effect.

THE PHOTOCHEMICAL DECOMPOSITION OF SILVER IODIDE.—The microbalance has been used by E. J. Hartung to study the photochemical decomposition of silver iodide. Thin layers of silver, chemically deposited on vitreous silica sheets, were iodinated and the films of pure iodide exposed to sunlight in oxygen, hydrogen, and nitrogen respectively at different pressures in the presence of silver, which was used as an iodine absorbent. The results of these experiments, and those on the rate of iodination of silver and previously insolated silver iodide, are published in the *Journal of the Chemical Society* for June 1926. They show that the decomposition into silver and iodine takes place in the absence of oxygen, the maximum percentage loss of iodine being, in hydrogen 91·6 per cent., in nitrogen 88·5 per cent., and in oxygen 94 per cent.

THE SLOW OXIDATION OF PHOSPHORUS TRIOXIDE.—The product of the luminescent oxidation of phosphorus trioxide has hitherto been assumed to consist of phosphorus pentoxide. A paper published in the *Proceedings of the Royal Society of Edinburgh*, Vol. 46, part 2, No. 21, describes the work of C. C. Miller, which proves that under certain conditions the tetroxide is produced. Phosphorus trioxide in the presence of water vapour of 0·1 mm. pressure from 98 per cent. sulphuric acid was submitted to the action of oxygen at a pressure of 600 mm. and at a temperature of 25°. The light snow-like solid was shaken into a weighed tube and analysed by oxidising the water solution with potassium bromate, treating with hydrochloric acid and excess of potassium iodide, the liberated iodine being titrated with sodium thiosulphate. The total phosphorus was obtained by precipitation as magnesium pyrophosphate after the solution had been boiled with strong nitric acid to remove halogens. The analytical results were confirmed by microscopic investigation of the resublimed crystals.

The Gustatory Sensory Reflex.

WE have already referred to certain of the researches carried out on the special senses by F. Allen and his collaborators in describing his investigation of the tactile sensory reflex. A recent paper on the gustatory sensory reflex presents an analysis of the sense of taste, the last of the 'five' special senses to be examined by this author, using the method which has proved so successful in the case of the senses of vision, hearing and touch; the sense of smell has so far defied investigation in this manner (F. Allen and Mollie Weinberg, *Quart. Journ. Exp. Physiol.*, 15, 385, 1925). The results obtained agree with what is known at present of the sense of taste, and, moreover, can be expressed by a formula which is closely related to those derived for the other three senses investigated.

The method used in all these researches is the determination of the fusion point of interrupted stimuli applied to the end-organ concerned. Thus in vision it is the critical frequency of flicker of the colour which is determined; in sound, the critical frequency of pulsation of the tone; and in touch, the critical frequency of percussion, by means of an interrupted blast of air; so in taste, the critical frequency of an interrupted electrical stimulus applied to the tongue is observed, using varying intensities of stimulation. The authors chose electrical stimulation of the tongue, which produces a sensation of sourness, as the most satisfying method of stimulating the taste-buds, the end-organs of taste, which are found in large numbers on the circumvallate and fungiform papillæ on the dorsal surface of the organ; their method requires the application of a stimulus of definite intensity to the same point at equal intervals of time and lasting only a definite fraction of a second. It is obvious that the mechanical application of substances in solution cannot be utilised for this purpose. In taking readings the tip of the tongue was protruded into a small mouthpiece containing the stimulating electrodes, the negative being applied to the dorsum and the positive to the under surface, so that the current ran through the tissue of the tongue itself; each measurement was completed in from two to three and a half seconds.

The results obtained, using different strengths of stimulation from 0·2 to 0·7 volt, at first sight appeared very irregular, but when plotted, with duration of the stimulus at the critical frequency as ordinate and intensity as abscissa, the readings were seen to fall along four curves, convex towards the abscissa: thus there are four fusion points for each strength of the stimulus. Since only four primary taste sensations are recognised, it was extremely probable that each of these curves represented the arousal of one of these sensations. The curve for the sour sensation was taken as the one on which the greatest number of points fell, since the actual stimulus used gave rise to this sensation. The identification of the other curves required special experiments.

It is known that gymnemic acid abolishes temporarily sweet and bitter sensations; after the application of a 0·5 per cent. solution to the spot on the tongue at which the measurements were made, only two complete curves and a portion of another were obtained. None coincided with any of the normals; their position indicated depression of the receptors in the tongue. The authors considered that the incomplete curve corresponded to the bitter sensation, the receptors of which only responded to relatively strong stimulation, and that the normal curve, above which this portion lay, was the curve of bitter sensation; the remaining two curves then represented the depressed sensations of sour and salt, and assuming they were equally depressed, the normal curve for the latter could be placed; the remaining curve, unrepresented after gymnemic acid, must be that of the sweet sensation. The curves fall into the following order, commencing with the most sensitive: bitter, sour, salt, sweet; the duration of stimulation at the fusion point, using 0·2 volt as stimulus, is from 0·0015 sec. to 0·0025 sec. (bitter and sweet respectively, with sour and salt giving intermediate values). With 0·7 volt the four curves approach one another with a duration of stimulation at the critical frequency of the order of 0·005 sec. The correctness of the identification of the curves is confirmed by the fact that the receptors for the four sensations, when investigated by tasting solutions of different strengths, can be placed in the same order of relative sensitiveness.

It may be noted that the fusion point of the electrical stimuli in any given experiment cannot be predicted; in fact, it may change during its course. Since the stimulation produces a sour sensation, but at the same time affects the receptors of the other sensations, it is probable that every gustatory stimulus affects the four sets of receptors in varying degree, stimulation of one set, however, predominating.

The effects of previous stimulation of the same or opposite side of the tongue upon the position of the fusion curves were also studied. The application of a weak solution of quinine bisulphate to either side of the tongue resulted in depression of all four sensations; that is, at a given voltage, fusion of the stimuli was obtained with a longer duration of each stimulus. Acetic acid applied to the same side of the tongue depressed all sensations except sweet, but applied to the opposite side, it produced an enhancement of all sensations. A solution of 10 per cent. sodium chloride depressed the sour, and bitter, and especially the salt, sensations, after homolateral application, but enhanced the sweet. Between strengths of stimulation represented by 0·4 volt and 0·6 volt this enhancement was very marked. A 20 per cent. solution applied to the opposite side of the tongue resulted in enhancement of all four sensations. Enhancement was also caused by a 20 per cent. cane sugar solution applied to the same side as the stimuli, but with 5 per cent. solution depression of the sweet, salt and sour sensations occurred.

It is thus clear that previous stimulation of a gustatory end-organ leads to a change in sensitiveness both of itself and of neighbouring end-organs, which may be in the direction of either depression or enhancement. The authors explain these results by postulating the release of efferent impulses to the end-organs following the receipt of the afferent impulses in the central nervous system; the efferent impulses are of two kinds, causing depression and enhancement of the receptors, and according as one set prevails over the other, so is the end-organ depressed or enhanced: a weak stimulus results in depression, a strong in enhancement.

The fusion curves correspond to the equation

$$\frac{1}{D} = -K \log Q + C,$$

where $1/D$ is the reciprocal of the duration of the stimulus at the critical frequency of gustation (or fusion point), Q is the quantity of electricity, and K and C are constants. This equation is closely related to those found by the same method of experimentation for vision, hearing and touch: in vision the negative log Q is replaced by the positive logarithm of the intensity of the light stimulus; in hearing and touch, the duration of the stimulus replaces its reciprocal, and in the former the logarithm of the air pressure is

positive, in the latter negative; in these latter two, low intensities of stimulation produce enhancement, and the higher the reverse.

When the logarithmic curves are plotted it is found that they are straight lines with two abrupt changes of slope. In their previous communication, Allen and Hollenberg (*ibid.*, vol. 14, p. 351, 1924) described only two instead of three branches in the curves of the tactile sensations. Allen and Weinberg have reinvestigated this point (*ibid.*, vol. 15, p. 377, 1925), and find that the superficial pressure sense certainly conforms with the other senses in showing three branches in its logarithmic curve, and that the deep pressure sense shows a curve of similar nature, though the lowest branch is missing, probably because the apparatus used was incapable of delivering a sufficiently rapid series of air-puffs to reach the critical frequency at low air pressures. It appears, then, that the sense of pressure agrees in its general characteristics with the other three senses investigated. To obtain results with low air pressures the authors found it necessary to use a more sensitive surface than the palmar aspect of the forefinger, and so carried out their experiments on the lip.

The similarity of the results obtained in the case of the four senses of sight, touch, hearing and taste, together with the shapes of the logarithmic curves, suggests that the sensitivity of the receptive end-organs is under the control of the nervous system in each case. This sensitivity can be increased or diminished by stimulation of any of the receptors, the enhancement or depression affecting not only the receptors stimulated but also, by reflex action, the others which are at rest.

International Ornithological Congress at Copenhagen.

THE sixth International Ornithological Congress was held in Copenhagen on May 24-29, Dr. Ernst Hartert being the president. It should have taken place in Sarajevo in 1915, but, this being impossible, Copenhagen was chosen, where local ornithologists, Herr Lehn Schiöler, Prof. Wesenberg-Lund, and Mr. Bovien, the secretary, made excellent arrangements. The meetings took place in the splendid rooms of the Parliament Building (in the Christiansborg castle), kindly put at the disposal of the Congress by the Danish Government. More than 200 members were announced, but only 164 actually attended. Nearly all European countries were represented, as well as the United States of America, Argentina, Canada, Brazil, Cuba, India and Japan. Next to Denmark, Germany was by far the most strongly represented country, and 18 British members were present.

More than 50 papers had been announced of which 47 were read; time being too short to read all, those authors who were present were given preference. The lectures were divided between the general meetings and five sections: Section (1): Systematic ornithology, geographical distribution, palæontology; (2) anatomy, physiology, heredity and evolution; (3) biology, including ecology and bird-migration; (4) oology, nidification; (5) bird-protection and aviculture. These five sections were amalgamated into two or three, as there were no or only single papers on several of the subjects.

The president opened the first general meeting with an address (in German) on the progress and development of ornithology since 1910 (the last congress). In another meeting he spoke (in English) on "A Plea for More Scientific Collecting and Labelling." Other systematic papers were, among others: Stresemann (Berlin) on distribution and grouping of some African groups of birds; Heim de Balsac (Paris) on the supposed identity of *Cinclus cinclus* L. and *Cinclus cinclus aquaticus* Bechst; Lönnberg (Stockholm) on the origin of the North American fauna; Sushkin (Petrograd) on hybrids of shrikes and of thrushes, and on a peculiarity of adaptive evolution in the insular faunæ; Chapman (New York) on the biological significance of altitudinal life zones; Rensch (Berlin) on the justification of ornithological systematic principles in other branches of zoology; Neumann (Berlin) on the genus Alisterus (New Guinea parrot); Murphy (New York) on the adaptive variation of the Tubinares. Of other papers might be mentioned Lucanus (Berlin) on the mental life of birds; Gröbbels (Hamburg) on various anatomical subjects; Verwey (Utrecht) on the biology of the heron in the pairing season, and on a fulmar with feathered feet; Boas (Copenhagen) lectured on the neck of birds.

Great interest was manifested in bird migration, and a number of papers dealt with this subject, especially Götz (Stuttgart) on relations between moult and migration, Drost (Heligoland) on migrations in the winter months, Geyr von Schweppenburg (Münden) on the migrations of *Sylvia curruca* (Lesser Whitethroat), Schenk (Budapest) on the value and elaboration of dates of migration, Weigold (Hanover) on bird migration on Heligoland, Jägerskiöld (Gothenburg) on bird ringing by the Gothenburg Biological Society. Hörtling (Finland) dealt with ornithological explorations in Finland, and Fleming (Toronto) with the Arctic collections in the Canadian National Museum.

A somewhat prominent feature of the Congress were the numerous lantern slides and the wonderful films, which were shown in the large and beautiful 'Palace Theatre.' Unforgettable will be the motion pictures from the Bird Islands of Chile and Peru by Drs. Frank M. Chapman and Murphy (New York), on the development of the young of Central European birds by Heinroth (Berlin), and, last but not least, on the last evening, Bengt Berg's films from the Upper White Nile, showing the wonderful bird life in those countries, among others the masses of migrants and the *Balæniceps rex* as well as large herds of elephants, etc. Gröbbels (Hamburg) attempted to explain the physiology of the flight of birds on a film. Lectures by Meinertzhagen (London) on bird life in the Himalayas, Jespersen (Copenhagen) on the frequency of birds over the High Atlantic Ocean, Jourdain (Ditchingham) and van Oordt (Utrecht) on the bird life of Spitsbergen, Krabbe (Copenhagen) on eider-ducks and Greenland falcons, by Helms and Hörtling and others, were accompanied by excellent lantern-slide projections. Lectures by Schoenichen (Berlin) and others dealt with bird protection.

Rather amusing and interesting were the imitations of birds' notes and song by Stadler and Preiss (Nürnberg), partially by mouth and partially with the help of instruments.

Much hospitality was shown to the members of the Congress. A half-day excursion took place in chars-à-bancs over a great part of Seeland, by the ancient renaissance castles Helsingör (Elsinore) and Frederiksborg to the estate of the enthusiastic bird-lover Herr Jarl, who is protecting his park and wood as a Nature reserve. Many members listened there for the first time to the powerful song of the 'Sprosser' or northern nightingale. The Minister of Foreign Affairs invited the Congress to a sumptuous tea in the rooms of the Royal Rifle Club and adjoining gardens. The

art-mæcenas Herr Jacobsen invited the Congress to his place at the Carlsberg Brewery. In the 'theatre' the lectures of Stadler and Preiss were delivered, a sumptuous Danish supper was served in one of the rooms of the Art Gallery, and the promenade through the extensive gardens, in the light of the full moon and lit up by numerous lanterns and torches, will long remain in the memories of those present.

Another feature of great scientific interest was the visit to the collections in Herr Schiöler's hospitable house. These collections, more or less limited to the Danish possessions, including Greenland and Iceland, are a masterpiece of completeness. All birds are represented by some beautifully mounted specimens and numerous skins, as well as very large series of skeletons, and anatomical preparations. The collection is in every way as it should be, though such completeness can at present only be reached in birds from a limited area, and is the work of a lifetime. A morning was spent in the Zoological Museum of the University, where lectures and discussions took place.

Invitations for the seventh International Ornithological Congress had come from Tunis, Finland, and Holland. A small number of the members of the International Committee voted for Tunis, others for Finland, but an overwhelming majority for Holland. The general meeting of the Congress adopted, therefore, Holland, where the next Congress is to take place in 1930, in the large and comfortable new Colonial Institute in Amsterdam.

The Lister Institute of Preventive Medicine.

THE annual report which was presented by the governing body of the Lister Institute to the meeting of members held on June 9 records another year of satisfactory progress. There has been only one substantial change in staff: Dr. A. T. MacConkey, who has been in charge of the serum laboratories at Elstree for twenty years, has retired, and is succeeded by Dr. G. F. Petrie. Dr. Muriel Robertson, after several years of absence through ill-health, has returned to work and will restore the protozoological laboratory to a working department. The activities of the staff are augmented by workers maintained by the Medical Research Council, the Foot-and-Mouth Disease Research Committee, the Rockefeller Foundation, the British Empire Cancer Campaign, and others who find in the Institute the facilities and atmosphere which they need.

Under Prof. Ledingham, the bacteriological department has pursued a variety of researches. Particular notice should be made of the inquiries into the invisible viruses of smallpox, vaccinia, and foot-and-mouth disease, and of those, due chiefly to Dr. J. A. Arkwright and Mr. Bruce White, into the variation and biochemical structure of the food-poisoning and other bacteria—questions which have an important bearing on the conception and differentiation of 'species.' The systematic classification, nomenclature, and identification of bacteria, upon which all good physiological and pathological work with them ultimately depends, are cared for by the National Collection of Type Cultures, maintained at the Institute by the Medical Research Council.

The biochemical department in charge of Prof. Harden, who has also acted as director of the Institute during Prof. C. J. Martin's absence on sick leave, has been continuing its work on hexosephosphates and alcoholic fermentation and on the concentration and possible isolation of vitamins; Dr. Zilva is supervising the preparation of large supplies of concentrated lemon juice for the Antarctic whaling expedition. Dr. Robison is following up his important discoveries of the phosphoric esters in blood and tissues and their hydrolysis by specific enzymes.

The department of experimental pathology is energised by the director and Dr. Chick, and in various directions they have extended the investigations of accessory food factors for which the laboratory is now so well known. Refinements of knowledge have led to technical difficulties, and the distinction which must now be made between vitamin A (which promotes growth) and the antirachitic vitamin D has made a good deal of previous work unsatisfactory and new experiments more and more complex. Dr. Boas has made the significant discovery that dehydration, however it is carried out, makes egg-white quite unsuitable as a sole source of protein, and indeed seems to confer on it almost poisonous properties. Long and laborious observations on the nutritional qualities of cows' milk show that diet is the important factor in determining its content in vitamin A, while the amount of sunlight the animal gets is the chief thing which influences the antirachitic value of its milk.

The finances of the Institute are superficially in good order, the past year's work leaving a balance of 14,000*l*. But the position is actually far from what it should be, for of a total income of 51,000*l*. no less than 36,000*l*. was derived from diagnosis fees and the sale of sera and vaccines. The demand for these products naturally varies with the vagaries of epidemics in different parts of the world, and the precarious nature of the income so obtained must hamper the governing body in extending the activities of the Institute along lines which involve long or permanent commitments. A reduplication of Lord Iveagh's splendid benefaction is much needed.

University and Educational Intelligence.

LONDON.—The following doctorates have been conferred:—*D.Sc.* (*Applied Statistics*) on Mr. G. M. Morant (University College) for a thesis entitled "A Study of Egyptian Craniology from Prehistoric to Roman Times"; *D.Sc.* (*Biochemistry*) on Mr. J. H. Quastel (Imperial College—Royal College of Science) for a thesis entitled (1) "The Relationship of the Chemistry of Resting Bacteria towards Bacterial Growth," and (2) "A Theory of the Mechanism of Oxidations and Reductions *in vivo*"; *D.Sc.* (*Zoology*) on Mr. F. W. R. Brambell (University College) for a thesis entitled "Oogenesis of the Fowl (*Gallus bankiva*)"; *D.Sc.* (*Engineering*) on Mr. E. Mallett (Imperial College—City and Guilds College) for a thesis entitled "Forced Oscillations, Electrical and Mechanical"; *D.Sc.* (*Geology*) on Mr. F. Raw for a thesis entitled "The Development of *Leptoplastus Salteri* and other Trilobites"; *D.Sc.* (*Physics*) on Dr. R. L. Smith-Rose for a thesis entitled "Some Recent Research in Wireless Direction Finding," and other papers; *D.Sc.* (*Zoology*) on Miss N. B. Eales for a thesis entitled "The Anatomy of the head of a Fœtal African Elephant," and other papers.

THE League of Nations' International Committee on Intellectual Co-operation held its eighth plenary session at Geneva on July 26–29 under the presidency of Prof. Lorentz. The British Empire was represented by Prof. Gilbert Murray and Sir J. C. Bose. Among the subjects discussed were: the means for securing profits for scientific workers in connexion with the industrial application of their discoveries, the organisation of an international system of scholarships for the promotion of science, the foundation of an international university for the training of

statesmen, diplomats, the study of political science, etc., the co-ordination of scientific bibliography, the foundation of an international meteorological office, and the establishment of an international museum office to improve the organisation of catalogues and promote mutual assistance by loans, exchanges, distribution of photographs, etc. Sitting as governing body of the International Institute of Intellectual Co-operation, the committee received its report, adopted a programme and drew up a budget. The Institute will have at its disposal this year the French Government's subsidy of two million French francs, the Polish Government's grant of 100,000 French francs and the Czechoslovak Government's subsidy of 15,000 gold francs. The committee emphasised the necessity of setting up national university information offices in countries where they do not already exist. It was decided to study the possibility of convening in 1927 a meeting of representatives of national committees of intellectual co-operation.

UNIVERSITY tutorial class (extra-mural) teaching and its problems form the subject of a paper by Mr. R. S. Lambert, hon. secretary of the Association of Tutorial Class Tutors, published in the June number of the *Bulletin of the Association of University Teachers*. The writer points out that as the classes are largely organised by the Workers' Educational Association, nearly every tutor finds himself connected with this body, becomes a member of it, shares in its propaganda, and finds many opportunities for service as a speaker in the meetings of trade union branches, co-operative societies and guilds, working men's clubs, etc., which form the students' recruiting ground. About half the classes are, he says, taken by lecturers holding a salaried post within a university, who take a single class or two classes, in addition to their internal work, or instead of part of it, and are paid a fee per class (80*l.* as a rule). The other half are taken by tutors giving the whole or a greater part of their time. Of these, about twenty-five hold permanent salaried posts as 'staff tutors' under the various Joint (University and W.E.A.) Committees, and thirty have no guaranteed salary or status, but are dependent for their livelihood on fees paid according to the number of classes they happen to be taking. The work is both physically and mentally exacting, and four or five classes per week (each class meets twenty-four times during the year) are enough to occupy a man's entire energies. It is clear that these extra-mural classes of adult three-year students constitute vitally important areas of contact between the universities and the community, and their development, which is proceeding rapidly, needs very close attention.

COMPARATIVE statistics of German university students in 1914 and 1925 show very remarkable changes in distribution among the various faculties. Students of medicine, the humanities, mathematical and natural sciences, and evangelical theology comprised in 1914 respectively 25, 21, 11, and 7 per cent. of the total numbers; in 1925 these percentages had shrunk to 11·5, 16, 8, and 3. Students of law, of political science, and of chemistry, on the other hand, increased from 17, 4, and 1 per cent. to 28, 15·5, and 5 per cent. The total number increased during the same period from 69,644 to 81,699, this last figure being smaller by nearly eight thousand than the corresponding figure for 1924. These statistics are taken from "Academicus," a useful handbook of information about German universities and polytechnics. The 1926 issue (published by Alfred Lorentz, Leipzig, price M2.40) includes, for the first time, particulars of the German-speaking institutions of Austria and Czechoslovakia.

Contemporary Birthdays.

August 14, 1861. Sir Richard Threlfall, K.B.E., F.R.S.
August 14, 1860. Dr. Arthur Prince Chattock, F.R.S.
August 15, 1842. Sir William A. Tilden, F.R.S.
August 15, 1871. Prof. Grafton Elliot Smith, F.R.S.
August 16, 1863. Prof. Frederic Stanley Kipping, F.R.S.
August 18, 1831. Mr. Ernest Noel, F.G.S.
August 19, 1868. Prof. William Bulloch, F.R.S.

Sir RICHARD THRELFALL, who was born at Hollowforth, Lancashire, was educated at Clifton and Caius College, Cambridge. He is chairman of the Fuel Research Board.

Dr. CHATTOCK was born at Solihull, Warwickshire. He is emeritus professor of experimental physics in the University of Bristol.

Sir WILLIAM TILDEN, the veteran chemist, to whom we offer our very hearty congratulations on the celebration of his eighty-fourth birthday, was born in London. Formerly a science master at Clifton College, he occupied next the chair of chemistry at Mason College, Birmingham. On leaving there he became professor of chemistry at the Royal College of Science, London, retiring in 1909. The Royal Society had awarded him in the previous year its Davy medal for his discoveries in chemistry. Sir William gave the Mendeléeff Memorial Lecture before the Chemical Society, in 1909, in all respects a masterly exposition. Incidentally, we may recall that Mendeléeff's last appearance in London was in November 1905, when he attended to receive the Copley medal of the Royal Society.

Prof. G. ELLIOT SMITH was born at Grafton, N.S.W., and educated at the Universities of Sydney and Cambridge. Formerly professor of anatomy in the University of Manchester, he now occupies a similar chair in University College (University of London). In 1912 the Royal Society awarded him a Royal medal in recognition of distinctive investigations on the comparative anatomy of the brain. Prof. Elliot Smith is the author (among many works) of "The Evolution of Man" (1924), and holds original views on the origin and diffusion of culture.

Prof. KIPPING was born at Manchester and educated there at the Grammar School, at Owens College, and at the University of Munich. For some time he was on the teaching staff of Heriot-Watt College, Edinburgh, and next became a lecturer in chemistry at the Central Technical College, London. In 1897 Prof. Kipping was appointed to the chair of chemistry in University College, Nottingham. The Royal Society awarded him its Davy medal in 1918 for his investigations in organic chemistry.

Mr. ERNEST NOEL, who is in his ninety-fifth year, is the *doyen* of the Geological Society of London. Educated at Edinburgh and Trinity College, Cambridge, he was elected into the Geological Society in 1849, and thus has been seventy-seven years on its roll.

Dr. WILLIAM BULLOCH was born at Aberdeen and educated there at the University. Formerly assistant professor of pathology in University College, London, he has been, since 1919, Goldsmiths' professor of bacteriology in the University of London. He is Hon. LL.D. Aberdeen.

Societies and Academies.

PARIS.

Academy of Sciences, July 5.—Gabriel **Bertrand** and M. **Mâchebœuf**: The influence of nickel and cobalt on the action exercised by insulin on the dog. The results of experiments carried out on the rabbit have been given in an earlier communication: it is now shown that the addition of cobalt and nickel to insulin causes similar effects on the dog and rabbit. There is an increase in activity in both animals; cobalt has a greater influence than nickel.—Gaston **Julia**: A series of polynomials connected with the conformal representation of simply associated areas.—Luigi **Fantappiè**: Analytical functionals which are functions of a finite number of linear functionals.—René **Lagrange**: Legendre functions of the first species and certain associated functions.—N. **Gunther**: The movement of a liquid filling a simply associated domain which is displaced.—Henri **Bénard**: The deviations of the values of the frequency of vortices alternating with respect to the law of dynamical similitude.—Th. De **Donder** and Fr. H. van den **Dungen**: The quantification deduced from Einsteinian gravific.—Léon **Brillouin**: The undulatory mechanics of Schrödinger; a general method of resolution by successive approximations.—W. H. **Keesom**: Solidified helium (*v.* NATURE, July 17, p. 81).—Jean **Lecomte**: Infra-red absorption spectra of cyclic derivatives. The infra-red absorption spectra of derivatives of benzene, cyclohexene, and cyclohexane have been compared and numerical data are given.—René **Lucas**: The rotatory power of tartaric acid. The effects of the addition of such substances as boric acid, tungstic acid, urea, etc., can be explained as being due to the appearance of one new form, strongly dextrorotatory, and in proportions varying with the reagents. It is possible that the anomalies of malic acid follow a similar mechanism.—P. **Daure**: The qualitative study of the fluorescence of bromine vapour.—R. de **Mallemann**: Magnetic rotatory dispersion and the dispersion of electric double refraction. From theoretical considerations it is concluded that the ratio of Verdet's constant to Kerr's constant should vary inversely as the wave-length, or, alternatively, the ratio of the magnetic rotatory dispersion to the dispersion of electric double refraction should be equal to the corresponding ratio of wave-lengths. This conclusion is verified experimentally for carbon disulphide and for camphor in hexane solution.—Paul Gabriel **Girault**: A possible influence of commutation on the stability of continuous current machines.—Georges **Fournier**: The absorption of β-rays by matter.—D. P. **Konovalov**: The heats of combustion of some hydrocarbons. Values are given for the heats of combustion of cyclohexene, methylene-cyclohexane, and dicyclohexane and the figures compared with those calculated from a formula given by the author in an earlier paper.—A. **Boutaric** and G. **Corbet**: On the critical temperature of solution of acrolein and water and on the molecular mass of soluble acrolein resin. The soluble acrolein resin studied is a polymer of ten molecules of acrolein.—— **Surun**: The estimation of the adsorbing power of carbons.—E. **Rouyer**: The determination of some double salts in solution by the boiling point method. Experimental data for the double sulphate of ammonium and RSO_4, where R is cadmium, iron, cobalt, manganese, zinc, magnesium, copper, and nickel, and also double chlorides of the carnallite type.—— **Holweck**: The spectrometry of the *K* series of the light elements. The *K* discontinuity of fluorine. The advantages of the method of critical potentials are emphasised; it brings out the *K* discontinuity of fluorine at 684·2 volts very clearly. By combining the results of several workers, the Moseley curve from helium to sulphur is shown to be a straight line.—V. **Ipatief** and A. **Andreevsky**: The displacement of platinum by hydrogen under high pressures. The precipitation of platinum from its solutions by hydrogen is a function of the temperature, pressure, concentration, and time, and results of experiments in which each of these factors was varied are given. The presence of metals such as iron and nickel, especially in acid solution, tends to retain platinum in solution.—Daniel **Florentin**: The estimation of soluble silica in cements, mortars, and concretes.—Georges **Denigès**: The action of concentrated hydrobromic and hydriodic acids on the cobalt ion. A new reaction for nickel. A description of new colour reactions of cobalt with concentrated hydrobromic and hydriodic acids and of nickel with concentrated hydriodic acid.—André **Job** and Antoine **Cassal**: The fixation of carbon monoxide on an organic magnesium compound by means of chromic chloride. A solution of phenylmagnesium bromide is without action upon carbon monoxide, but the addition of anhydrous chromium chloride causes an immediate absorption of the gas. From the products of this reaction benzopinacone, benzophenone, benzhydrol, diphenyl, diphenyl-acetophenone, and benzaldehyde were isolated. Some chromium-carbonyl is also produced.—Marcel **Delépine**: A supposed isomer of methylene-amino-acetonitrile. Methylene-bis-imino-diacetonitrile. The substance previously described as an isomeride of methylene-aminonitrile is proved to be the methylene derivative of imino-diacetonitrile.—Emile **Votoček** and F. **Valentin**: The optical inverse of natural rhamnose. Starting with isorhodeonic acid, *d*-rhamnose has been prepared; it has all the properties of natural rhamnose except that its rotation is of opposite sign.—F. **Salmon-Legagneur**: The action of ethyl-magnesium bromide on the methyl ether of the α-mononitrile of camphoric acid. The products of the reaction are α-ethylidene-camphidone and a secondary nitrile alcohol.—Octave **Bailly** and Jacques **Gaumé**: The synthesis and hydrolysis of glyceromonophosphoric di-ester; $\alpha\beta$-diglyceromonophosphoric acid and the constitution of orthophosphoric acid.—René **Delaplace**: The preparation of cæsium eosinate. Cæsium hydroxide is treated with the theoretical quantity of acid eosin to prepare the eosinate. Details are given of the preparation of the eosin and of the cæsium hydroxide, together with the method of recovering the cæsium.—— **Viret**: New observations relating to the rodent fauna of Saint-Gérand-le-Puy.—Mlle. G. **Bonne**: The nature of the floral section in the Chrysobalaneæ.—M. **Bridel** and C. **Béguin**: A new glucoside, hydrolysable by rhamno-diastase, extracted from the fresh flowers of *Ulex europæus*. Details of the extraction, chemical and physical properties of a new glucoside, to which is given the name ulexoside. This gives the methyl-pentose reaction, and can be hydrolysed by rhamno-diastase giving a sugar and ulexogenol.—A. **Sartory**, R. **Sartory**, and J. **Meyer**: The study of the action of radium on *Aspergillus fumicatus* in culture on dissociated and non-dissociated media.—M. and Mme. A. **Chauchard**: The action of curare on the electrical apparatus of the torpedo (*Torpedo marmorata*). The curarisation of the electrical apparatus of the torpedo necessitates the use of relatively large doses of curare. The poison does not act on the nerve but on the electrical organ.—G. A. **Nadson** and M. N. **Meisl**: The mechanism of the action of chloroform on living matter. Description of the action of chloroform on

a yeast (*Saccharomyces Ludwigii*), the observations being so arranged that the same cell was studied throughout.—Pierre **Girard** and Edouard **Peyre**: The suppression of shock and modification of the anaphylactic sensibilisation by certain fluorescent colouring matters. The colloidal mechanism.—Charles **Pérez**: Some secondary sexual characters in Galathea.—Louis **Roule** and Léon **Bertin**: The development with complex metamorphoses (hypermetamorphosis) of *Nemichthys scolopaceus*.—Paul **Mathias**: The evolutive cycle of a trematode of the family of the Echinostomidæ (*Echinoparyphium recurvatum*).—Robert **Regnier** and Roger **Pussard**: The constitution of the reserve stores of *Microtus arvalis* (field mouse), and its importance for the multiplication of this rodent.—E. **Aubel** and L. **Genevois**: Researches on the reduction of thionine by various organic substances, in the absence of air and light.—L. **Lutz**: The soluble ferments secreted by the Hymenomycetes. Oxidising actions.—J. **Sabrazès**: Spirochætes in experimental peritonitis by intestinal perforation in the guinea-pig.

CAPE TOWN.

Royal Society of South Africa, June 16.—K. H. **Barnard**: A study of the freshwater isopodan and amphipodan Crustacea of South Africa. A general account of the biology of *Phreatoicus capensis*, including a curious habit of æstivation, and certain tendencies to variation, is given. *P. capensis* is closely allied to *P. australis*; both forms are regarded as being the direct descendants of the ancestral stirps represented by the fossil species *wianamattensis*. A freshwater isopod of the family Jæridæ having affinities with the Australian genus *Heterias* is described. Several new species of 'blind' gammarids are described; the localised habitat of these 'blind' species is contrasted with the wider distribution of the single black-eyed species. *Phreatoicus capensis* is confined to old and mature valleys in the less highly tilted mountains, and is not found now outside the limits of the effective deposition of moisture from the clouds formed by the S.E. Trade winds. The finding of a fossil species of Phreatoicus shows that the tribe was both austrogenic and palaegenic, and rules out the theory of a migration of northern Crustacea via the Andes into Australasia.—S. H. **Haughton**: The river system of S.W. Gordonia: In the last few miles of its course, the Molopo River shows all the characters of rejuvenation impressed upon a mature stream—waterfalls, a winding deep gorge, and old river-gravels. This rejuvenation is due to the recession of the Aughrabies Falls past the mouth of the Molopo and the consequent cutting-back of the Molopo Falls to their present position. There is no permanent stream in the Molopo now. The tributaries of the Orange to the west of the Molopo in Gordonia have arrived at a more mature stage, although they are deeply entrenched. The cessation of erosive action in S.W. Gordonia seems to have been an event of geologically recent date.—B. F. J. **Schonland** and J. **Craib**: Measurements of the electric fields of thunderstorms. An observatory for the study of electrical meteorology was established on the farm Gardiol, near Somerset East, in January 1926, and a photographic recording apparatus similar to that designed by C. T. R. Wilson has been in use.

ROME.

Pontifical Academy of Sciences (Nuovi Lincei), May 24.—**Stein**: Double stars in the astrographic catalogue of the Vatican zone.—**Colonnetti**: Experimental investigations on elastic co-actions.—**Sesini**: Elastic co-actions.—**Pugno**: Study of the compensators in use in optical experiments on elasticity.—**Luigioni**: New species of blind coleoptera (*Duvalites Franchetti*) discovered by Baron Carlo Franchetti in a grotto near Subiaco (Central Italy).—**Luigioni**: The specific validity of *Anoxia sicula*.—**Pagnini**: The hypotheses serving as foundation for the undulatory theory of light.—**Palazzo**: Geophysical observations relating to the total eclipse of the sun.—**Palazzo**: The magnetic contour of Somaliland.—**Silvestri**: Pseudonummulites in the tertiaries of Tuscany.

SYDNEY.

Linnean Society of New South Wales, May 26.—Rev. H. M. R. **Rupp**: Further notes on the genus Pterostylis. Records are given of five additional species, together with corrections and additions to some of the previous notes on the genus.—E. W. **Ferguson**: Revision of Australian Syrphidæ (Pt. 1). Little attempt has hitherto been made to deal systematically with the Australian species. Keys for the separation of the subfamilies, and for the identification of the species of Cerioides, Eristalis, Helophilus and Microdon are given. Twenty-three species are described as new.—P. D. F. **Murray**: An experimental study of the development of the limbs of the chick. Grafts on to the chorio-allantoic membranes of seven-day chicks, of the limb buds and fragments of limb buds of three-, four- and five-day chicks, and of limb *anlagen* at earlier stages, show the limb *anlagen* to have in a high degree the power of self-differentiation, their development being apparently independent of other regions of the chick, except for the blood supply. The limb bud is a mosaic structure. Ends of skeletal elements may develop normal joint structures in the absence of the neighbouring element upon which the joint would normally work.—R. **Greig-Smith**: The influence of certain colloids upon fermentation (Pt. 3). Fuller's earth and aeration in the alcoholic fermentation. Judging by the action of fuller's earth, the mineral colloids have an action of their own in accelerating the activity of yeast in the fermentation of dextrose. Their faculty of assisting the dispersal of dissolved carbon dioxide does not explain their action, for when the fermenting fluids were aerated, the colloid still hastened the fermentation.

VIENNA.

Academy of Sciences, June 17.—V. **Oberguggenberger**: The scintillation of the stars. A coarse diffraction grating was fixed to a telescope so that the grid was parallel to the daily motion. The telescope being fixed, the star traversed the field and showed a spectrum trace on the photographic plate. In this way the Innsbruck Observatory has examined the frequency of the scintillation.—G. **Rzimann**: The formation of organs from adventitious buds in *Tolmiea Menziesii*. An attempt to trace the influence of the ratio between carbohydrates and mineral salts in forming leaves or roots.—M. **Kofler**: A simple definition of the inconstancy of a natural phenomenon.—J. **Pircher**: An apparatus for registering the squalliness of the wind connected to a Dines' anemograph.—V. **Conrad**: Fluctuations of seismic activity in various fold-regions.—A. **Wagner**: Wind registrations on the 150-metre high radio tower at Altenburg, Germany.—W. **Schmidt**: Experiments with models on the influence of the rotation of the earth on the course of rivers.

Official Publications Received.

Department of Scientific and Industrial Research. Second Report of the Gas Cylinders Research Committee (Periodical Heat Treatment). Pp. iv+29+13 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

The National Physical Laboratory. Watch and Chronometer Trials, 1925. Pp. 5. (London: H.M. Stationery Office.) 6d. net.

Ceylon Administration Reports for 1925. Part 4: Education, Science and Art (F). Administration Report of the Government Marine Biologist for 1925. By Dr. Joseph Pearson. Pp. F16. (Colombo: Government Record Office.) 35 cents.

Ceylon. Sessional Paper 15, 1926: Reports on the Pearl Fishery of 1925. By Dr. Joseph Pearson. Pp. 80+11 plates. (Colombo: Government Record Office.) 2.25 rupees.

Proceedings of the Imperial Academy. Vol. 2, No. 5, May. Pp. xiii-xviii+193-240. (Ueno Park, Tokyo.)

Proceedings of the United States National Museum. Vol. 69, Art. 3: Miscellaneous new Chalcid-Flies of the Hymenopterous Family Encyrtidae. By P. H. Timberlake. (No. 2629.) Pp. 34+2 plates. (Washington, D.C.: Government Printing Office.)

Methods and Problems of Medical Education. (Fourth Series.) Pp. ix+32+48. (New York City: The Rockefeller Foundation.)

Bulletin of the American Museum of Natural History. Vol. 56, Art. 3: The Skeleton of *Moschops capensis* Broom, a Dinocephalian Reptile from the Permian of South Africa. By William K. Gregory. Pp. 179-251+21 plates. (New York City.)

Journal of the Faculty of Science, Imperial University of Tokyo, Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 1. Part 1: Theory of Generating Functions and its Application to the Theory of Probability. By Toyojiro Kameda. Pp. 62. 1.40 yen. Vol. 1, Part 2: Studies on Binary Mixtures. By Jitsusaburo Sameshima. Pp. 63-103. 1.10 yen. Vol. 1, Part 3: Über die Maximalordnung einiger Funktionen in der Idealtheorie. Von Zyoiti Suetuna. Pp. 105-153. 1.05 yen. Vol. 1, Part 4: Thermochemical Studies. By Hajime Hirobe. Pp. 155-222. 1.30 yen. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 1, Part 1: Tertiary Mollusca from Shinano and Echigo. By Matajiro Yokoyama. Pp. 23+7 plates. 1.60 yen. Vol. 1, Part 2: Podsol in South Saghalien, by Prof. Tetsugoro Wakimizu; Physiographical Studies of the Southeastern Part of Bōsō Peninsula, by Prof. Naomasa Yamasaki; Brief Notes on Fergusonite and Allanite from Iyo, Shikoku, by Prof. Denzō Satō; Variation of Specific Gravity of Japanese Crude Oils, with Special Reference to their Geological Occurrence, by Prof. Tsunenaka Iki; The Cupriferous Pyritic Ore Deposits of the Shibuki and Seki Mines in the Province of Bungo, Japan, by Prof. Takeo Kato; The Genetical Interpretation of Extrusive Rocks, by Seitarō Tsuboi; A Tertiary Forerunner of Effusive Rocks in the Northeastern Japan, by Kōroku Tsuboya; The Post-Paleozoic and Late-Mesozoic Earth-Movements in the Inner Zone of Japan, by Yoshiaki Ozawa; Zonal Growth of Plagioclase and Sodaorthoclase in Syenitic Magma, by Tei-ichi Itō. Pp. 25-109+plates 8-13. 2.00 yen. Vol. 1, Part 3: Mollusca from the Tertiary Basin of Chichibu. By Matajiro Yokoyama. Pp. 111-126+plates 14-15. 0.80 yen. Vol. 1, Part 4: Tertiary Mollusca from Shiobara in Shimotsuké. By Matajiro Yokoyama. Pp. 127-138+plates 16-20. 1.10 yen. Vol. 1, Part 5: A Dispersion Method of Discriminating Rock-Constituents and its Use in Petrogenic Investigation. By Seitarō Tsuboi. Pp. 139-180. 1.00 yen. Vol. 1, Part 6: The Cretaceous Formation of Futaba in Iwaki and its Fossils. By Shigeyasu Tokunaga and Saburo Shimizu. Pp. 181-212+plates 21-27. 1.70 yen. Vol. 1, Part 7: Molluscan Fossils from the Tertiary of Mino, by Matajiro Yokoyama; Neogene Shells from Kōzuké and other Provinces, by Matajiro Yokoyama; Tertiary Mollusca from the Oil-Fields of Embets and Etaibets, by Matajiro Yokoyama. Pp. 213-248+plates 28-32. 1.50 yen. Section 3: Botany. Vol. 1, Part 1: Über dei Reifungsvorgänge des Pharbitis-Samens mit besonderer Rücksicht auf die Keimungsfähigkeit des unreifen Samens. Von Yoshiji Yoshii. Pp. 139+1 Tafel. 2.65 yen. Section 4: Zoology. Vol. 1, Part 1: Studies on some Nematode Parasites of Frogs and Toads in Japan, with Notes on their Distribution and Frequency, by Kaoru Morishita: On Two new Genera of Frog Trematodes, Cryptotrema and Microlecithus, and a new Species of Pleurogenes, by Yoshimasa Ozaki; The Anatomy and Development of a Rhizostome Medusa, *Mastigias papua* L. Agassiz, with Observations on the Phylogeny of Rhizostomae, by Tohru Uchida; Three new Species of Amphistomata from Mammals, by Tamao Fukui. Pp. 113+6 plates. 2.90 yen. Section 5: Anthropology. Vol. 1, Part 1: On the Cephalic Index and Stature of the Japanese and their Local Differences; a Contribution to the Physical Anthropology of Japan. By Akira Matsumura. Pp. 312+10 plates. 11.00 yen. (Tokyo: Maruzen Co., Ltd.)

New South Wales. Department of Mines: Geological Survey. Mineral Resources No. 34: A Contribution to the Mineralogy of New South Wales. By George Smith. Pp. 145+32 plates. (Sydney, N.S.W.: Alfred James Kent.) 3s. 3d.

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty, for the Year 1925. Pp. 10. (Cape Town.)

South Australia: Department of Mines. Mining Review for the Half-year ended December 31st, 1925. (No. 43.) Pp. 82+8 plates. (Adelaide: R. E. E. Rogers.)

The Cordwainers Technical College (Incorporated), Eagle Court, St. John's Lane, E.C.1. Prospectus of Classes in Boot and Shoe Manufacture and Making, and Leather Goods Manufacture: Day and Evening Classes, Session 1926-7. Pp. 42. (London.)

Journal of the Royal Statistical Society. New Series, Vol. 89, Part 3, May. Pp. viii+405-634. (London: Royal Statistical Society.) 7s. 6d.

Canada. Department of Mines: Mines Branch. Final Report of the Peat Committee appointed jointly by the Governments of the Dominion of Canada and the Province of Ontario: Peat, its Manufacture and Uses. By B. F. Haanel. (Mines Branch No. 641.) Pp. xviii+298+58 plates. (Ottawa: F. A. Acland.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Horticultural Section, Technical Bulletin No. 75: Influence of Nutrient Supply on Earliness of Maturity in Cabbage. By J. B. Edmond and E. P. Lewis. Pp. 16. (East Lansing, Mich.)

Proceedings of the American Academy of Arts and Sciences. Vol. 61, No. 5: Measurement of the Compressibility of the Alkali Halides. By J. C. Slater. Pp. 135-150. 50 cents. Vol. 61, No. 6: Contributions to Mineralogy from the Department of Mineralogy and Petrography, Harvard University. 12: Catalogue of the Collection of Meteorites in the Mineralogical Museum of Harvard University. By Charles Palache. Pp. 151-159. 25 cents. Vol. 61, No. 7: A Mathematical Study of Crystal Symmetry. By Austin F. Rogers. Pp. 161-203. 75 cents. (Boston, Mass.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1484: The Clover Leaf-Weevil and its Control. By W. H. Larrimer. Pp. ii+6. (Washington, D.C.: Government Printing Office.) 5 cents.

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1925. Pp. 30. (Entebbe.)

Loughborough College, Leicestershire. Calendar, Session 1926-27. Pp. xiv+228+67 plates. (Loughborough.) 2s. 6d. net.

Diary of Societies.

SATURDAY, AUGUST 14.

MINING INSTITUTE OF SCOTLAND (at Glasgow).

WEDNESDAY, AUGUST 18.

CORRELATION OF SCIENCE SOCIETY (at Royal Botanic Society of London), at 3.—Conference on Partial Impact and Whirling Coalescence.

SATURDAY, AUGUST 21.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Annual Meeting) (at Newcastle-upon-Tyne), at 2.30.

CONGRESSES.

AUGUST 27 AND 28.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Stockholm).—F. Adcock: The Effect of Nitrogen on Chromium and some Iron Chromium Alloys (Alloys of Iron Research, Part IV.).—J. H. Andrew and H. A. Dickie: A Physical Investigation into the Cause of Temper Brittleness.—Prof. C. Benedicks, H. Bäckström, and P. Sederholm: Anomalies in Heat Conduction, with some Determinations of Thermal Conductivity in Iron and Carbon Steels.—Prof. C. Benedicks and R. Sundberg: Electrochemical Potentials of Carbon and Chromium Steels.—G. F. Comstock: The Treatment of Steel with Ferro Carbon-Titanium.—G. A. Hankins, D. Hanson, and Miss G. W. Ford: The Mechanical Properties of Four Heat-Treated Spring Steels.—Prof. K. Honda: Is the Direct Change from Austenite to Troostite Possible?—A. Johansson and R. Von Seth: The Carburisation and Decarburisation of Iron and Some Investigations on the Surface Decarburisation of Steel.—A. Johansson and A. Wahlberg: The Development of the Swedish Iron and Steel Industry during the last thiry years.—E. Kinander: Notes on Jernkontoret.—A. Lundgren: The Testing of Hardened Steel.—W. Petersson: Notes on the Development of the Swedish Mining Industry during the last twenty-five years.—G. Phragmen: The Constitution of the Iron-Silicon Alloys.

AUGUST 29 TO SEPTEMBER 1.

SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES (at Fribourg).—In Sections devoted to Mathematics, Physics, Geophysics, Meteorology and Astronomy, Chemistry, Geology, Mineralogy and Petrography, General Botany, Special Botany and Geographical Botany, Zoology, Entomology, Anthropology and Ethnology, Palæontology, Medical Biology, History of Medicine and Natural Science.

AUGUST 31 TO SEPTEMBER 8.

WORLD POWER CONFERENCE (at Basle), Technical Programme of Sectional Meeting:

Utilisation of Water Power, and Inland Navigation.
Exchange of Electrical Energy between Countries.
The Economic Relation between Electrical Energy Produced Hydraulically and Electrical Energy Produced Thermally: Conditions under which the two systems can work together with advantage.
Electricity in Agriculture.
Railway Electrification.

SEPTEMBER 1 TO 4.

INSTITUTE OF METALS (Autumn Meeting) (at Liége) (September 1, at 8.—Dr. W. Rosenhain: Ancient Industries and Modern Metallurgy) (Autumn Lecture).—Dr. C. J. Smithells, H. P. Rooksby, and W. R. Pitkin: The Deformation of Tungsten Crystals.—Prof. K. Honda: A Comparison of Static and Dynamic Tensile and Notched-Bar Tests.—C. H. M. Jenkins: The Constitution and the Physical Properties of the Alloys of Cadmium and Zinc.—H. J. Gough, S. J. Wright, and Dr. D. Hanson: Some Further Experiments on the Behaviour of Single Crystals of Aluminium under Reversed Torsional Stresses.—B. Ōtani: Silumin and its Structure.—G. B. Phillips: The Primitive Copper Industry of America. Part II.—Kathleen E. Bingham: The Constitution and Age-Hardening of Some Ternary and Quaternary Alloys of Aluminium containing Nickel.—Dr. A. G. C. Gwyer and H. W. L. Phillips: The Constitution and Structure of the Commercial Aluminium-Silicon Alloys. With an Appendix upon The Properties of the Modified Aluminium-Silicon Alloys, by Dr. D. Stockdale and I. Wilkinson.—J. D. Grogan: Some Mechanical Properties of Silicon-Aluminium Alloys.—Dr. C. S. Smith and Prof. C. R. Hayward: The Action of Hydrogen on Hot Solid Copper.—Capt. F. R. Barton: The Development of the Use of Nickel in Coinage.—A. Pinkerton and W. H. Tait: Season-Cracking in Arsenical Copper Tubes.—Prof. P. Chevenard: Thermal Anomalies of Certain Solid Solutions.—W. T. Cook and W. R. D. Jones: Preliminary Experiments on the Copper-Magnesium Alloys.—F. W. Rowe: Bronze Worm Gear Blanks produced by Centrifugal Casting.—L. Boscheron: An Account of the Non-Ferrous Metals Industry in the Liége District.